Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Rhode Island and Massachusetts

Biological Assessment (August 2012)

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

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Acronyms and Abbreviations

ADCP	Acoustic Doppler Current Profiler
AMAPPS	Atlantic Marine Assessment Program for Protected Species
ATCA	Atlantic Tuna Convention Act
BOEM	Bureau of Ocean Energy Management
C	Celsius
CETAP	Cetacean and Turtle Assessment Program
CODAR	Coastal Ocean Dynamic Application Radar
COP	Construction and Operations Plan
CPT	Cone Penetrometer Test
DMA	Dynamic Management Area
DPS	Distinct Population Segment
EA	Environmental Assessment
EPACT	Energy Policy Act of 2005
ESA	Endangered Species Act
F	Fahrenheit
GGARCH	Geological, Geophysical, and Archeological
GIS	Geographic Information System
HRG	High Resolution Geophysical
ICCAT	International Convention for the Conservation of Atlantic Tunas
IP	Interim Policy
LIDAR	Light Detecting and Ranging
MMPA	Marine Mammal Protection Act
NARWSS	North Atlantic Right Whale Sighting Survey
NEFSC	Northeast Fisheries Science Center
NM	Nautical Mile
NMFS	National Marine Fisheries Service
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
ROV	Remotely Operated Vehicle
SAMP	Special Area Management Plan
SAP	Site Assessment Plan
SAS	Sighting Advisory System
SEFSC	Southeast Fisheries Science Center
SMA	Special Management Area
SODAR	Sonic Detection And Ranging
SPUE	Sightings Per Unit of Effort
USACE	United States Army Corps of Engineers
USDOC	United States Department of Commerce
USDOI	United States Department of Interior
USFWS	United States Fish and Wildlife Service
WEA	Wind Energy Area

1 Introduction

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

This document is a biological assessment (BA) of impacts to endangered and threatened species listed under the Endangered Species Act (ESA) from proposed commercial wind energy lease issuance, associated site characterization activities, and subsequent site assessment activities on the OCS off Rhode Island and Massachusetts. This BA initiates informal consultation under Section 7 of the ESA.

1.1 Project Area

The Project Area comprises two "Wind Energy Areas" (WEAs) on the OCS, off the coasts of Massachusetts and Rhode Island: the "Massachusetts" WEA (MA WEA) and the "Rhode Island and Massachusetts" WEA (RI/MA WEA) (see Figure 1-1). These WEAs were developed through collaboration and consultation with state intergovernmental task forces, Federal agencies, Native American Tribes, the general public, and other stakeholders. Both WEAs are located in relatively shallow waters (approximately 30-60 m) of the OCS, in the Southern New England planning region of the Northeast Continental Shelf Large Marine Ecosystem (NCSLME) (Cook and Auster, 2007; Sherman, 1991). The coastal waters and OCS in this region are described in detail in the Massachusetts Ocean Management Plan (MAEEA, 2009) and the Rhode Island Ocean Special Area Management Plan (RICRMC and URI, 2011).

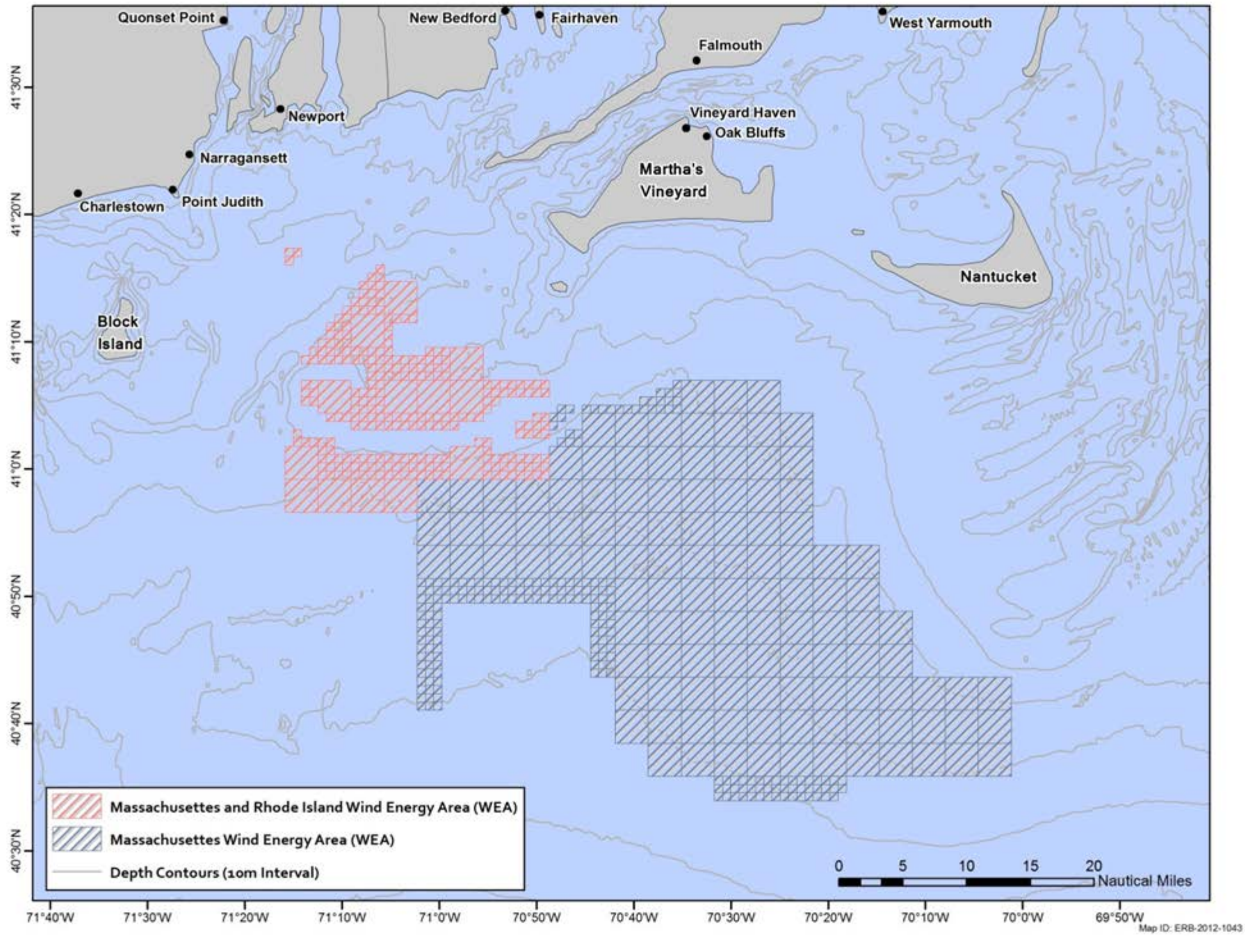

Figure 1.1. Project Area showing the RI/MA and MA WEAs

1.2 Proposed Action

The proposed action, that is the subject of this BA, is the issuance of commercial wind energy leases and the approval of site assessment plans to provide for the responsible development of wind energy resources within all or some of the RI/MA WEA and the MA WEA. This BA will consider the environmental consequences associated with reasonably foreseeable site characterization scenarios associated with leasing (including geophysical, geotechnical, archeological and biological surveys), and site assessment activities (including the installation, operation and decommissioning of meteorological towers and buoys) in the Project Area.

1.3 Renewable Energy Process

Under the renewable energy regulations, the issuance of leases and subsequent approval of wind energy development on the OCS is a staged decision-making process. BOEM's wind energy program occurs in four distinct phases:

1) **Planning and Analysis.** The first phase is to identify suitable areas to be considered for wind energy project leases through collaborative, consultative, and

analytical processes using the state's task forces, public information meetings, input from the states, Native American Tribes, and other stakeholders.

2) **Lease Issuance.** The second phase is the issuance of a commercial wind energy lease. The competitive lease process is set forth at 30 CFR 585.210 to 585.225, and the noncompetitive process is set forth at 30 CFR 585.230 to 585.232. A commercial lease gives the lessee the exclusive right to subsequently seek BOEM approval for the development of the leasehold. The lease does not grant the lessee the right to construct any facilities; rather, the lease grants the right to use the leased area to develop its plans, which must be approved by BOEM before the lessee can move on to the next stage of the process (30 CFR 585.600 and 585.601).

3) **Approval of a Site Assessment Plan (SAP).** The third stage of the process is the submission of a SAP, which contains the lessee's detailed proposal for the construction of a meteorological tower and/or the installation of meteorological buoys on the leasehold (30 CFR 585.605 to 585.618). The lessee's SAP must be approved by BOEM before it conducts these "site assessment" activities on the leasehold. BOEM may approve, approve with modification, or disapprove a lessee's SAP (30 CFR 585.613).

4) **Approval of a Construction and Operation Plan (COP).** The fourth and final stage of the process is the submission of a COP, a detailed plan for the construction and operation of a wind energy project on the lease (30 CFR 585.620 to 585.638). BOEM approval of a COP is a precondition to the construction of any wind energy facility on the OCS (30 CFR 585.628). As with a SAP, BOEM may approve, approve with modification, or disapprove a lessee's COP (30 CFR 585.628).

The regulations also require that a lessee provide the results of surveys with its SAP or COP, including a shallow hazards survey (30 CFR 585.626 (a)(1)), geological survey (30 CFR 585.616(a)(2)), geotechnical survey (30 CFR 585.626(a)(4)), and an archaeological resource survey (30 CFR 585.626(a)(5)). BOEM refers to these surveys as "site characterization" activities. Although BOEM does not issue permits or approvals for these site characterization activities, it will not consider approving a lessee's SAP or COP if the required survey information is not included. *See* "Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 585,"[1] referred to herein as the 'GGARCH guidelines' (USDOI, BOEMRE, OAEP, 2011a).

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[1] *see* http://www.boem.gov/Renewable-Energy-Program/Regulatory-Information/Index.aspx#Notices_to_Lessees,_Operators_and_Applicants

2 Endangered Species Act (ESA) Section 7 Consultation History

The proposed action is similar in many respects to the consultation for *Issuance of Leases for Wind Resource Data Collection on the Outer Continental Shelf Offshore Delaware and New Jersey Environmental Assessment* (IP EA) that was concluded in the Spring of 2009 (USDOI MMS 2009) and the action described in the *Environmental Assessment (EA) for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia* (NJ-VA EA) and its associated biological assessment which were finalized in January 2012 (USDOI BOEM 2012). Each of these assessments considered the issuance of leases for wind resource data collection, including geological and geophysical, hazards, and archaeological (GGARCH) site characterization surveys. The IP EA considered issuing leases for seven lease blocks and the NJ-VA EA considered issuing leases within all or part of four WEAs while the project area in the NJ-VA EA was comprised of approximately 117 OCS lease blocks across four states.

This BA addresses activities within the RI/MA WEA and the MA WEA which have a total of 130 whole and 49 partial lease blocks (13 whole and 29 partial lease blocks within the RI/MA WEA and 117 whole and 20 partial lease blocks within the MA WEA) (Figure 1-1). The primary activities that would occur as part of the site assessment described in the Proposed Action for this BA include: geological and geophysical surveys (sonar and sediment work), wind resource assessments (meteorological towers and buoys), biological assessments, and cultural/archeological assessments. This type of activity would be similar across both the MA and RI/MA WEAs. The following is a summary of the consultation history for previous consultations for the IP and NJ-VA lease issuance and site assessment activities.

2.1 NOAA's National Marine Fisheries Service

On January 9, 2009, BOEM (formerly BOEMRE) initiated consultation with NMFS for the actions described in the IP EA. This consultation evaluated the issuance of several IP leases for wind resource data collection, including geological and geophysical, hazards, and archaeological (GGARCH) site characterization surveys. These IP leases were concentrated off of Delaware and New Jersey. The consultation was concluded in a May 14, 2009, letter from NMFS concurring with the determination that the issuance of seven IP leases by BOEM to allow the construction of up to seven meteorological facilities and associated GGARCH surveys would not be likely to adversely affect any listed species under NMFS jurisdiction. BOEM reinitiated consultation with NMFS when the Garden State Offshore Energy/Deepwater Wind Project Plan proposed the use of a unique light detecting and ranging (LIDAR) equipped meteorological spar buoy rather that a meteorological tower for one of the IP leases. In a letter dated December 6, 2010, NMFS concluded that all the effects of the proposed action would be insignificant or discountable, and not likely to adversely affect any ESA-listed species under their jurisdiction.

In March 2011, BOEM initiated informal consultation with NMFS for the issuance of leases, site assessment, and site characterization activities for NJ-VA. The consultation was concluded in a September 20, 2011, letter from NMFS concurring with the determination that the issuance of leases associated with site characterization and subsequent site assessment activities for siting of wind energy facilities in the identified WEAs may affect but is not likely to adversely affect any listed species under NMFS jurisdiction.

2.2 U.S. Fish and Wildlife Service

Informal ESA Section 7 consultations for the IP EA were initiated with USFWS on January 9, 2009. The consultation was concluded in a letter from USFWS dated February 26, 2009. The informal consultation concluded that the site assessment activities would not jeopardize the continued existence of the federally listed roseate tern (*Sterna dougallii dougallii*) and piping plover (*Charadrius melodius*), and the candidate species, red knot (*Calidris canutus rufa*). In addition, USFWS stated that although the extent to which these species occur 8 or more miles offshore is not well known, the likelihood to which these species occur offshore was concluded to be low. USFWS further stated that the greater threat posed to avian species from site assessment activities, specifically the construction of meteorological towers, was the threat collisions between vessels and the structures and subsequent spilling of oil in the case of oil tankers. However, given the low number of proposed structures and the U.S. Coast Guard (USCG) requirements for navigational aids, the risk was still considered to be low. In order to evaluate future collision risk assessment USFWS recommended the placement of a visibility sensor, which measures transparency of the atmosphere by calculating a meteorological optical range, on the meteorological tower in addition to the biological monitoring devices already included.

More recently, there was an informal ESA Section 7 consultation with USFWS on March 24, 2011, for lease issuance and site assessment activities off of NJ-VA. The consultation was concluded in a letter from USFWS dated June 20, 2011, concurring with the determination that the meteorological tower and buoy construction activities are not likely to adversely affect the three listed species under USFWS jurisdiction (roseate tern, piping plover or red knot). USFWS also found that although the extent to which these species occur between 7 and 37 miles (11.3 and 59.5 kilometers) offshore is not well known, the collision risk throughout these mid-Atlantic WEAs was considered to be negligible. USFWS recommended the placement of visibility sensors on meteorological towers to provide measures of visibility such as how often low visibility conditions occur during various times of year.

3 Threatened and Endangered Species in the Proposed Action Area

The proposed action area is defined as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action” (50 CFR §402.02). For this activity, the proposed action area includes the Project Area (the two WEAs) (*see* Figure 1-1) as well as waters between the Project Area and shore. This area is expected to encompass all effects of the proposed action. Several ESA-listed species occur both seasonally and year round in the action area. Since the proposed activities could occur year-round it can be assumed that these species could be present for all or some of the proposed activity. The Programmatic EIS for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf (USDOI, MMS 2007) gives greater detail of the life histories of the species outlined in this Section and is thus incorporated by reference and not repeated herein.

3.1 Marine Mammals

There are six whale species in the North Atlantic that are federally listed as endangered (Table 3.1-1). The six whale species are the North Atlantic right whale (*Eubaleana glacialis),* fin whale (*Balaenoptera physalus),* humpback whale (*Megaptera novaengliae),* blue whale (*Baleanoptera musculus*), sei whale (*Balaeonoptera borelais*), and sperm whale (*Physeter macrocephalus*). Of these six species, there are five –North Atlantic right, fin, humpback, sei, and sperm whales – that are likely to occur in and around the Project Area. These 5 species are expected to occur in the region during all times of the year; however, they are more prevalent in some seasons than others. The right, humpback, and sei whales are most likely to occur in the Project Area spring; sperm whales are most likely to occur in the summer; and fin whales are most likely to occur in the Project Area in the winter. Although blue whales occur in the North Atlantic, sightings data indicate that they are more likely to be found offshore the Grand Banks and Newfoundland and only occasionally in the U.S. exclusive economic zone (EEZ) (Waring *et al.,* 2011) and therefore, not likely to be found in the Project Area or its surrounding waters.

Manatees are federally-listed as endangered (USDOI, USFWS 2008). Occasional sightings of individual manatees have occurred in the New England region during the summer months. However, since sightings are rare and there is no regular occurrence of this species within the region during any season, they will not be discussed further in this document.

Table 3.1-1
Marine Mammals in the North Atlantic

Species	Status	General Occurrence North Atlantic
Order Cetacea		
Suborder Mysticeti (Baleen Whales)		
Family Baleanidae		
North Atlantic Right Whale (*Eubaleana glacialis*)	E	Year-round
Family Balaenopteridae		
Blue Whale (*Balaenoptera musculus*)	E	Summer
Fin Whale (*Balaenoptera physalus*)	E	Year-round
Humpback Whale (*Megaptera novaeangliae*)	E	Year-round
Minke Whale (*Balaenoptera acutorostrata*)		Spring/Summer
Sei Whale (*Balaenoptera borealis*)	E	Spring/Summer
Suborder Odontoceti (toothed whales and dolphins)		
Dwarf Sperm Whales (*Balaenoptera borealis*)		Late Spring/ Summer1
Pygmy Sperm Whale (*Kogia breviceps*)		Late Spring/ Summer1
Sperm Whale *(Physeter macrocephalus*)	E	Spring/Summer/Fall
Family Ziphiidae		
Blainville's Beaked Whale (*Mesoplodon densirostris*)		Later Spring/Summer1
Cuvier's Beaked Whale (*Ziphius cavirostris*)		Later Spring/Summer1
Gervais' Beaked Whale (*Mesoplodon europaeus*)		Later Spring/Summer1
True's Beaked Whale (*Mesoplodon mirus*)		Later Spring/Summer1
Sowerby's Beaked Whale (*Mesoplodon bidens)*		Later Spring/Summer1
Family Delphinidae		
Short-Beaked Common Dolphin (*Delphinus delphis*)		Year-round
Pantropical-Spotted Dolphin (*Stenella attenuata*)		Later Spring/Summer1
Bottlenose Dolphin (*Tursiops truncatus*)		Year-round
Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*)		Year-round
White-Beaked Dolphin (*Lagenorhynchus albirostri)*		Later Spring/Summer1
Killer Whale (*Orcinus orca*)		Later Spring/Summer1
Atlantic Spotted Dolphin *(Stenella frontalis*)		Year-round
Short-Finned Pilot Whale (*Globicephala macrorhynchus*)		Later Spring/Summer1
Long-Finned Pilot Whale *(Globicephala melas*)		Year-round
Risso's (*Grampus griseus*)		Year-round
Striped Dolphin (*Stenella coeruleoalba*)		Year-round
Harbor Porpoise *(Phocoena phocoena*)		Year-round
Order Carinovora		
Suborder Fissipedia		
Family Phocidae		
Harbor Seal (*Phoca vitulina*)		Year-round
Grey Seal (*Halichoerus grypus*)		Year-round
Harp Seal (*Pagophilus groenlandicus)*		Winter/Spring
Hooded Seal (*Cystophora cristata)*		Winter/Spring

Note:
[1] Due to insufficient sighting data and information on these species, the best available information for the season of general occurrence in the North Atlantic corresponds with survey effort

Key:
E = Endangered under the Endangered Species Act.

Source: Waring *et al*, 2011.

Information on the occurrence of ESA listed species and their existing environment within the North Atlantic has been developed based on recent studies and a literature synthesis that specifically aims at areas encompassing the waters of the greater New England region, and more specifically southern New England and the water within and surrounding the Project Area that could be affected by the proposed action. These studies include the NMFS marine mammal stock assessment reports, the Rhode Island SAMP (and its accompanying appropriate technical reports), preliminary data from the *2010 Atlantic Marine Assessment Program for Protected Species* (AMAPPS) (Palka 2010), and the 1982 Final Report *from A Characterization of Marine Mammals and Sea Turtles in the Mid- and North Atlantic Areas of the U.S. Outer Continental Shelf* (Cetacean and Sea Turtle Assessment Program [CETAP] 1982).

The Rhode Island SAMP technical report, *Marine Mammals and Sea Turtles of Narragansett Bay, Block Island Sound, Rhode Island Sound, and Nearby Waters: An Analysis of Existing Data for the Rhode Island Ocean Special Area Management Plan (SAMP)* (Kenney and Vigness-Raposa 2010), used available sources of information on the occurrence of marine mammals and sea turtles within the Rhode Island study area, which encompasses the RI/MA WEA. The Rhode Island SAMP was then able to map the spatial and temporal distributions and relative abundances of all marine mammals known to occur within the Rhode Island study area (Kenney and Vigness-Raposa 2010). The AMAPPS surveys are the result of an inter-agency agreement between BOEM and NMFS in an effort to assess the abundance and spatial distribution of marine mammals and sea turtles along the U.S. east coast. Surveys were conducted by the Northeast Fisheries Science Center (NEFSC) and the Southeast Fisheries Science Center (SEFSC). Preliminary data for this program was collected by NEFSC during 5,723 miles (9,210 kilometers) of on-effort aerial line-transect abundance surveys over the Atlantic continental shelf between Cape May, NJ and Gulf of St. Lawrence, Canada. These surveys were conducted between August 17 and September 26, 2010 (Palka 2010). The preliminary data from this survey effort was used to support the summer distribution of marine mammal species within the New England Region, in particular within the Project Area and its surrounding waters. Information from the NOAA Northeast Fisheries Science Center's North Atlantic Right Whale Sightings Advisory System (SAS) and data reported in Duke University's Ocean Biogeographic Information System (OBIS)-SEAMAP were also used for recent sightings of North Atlantic right whales within the region.

3.1.1 North Atlantic Right Whale

3.1.1.1 Status

The North Atlantic right whale was listed as federally endangered under the ESA in 1970 (NMFS 2012a). Currently, the minimum population is estimated between 350 and 400 individuals and is globally considered one of the most critically endangered large whale populations, although recent data suggests a slight positive trend in population size (Waring *et al.,et al.*, 2011).

3.1.1.2 Description

The North Atlantic right whale is a species of baleen whale that feeds primarily on zooplankton such as large copepods (*Calanus finmarchicus*), smaller copepods, krill and barnacle larvae (NMFS 2004; Kenney and Vigness-Raposa 2010). Feeding is accomplished by skimming along the surface and filtering out the preferred prey through their baleen plates (NMFS 2004).

Adult North Atlantic right whales measure between 45 and 55 feet (14 and 17 meters) in length and can weigh up to 70 tons (63,503 kilograms) (NMFS 2004). The species is sexually dimorphic, with females being generally larger than males (NMFS 2004). The North Atlantic right whale has several distinguishing features including a stocky body, large head, a highly arched margin of the lower lip, and callosities in the head region (NMFS 2004).

3.1.1.3 Distribution

The North Atlantic right whale can be found in U.S. waters spanning the entire east coast from the Gulf of Maine to the waters off northeast Florida (Waring *et al.*, 2011; Kenney and Vigness-Raposa 2010). It is primarily a coastal and continental shelf species, likely due to the availability and distribution of their preferred prey item, late-stage juvenile and adult copepods in these waters (NMFS 2004; Kenny and Vigness-Raposa 2010).

Annually, the species migrates from winter calving grounds in the southern latitudes of its range to spring and summer feeding grounds in higher latitudes. During the winter right whales can be found in the nearshore waters of northeast Florida and Georgia where it is expected that reproductive females return annually to calve (NMFS 2004; Kenney and Vigness-Raposa 2010). During spring and summer months, right whales migrate north to the productive waters of the northeast region to feed and nurse their young. Within the northeast region feeding habitats have been observed off the coast of Massachusetts, at Georges Bank, the Great South Channel, in the Gulf of Maine and over the Scotian Shelf (Waring *et al.*, 2011). These feeding and calving habitats are considered high-use areas for the species.

While high-use areas have been established for the right whale, frequent travel along the east coast of the U.S. is common. Satellite tags have shown North Atlantic right whales making round-trip migrations to an area off the southeastern U.S. and back to Cape Cod Bay at least twice during the winter (Waring *et al.*, 2011).

3.1.1.4 Threats

Vessel collisions and entanglement in fishing gear cause approximately 40 percent of the North Atlantic right whale deaths (Waring *et al.*, 2011). Other threats include habitat degradation, contaminants and pollutants, climate and ecosystem change, anthropogenic disturbance and low frequency sound, predators such as large sharks or killer whales (NMFS 2004; Parks *et al.*, 2011).

3.1.1.5 Occurrence in the Project Area

The Project Area (i.e., the MA WEA and the RI/MA WEA) is 15 miles (13 nm) from the south coast of Martha's Vineyard, Massachusetts. Although outside all of the major high use habitat areas, the Project Area may be used to transit between habitats.

Sightings per unit effort (SPUE)

All SPUE data for right whales from 1828 to 2009, provided by the Right Whale Consortium, (2012) within the Project Area and the surrounding waters are plotted in Figure 3.1.2-1. The vast majority of sightings were from the 1970's to 2009; however, the historic data was included to capture all areas of potential use by this species. Since whales may be sensitive to anthropogenic noise at long distances from the source (Madsen *et al.*, 2006; Nieukirk *et al.*, 2004), the occurrence of this species (and the other large whale species in this section of the report) will be reported for the Project Area (within the delineated WEAs) as well as in an expanded area within 40 nm from the WEA boundaries.

Within 40 nm of the Project Area boundary, SPUE for right whales were highest in the spring with several locations ranging from 0.5 to 100 whales per 1,000 km (Figure 3.1.1-1). SPUE were lower in the summer with two locations near Nantucket ranging from 0.5 to 25 whales per 1,000 km, followed by one location in the fall and one location in the winter (Figure 3.1.1-1). Figure 3.1.1-1 does not include 2010 or 2011, both years in which high numbers of right whales were observed both in the Project Area and within 40 nm to the west of the Project Area (Khan *et al.*, 2011; NMFS NEFSC, 2010). 2010 and 2011 sightings data are included in Figures 3.1.1-4, 3.1.1-5, and 3.1.1-6.

According to Kenney and Vigness-Raposa (2010), the highest occurrence of right whales within the Rhode Island Ocean SAMP study area (from the middle of Long Island to outer Cape Cod and south to 39°15') was in the spring (58% of all sightings), with less in the winter (19%) and summer (16%), and relatively low occurrence in the fall (4.5%). Kenney and Vigness-Raposa, (2010) also indicated that this pattern likely reflects migration from winter grounds to feeding grounds. According to Kenney and Vigness-Raposa (2010), migratory whales are likely to be less detectable and therefore this species may be occurring with greater frequency than determined from surveys.

Mate *et al.*, (1997) radio-tagged right whales in the Bay of Fundy and tracked their movements in the western North Atlantic in 1990 and 1991. Satellite-acquired positions of the nine whales tagged (six females, one pregnant and three with calves, two males, and one juvenile) are shown on Figure 3.1.1-2, showing that right whales occurred in the Project Area (Mate *et al.*, 1997). Figure 3.1.1-3 shows the movements of the three females with calves and the pregnant female, tracked for 7 to 42 days (Mate *et al.*, 1997). Although these monitoring data occurred over a relatively short period of time, they show the relatively high mobility in the western North Atlantic region and the use of the Project Area.

Supplemental to the above maps, are summaries of right whale sightings from two separate but overlapping sources, New England Aquarium and NMFS North Atlantic Right Whale Sightings Surveys (NARWSS). Right whale survey sightings were mapped for each year from 1978 to 2003 by the GIS group at the New England Aquarium. A summary of these sightings within 40nm of the Project Area is presented in Table 3.1-2. The first year that the survey included the Project Area was 1991. From 1991 to 2003, right whale sightings have been recorded for most years even with the relatively low survey effort (i.e. a single track line in the early 1990's) specifically in the Project Area, or the Nantucket Shoals.

Table 3.1-2
Summary of Right Whale Aerial Surveys. Surveys in months which at least one right whale aerial survey was conducted within 40 nm of the Project Area.

*Year Surveyed	Months Surveyed	Number of Tracklines	Right Whale Sighted within 40 nm of the Project Area (Month)
1991	May – July	1	June
1992	April – August	1	
1993	June – August	1	
1995	June – September	Multiple	
1998	April – August	Multiple	April
1999	February – June	Multiple	February, March
2000	February – May; August – September	Multiple	January, February, March
2001	February – July	Multiple	
2002	February – November	Multiple	May, June
2003	March – December	Multiple	

Source: NEAQ GIS Group, 2012.
*This study included right whale surveys in various locations within the Northwest Atlantic from 1978 -2003

NMFS NARWSS reports document right whale survey sightings from 2002 to present and are summarized in Table 3.1-3. These reports showed very high numbers in 2010 and 2011 in the nearby waters to the west of the Project Area (Table 3.1-3). In 2010, the whales were observed in the Project Area and within 40nm northwest of the Project Area, and in 2011 the whales were also observed in the Project Area and in the adjacent waters to the west of the Project Area (Figures 3.1.1-4, 3.1.1-5, and 3.1.1-6). The 2010 event, with a total of 98 whales, triggered implementation of a dynamic management area (DMA), which encompassed the Project Area. DMAs were also implemented off Nantucket in February, March, and April, 2010 (Khan *et al.,* 2011). DMAs are triggered when three or more right whales are sighted outside of a special management area (SMA). "DMAs are put in place for two weeks and encompass an area commensurate to the number of whales present. Mariners are notified of DMAs via email, the internet, Broadcast Notice to Mariners (BNM), NOAA Weather Radio, and the Mandatory Ship Reporting system (MSR), and are requested to reduce their speed when transiting through DMAs. Unlike SMAs, compliance is voluntary for DMAs" (Khan *et al.*, 2011). NMFS NARWSS data indicate that the waters within the Project Area and out to 40 nm from the Project Area are at a minimum an occasional area of use, and possibly a regularly utilized area. However, due to the relatively low survey effort prior to these most recent reports, more data are needed for a more definitive summary of right whale abundance in this area.

Table 3.1-3
Summary of confirmed right whale sightings. Data compiled from National Marine Fisheries Service, North Atlantic Right Whale Sightings Survey (NMFS NARWSS) Reports from 2002 to 2011.

NARWSS Report Year	Months Project Area surveyed	[1]SPUE (per nm surveyed) or Number of sightings within 40 nm of the in Project Area	Reference[2]
2002	March – July; September-November	SPUE = low (<0.25)	Cole *et al.*, 2007
2003	April - December	1-4 Sightings	Rone *et al.*, 2007a
2004	February – July; September – December	1-4 Sightings	Rone *et al.*, 2007b
2005	April - December	1-2 Sightings	Niemeyer *et al.*, 2007a
2006	January - December	1-2 Sightings	Niemeyer *et al.*, 2007b
2007	January – March (only 1 transect line)	2-4 Sightings	Niemeyer *et al.*, 2008
2008	0	1 Sighting (source = whale watch)	Khan *et al.*, 2009
2009	0	0	Khan *et al.*, 2010
2010	April – June	21 Sightings (98 whales)[3,4]	Khan *et al.*, 2011
2011	NA	1-25 whales at 10 sightings locations	NMFS NEFSC 2012[5]

[1]Sightings reported as SPUE in 2002 and by count from 2003-2011; depending on presentation in report.
[2]Sightings sources include aerial and shipboard surveys, whale watches, and opportunistic (i.e. the general public, Coast Guard, commercial ships, and fishing vessels). Unconfirmed reports were not included in the report.
[3]DMA (triggered by ≥3 right whales outside a SMA) in Rhode Island Sound, April – May.
[4] Source: Kenney and Vigness-Raposa, 2010
[5]Sightings map (October 2010- June 2011) only, report not available yet.

Right whale sightings in the Project Area during 1998, 2010, and 2011

Kenney and Vigness-Raposa (2010) described what they called an “aggregation of feeding right whales just east of Block Island in April 1998” that lasted for at least three weeks. Eighteen whales were identified either against the right whale catalog or as uncataloged individuals that were seen on multiple days. Most individuals were males. The rate of resightings was low, however, and it is suspected that there were substantially more than 18 individuals feeding in Rhode Island Sound during this period. Observers were not able to determine the spatial extent of this high-use area. Knowlton *et al.*, (2005) noted that six individuals observed in Block Island Sound in 1998 had actually been recorded earlier in the year in the traditional winter/spring feeding grounds of Cape Cod Bay. No further sightings of these particular individuals were made until they reached the Bay of Fundy in the summer.

During the week of April 23, 2010, 98 right whales were reported feeding in the waters between Martha's Vineyard and Block Island (Figure 3.1-4; Khan *et al.*, 2011). From October 2010 through September 2011, a relatively high number of right whales were observed at ten sightings locations ranging from one to 25 right whales at each location within the Project Area (Figures 3.1.1-4, 3.1.1-5, and 3.1.1-6; NMFS NEFSC, 2012).

Right whale strandings in Massachusetts and Rhode Island

Although the stranding location of a whale is not necessarily indicative of the location or area inhabited by the whale, strandings data for the south coast of Massachusetts and Rhode Island are included for two reasons: 1) as potentially showing a whale's presence in the area, and 2) as a baseline for serious injuries and mortalities to this species to be used when assessing potential impacts. Five right whale strandings have been recorded in the vicinity of the Project Area from south of Block Island to Monomoy Island, Massachusetts from 2000 to 2009 (Table 3.1-4).

Table 3.1-4
Records of right whales strandings from 2000 to 2009.

Date	Location	Cause of Mortality
19 January 2000	15 km southeast of Block Island, RI	Not determined
12 October 2002	Nantucket, MA	Entangled in fishery gear
28 April 2005	Monomoy Island, MA	Ship strike
13 May 2005	39 km south of Martha's Vineyard, MA	Not determined
21 May 2006	56 km south of Block Island, RI	Not determined

Source: Kenney and Vigness-Raposa, 2010; Henry *et al.*, 2011

In summary, North Atlantic right whales were rare (SPUE 0.1 to 25 whales per 1,000 km) within 40 nm of the Project Area through 2010 during the winter, summer, and fall, and were most abundant (SPUE as high as 50 to100 whales per 1,000 km) in the spring (Right Whale Consortium, 2012). Periods of high right whale activity in or near the Project Area during 1998, 2010, and 2011 demonstrate that the current knowledge of migratory and feeding activities is incomplete, and that there is interannual variability in the timing and location of these activities.

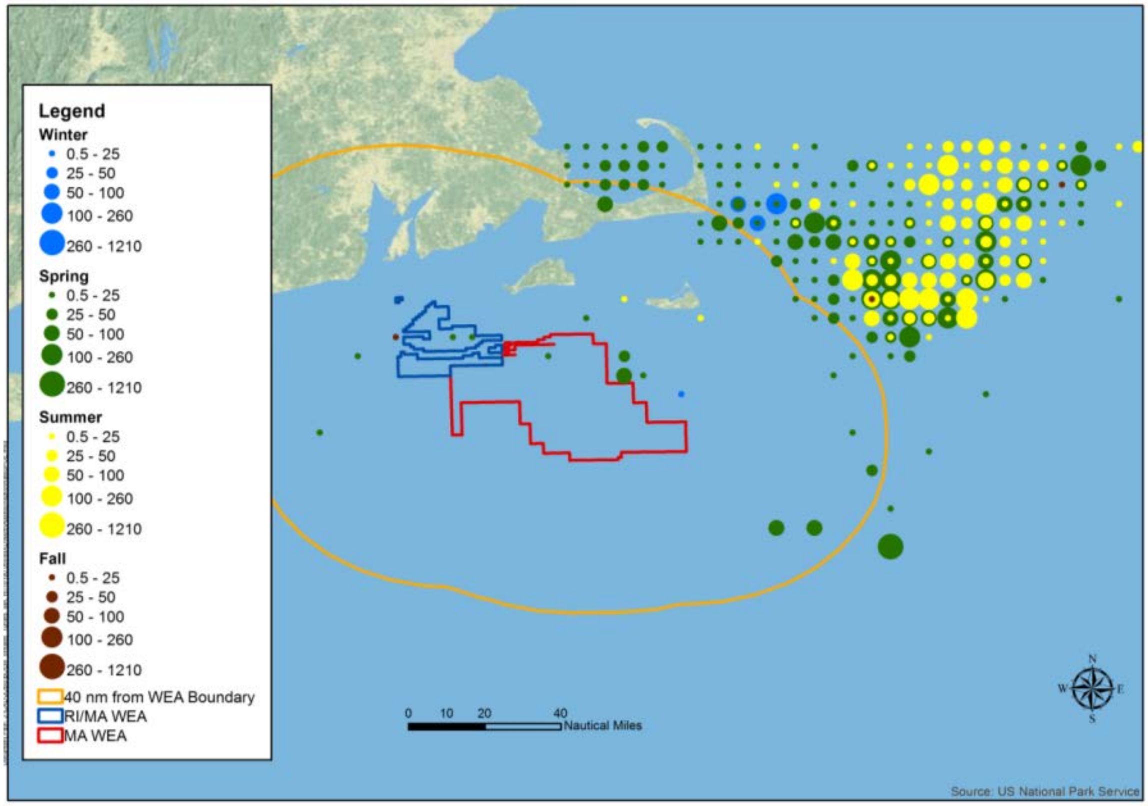


Figure 3.1.1-1: SPUE for North Atlantic right whales. Map depicts Project Area and surrounding waters (40 nm from the Project Area outlined in orange for reference).

Note: Data Source Right Whale Consortium, 2012. Map provided by Normandeau Associates, Inc.

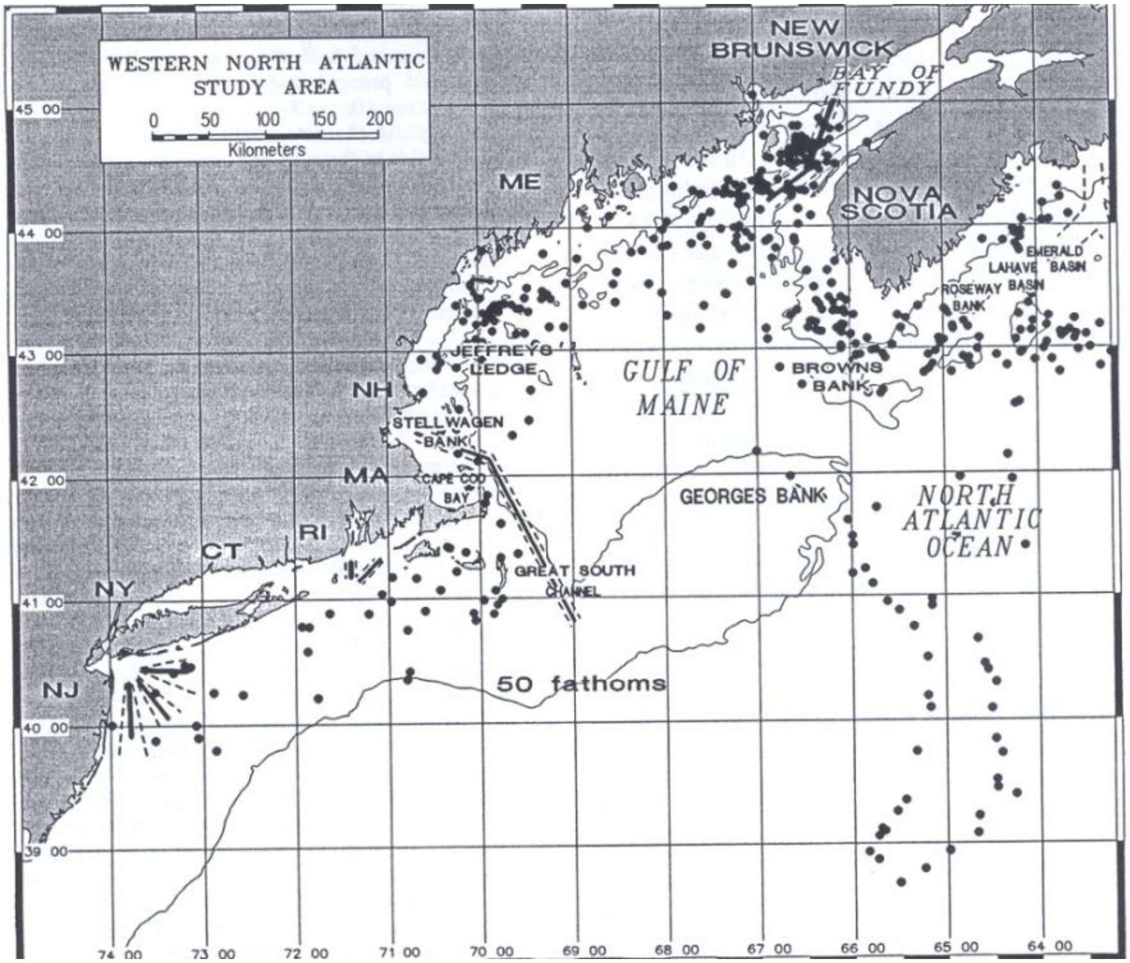


Figure 3.1.1-2: Satellite-acquired locations for 9 right whales. Whales tagged in the Bay of Fundy from 1989-1991, tagging data ranged from 7 to 42 days (Mate *et al.*, 1997).

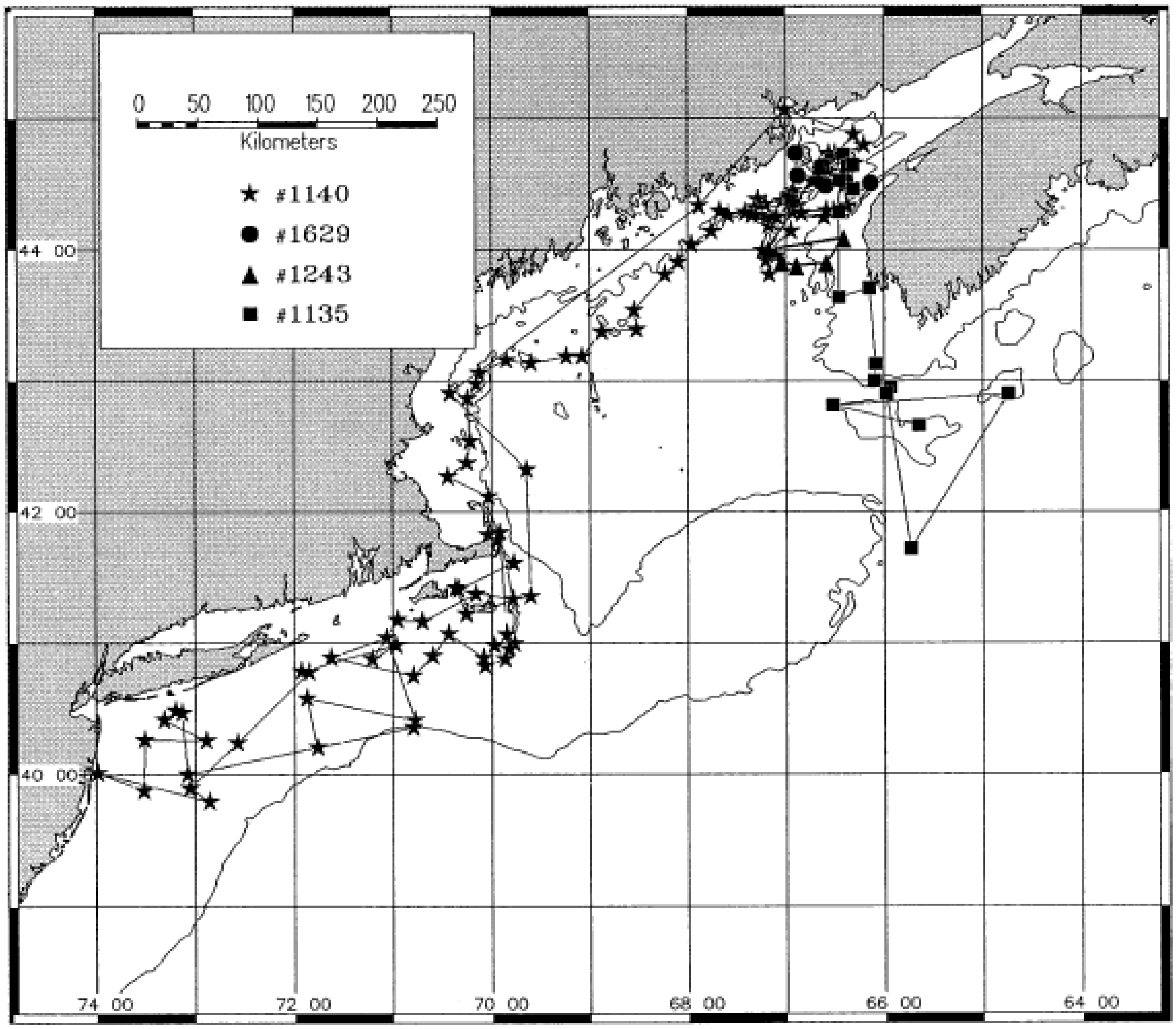


Figure 3.1.1-3: Satellite-monitored movements of 4 female right whales radiotagged.

Note: In the Bay of Fundy in 1990 and 1991, including a pregnant female (#1135 tagged for 7 days) and 3 female with calves (#1140 tagged for 42 days, #1629 tagged for 10 days, and #1243 tagged for 10 days, Mate *et al.*, 1997).

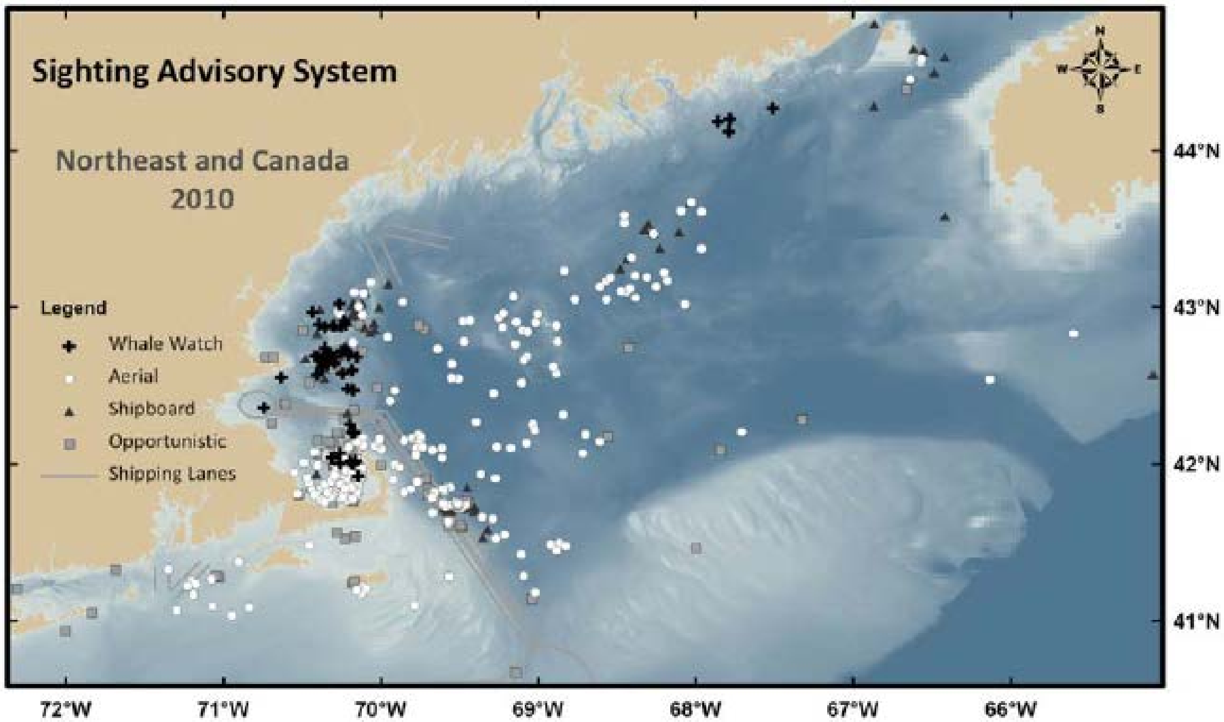


Figure 3.1.1-4: Locations of all right whale sightings reported to the Right Whale Sightings Advisory System.

Note: (RWSAS) within Northeast US and Canadian waters in 2010, shown by reporting source. The category 'Opportunistic' includes reports made by the general public, the Coast Guard, commercial ships, and fishing vessels. Unconfirmed reports were excluded from this figure (Khan *et al.*, 2011).

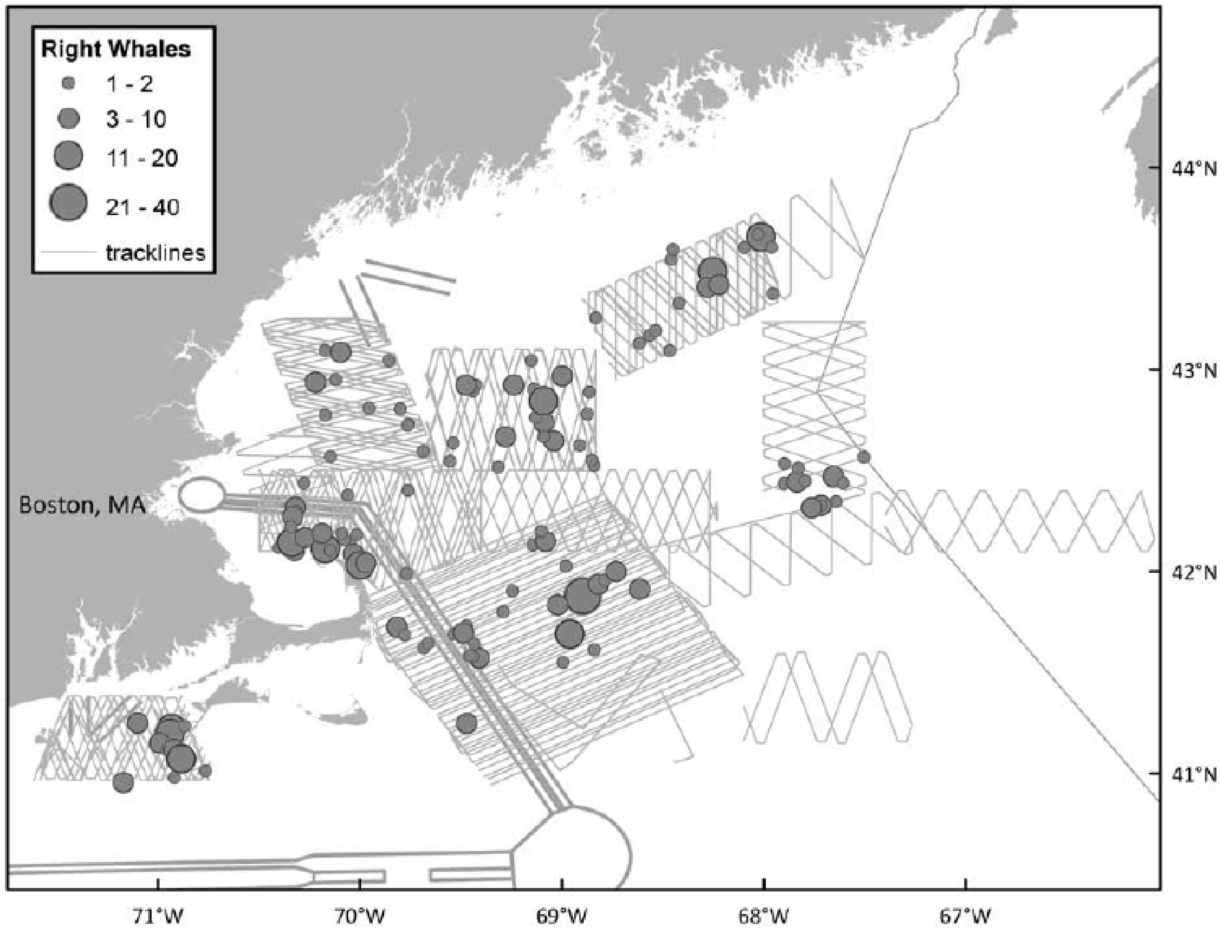


Figure 3.1.1-5. North Atlantic right whale aerial survey. Results from October 2010 through September 2011 (NMFS NEFSC, 2012).

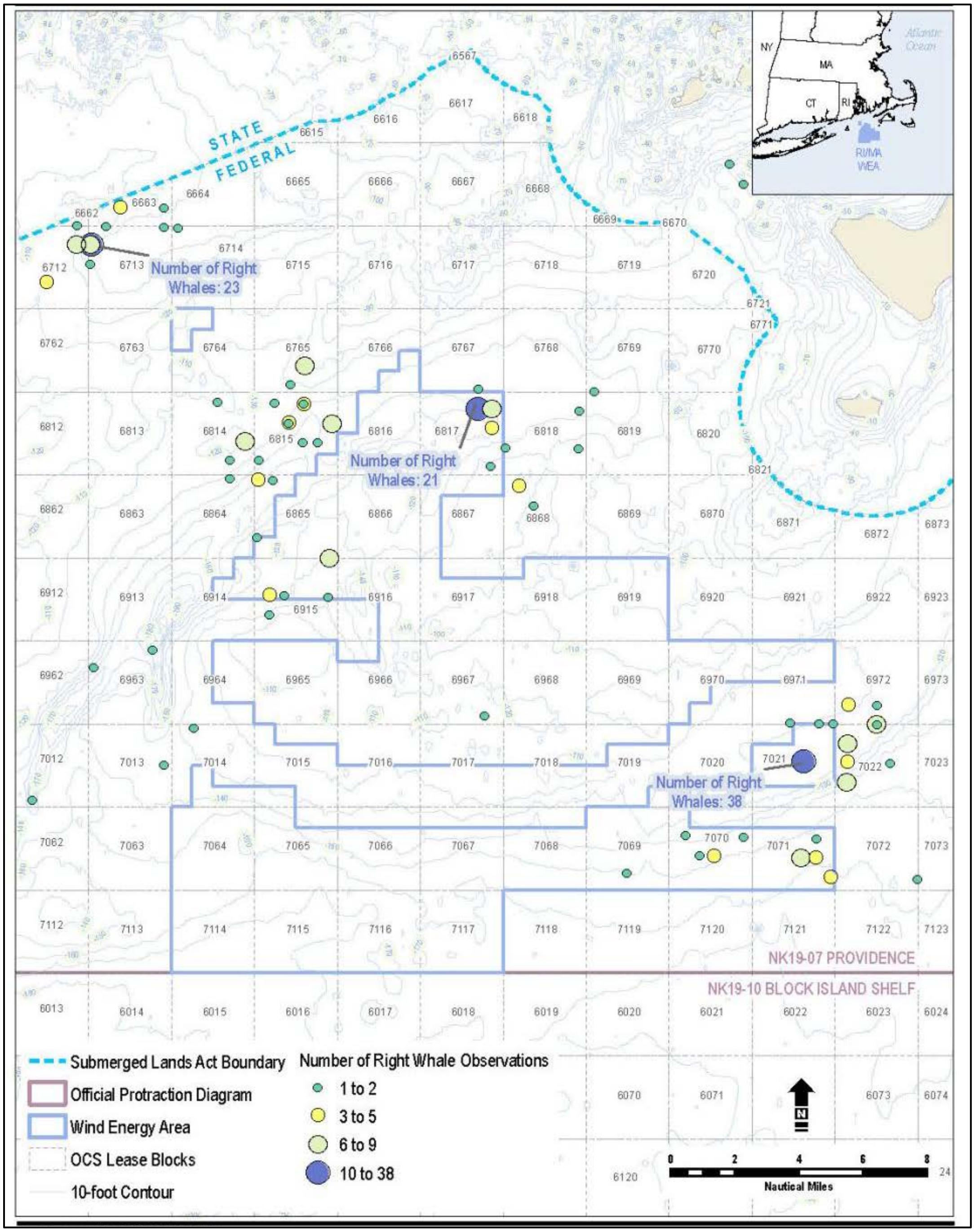


Figure 3.1.1-6. North Atlantic Right Whale Observations within the RI WEA April 2010. Map provided by Ecology and Environment Inc.

3.1.1.6 Critical Habitat

No critical habitat exists for the North Atlantic right whale within the Project Area and its surrounding waters. The closest critical habitat near the Project Area is the Great South Channel east of Cape Cod. Critical habitat is also located in Cape Cod Bay, and in coastal Florida and Georgia from the Sebastian Inlet to the Altamaha River (NMFS 2004; NMFS 2012a).

3.1.2 Humpback Whale

3.1.2.1 Status

The humpback whale was listed as federally endangered under the ESA in 1970 (NMFS 1991). According to tagging data the North Atlantic population of the humpback whale is estimated to be composed of 4,894 males and 2,804 females. However this population estimate is thought to be an underestimate because the sex ratio of the species is known to be even (Waring *et al.,* 2011).

3.1.2.2 Description

The humpback whale is a species of baleen whale that feeds primarily on krill and small fish such as herring (*Clupea harengusy*), sand lance (*Ammodytes americanus*), and capelin (*Mallotus villosus*). Feeding is accomplished by gulping large amounts of water and filtering out their preferred prey thought the baleen plates (Kenny and Vigness-Raposa 2010; NMFS 1991).

Adult male and female humpback whales measure 40 to 48 feet (12.2 and 14.6 meters) and 25 to 50 feet (13.7 to 15. 2 meters) in length, respectively. Both sexes weigh from 25 to 40 tons (22,680 to 36,287 kilograms) (ACS 2004a). The humpback whale has several distinguishing features including particularly long flippers (average about 1/3 total body length), a robust body, and dark coloring on the back, contrasted by white pigmentation on the side and ventral surface of the body, flukes and flippers (NMFS 1991).

3.1.2.3 Distribution

Humpback whales can be found in U.S. waters spanning the entire east coast from the Gulf of Maine to the waters off Florida (Waring *et al.,* 2011). They are also known to occur in waters north of the Gulf of Maine such as the Gulf of St. Lawrence, Newfoundland/Labrador during the spring, summer, and fall to feed (Waring *et al.,* 2011). During winter months, humpback whales from all of the northern feeding locations migrate south to the West Indies to mate and calve (Waring *et al.,* 2011).

The distribution of humpback whales in the northeast is thought to be greatly dependent on the distribution of its Gulf of Maine prey species - herring and sand lance (Kenney and Vigness-Raposa 2010). Shifts in prey abundance have been correlated with shifts in humpback distribution between the Gulf of Maine and Cape Cod Bay/east of Cape Cod (Kenney and Vigness-Raposa 2010).

3.1.2.4 Threats

Threats to humpback whales include vessel collisions, entanglement in fishing gear, disturbance from anthropogenic noise (specifically low frequency sound), pollutants and contaminants, habitat degradation, and overfishing of the animals prey base (NMFS 1991). Vessel collisions and entanglement in fishing gear are likely the main cause of humpback mortality (Waring *et al.,* 2011).

3.1.2.5 Occurrence in the Project Area

Within the Gulf of Maine region and south, humpback whales are distributed across the continental shelf, especially during the spring. During the summer, sightings are more common in the eastern half of the Rhode Island Ocean SAMP study area (Figure 3.1-2; Kenney and Vigness-Raposa, 2010). This species occurs in this region throughout the year, with 71% of all sightings (including whale watching records) occurring in the summer, 16% in the spring, 10% in the fall, and 3% in the winter (Kenney and Vigness-Raposa, 2010). Within the Rhode Island Ocean SAMP study area, humpback whales are likely to be relatively rare in most years, but may be locally abundant in other years (Kenney and Vigness-Raposa, 2010).

Regionally, SPUE for humpback whales were highest in the Great South Channel during summer and fall, with levels ranging from 0.2 to 1,090 whales per 1,000 km (Right Whale Consortium, 2012; Figure 3.1.2-1). Within the Project Area, SPUE were more scattered, and ranged from 0.2 to 40 whales per 1,000 km in the spring, 40 to 100 whales per 1,000 km in the winter, and 100 to 200 whales per 1,000 km in the summer (Right Whale Consortium, 2012). Within 40 nm of the Project Area, humpback whale sightings were higher in the winter, spring, and fall with SPUE ranging from 40 to 100 whales per 1,000 km, and lower in the summer (SPUE ranging from 0.2 to 40 whales per 1,000 km; Right Whale Consortium, 2012; Figure 3.1.2-1).

Humpback whales have stranded relatively frequently in recent years. Over the past decades, there have been 13 humpback whale strandings recorded off Massachusetts and Rhode Island (Table 3.1-4). Four of the strandings were recorded in Rhode Island from 2001 to 2005, and nine were recorded in within Massachusetts waters (Waring *et al.*, 2011; Kenney and Vigness-Raposa, 2010).

Table 3.1-5
Record of humpback whale strandings or serious injury/mortality in Massachusetts and Rhode Island for the past decades.

Date	Location	[1]Cause of serious injury or mortality or [2]Stranding
22 June 2001	Newport, RI	Stranding
10 August 2001	Middletown, RI	Stranding
3 June 2004	Charlestown, RI	Stranding
6 July 2005	Newport, RI	Stranding
October 1987	[3]Massachusetts Islands	Stranding
November 1988	Massachusetts Islands	Stranding
January 1991	Massachusetts Islands	Stranding
June 1992	Massachusetts Islands	Stranding
6 September 2006	East of Cape Cod	Fisheries entanglement
13 May 2007	Rockport, MA	Ship strike
24 June 2007	Stellwagen Bank	Ship strike
8 July 2008	Off Nauset, MA	Ship strike
21 August 2008	Off Chatham, MA	Fisheries entanglement

[1]Waring *et al.*, 2011.

[2] Kenney and Vigness-Raposa, 2010.

[3]More specific information regarding which of the “Massachusetts Islands” on which these strandings took place was not available. There are multiple islands off Massachusetts, and those referred to here are not necessarily Martha’s Vineyard or Nantucket.

3.1.2.6 Critical Habitat

Critical habitat has not been designated for the humpback whale (NMFS 1991).

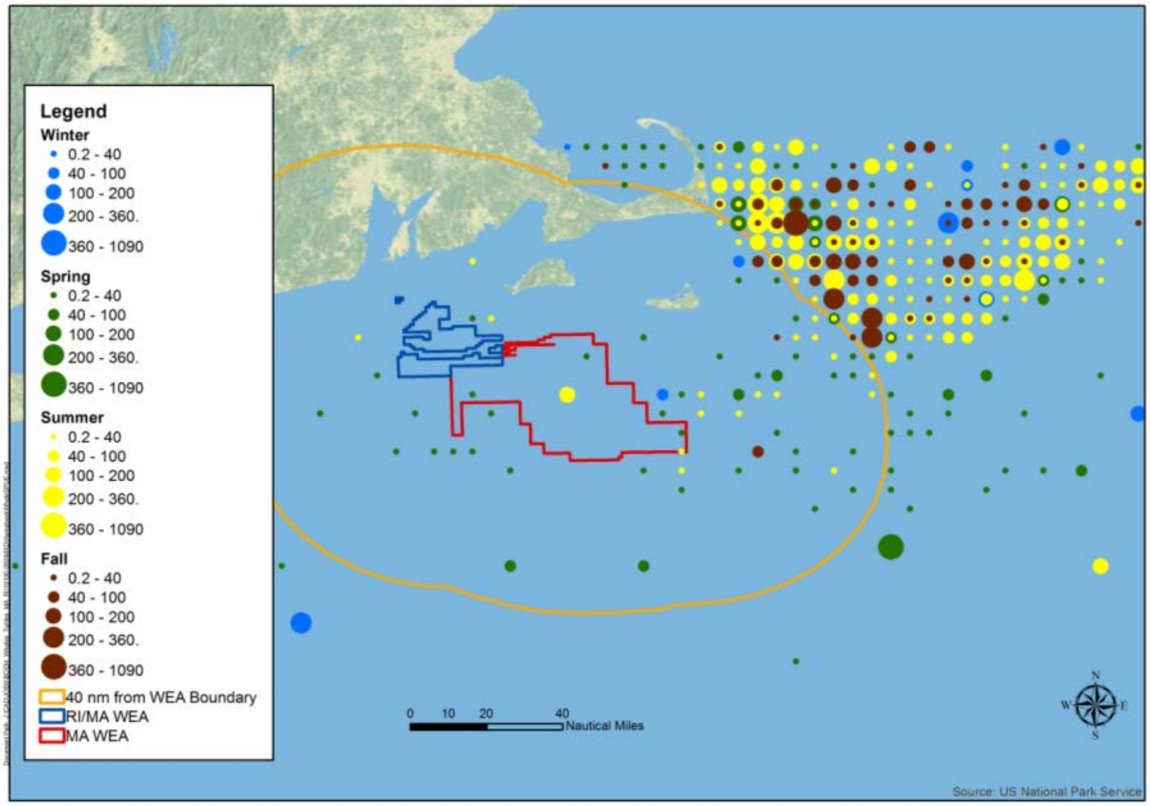


Figure 3.1.2-1. SPUE for humpback whales. Map depicts the Project Area and surrounding waters (40 nm from the Project Area outlined in orange for reference).

Note: Data Source Right Whale Consortium, 2012. Map provided by Normandeau Associates Inc.

3.1.3 Fin Whale

3.1.3.1 Status

The fin whale was listed as federally endangered under the ESA in 1970 (NMFS 2011b). Based on surveys conducted in 2006 and 2007, the best abundance estimate for the western North Atlantic stock is 3,985 individuals (Waring *et al.*, 2011).

3.1.3.2 Description

The fin whale is a species of baleen whale that feeds primarily on krill and small schooling fish, such as herring, sand lance and capelin (NMFS 2010b). Feeding is accomplished by gulping large amounts of water and filtering out their preferred prey through the baleen plates (Kenny and Vigness-Raposa 2010).

The fin whale is the second largest whale species in length measuring up to 78 feet (24 meters) in the northern hemisphere and 88 feet (26.8 meters) in the southern hemisphere (NMFS

2010b). The fin whale has several distinguishing features including a sleek, streamlined body form, dorsal fin located between two-thirds and three-quarters of the way back on the body, and a distinct ridge along the back between the dorsal fin and the fluke (Kenney and Vigness-Raposa 2010).

3.1.3.3 Distribution

Fin whales are widely distributed throughout the North Atlantic. Within U.S. waters they can occur from the Gulf of Maine to the Gulf of Mexico (NMFS 2010b). Primarily they are found between the Gulf of Maine and Cape Hatteras (Waring *et al.*, 2011). Fin whales are one of the most commonly observed large whales. During surveys conducted between 1978 and 1982 fin whales accounted for 46 percent of the large whales observed (CETAP 1982, Waring *et al.,* 2011). Mass migratory movements along a defined migratory corridor have not been supported by sightings (NMFS 2010b). However, acoustic data have indicated a "southward flow pattern" occurring in the fall from the Labrador/Newfoundland area, past Bermuda, and to the West Indies (NMFS 2010b).

Off the coast of the eastern United States, fin whales are generally centered over the 328 foot (100 meter) isobath but have been sighted in shallower and deeper water, including submarine canyons off the continental shelf (NMFS 2010b). Within the northeast region, fin whales are primarily found from spring through the fall months as New England is a major feeding habitat for the population (Hain *et al.*, 1992 *as cited in* Kenney and Vigness-Raposa 2010; Waring *et al.,* 2011).

3.1.3.4 Threats

Commercial harvest for fin whales in the North Atlantic has not occurred since 1987, however, hunting (based on a catch limit system), still occur in the waters of Greenland. Other threats to fin whales include vessel collisions, reduced prey as a result of overfishing, entanglement in fishing gear, habitat degradation, and anthropogenic sound. (NMFS 2010b).

3.1.3.5 Occurrence in the Project Area

According to Kenney and Vigness-Raposa (2010), this species occurs throughout the continental shelf in the Rhode Island Ocean SAMP study area in all seasons, with the highest sightings in the summer (81% of all sightings), and 12% in spring. These sightings include whale watch data in addition to Right Whale Consortium survey data. Within the Rhode Island Ocean SAMP study area, the highest occurrence of fin whales is in the outer half of the area from south of Montauk Point to south of Nantucket, "in precisely the same area as the dense aggregations of sighting records from the whale watch boats" (Kenney and Vigness-Raposa, 2010). In other words, this area is targeted by whale watch boats because of the high probability of finding whales in the area.

Regionally, SPUE for fin whales were relatively high in all seasons along the 100m isobaths southeast of Cape Cod, and along the continental shelf west, south, and east of the Project Area (Right Whale Consortium, 2012; Figure 3.1.3-1). Within the Project Area, fin whales were relatively abundant in all seasons with SPUE ranging from 0.3 to 350 whales per 1,000 km in the summer, 0.3 to 135 whales per 1,000 km in the winter, 0.3 to 50 whales per 1,000 km in the spring, and 0.3 to 135 whales per 1,000 km in the fall (Right Whale Consortium, 2012; Figure 3.1.3-1).

Strandings and human caused mortalities in Massachusetts and Rhode Island

Fin whales are the most commonly stranded large whale in the Rhode Island Ocean SAMP study area, with a recorded 28 strandings from 1970 to present, and have also been common in Massachusetts (Kenney and Vigness-Raposa, 2010; Table 3.1-6). However, no fin whale strandings have been reported in Massachusetts from 2004 to 2008 (Waring *et al.*, 2011). Between 2004 and 2008, ten fin whale mortalities resulting from ship strike, were recorded from Virginia to Canada (Waring *et al.*, 2011). From 2004 to 2008, entanglement in fishing gear caused one mortality in the Project Area region, off Martha's Vineyard, on September 26, 2007 (Waring *et al.*, 2011).

Table 3.1-6
Location of fin whale strandings in Rhode Island in the past decades.

Year of Stranding	Location (Rhode Island)
1983	Block Island
1989	Quonset Point
1991	East Matunuck State Beach
1996	Little Compton
2002	Newport
2004	Fort Adams State Park
2004	Brenton Point State Park

Source: Kenney and Vigness-Raposa, 2010

3.1.3.6 Critical Habitat

Critical habitat has not been designated for the fin whale (NMFS 2010b).

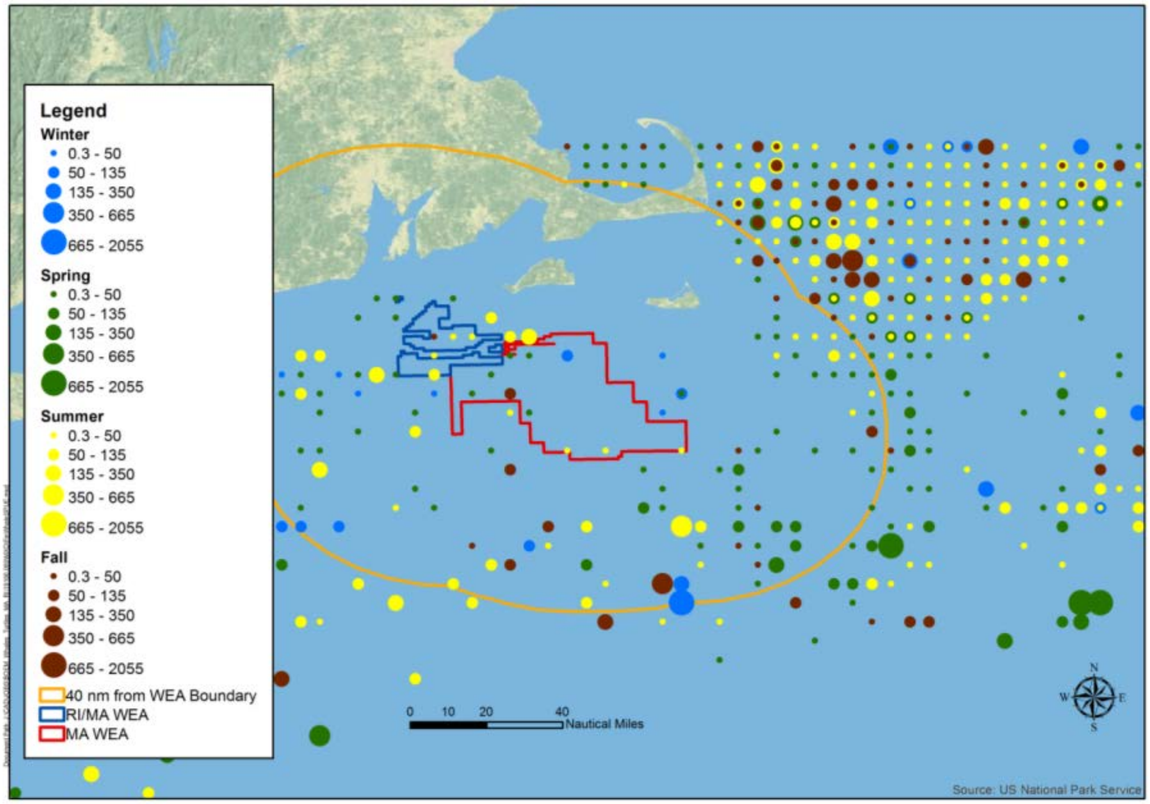


Figure 3.1.3-1. SPUE for fin whales. Map depicts Project Area and surrounding waters (40 nm from the Project Area outlined in orange for reference).

Note: Data Source Right Whale Consortium, 2012. Map provided by Normandeau Associates Inc.

3.1.4 Sei Whale

3.1.4.1 Status

The sei whale was listed as federally endangered under the ESA in 1970 (NMFS 2011a). Abundance estimates for sei whales are only reliably given for the Scotian Shelf population (386) but this does not include the Project Area (Waring *et al.*, 2011).

3.1.4.2 Description

The sei whale is a species of baleen whale that feed on plankton (e.g., copepods and krill), small schooling fish, and cephalopods (e.g., squid) by both gulping and skimming. They prefer to feed at dawn and may exhibit unpredictable behavior while foraging and feeding on prey. Sometimes seabirds are associated with the feeding frenzies of these and other large whales.

Sei whales become sexually mature at 6-12 years of age when they reach about 45 ft (13 m) in length, and generally mate and give birth during the winter in lower latitudes. Females breed every 2-3 years, with a gestation period of 11-13 months. Females give birth to a single calf that is about 15 ft (4.6 m) long and weighs about 1,500 lbs (680 kg). Calves are usually nursed for 6-9 months before being weaned on the preferred feeding grounds. Sei whales have an estimated lifespan of 50-70 years (NMFS, 2011a).

3.1.4.3 Distribution

The Nova Scotia stock of sei whales is distributed across the continental shelf waters from the northeast U.S. coast to south of Nova Scotia (Waring *et al.*, 2011) and is typically sighted on the U.S. Atlantic mid-shelf and the shelf edge and slope. Predominantly a deep water species, most commonly observed over the continental slope, shelf breaks, and deep ocean basins situated between banks (NMFS, 2011a) sei whales are also known to come inshore into more shallow waters episodically (Schilling *et al.*, 1992). According to Olsen *et al.*, (2009), sei whale's movements appear to be associated with oceanic fronts, sea surface temperatures, and specific bathymetric features. Along the U.S. Atlantic seaboard, in spring and early summer sei whales are frequently observed in areas with North Atlantic right whales in the Great South Channel and southern Gulf of Maine (NMFS, 2011a). Major changes have been noted in sei whale distribution and movements over the last few decades in the North Atlantic.

3.1.4.4 Threats

Human caused threats to sei whales include ship strikes and entanglement in fishing gear.

3.1.4.5 Occurrence in the Project Area

Past sightings in the continental shelf waters off Cape Cod include a group of at least 40 sei whales, which were part of a larger, multi-species group of whales, recorded in Hydrographer Canyon, in April 1981 (Kenney and Winn, 1987). Groups of up to 10 sei whales were recorded in the inshore waters of the southern Gulf of Maine on 30 of 67 days during the summer of 1986 (NMFS, 2011a). Baumgartner *et al.*, (2011) have observed sei whales in the Great South Channel during spring from 2004 to 2010, indicating that this species is more common in the area than previously thought.

According to Kenney and Vigness-Raposa, (2010) though sightings in southern New England are considered rare, with only 35 records in the Rhode Island Ocean SAMP study area; most sightings occurred in the spring (83%). There are two locations of note in the vicinity of the Project Area. South of Montauk and Block Island there was a small cluster of inshore sightings of individual whales during July 1981 on three different days; one in August 1982, and one in May 2003. The second noteworthy sighting was on May 7, 2001 when 23 sightings of a total of 112 whales were observed on the mid-shelf area south of Nantucket (Kenney and Vigness-Raposa, 2010).

Regionally, sei whale SPUE data from the Right Whale Consortium show the highest levels of sightings in the Great South Channel occurring in the spring and summer, and ranging from low to high (0.004 to 4,840 whales per 1,000 km; Right Whale Consortium, 2012; Figure 3.1.4-1). Within the Project Area, SPUE were at relatively low levels and scattered in all seasons, ranging from 0.004 to 25 whales per 1,000 km, with a few slightly higher in the spring (25 to 100 whales per 1,000 km; Right Whale Consortium, 2012). Within 40 nm of the Project Area, SPUE were lowest (0.004 to 25 whales per 1,000 km) in the winter, summer, and fall, and highest in the spring (ranging from 100 to 380 whales per 1,000 km; Right Whale Consortium, 2012).

There have been three reports of sei whale strandings or mortalities in the northeast U.S.area: (1) on November 17, 1994, a sei whale carcass came in on the bow of a container ship as it docked in Boston, MA; (2) in May 2001, a sei whale slid off the bow of a ship arriving in New York Harbor; and, (3) a sei whale was found off Deer Island, MA, with ship strike known as the primary cause of death (Waring *et al.*, 2011; Kenney and Vigness-Raposa, 2010). There are no known sei whale strandings in Rhode Island in recent years (Kenney and Vigness-Raposa, 2010).

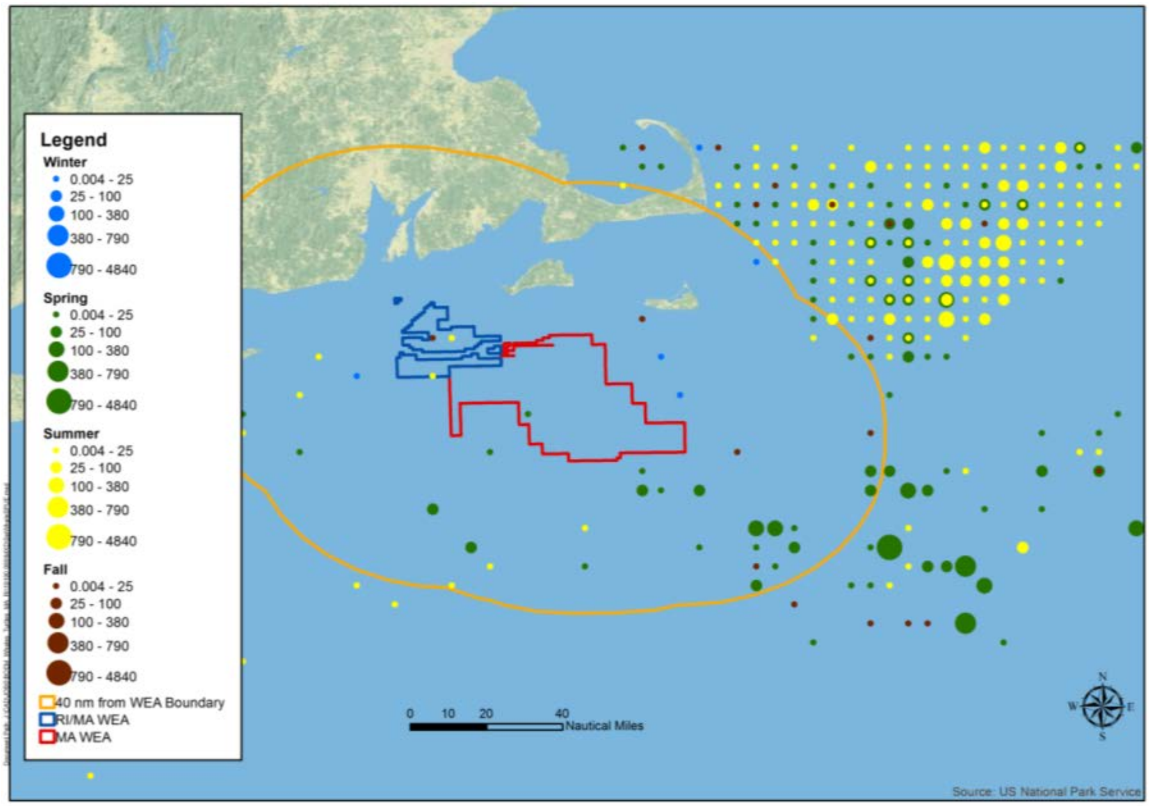


Figure 3.1.4-1. SPUE for sei whales. Map depicts the Project Area and surrounding waters (40 nm from the Project Area outlined in orange for reference).

Note: Data Source Right Whale Consortium, 2012 Map provided by Normandeau Associates Inc.

3.1.5 Sperm Whale

3.1.5.1 Status

The sperm whale was listed as federally endangered under ESA in 1970 (NMFS, 2012a). The current abundance estimate for the western North Atlantic stock (Bay of Fundy to Florida) of sperm whales is 4,804. Sperm whales occurring in the North Atlantic are considered to be one stock, with those occurring in the eastern U.S. Atlantic EEZ likely representing only a fraction of the total stock (Waring *et al.*, 2011).

3.1.5.2 Description

Sperm whales (*Physeter macrocephalus*) are the largest of the odontocetes (toothed whales) and the most sexually dimorphic cetaceans, with males considerably larger than females. Adult females may grow to lengths of 36 feet (11 m) and weigh 15 tons (13607 kg). Adult males, however, reach about 52 feet (16 m) and may weigh as much as 45 tons (40823 kg). Sperm whales spend most of their time in deep waters (300-600m) and thus their diet consists of many larger organisms that also occupy deep waters of the ocean. Their principle prey are large squid weighing between 3.5 ounces and 22 pounds (0.1 kg and 10 kg), but they will also eat large demersal and mesopelagic sharks, skates, and fishes. The average dive lasts about 35 minutes and is usually down 1,312 feet (400 m), however dives may last over an hour and reach depths over 3280 feet (1000 m).

3.1.5.3 Distribution

The overall distribution of sperm whales along the U.S. east coast is centered along the shelf break and over the slope (NMFS, 2010a). Sperm whales tend to inhabit offshore waters, usually in depths of 600 m, and are uncommon in waters less than 300 m deep (NMFS, 2012a). The exception to this distribution pattern is found with a relatively high number of sightings in the shallow continental shelf waters of southern New England (Scott and Sadove, 1997). Geographic distribution may be linked to their social structure, with females and juveniles generally found in tropical and subtropical waters, and males ranging more widely (Waring *et al.*, 2011).

3.1.5.4 Threats

Although largely discontinued, commercial harvest of sperm whales was the biggest threat to its existence until the early 1980s. Other threats to sperm whales include vessel collisions, fishing gear entanglements, pollution, and exposure to anthropogenic sound (NMFS 2012a).

3.1.5.5 Occurrence in the Project Area

Within the northeast U.S., this species occurs in all seasons, but is found in higher numbers in the spring and summer, with fewer in the fall and winter (Kenney and Vigness-Raposa, 2010). Within the Rhode Island Ocean SAMP study area, “sperm whales are predicted to be present in all four seasons, but in scattered and low abundance” (Kenney and Vigness-Raposa, 2010).

SPUE data supports this information, with the highest SPUE found along the continental shelf edge and slope south of the Project Area in all seasons. The highest overall SPUE in the shelf waters occurred in the summer, with up to 3,000 whales per 1,000 km (Right Whale Consortium, 2012; Figure 3.1.5-1). Within the Project Area SPUE were highest in the fall (ranging from 125 to 335 whales per 1,000 km; Right Whale Consortium, 2012) followed by the spring and summer (ranging from 2 to 125 whales per 1,000 km). Within 40 nm of the Project

Area sperm whales occurred in all seasons (SPUE ranging from 125 to 335 whales per 1,000 km in the winter, spring, and fall, and slightly lower in the summer ranging from 2 to 125 whales per 1,000 km; Right Whale Consortium, 2012).

There have been occasional sperm whale strandings in Massachusetts; two whales from 2001 to 2005 (Waring *et al.*, 2011), and none in Rhode Island in the past decades (Kenney and Vigness-Raposa, 2010).

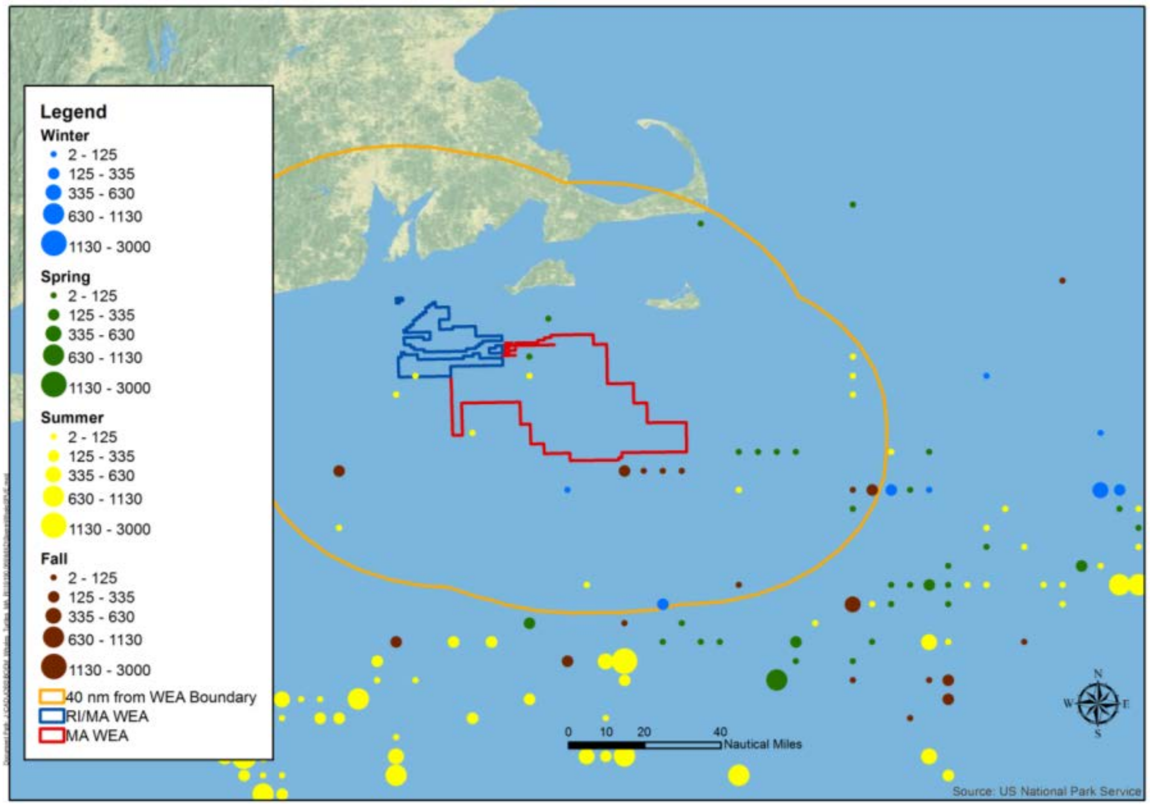


Figure 3.1.5-1. SPUE for sperm whales. Map depicts the Project Area and surrounding (40 nm from the Project Area outlined in orange for reference).

Note: Data Source Right Whale Consortium, 2012. Map provided by Normandeau Associates Inc.

3.2 Sea Turtles

There are six species of sea turtles that can be found in the offshore waters of the U.S.. Of these six species, there are four that could potentially occur within the Project Area and its surrounding waters. All four species are either threatened or endangered under the ESA (Table 3.2). These sea turtles species include the Northwest Atlantic Distinct Population Segment (DPS) of loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), green (*Chelonia mydas*), and leatherback (*Dermochelys coriace*). These four species are highly migratory and only found seasonally within the Project Area and its surrounding waters. It is not likely that any individual members of these species are year-round residents of the Project Area or its surrounding waters.

Table 3.2
Sea Turtle Species of the Western North Atlantic

Species	Status	General Occurrence North Atlantic	Occurrence in WEA[1]
Northwest Atlantic DPS Loggerhead Sea turtle (*Caretta caretta*)	T	Summer/Fall	Common
Green Sea Turtle (*Chelonia mydas*)	T	Summer	Possible
Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)	E	Summer/Fall	Possible
Leatherback Sea Turtle (*Dermochelys coriacea*)	E	Summer/Fall	Common

Note:
[1] The occurrence category is based upon historical sightings data compiled in the Rhode Island Ocean Special Area Management Plan , and Kenney and Vigness-Raposa 2010

Key:
E = Endangered.
T = Threatened.

Density information for sea turtles in the New England region is limited. However useful information is available from the CETAP survey program. This program provided the data synthesized in Shoop and Kenney (1992), was conducted between 1978 and 1982, and provided the first comprehensive look at sea turtle distribution in the North Atlantic from Nova Scotia, Canada to Cape Hatteras, North Carolina. The program consisted of three years of both aerial and shipboard surveys. Overall, they were able to determine seasonal distributions of loggerhead and leatherback seas turtles, the two most commonly sighted turtles during the survey. The sightings data allowed the authors to determine density of the two species per square km. The density for loggerheads was estimated at 0.00164-0.510 per square kilometer, and the density for leatherbacks was estimated at 0.00209-0.0216 per square kilometer. It should be noted that these density estimates were averaged for the entire survey range. Therefore, individual abundance estimates within the Project Area will not necessarily reflect this data. However, the survey was useful in providing information on the seasonal distribution of the species and the general sighting locations, indicating the presence of both loggerhead and leatherback sea turtles within southern New England. This information coupled with the Rhode Island's SAMP (Rhode Island CRMC 2010) and the preliminary AMAPPS data provided information on the potential occurrence of sea turtles in the Project Area and its surrounding waters.

While the loggerhead and leatherback sea turtles are more commonly observed in New England waters, green and Kemp's ridley sea turtles can also be found seasonally in southern New England waters, and as far north as the Gulf of Maine.

3.2.1 Northwest Atlantic Loggerhead Sea Turtle

3.2.1.1 Status

The Northwest Atlantic DPS of the loggerhead sea turtle was listed as federally threatened under the ESA effective October 24, 2011 (76 FR 58868). This is the DPS of loggerhead sea turtle that is likely to be present in the action area.

3.2.1.2 Description

The loggerhead sea turtle is its relatively large head, which supports powerful jaws used to crush hard shelled prey (NMFS 2012c). Preferred prey consists of crustaceans, mollusks, jellyfish, and small fin fish (NMFS and USFWS 2008). The adult and juvenile carapace, dorsal and lateral head scales, and dorsal flipper scales are reddish-brown in color. The flippers also have light to medium yellow edges (NMFS and USFWS 2008). Adult loggerhead sea turtles weigh 250 pounds (113 kilogram) on average, and can reach up to 3 feet (~1meter) in length (NMFS 2012c).

3.2.1.3 Distribution

Loggerhead sea turtles occur in temperate and tropical waters of the Atlantic, Pacific, and Indian Oceans (NMFS and USFWS, 2008). They are the most common sea turtle species along the U.S east coast. In the eastern U.S. the majority of loggerhead sea turtle nesting occurs from North Carolina through southwest Florida. Some nesting also occurs in southern Virginia and along the Gulf of Mexico coast westward into Texas (NMFS and USFWS, 2008). Despite its northern nesting limit of Virginia, the loggerhead sea turtle can be found in waters as far north as the Gulf of Maine (Shoop and Kenney 1992). Non-breeding adults and juveniles are commonly observed within the Long Island Sound region and the waters of southern New England (Shoop and Kenney 1992).

Loggerhead presence within the U.S. is potentially influenced by both water temperature and depth. During the CETAP aerial surveys loggerheads were most frequently observed in waters between 72 and 160 feet (22 and 49 meters) deep, and approximately 84 percent of the sightings occurring in waters less than 262 feet (80 meters), suggesting that loggerheads prefer shallower waters (Shoop and Kenney 1992). Loggerhead sightings occurred most frequently in surface water temperatures of between 7 and 30º Celsius (44.6 and 86º Fahrenheit), which tracked the seasonal change in ocean temperature (Shoop and Kenney 1992).

In southern New England loggerhead sea turtles can be found seasonally, primarily during the summer and fall months (Kenney and Vigness-Raposa 2010). Loggerheads are absent from southern New England during winter months (Kenney and Vigness-Raposa 2010; Shoop and Kenney 1992). During the CETAP surveys, one of the greatest aggregations of loggerheads was observed along the continental shelf northeast of Long Island (Shoop and Kenney 1992). According to preliminary data from AMAPPS, the loggerhead was the most frequently observed sea turtle species in the Northeast region between August and September (29 sightings of single animals) (Palka 2010). It is likely that the number of loggerheads in New England waters is greatly underestimated due the high likelihood that large numbers of juveniles occur in embayments and bays within the southern New England region. This life stage of the species would be too small to be detected during surveys (Kenney and Vigness-Raposa 2010).

3.2.1.4 Threats

Threats to loggerhead sea turtles include beach development, beach armoring and shoreline stabilization, and vehicle use of beaches, all of which cause destruction to their nesting habitat. Lighting pollution is also a potential threat as it could deter females from nesting, or disorienting hatchlings attempting to find the ocean (NMFS and USFWS 2008). In water threats include bycatch from fisheries such as pelagic longlining, trawling, dredging, and gill net fisheries, vessel strikes, anthropogenic noise, marine debris, legal and illegal harvest, oil pollution and predation by native and exotic species (NMFS and USFWS 2008).

3.2.1.5 Occurrence in the Project Area

Loggerhead sea turtles are frequently seen in waters off Rhode Island and southern Massachusetts seasonally. Most recently the AMAPPS aerial survey observed loggerheads within Rhode Island Sound, directly off shore of Point Judith, Rhode Island, and in the waters adjacent to the Project Area (Palka 2010). Loggerhead turtles have been observed relatively consistently in low numbers within and south of the Project Area in the summer and fall (ranging from 1 to 85 turtles per 1,000 km; Right Whale Consortium, 2012; Figure 3.2.1-1). SPUE for this species are likely to be underestimated due to the relatively small size, the high submergence time of the turtles, and subsequent difficulty for observation.

Stranding data for Cape Cod Bay indicate that loggerheads are relatively common in southern New England waters. Of 1,381 sea turtles stranded in Cape Cod Bay from 1979 to 2003, 20.3% were loggerheads (Dodge *et al.,* 2003). Among the 279 loggerheads known to strand in Massachusetts from 1986 to 2007, ten were stranded on Martha's Vineyard, and five on Nantucket (NMFS SEFSC, 2012). An additional 31 loggerhead turtles were stranded in Rhode Island during the same time period (NMFS SEFSC, 2012).

Because of their documented occurrence and use of southern New England waters, particularly within the vicinity of the Project Area, it is likely that loggerhead sea turtles could occur within the Project Area or its surrounding waters during the summer and fall, however it is not likely that concentrations of these animals would be found within the area, as observations indicated that these animals are generally single and relatively dispersed throughout the area (Kenney and Vigness-Raposa 2010; Palka 2010).

3.2.1.6 Critical Habitat

Critical habitat has not been designated for the loggerhead sea turtle (NMFS, 2012c).

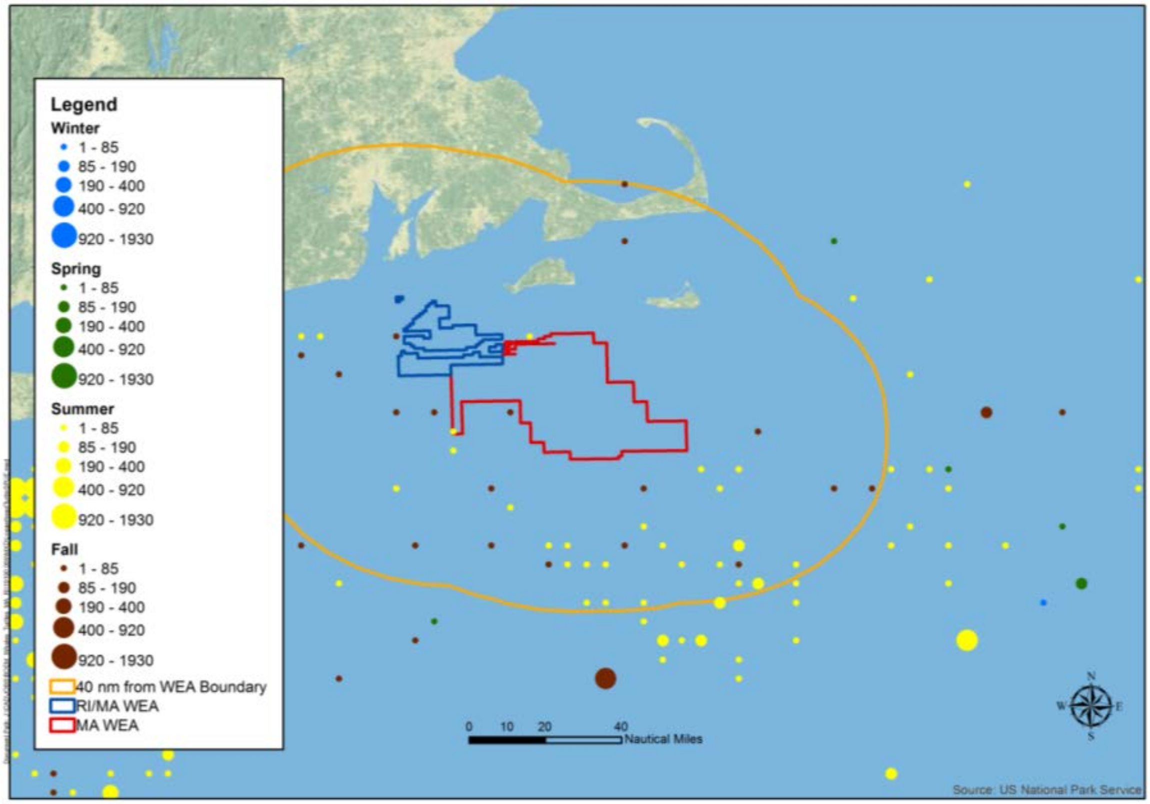


Figure 3.2.1-1. SPUE for loggerhead sea turtles. Map depicts the Project Area and surrounding waters (40 nm from the Project Area outlined in orange for reference).

Note: Data Source Right Whale Consortium, 2012. Map provided by Normandeau Associates Inc.

3.2.2 Leatherback Sea Turtle

3.2.2.1 Status

The leatherback sea turtle was listed as federally endangered under the ESA in 1970 (NMFS 2012c).

3.2.2.2 Description

The leatherback sea turtle is the largest sea turtle and the largest living reptile in the world (NMFS 2012c). Adults can reach up to 2,000 pounds (900 kilograms) in weight and 6.5 feet (2 meters) in length (NMFS 2012c; NMFS and USFWS 2007c). The leatherback sea turtle is the only sea turtle that does not have a carapace comprised of bony plates. Instead, the carapace of the leatherback sea turtle consists of a tough, oil-saturated connective tissue with a nearly continuous layer of small dermal bones that lie just below the leather like outer layer of the carapace (NMFS and USFWS 1992). The front flippers of the leatherback sea turtle are proportionally longer than other sea turtles, and can reach up to 106 inches (270 centimeters). The leatherback jaw is not designed for crushing, as other sea turtle species. Instead the jaw is pointed with sharp edges that make it useful for consuming a diet of soft-bodied oceanic prey such as jellyfish and salps (NMFS 2012c).

3.2.2.3 Distribution

The leatherback sea turtle is the most globally distributed sea turtle, occupying habitats in tropical and subtropical waters, as well as cold-temperate waters (NMFS and USFWS 1992). They are also considered the most pelagic sea turtle, however they are often reported in coastal waters off the U.S. continental shelf (NMFS and USFWS 1992). Leatherbacks have been sighted along the entire coast of the eastern U.S. from the Gulf of Maine in the north and south to Puerto Rico, the Gulf of Mexico, and the U.S. Virgin Islands (NMFS and USFWS 1992). The CETAP aerial survey reported leatherbacks to be present throughout their study area (the outer continental shelf between Cape Hatteras and Nova Scotia) with the greatest concentrations seen between Long Island and the Gulf Maine (Shoop and Kenney 1992).

The leatherback sea turtle is not known to nest as far north as Rhode Island and Massachusetts. Along the eastern continental U. S. nesting occurs in lower latitudes, primarily southeastern Florida where minor nesting colonies are known to exist (NMFS and USFWS 1992, Eckert *et al.*, 2002). Mating often occurs in the waters adjacent to nesting beaches and along the migratory pathway. Following nesting, leatherback turtles that have nested along Florida beaches often head north toward feeding grounds in higher latitude, colder waters (Eckert *et al.,* 2002; James *et al.,* 2005). Adult leatherback sea turtles have thermoregulatory adaptations that allow them to tolerate colder water temperatures than other sea turtles, allowing them to seasonally forage as far north as Newfoundland (NMFS 2012c). The migration north is driven by foraging habitat present in colder waters, allowing the leatherback to feed on its preferred prey of jellyfish and other gelatinous plankton (James *et al.,* 2005; NMFS and USFWS 1992).

3.2.2.4 Threats

The primary threat to the leatherback sea turtle is legal and illegal harvesting of eggs and nesting females. Threats in the nesting habitat also include beach development, beach armoring and shoreline stabilization, and vehicle use of beaches, all of which cause destruction to their nesting habitat. Lighting pollution is also a potential threat as it could deter females from nesting, or disorienting hatchlings attempting to find the ocean (NMFS and USFWS 1992). In water threats include bycatch from fisheries such as pelagic longlining, trawling, dredging, and gill net fisheries, vessel strikes, anthropogenic noise, marine debris, oil pollution and predation by native and exotic species (NMFS and USFWS 1992).

3.2.2.5 Occurrence in the Project Area

In southern New England, leatherback sea turtles are generally observed during summer and fall (Kenney & Vigness-Raposa 2010). Sightings data indicate that leatherback occurrence within the two WEAs and coastal areas is more dispersed, with no concentration areas noted in the WEAs. However concentrations of leatherbacks have been noted near the WEAs. One area was noted south of central Long Island during the CETAP aerial surveys (Shoop and Kenney 1992). Also, according to Kara Dodge of the Large Pelagics Research Center (pers. comm., 2012), the area of Nantucket Shoals south of Martha's Vineyard and Nantucket and east is considered a "hot spot" for leatherbacks from at least July (and maybe June) through September. It is not known why leatherbacks spend time in southern New England waters, however during the CETAP aerial surveys leatherbacks were observed off the Rhode Island coast in association with aggregations of *Cyanea sp.* (Shoop and Kenney 1992).

Regionally, relatively high SPUE were recorded, ranging from 20 to 105 leatherback turtles per 1,000 km in the fall and 20 to 35 turtles per 1,000 km in the summer and winter (Right Whale Consortium, 2012). In the surrounding continental shelf waters to the southwest, south, and southeast of the Project Area, SPUE were as high as 105 to 230 turtles per 1,000 km in the summer and fall (Right Whale Consortium, 2012; Figure 3.2.6.3-2). Recently the AMAPPS aerial survey observed leatherbacks within Block Island Sound, to the west of the Project Area during August and September (Palka 2010).

Leatherback sea turtle strandings have been recorded for Rhode Island and Massachusetts. However unlike most other sea turtles, the strandings in this case are not likely due to cold-stunning, due to this species' thermoregulatory abilities. Leatherback sea turtles are the most common species to strand in Rhode Island with 144 records from 1986 to 2007 (NMFS SEFSC, 2012). Among the 159 leatherbacks known to strand in Massachusetts from 1986 to 2007, 29 were stranded on Martha's Vineyard, and four on Nantucket (NMFS SEFSC, 2012).

Because of their documented occurrence and use of southern New England waters, particularly within the vicinity of the Project Area, it is likely that leatherback sea turtles could occur within the Project Area during the summer and fall. However, it is not likely that concentrations of these animals would be found within the WEAs, as observations indicated that these animals are relatively dispersed throughout the area (Kenney and Vigness-Raposa 2010).

3.2.2.6 Critical Habitat

No critical habitat is designated for the leatherback sea turtle within the Project Area or along the U.S. Atlantic Coast (NMFS 2011c). Critical habitat has been designated since 1979 in the coastal waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands (44 FR 17710). Critical habitat has also been designated on the U.S. Pacific Coast, in California, Washington and Oregon (77 FR 4170). On May 5, 2011 the petition to revise critical habitat off the coast of Puerto Rico was accepted by the NMFS (76 FR 25660).

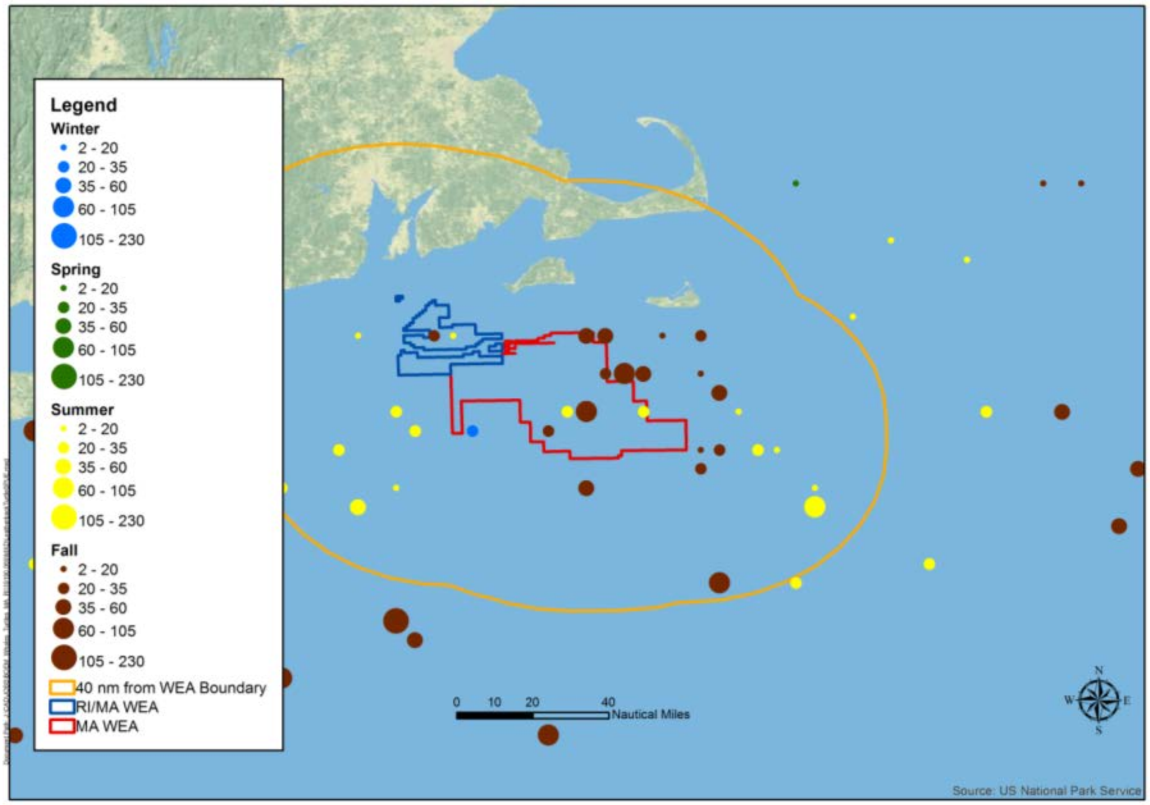


Figure 3.2.2-1. SPUE for leatherback sea turtles. Map depicts the Project Area and surrounding waters (40 nm from the Project Area outlined in orange for reference).

Note: Data Source Right Whale Consortium, 2012. Map provided by Normandeau Associates Inc.

3.2.3 Green Sea Turtle

3.2.3.1 Status

The green sea turtle was listed under the ESA in 1978 (NMFS 2011d). The breeding populations in Florida and along the Pacific coast of Mexico are listed as endangered, while it is listed as threatened throughout the rest of its range, including Rhode Island and Massachusetts.

3.2.3.2 Description

The green sea turtle is the largest of the hard-shelled sea turtles, growing to a maximum length of approximately 4 feet (1.2 meters) and weighing up to 440 pounds (200 kilograms) (NMFS and USFWS 1991). Adult green sea turtles are herbivorous, feeding on seagrasses, sea lettuce, and algae. Their carapace color can vary between black, gray, green, brown, or yellow (NMFS and USFWS 1991). The carapace is more oval in shape and less tapered than that of a loggerhead sea turtle (Kenney and Vigness-Raposa 2010). The head is also narrow and lacks the large crushing jaws that are found on loggerhead sea turtles (Kenney and Vigness-Raposa 2010).

3.2.3.3 Distribution

The green sea turtle can be found globally, most often in tropical and subtropical waters. Some individuals are also known to occur in cooler, temperate regions (NMFS and USFWS 1991). They can be found throughout the Caribbean, and in continental U.S. waters from Texas to Massachusetts (NMFS and USFWS 1991).

The green sea turtle is not known to nest as far north as Rhode Island and Massachusetts. Along the eastern continental U.S. nesting occurs in large numbers in the lower latitudes, primarily southeastern Florida, and more specifically Brevard, Indian River, St. Lucie, Martin, Palm Beach and Broward Counties (NMFS and USFWS 1991). They can generally be found feeding in shallow waters of reefs, bays, inlets, lagoons, and shoals that are abundant in algae or marine grass, such as eel grass (NMFS and USFWS 2007b).

3.2.3.4 Threats

Threats to green sea turtles include beach development, beach armoring and shoreline stabilization, and vehicle use of the beaches, all of which cause destruction to their nesting habitat. Light pollution is also a potential threat as it could deter females from nesting, or disorienting hatchlings attempting to find the ocean (NMFS and USFWS 1991). In water threats include bycatch from fisheries such as pelagic longlining, trawling, dredging, and gill net fisheries, sea grass bed degradation, vessel strikes, anthropogenic noise, marine debris, oil pollution and predation by native and exotic species NMFS and USFWS 2007b). The principal cause of the decline in green sea turtle populations globally can be attributed to long-term harvesting of eggs, as well as juveniles and adults. While harvesting of this species is illegal in most parts of the world, it still occurs (NMFS and USFWS 1991).

3.2.3.5 Occurrence in Project Area

In southern New England, green sea turtles are rare, yet when they are observed it is generally during summer months due to the limiting factor of water temperature (CETAP 1982). Should green sea turtles be present within the area, they will mostly likely be juveniles, as this is the life stage that is most often reported in New England waters. Within southern New England, green sea turtles are known to be found in the waters of Cape Cod Bay and Block Island and Long Island Sounds (CETAP 1982).

Within the Project Area, there has been one confirmed green sea turtle sighting in 2005 (Kenney and Vigness-Raposa 2010). Two strandings were reported in Connecticut and Rhode Island between 1987 and 2001, however the exact locations and dates of the strandings are unknown (Kenney and Vigness-Raposa 2010). Most recently the AMAPPS aerial survey observed a single green sea turtle south west of the Project Area in August 2010 (Palka 2010). The survey did not indicate whether it was an adult or a juvenile. Due to the infrequent occurrence of green sea turtles within waters of southern New England, and their preference for the shallow waters of Long Island Sound when in southern New England waters, it less likely that green sea turtle may occur within the Project Area or its surrounding waters.

3.2.3.6 Critical Habitat

No critical habitat has been designated for the green sea turtle within or surrounding the Project Area (NMFS and USFWS 2007b). Critical habitat has been designated, however, within the coastal waters around Culebra, Puerto Rico (NMFS and USFWS 2007b)

3.2.4 Kemp's Ridley Sea Turtle

3.2.4.1 Status

The Kemp's ridley sea turtle was listed as federally endangered in 1970 (NMFS and USFWS 2007a).

3.2.4.2 Description

The Kemp's ridley sea turtle, along with the olive ridley sea turtle, is the smallest of sea turtle species. Adults can weigh between 70.5 and 108 pounds (32 and 49 kilograms) and reach up to 24 to 28 inches (60 to 70 centimeters) in length (NMFS and USFWS 2007a). An adult Kemp's ridely turtle's carapace can be almost as wide as it is long, and is lighter grey-olive in color. Males and females are very similar in size, however secondary sexual characteristics, such as long tails and re-curved claws are present in males (NMFS, USFWS and SEAMARNAT 2011). The preferred diet of this sea turtle species is crabs, although they may also eat fish, jellyfish and mollusks (NMFS and USFWS 2007a).

3.2.4.3 Distribution

The Kemp's ridley sea turtle is found most commonly in the Gulf of Mexico and along the U.S. Atlantic Coast. However a few records have reported them near the Azores, Morocco and in the Mediterranean Sea. It is a nearshore species and rarely ventures into waters deeper than 160 feet (50 m), primarily occupying the neritic zone which contains muddy or sandy bottoms where their prey can be found (NMFS and USFWS 2007a).

Their nesting is mostly limited to the Western Gulf of Mexico, primarily Tamaulipas and Veracruz, Mexico. Ninety-five percent of Kemp's ridley nesting occurs in Tamaulipas, Mexico where females arrive onshore in large aggregations to nest during what is called the "arribada". Some nesting also occurs in Texas and irregularly in a few other U.S. states and occasional nests along the U.S. Atlantic Coast have been identified as far north as North Carolina. Juvenile Kemp's ridely sea turtles are known to travel north to New England waters seasonally for foraging habitat found in Long Island Sound, New York (NMFS, USFWS and SEAMARNAT 2011).

3.2.4.4 Threats

Threats to Kemp's ridley sea turtles in the nesting habitat include beach development, beach armoring and shoreline stabilization, and vehicle use of beaches, all of which cause destruction to their nesting habitat. Lighting pollution is also a potential issue threat as it could deter females from nesting, or disorienting hatchlings attempting to find the ocean (NMFS, USFWS and SEAMARNAT 2011). In water threats include bycatch from fisheries such as pelagic longlining, trawling, dredging, and gill net fisheries, vessel strikes, anthropogenic noise, marine debris, oil pollution and predation by native and exotic species (NMFS, USFWS and SEAMARNAT 2011).

3.2.4.5 Occurrence in Project Area

In southern New England, juvenile Kemp's ridley sea turtles are known to occur both in Long Island Sound and Cape Cod Bay (CETAP 1982). Many of the reports of juvenile Kemp's ridley sea turtles in Long Island Sound are those of cold shock turtles, and the only records in the Rhode Island area are during summer and fall months (Kenney and Vigness-Raposa 2010). Strandings of Kemp's ridley, loggerhead, and green sea turtles in Cape Cod Bay increased dramatically from 1999-2003, with the mean annual number of stranded turtles equal to 144 per year (Dodge *et al.,* 2003). The increase in the number of Kemp's ridley strandings is in proportion to the number of hatchlings released from the head start program from nesting beaches in the southern U.S. two years earlier (Dodge *et al.*, 2003). In the headstart program, hatchlings are caught just as they begin to swim offshore (to enable "imprinting" on the ocean) and brought to a facility to develop, where they can avoid the high predation rate (1% survival for neonates; NMFS, USFWS, and SEMARNAT, 2011). During this time period, they are tagged and subsequently released at variable ages. An additional dataset of sea turtle strandings by state can be found at the NMFS Sea Turtle Stranding and Salvage Network. This dataset includes sea turtle stranding data for Massachusetts and Rhode Island from 1986 through 2007, including species, year, month, and location by county. NMFS, Southeast Fisheries Science Center (SEFSC) has verified all data through 2005, and may make changes as needed for 2006 and 2007 data. Although the numbers of Kemp's ridleys strandings are relatively high (1,156) in Massachusetts (more specifically Cape Cod Bay), the stranding numbers are low near the Project Area, with two on Martha's Vineyard, one on Nantucket, and four in Rhode Island from 1986 to 2007 (NMFS SEFSC, 2012).

There is little visual sighting data information for this species, as it is a small species and is difficult to sight during aerials surveys. Also, the majority of ocean based surveys do not take into account bays and estuaries; therefore, they are less likely encounter Kemp's ridleys as they are more commonly found in these protected areas within southern New England. The only sightings of Kemp's ridley turtles were reported from three locations. The first location was within 20 nm south of the Project Area (from 21 to 45 turtles per 1,000 km during the summer), the second was a larger group (90 to 170 turtles per 1,000 km southwest of the Project Area) also in the summer, and the third was 21 to 45 turtles per 1,000 km during the fall (Right Whale Consortium, 2012; Figure 3.2.4-1). SPUE for this species are likely to be greatly underestimated due to the relatively small size, the high submergence time of the turtles, and subsequent difficulty for observation.

Despite Kemp's ridely turtles commonly occurring in Long Island Sound and Cape Cod Bay, they are not as common in Rhode Island and southern Massachusetts waters. It is expected that this area does not have suitable habitat for the juvenile turtles. Therefore, Kemp's ridely turtles are expected to be rare within the Project Area, however there is the potential that they may transit through the area occasionally while traveling between Long Island Sound and Cape Cod Bay during summer months (Kenney and Vigness-Raposa 2010).

3.2.4.6 Critical Habitat

There is no critical habitat is designated for the Kemp's ridley sea turtle within the Project Area or along the U.S. Atlantic Coast (NMFS and USFWS 2007a). On February 17, 2010, NMFS and USFWS were petitioned to designate critical habitat for nesting beaches on the Texas coast and marine habitat in the Gulf of Mexico and Atlantic Ocean. The petition is currently being reviewed (NMFS and USFWS 2007a).

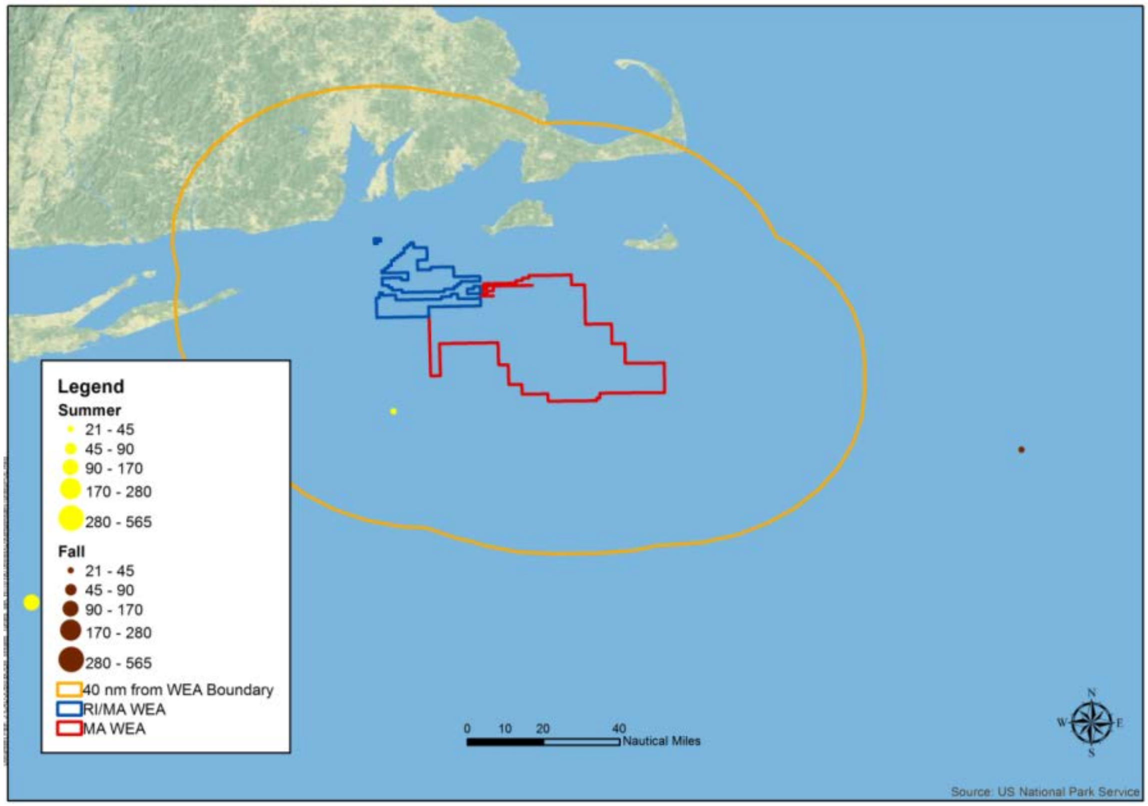


Figure 3.2.4-1. SPUE for Kemp's ridley sea turtles. Map depicts the Project Area and surrounding waters (40 nm from the Project Area outlined in orange for reference).

Note: Data Source Right Whale Consortium, 2012. Map provided by Normandeau Associates Inc.

3.3 Marine Fish

Marine finfish present throughout the Southern New England-New York Bight, and associated with the Project Area include demersals, pelagics and shark finfish assemblages. Within the Project Area there is one endangered species of fish (Atlantic sturgeon) and several species of concern and/or candidate species that may likely occur.

3.3.1 Atlantic Sturgeon

3.3.1.1 Description

The Atlantic sturgeon is a long-lived (up to 60 years), estuarine dependent, anadromous (migrates from the ocean into coastal estuaries and rivers to spawn) species of fish (ASSRT 2007). Adult Atlantic sturgeon can reach sexual maturity between years 5 and 34, have five rows of bony plates (scutes), covering the head and body; a long, hard snout that turns upward at the tip; and a soft, toothless mouth within four sensory barbels on the underside of the snout. They typically have bluish-black to tan dorsal side, brown coloring on the lateral sides, and a grayish-white ventral side. Adults can reach 14 feet (4.3 meters) in length and weight more than 600 pounds (270 kilograms) (ASSRT 2007).

3.3.1.2 Distribution

The Atlantic sturgeon is a subtropical species occurring along the Atlantic coast and in estuaries from Labrador, Canada to Florida (ASSRT 2007). It is currently known to occur in 35 rivers, including 20 in which spawning is known to occur (ASSRT 2007). Atlantic sturgeon occupy coastal waters and estuaries when not spawning, generally in shallow, nearshore areas dominated by sand or gravel substrate at depth between 33 and 164 feet (10 and 50 meters) (ASSRT 2007).

The Atlantic sturgeon population has been divided into five DPSs (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic). These DPSs were configured to account for the marked difference in physical, genetic, and physiological factors within the species, as well as the unique ecological settings and unique genetic characteristics that would leave a significant gap in the range of the taxon if one of them were to become extinct (ASSRT 2007). As published in the *Federal Register* by NMFS, Atlantic sturgeon DPSs were listed as either threatened or endangered on February 6, 2012 (*see* 77 FR 5880 and 77 FR 5914) (Table 3-3).

Table 3-3
Atlantic Sturgeon Federal Listings

Distinct Population Segment	Status
Gulf of Maine (GOM)	Threatened
New York Bight (NYB)	Endangered
Chesapeake Bay (CB)	Endangered
Carolina	Endangered
South Atlantic	Endangered

Source: 77 FR 5880; 77 FR 5914

Of the five DPS’s designated by the NMFS, the DPS most likely to be present within the Project Area and its surrounding waters is the New York Bight DPS, as this encompasses all Atlantic sturgeon that spawn in watersheds that drain into coastal waters from Chatham, MA to the Delaware / Maryland border on Fenwick Island (*see* 77 FR 5880). Within this range, Atlantic sturgeon have been documented from the Hudson and Delaware rivers as well as at the mouth of the Connecticut and Taunton rivers, and throughout Long Island Sound, with evidence to support that spawning occurs in the Hudson and Delaware rivers (ASSRT 2007). NOAA Fisheries determined that the Atlantic sturgeon New York Bight DPS is currently in danger of extinction throughout its range due to precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; limited amount of current spawning; and the impacts and threats that have and will continue to prevent population recovery (NMFS 2012d). In fact, Atlantic sturgeon aggregation areas in the New York Bight exhibit the highest abundance along the east coast of the U.S. and have been recommended as essential fish habitat, which could warrant either full time or seasonal closures (Dunton *et al.*, 2010). But, based on NMFS’s opinion and current literature (Dunton *et al.*, 2012), since there is the potential for offshore genetic mixing of stocks from other DPSs within areas associated with the Project Area, this BA has considered impacts to all 5 DPSs including: the New York Bight DPS (endangered); the Gulf of Maine DPS (threatened); the Chesapeake Bay DPS (endangered); the South Atlantic DPS (endangered), and the Carolina DPS (endangered).

3.3.1.3 Threats

Primary threats to Atlantic sturgeon include habitat degradation and loss, ship strikes, and general depletion from historical fishing (ASSRT 2007). Sturgeons are particularly vulnerable to anthropogenic stressors given their complex life cycle and low intrinsic rates of population increase (ASSRT 2007). Genetic studies suggest that adult sturgeon return to spawn in their natal river (ASSRT 2007), which means that overfishing or habitat degradation within rivers can cause rapid, localized and lasting stock collapse.

3.3.1.4 Occurrence in the Project Area

The Atlantic sturgeon may occur within the Project Area. According to capture records from various surveys, the species is known to occur throughout the southern New England coastal region during all months of the year.

The results of the surveys indicate that the event of an Atlantic sturgeon capture in the Project Area is very rare. Only one Atlantic sturgeon was caught in the Massachusetts Department of Marine Fisheries (MADMF) bottom trawl surveys between 1978 and 2007, with the total number of trawls completed = 5,563, and a depth range of 4 to 86 m (Dunton, *et al.,* 2010). However, a study using observer data collected between 1989 and 2000 found that sturgeon species have been captured in groundfish fisheries that take place in and near the Project Area, with gear including bottom otter trawls, sink gill nets, and drift gill nets (Stein, *et al.,* 2004a; Zollett, 2009). Additionally, interestuarine migrations have been documented (Loesch *et al.,* 1979), indicating that coastal areas may be used to transit between rivers, though the tagging literature does not indicate that any Atlantic sturgeon have migrated around Cape Cod via the waters in and adjacent to the Project Area (Eyler *et al.,* 2009).

3.3.1.5 Critical Habitat

Currently, no critical habitat has been designated for the Atlantic sturgeon.

3.3.2 Species of Concern and Candidate Species

Four species of concern/candidate species that may occur in the Project Area are the Atlantic bluefin tuna (*Thunnus thynnus*), American eel (*Anguilla rostrata*), alewife (*Alosa psuedoharengus*), and blueback herring (*Alosa aestivalis*). Alewife and blueback herring, collectively called river herring, are generally found throughout the New York-Southern New England Bight in nearshore waters, coastal bays and estuaries up to spawning grounds in upstream riverine habitats. Their decline has generally been attributed to loss of upstream habitat due to man-made impediments (i.e., dams) and fishing pressure. Although they may occur in the offshore marine environment including the wind energy areas, their presence is predominantly nearshore. River herring are currently undergoing a status review by the National Marine Fisheries Service. The American eel is currently undergoing a status review by the U.S. Fish and Wildlife Service (USFWS) and the status review for Atlantic Bluefin tuna was concluded in May 2011 with the determination that listing under the ESA was not currently warranted.

3.3.2.1 Atlantic Bluefin Tuna

Atlantic bluefin tuna (*Thunnus thynnus*) are a highly migratory, epipelagic species that ranges from Newfoundland to Brazil in the Western Atlantic and Norway to central Africa in the Eastern Atlantic. Bluefin tuna in the Northwest Atlantic are managed by the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) under the authority of the Atlantic Tunas Convention Act (ATCA) and the Magnuson-Stevens Fisheries Conservation and Management Act (Magnuson-Stevens Act). ATCA authorizes and implements conservation and management recommendations adopted by the International Commission for the Conservation of Atlantic Tunas (ICCAT). The harvest of this species is highly regulated due to recent concern over population levels, and the bluefin tuna is listed as a federal species of concern (ABTSRT 2001). Spawning takes place principally in the Gulf of Mexico and in the Florida Straits, and foraging grounds are along the U.S. eastern continental shelf, including the vicinity of the Project Area, where they prey on squid, herring, mackerel, and other pelagic forage species (ABTSRT 2011). The Project Area falls inside the Essential Fish Habitat (EFH) for both adult and juvenile Atlantic bluefin tuna (ABTSRT, 2011).

There is no dedicated fishery-independent survey for Atlantic bluefin tuna in the Northwest Atlantic. Data for stock assessments comes from NOAA's Marine Recreational Information Program (MRIP), and commercial catch rates and landings (ICCAT, 2010). The most recent stock assessment conducted in 2010 updated and summarized fishery indicators, status of the stock and its outlook. The highest catch level since 1981 was seen in 2002, followed by a steady decline through 2007, largely due to reductions in catch levels. Higher catch levels occurred in 2008-2010 than the previous years, 2002-2007.

3.3.2.2 American Eel

The American eel (*Anguilla rostrata*) is a catadromous species found in fresh, brackish, and coastal waters from Greenland to northeastern South America, and the only freshwater eel in the Western Hemisphere. American eels spawn in the Sargasso Sea, and eggs hatch into transparent, laterally-compressed leptocephali. Leptocephali and glass eel life stages then take years to reach freshwater streams where they mature. Mature American eels eventually return to their Sargasso Sea birth waters to spawn and die. Threats to American eel include habitat loss, riverine impediments to migration such as dams, pollution, nearshore habitat destruction, and fishing pressure (Greene *et al.*, 2009).

The American eel is present in many streams and rivers of Massachusetts, but the species is rarely seen in coastal and oceanic surveys (Greene *et al*, 2009), and is therefore unlikely to be encountered in the Project Area in any great numbers.

3.4 Marine Birds

3.4.1 Species of Concern

The Atlantic coast is a major flyway for birds, including terrestrial species, shorebirds, waterbirds, and marine birds. Two species of federally listed threatened or endangered bird species are known to occur in the coastal counties of both Rhode Island and Massachusetts – the federally threatened piping plover (*Charadius melodus*) (USFWS 2012a) and the federally endangered roseate tern (*Sterna dougallii dougallii*) (USFWS 2012b). Both species use coastal habitats, with the piping plover primarily using beaches, marshes, and intertidal wetlands and the roseate tern using beaches, intertidal wetlands, and open coastal waters. The red knot (*Caladris canutus rufa*), a candidate for listing under the ESA (USFWS 2012c), is found along the coastal habitats of Rhode Island and Massachusetts during spring and fall migration. All three species may pass through the Project Area during spring and fall migration.

3.4.2 Piping Plover

The Piping Plover (*Charadrius melodus*) is a small migratory shorebird that breeds in sandy dune-beach-riparian habitat along the Atlantic Coast, the Great Lakes, and the Great Plains regions of the U.S., and winters in coastal habitats of the southeastern US, coastal Gulf of Mexico, and the Caribbean (Elliot-Smith *et al.,* 2004; USFWS, 2009). The Great Lakes breeding population is listed as endangered, while the Atlantic Coast and Great Plains breeding populations are listed as threatened (USFWS, 2009). Critical wintering habitat has been established for the species along the coast of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas (66 FR 36038-36143). Only the Atlantic Coast population is likely to occur within the Project Area.

The most likely cause of its population declines and the primary anthropogenic threat to Piping Plovers is coastal development. Other threats include disturbance by humans, dogs, and vehicles on sandy beach and dune habitat (Elliott-Smith *et al.,* 2004; USFWS, 2009). Despite these population pressures, there is little risk of near-term extinction of the Atlantic Coast population of piping plovers (Plissner and Haig, 2000). From 1989 and 2010, the New England portion of the Atlantic Coast population has increased 266% (from 206 to 753 breeding pairs) and has continued to increase in recent years (7% between 2007 and 2010), while other portions of the population (New York-New Jersey, Eastern Canada, and Southern) have slightly decreased (Hecht and Melvin, 2009; USFWS, 2011).

As of 2010, there were 591 nesting pairs nested in Massachusetts and 85 in Rhode Island (USFWS, 2011). In Massachusetts, piping plovers occur in Barnstable, Bristol, Dukes, Essex, Nantucket, Plymouth, and Suffolk counties (USFWS, 2012a). In Rhode Island, plovers occur in Newport and Washington counties (USFWS, 2012a). Piping Plovers occur in both states from late-March through mid-October. During the breeding season (mid-May through mid-August), Piping Plovers are strictly confined to sandy coastal habitats (Burger *et al.,* 2011) and are unlikely to be in the Project Area.

The Atlantic Coast population of Piping Plovers winters along the southern Atlantic Coast from North Carolina to Florida and in the Bahamas and West Indies (Elliott-Smith and Haig, 2004). The migratory pathways along the coast and to the Bahamas are not well known (USFWS, 2009; Normandeau Associates, 2011), and there are no definitive observations of this species in offshore environments greater than three miles from the Atlantic Coast (Normandeau Associates, 2011). However, it may be very difficult to detect Piping Plovers in the offshore environment during migration because of nocturnal and/or high elevation migratory flights (Normandeau Associates, 2011). Therefore, it is likely that some individual Piping plovers may traverse the Project Area during the spring time (April-May) and fall migratory periods, because migration does not appear to be concentrated up and down the coast. Both breeding and wintering sites include islands greater than three miles from the coast, and significant premigratory concentrations of this species have been observed in southeastern Cape Cod and Monomoy Island in late summer (Normandeau Associates, 2011).

3.4.3 Roseate Tern

The Roseate Tern (*Sterna dougallii dougallii*) is a small tern that breeds in colonies. Only terns in the Northwestern Atlantic population are likely to occur within the Project Area. Birds in this population breed along the coast of the northeastern U.S. and the maritime provinces of Canada and winters along the Northeastern coast of South America. Roseate terns in the Northwestern Atlantic population are listed under the ESA as endangered (USFWS, 2010). No critical habitat has been designated for this species (52 FR 42064-42068). The USFWS recently published a five-year status review of the roseate tern (USFWS, 2010).

In the late 19th Century, roseate terns suffered a drastic population decline in the U.S. due to egg collecting and hunting for their feathers (Gochfeld *et al.*, 1998). Following protection of colonies in North America, their numbers have increased (Gochfeld *et al.*, 1998). However, roseate terns have been displaced from their traditional sites by encroaching gull colonies, resulting in fewer tern colonies and a reduced population size (Gochfeld *et al.*, 1998). Additionally, erosion continues to reduce the number of suitable nest sites for terns and limits the ability of the species to avoid nesting on islands that have high predation rates (Northeast Roseate Tern Recovery Team 1998).

The Northwestern Atlantic Roseate Terns population currently breeds on a handful of island colonies from Long Island, New York to the Canadian maritime provinces (Gochfeld *et al.*, 1998; USFWS, 2010). There are many Roseate Terns breeding in Massachusetts. In 2009, there were 50 breeding pairs of roseate terns each on Norton's Point and Penikese Island, 645 breeding pairs on Ram Island, and 782 pairs on Bird Island (USFWS, 2010). Although Roseate Terns did breed in Rhode Island (USFWS, 2010), there are currently no breeding populations in Rhode Island (Paton *et al.*, 2010),

Although a group of several uncommon tern species (including Roseate Terns) is predicted to be in the northern parts of the Project Area near Martha's Vineyard and Nantucket islands (Figure 3.4.3-1) (Menza, *et al.*, 2012), very little Roseate Tern activity is expected to occur within the Project Area during both nesting and post-breeding staging periods. The modeled results from Menza and others (2012) are based on the relationship between of terns (Roseate, Least, Royal, Arctic, Sooty, Bridled, Caspian, and Forster's and unidentified species) and several environmental variables (see Figure 6.29 in Menza *et al.*, 2012). Most observations of terns were in the summer breeding months and within 50 km of shore. The model predicts (in blue) that terns are virtually absent from the Project Area with high certainty. Caution should be exercised because the analysis lumped many species together which may add to uncertainty to the predicted distribution of Roseate Terns.

In spring, Roseate Terns arrive on their Northwestern Atlantic breeding colony sites to initiate courtship activities prior to nesting (Gochfeld *et al.*, 1998). During the nesting period (mid-May to late-July), breeding birds typically remain within 7 km of their nesting colonies while foraging for fish to provision their young (Rocky *et al.*, 2007), but may occasionally travel up to 30 km from their colony (Burger *et al.*, 2011). Roseate Terns complete nesting activity between late July to mid-August, and then the adults and young move to the post-breeding staging areas until mid-September before migrating southward (Burger *et al.*, 2011). The coastal region of southeastern Cape Cod, Massachusetts, near Chatham and Monomoy Island, is the most important post-breeding staging area for this species, hosting up to 7,000 individuals representing nearly the entire Northwestern Atlantic population (Burger *et al.*, 2011). During post-breeding period, most foraging activity is concentrated in shallow water close to shore, but some individuals may occur up to 16 km from the coast (Burger *et al.*, 2011).

The migration routes of Roseate Terns are very poorly known, but are believed to be largely or exclusively pelagic (far from shore) in both spring and fall (Nisbet, 1984; Gochfeld *et al.*, 1998; USFWS, 2010), hence it is likely that Roseate Terns will traverse the Project Area during this period (Burger *et al.*, 2011). Only a small amount of offshore Roseate Tern observations have been recorded, including five recoveries of banded individuals at sea on ships (Nisbet, 1984), as well as a small number of additional boat-based observations (Normandeau Associates, 2011).

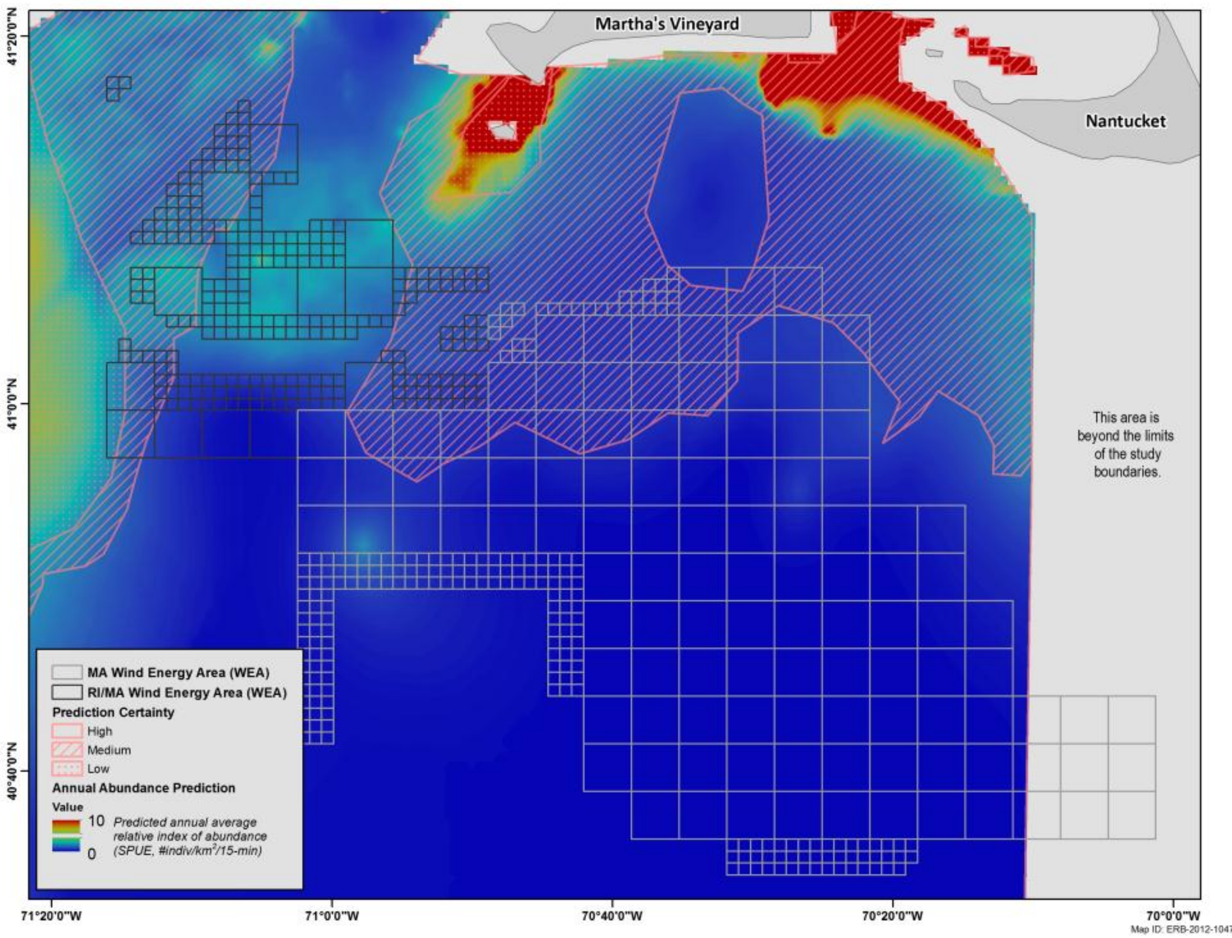


Figure 3.4.3-1. Predicted annual distribution and relative abundance of several less common tern species in the Project Area.

3.4.4 Red Knot (ESA Candidate Species)

The Red Knot is one of the longest-distance migrants in the world. It breeds in the central Canadian arctic and winters as far south as Tierra del Fuego in South America. In 2006, the USFWS designated the red knot as a candidate species for ESA listing (71 FR 53756-53835). During the past 20 years, the Red Knot population has declined dramatically from an estimated 100,000 to 150,000 down to 18,000 to 33,000 (Niles *et al.*, 2008). Each spring, Red Knots congregate in Delaware Bay during their northward migration to feed on horseshoe crab eggs (*Limulus polyphemus*) and refuel for breeding in the Artic. However, the availability of horseshoe crab eggs has been reduced due to the increase in the harvest of adult crabs for bait in the conch and eel fishing industries (Niles *et al.*, 2008). Despite restrictions on the crab harvest, the 2007 horseshoe crab harvest was still larger than the harvest in 1990, and there still has been no detectable recovery in the Red Knot population (Niles *et al.,* 2009). Other threats to the species include human development and beach replenishment (Niles *et al.,* 2008).

Red Knots have the potential to occur in both Massachusetts and Rhode Island, although their locations within these states have not been documented to the county level (USFWS 2012c). For the last 50 years, Cape Cod and Massachusetts Bay have been important staging areas for Red Knots during fall migration (Niles *et al.*, 2008). Still, the numbers of southbound red knots passing through Massachusetts in the fall are substantially lower than pass through Delaware Bay during spring migration (Niles *et al.,* 2008). In Rhode Island, the species has been documented sporadically at three stop-over locations (Napatree Point-Sandy Point Island, Westerly, Ninigret Pond, Charlestown; and Quicksand Pond, Little Compton), but there are rarely more than 50 individuals at any of the sites, and none of the sites are considered to be critical for the species (Niles *et al.*, 2008).

Red Knot occurrence in the Project Area is most likely during the southward fall migration from their breeding to their wintering grounds. Migratory routes of this species are not very well characterized, but recent studies using birds tracked with light-sensitive geo-locators, as well as analysis of large geospatial datasets of coastal observations have begun to reveal some migratory patterns of Red Knots in the U. S. Atlantic OCS (Niles *et al.*, 2010; Normandeau Associates, 2011; Burger *et al.,* 2012a, 2012b). These studies have revealed that migratory pathways of Red Knots through this region are fairly widespread and diverse, with some individuals traversing northern sections of the US Atlantic OCS as they travel directly between northeastern U.S. migratory stopover sites and wintering areas or stopover sites in South America and the Caribbean, and others following the U.S. Atlantic coast or traversing the U.S. Atlantic OCS further to the south, as they move between U.S. Atlantic coastal stopover sites and wintering areas in the southern U.S., Caribbean, or northern South America (Niles *et al.,* 2010; Normandeau Associates, 2011; Burger *et al.,* 2012b). Amid this migratory route variation, there appears to be more of a mid-Atlantic and southerly concentration of Red Knot coastal arrivals in spring, compared with a more northerly concentration, particularly in Massachusetts, of fall migrant activity and departure (Niles *et al.,* 2010; Normandeau Associates, 2011; Burger *et al.,* 2012b), hence it is likely that more Red Knot migratory passage occurs through the offshore Massachusetts area of interest during fall migration than during spring migration.

3.5 Bats

There are no ESA-listed or ESA-candidate bat species in Massachusetts and Rhode Island (USFWS, 2012d). Although bats have been known to fly on the Atlantic OCS, the neighboring states Maine, New Hampshire, and Connecticut do not have any ESA-listed or ESA-candidate bat species either (USFWS, 2012d). Therefore, no ESA-listed or ESA-candidate bat species are expected to be in the Project Area. Additional information or a more detailed analysis and migration descriptions of bats can be found in the Cape Wind Energy Project DEIS (MMS, 2008) and the Alternative Energy Programmatic EIS (MMS, 2007).

4 Proposed Action

4.1 Overview

The actions being evaluated as a part of this consultation are the issuance of a renewable energy lease and subsequent site assessment activities to aid in the siting of potential wind turbine generators in the OCS off of Rhode Island and Massachusetts. The issuance of the lease does not constitute an irreversible commitment of the resources toward full development of the lease area. Thus this action does not authorize, and the consultation does not evaluate, the construction of any commercial electricity generating facilities or transmission cables with the potential to export electricity.

The type of activities evaluated for this action includes, but is not limited, to the following:

1. GGARCH assessment
   - High resolution geophysical surveys (surface and subsurface seismic profiling, extent/intensity determined by the area being considered for development (primarily high to mid frequency sonar (i.e., side scan sonar, echo sounder, sub-bottom profilers). The use of airguns is NOT being considered as a part of this activity.
   - Geotechnical sub-bottom sampling (includes CPTs, geologic borings, vibracores, etc).
2. Wind resource assessment
   - Construction of meteorological towers
   - Installation of LIDAR buoys
3. Biological resource assessment:
   - Presence/absence of threatened and endangered species
   - Presence/absence of sensitive biological resources/habitats
4. Archaeological resource assessment
5. Assessment of coastal and marine use

4.1.1 Project Area

The two WEAs offshore of Rhode Island/Massachusetts and Massachusetts comprise a total area of approximately 1,419 square statute miles (907,724 acres) and contains 130 whole OCS lease blocks and 49 partial OCS lease blocks. These areas are collectively referred to as the Project Area. The total area is shown in Figure 1-1.

The proposed action consists of the issuance of commercial wind energy leases in the Project Area and implementation of BOEM-approved site assessment and characterization activities on those leaseholds. This action presumes reasonably foreseeable scenarios for leasing, site characterization, and site assessment. Because of the expressions of commercial wind energy interests, BOEM assumes that the entire Project Area would be leased.

4.2 Site Characterization Surveys

Site characterization surveys include a number of activities that allow the lessee to locate shallow hazards, physical restrictions and cultural and biological resources in the area where a project may take place. The activities are described below.

4.2.1 High-resolution Geophysical (HRG) Survey

Data obtained from the HRG surveys will provide information on geophysical shallow hazards, the presence or absence of archaeological resources, biological resources and to conduct bathymetric charting. This information is used in the design construction and operations of meteorological towers and future wind turbine placement to mitigate the potential impacts to installations, operations and production activities, and structure integrity. The scope of HRG surveys will be sufficient to reliably cover any portion of the site that may be affected by the renewable energy project's construction, operation, and decommissioning. This includes the project area encompassing all seafloor/bottom-disturbing activities. The maximum project area includes but is not limited to the footprint of all seafloor/bottom-disturbing activities (including the areas in which installation vessels, barge anchorages, and/or appurtenances may be placed) associated with construction, installation, inspection, operation, maintenance, and removal of structures.

The geophysical survey grid(s) for the proposed transmission cable route(s) to shore would be oriented with respect to the bathymetry, shallow geologic structures, and renewable energy structure locations. The grid pattern for each survey would cover the project area for all anticipated physical disturbances from construction and operation of a wind facility. Parameters for line spacing include:

For collection of geophysical data for shallow hazard assessments using side scan-sonar/sub-bottom profilers, spacing would not likely exceed 492 feet (150 meter) throughout the project area.

For collecting geophysical data for archaeological resource assessment using magnetometers, side-scan sonar, and all sub-bottom profilers, lines are to be flown at approximately 98 feet (30 meter) throughout the project area.

For bathymetric charting using a multi-beam echo-sounder or side-scan sonar mosaic, construction may vary based on water depth but will provide full coverage of the seabed plus suitable overlap and resolution of small discrete targets of 1.6 to 3.3 feet (0.5 to 1.0 meters) in diameter. This is also necessary for the identification of potential archaeological resources.

4.2.1.1 HRG Survey Instrumentation

Table 4.1 gives an overview of the types of instrumentation that could be used during HRG survey work in the Project Area.

Bathymetry/Depth Sounder. The depth sounder system would record with a sweep appropriate to the range of depths expected in the survey area. Lessees can use multi-beam and/or single-beam bathymetry systems. The use of a multi-beam bathymetry system may be more appropriate for characterizing those lease areas containing complex topography or fragile habitats.

Magnetometer. Magnetometer surveys would be used to detect the identification of ferrous, ferric, or other objects having a distinct magnetic signature. The magnetometer sensor is typically towed as near as possible to the seafloor, which is anticipated to be approximately 20 feet (6 meters) above the seafloor.

Seafloor Imagery / Side-Scan Sonar. A typical side-scan sonar system consists of a top-side processor, tow cable, and towfish with transducers (or 'pingers') located on the sides, which generate and record the returning sound that travels through the water column at a known speed. BOEM assumes that lessees would use a digital dual-frequency side-scan sonar system with frequencies of 445 and 900 kiloHertz (kHz) and no less than 100 and 500 kHz to record continuous planimetric images of the seafloor. The data would be processed in a mosaic form to allow for a true plan view and 100 percent coverage of the project area. The side-scan sonar sensor would be towed above the seafloor at a distance that is 10 to 20 percent of the range of the instrument.

Shallow and Medium Penetration Sub-bottom Profilers. A high-resolution Compressed High-Intensity Radar Pulse (CHIRP) System sub-bottom profiler is used to generate a profile view below the bottom of the seabed, which is interpreted to develop a geologic cross-section of subsurface sediment conditions under the track line surveyed. A boomer sub-bottom profiler system is capable of penetrating depth ranges of 32 to 328 feet (10 to 100 meters) depending on frequency and bottom composition. The sub-bottom profiler would deliver a simple, stable, and repeatable signature that is near to minimum phase output with usable frequency content.

HRG survey method source levels and pulse lengths were used to model threshold radii for the various profiler methods for the Atlantic OCS Proposed Geological and Geophysical (G&G) Activities Mid-Atlantic and South Atlantic Planning Areas Draft Programmatic Environmental Impact Statement (DPEIS) (USDOI, BOEM 2012a). These profilers include a boomer, side-scan sonar, chirp sub-bottom profiler, and a multi-beam depth sounder. Three of the four profiler methods have operating frequencies that are within the range of cetacean and sea turtle hearing (Table 4.1). The pulse length and peak source level that were used for each profiler method modeling scenario and can be assumed to representative of profiler sources that could be used for HRG surveys during the proposed action.

Table 4.1
Summary of Peak Source Levels for HRG Survey Activities and Operating Frequencies within Cetacean Hearing Range

Source	Pulse Length	Broadband Source Level (dB re 1 µPa at 1 m)	Operating Frequencies	Within Hearing Range	
				Cetaceans	Sea Turtles
Boomer	180µs	212	200 Hz – 16kHz	Yes	Yes
Side-scan sonar	20 ms	226	100 kHz	Yes	No
			400 kHz	No	No
Chirp sub-bottom Profiler	64 ms	222	3.5 kHz	Yes	No
			12 kHz	Yes	No
			200kHz	No	No
Multi-beam depth sounder	225 µs	213	240kHz	No	No

Source: USDOI, BOEM 2012

There were several modeling scenarios run for the OCS G&G DPEIS that captured environmental and oceanographic conditions at various depths and seasons. Based on these modeling results, threshold radii for each HRG survey method potentially used for the proposed action are displayed in Table 4.2. The threshold radii for 180 dB re 1 µPa rms (Level A harassment) from any of the survey methods is not expected to be greater than 200 meters. Threshold radii for 160 dB re 1 µPa rms (Level B harassment) is not expected to be greater than 700 meters. Therefore, 700m is the exclusion zone that has been developed for all whales. Sea turtles would be excluded from a 45m zone around the vessel. This threshold is based upon vessel strike avoidance criteria, but fully encompasses the area of ensonification by the boomer (16 meters). (*see* Section 8). The exclusion zones are based on preventing any whales from experiencing Level A and Level B harassment from and non-continuous noise source under the Marine Mammal Protection Act (MMPA).

Table 4.2
Estimated Ranges for Level A and Level B Harassment of Cetaceans Based on the NMFS 180dB and 160dB Criteria

Equipment	Number of Scenarios Modeled	Pulse Duration	Adjustment (dB) for Short Pulse Duration[a]	180-dB Radius (m)		160-dB Radius (m)	
				Calculated using Nominal Source Level[b]	Recalculated for Short Pulse Duration[a]	Calculated using Nominal Source Level[b]	Recalculated for Short Pulse Duration[a]
Boomer	14	180 µs	-27.3	38-45	<5	1,054-2,138	16
Side-Scan Sonar	14	20 ms	-7.0	128-192	65-96	500-655	337-450
Chirp Subbottom Profiler	14	64 ms	-1.9	32-42	26-35	359-971	240-689
Multibeam Depth Sounder	7	225 µs	-26.5	27	<5	147-156	12

Source: USDOI, BOEM 2012a.
Notes:
a. The nominal source level was adjusted by the amount indicated to recalculate the 180dB radius in the last column.
b. The value is the radius (Rmax) for the maximum received sound pressure level (USDOI, BOEM 2012a).

It should be noted that while the modeling scenarios are based on sites offshore of the mid and sout Atlantic, the modeling scenarios included similar bottom sediments , and depth ranges. Thusthe sound velocity profiles are expected to be inclusive of what would be expected in the Project Area. See Appendix D in the Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas Draft Programmatic Environmental Impact Statement for a full explanation of the threshold radii modeling (USDOI, BOEM 2012a).

4.2.1.2 Proposed HRG Survey Action Scenario

It is assumed that the HRG survey would cover the entire Project Area, and geophysical surveys for shallow hazards (approximately 492 feet [150 meters] line spacing) and archaeological resources (approximately 98 feet [30 meters] line spacing) would be conducted at the same time on the same vessels conducting sweeps at the finer line spacing. This would result in about 500 NM of HRG surveys per OCS block (3 statute miles by 3 statute miles [approximately 5 kilometers by 5 kilometers]), not including turns. Assuming a vessel speed of 4.5 knots and 10 hour days (daylight hours minus transit time to the site), it would take about 11 days to survey one OCS block or about 100 days to survey an average-size lease of eight OCS blocks. To survey all of the Project Area, HRG surveys would have to be conducted by multiple vessels and/or over multiple years and potential cable routes. Assuming 100 percent coverage of the Project Area, the proposed action would result in a total of approximately 79,000 NM or 17,490 hours of HRG surveys.

Table 4.3
Projected Site Characterization and Assessment Activities for the Proposed Action in the Rhode Island and Massachusetts Wind Energy Areas

		Site Characterization Activities		Site Assessment Activities	
WEA	Leaseholds	High-Resolution Geophysical (HRG) Surveys (max NM/hours)	Geotechnical Sampling (min-max)	Installation of Meteorological Towers (max)	Installation of Meteorological Buoys (max)
RI/MA	Up to 4	17,500/4,000	500 - 1,400	4	8
MA	Up to 5	61,500/13,490	708 – 2,900	5	10
Total	Up to 9	79,000/17,490	1208 – 4300	9	18

4.2.2 Biological Resources Surveys

Vessel and/or aerial surveys would need to characterize three primary biological resources categories: (1) benthic habitats; (2) avian resources; and (3) marine fauna. Sub-marine surveys such as the shallow hazard and geological and geotechnical surveys described earlier would be able to capture all the salient features of the benthic habitat on the leasehold. These surveys would acquire information suggesting the presence or absence of exposed hard bottoms of high, moderate, or low relief; hard bottoms covered by thin, ephemeral sand layers; seagrass patches; and other algal beds, all of which are key characteristics of benthic habitat. The various remote sensing activities used in the biological resource survey will likely occur simultaneously with the HRG survey activity and is thus not repeated here. Shipboard observers would monitor and document sightings of marine mammals, sea turtles, fish and birds within the lease area.

4.2.3 Geotechnical Sampling

Geotechnical sampling is used to determine site specific geology profile of a specific site within the lease area. In order to achieve this, geotechnical sampling is typically conducted using cone penetration tests (CPT) or deep sediment boring / drilling at the location of the proposed meteorological tower or wind turbine. The purpose of this work is to assess the suitability of shallow foundation sediments to support a structure of transmission cable under any operational or environmental conditions that may be encountered, and document the soil characteristics necessary for design and installation of all structures. Vibracores may be taken when there are known or suspected archaeological/and or cultural resources present (identified through the HRG survey or other work) or for some limited geological sampling.

Vibracores would likely be deployed from a small (less than 45 foot) gasoline powered vessel. The diameter of a typical vibracore barrel is approximately 4 inches (10.15 centimeters) and the cores are advanced up to a maximum of 15 feet (4.5 meters). Deep borings would be advanced from a truck-mounted drill rig placed upon a jack-up barge that rests on spuds lowered to the seafloor. Each of the four spuds would be approximately 4 feet (1.2 meters) in diameter, with a pad approximately 10 feet (3.05 meters) on a side on the bottom of the spud. The barge would be towed from boring location to location by a tugboat. The drill rig would be powered using a gasoline or diesel powered electric generator. Crew would access the boring barge daily from port using a small boat. Geologic borings generally can be advanced to the target depth (100 to 200 feet [30.5 to 70 meters]) within 1 to 3 days, subject to weather and substrate conditions. Drive and wash drilling techniques would be used; the casting would be approximately 6 inches (15.24 centimeters) in diameter. The CPT or an alternative subsurface evaluation technique would supplement or be used in place of deep borings. A CPT rig would be mounted on a jack-up barge similar to that used for the borings. The top of a CPT drill probe is typically up to 3 inches (7.6 centimeters) in diameter, with connecting rods less than 6 inches (15.24 centimeters) in diameter

Environmental considerations for geotechnical sampling are mainly focused on benthic disturbance. This can come from vessels anchoring or from the boring activity itself. Acoustics from boring are also considered. It is anticipated that the majority of the work will be accomplished by CPT which does not require deep borehole drilling. However, should CPT be found an inappropriate technique given the conditions encountered, borehole drilling may be required. Previous estimates submitted to BOEM for geotechnical drilling have sound source levels at around 118-145 dB re 1 µPa at a frequency of 120 Hertz (Hz) (MMS, 2009b). With the standard operating conditions in place, including the 200m exclusion zone around geotechnical sampling (*see* Section 8.1) the exposure to noise from boring are expected to be below the 120 dB re 1µPa threshold established by NMFS for marine mammal harassment from continuous noise sources.

4.2.3.1 Geotechnical Sampling Scenario

In order to estimate the number of geotechnical samples per leasehold it is necessary to estimate the number of turbine foundations in each leasehold. As discussed in the Programmatic EIS (USDOI, MMS 2007), spacing between turbines is typically determined on a case-by-case basis to minimize wake effect and is based on rotor diameter associated with turbine size. In Denmark’s offshore applications, for example, a spacing of seven rotor diameters between units has been used (USDOI, MMS 2007). Spacing of 6 by 9 rotor diameters, or six rotor diameters between turbines in a row and nine rotor diameters between rows was approved for the Cape Wind project (USDOI, MMS 2009b). In some land-based settings, turbines are separated by much greater distances, as much as 10 rotor diameters from each other (USDOI, MMS 2007). Based on this spacing range for a 3.6-megawatt (MW) (110 meter rotor diameter) turbine and a 5 MW (130 meter rotor diameter) turbine, it would be possible to place anywhere from 14 to 40 turbines in one OCS block (3 statute miles by 3 statute miles [approximately 5 kilometers by 5 kilometers]).

Based on the information presented above and assuming:

1) “maximum” scenario of wind development on every OCS block (which is extremely unlikely, but the lower amount of samples associated with less development would result in lower environmental impacts)
2) geotechnical sampling (vibracore, CPT, and/or deep boring) would be conducted at every potential wind turbine location throughout the Project Area
3) geotechnical sampling would be conducted every nautical mile along the projected transmission corridors to shore
4) geotechnical sampling would be conducted at the foundation of each meteorological tower and/or buoy, then a total of 1208 to 4300 geotechnical surveys could occur as a result of the proposed action (see Table 4.3).

4.2.4 Site Assessment

“Site assessment” describes the assessment of wind resources and ocean conditions to allow the lessee to determine whether the lease area is suitable for wind energy development, where on the lease it would propose development, and what form of development to propose in a COP. To determine this, a meteorological tower or buoy would be installed or deployed in the lease area to measure wind speeds and collect other relevant data necessary to assess the viability of a potential commercial wind facility.

To obtain meteorological data, scientific measurement devices, consisting of anemometers, vanes, barometers, and temperature transmitters, would be mounted either directly on the tower or buoy or on instrument support arms. In addition to conventional data collection methods, buoys and/or bottom-founded structures could use LIDAR, Sonic Detecting and Ranging (SODAR) and Coastal Ocean Dynamic Applications Radar (CODAR) technologies for collecting wind resource data. At this time, no proposals have been submitted meteorological towers (towers in this case being up to the estimated hub height for a commercial wind turbine) mounted on a floating platform (e.g., spar, semi-submersible, or tension leg). This BA assumes full-size met towers will utilize a fixed, pile-supported platform (monopile, jackets, or gravity bases) and that buoys would use the floating designs (e.g., boat-shaped, spar-type, tension-leg, disc-shaped or similar).

The following scenario addresses the reasonably foreseeable range of data collection devices that lessees may install under an approved SAP. The actual tower and foundation type and/or buoy type and anchoring system would be included in a detailed SAP submitted to BOEM, along with the results of site characterization surveys. This would be done prior to the installation of any device(s).

Source: Cape Wind Associates, LLC 2011a.

Figure 4.1. Cape Wind Meteorological Tower

4.2.4.1 Proposed Action Scenario

It is assumed that each of the nine leaseholds projected for the Project Area would result in zero or one meteorological tower, zero or two buoys or a combination, being constructed or deployed. This would result in a maximum of nine meteorological towers and 18 meteorological buoys within the Project Area.

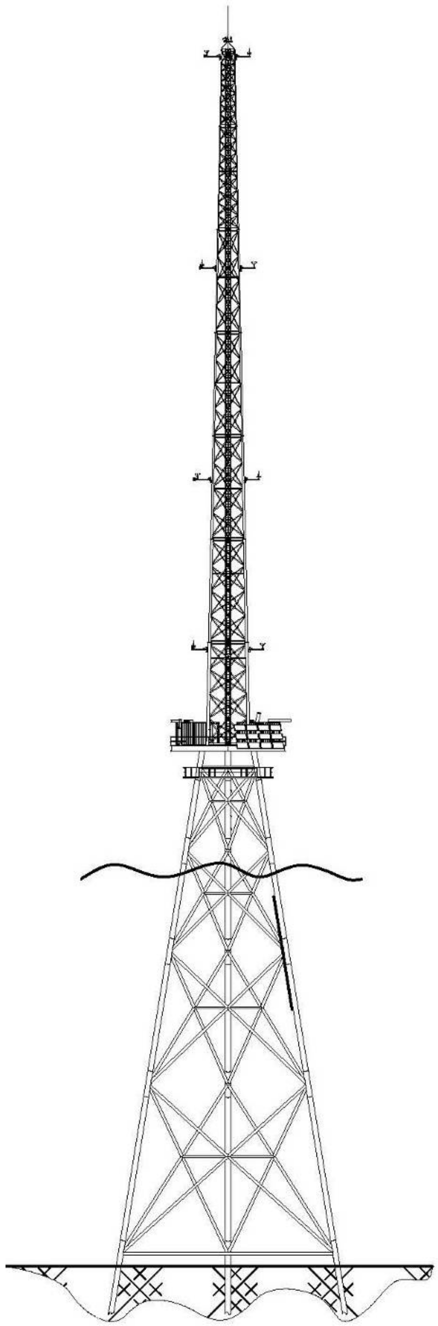
Case Study: Cape Wind Meteorological Tower

The only meteorological tower currently installed on the OCS for the purposes of renewable energy site assessment is located on Horseshoe Shoal, in Nantucket Sound (Figure 4-1). As shown on Figure 4-1, a monopile mast was used for this meteorological tower. The tower was installed in 2003 and consists of three pilings supporting a single steel pile that supports the deck. The overall height of the structure is 197 feet (60 meters) above the mean lower low water datum. The Cape Wind meteorological tower represents the smaller end of the range of structures anticipated in southern New England. It is located in shallower water (8 to 10 feet [2.4 to 3 meters]) and nearer to shore (approximately 6 miles [9.7 kilometers]) than the Project Area.

4.2.4.2 Meteorological Tower

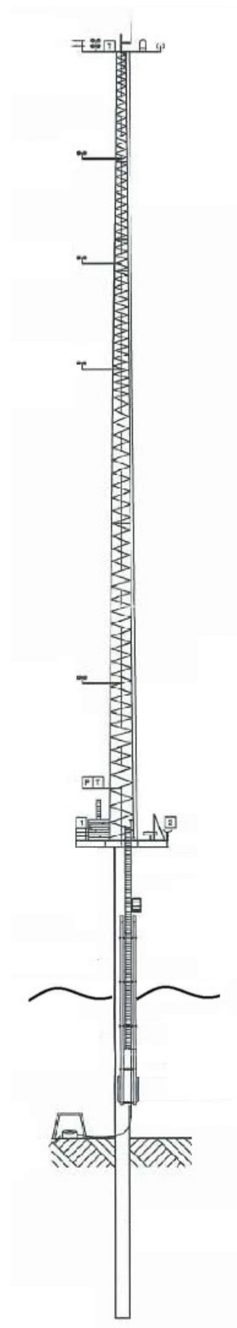
As mentioned previously in the Cape Wind example, one of the traditional instruments used for characterizing offshore wind conditions is the meteorological tower. At a maximum, a single meteorological tower would be installed per lease area. The foundation structure and a scour control system, if required based on potential seabed scour anticipated at the site, would occupy less than 2 acres. Once installed, the top of a meteorological tower would be 295 to 328 feet (90 to 100 meters) above mean sea level.

A meteorological tower consists of a mast mounted on a foundation anchored to the seafloor. The mast may be either a monopole such as that used in the Cape Wind project mentioned above (Figure 4-1) or a lattice (i.e. jacket foundation) (Figure 4-2). The mast and data-collection devices would be mounted on a fixed or pile-supported platform (monopile, jackets, or gravity bases) or floating platform (spar, semi-submersible, or tension-leg) (Figure 4-3).



Source: Deepwater Wind, LLC a*s cited in* USDOI, BOEM, OREP 2012.

Figure 4.2(a).
Lattice-type Mast Mounted on a Steel Jacket Foundation

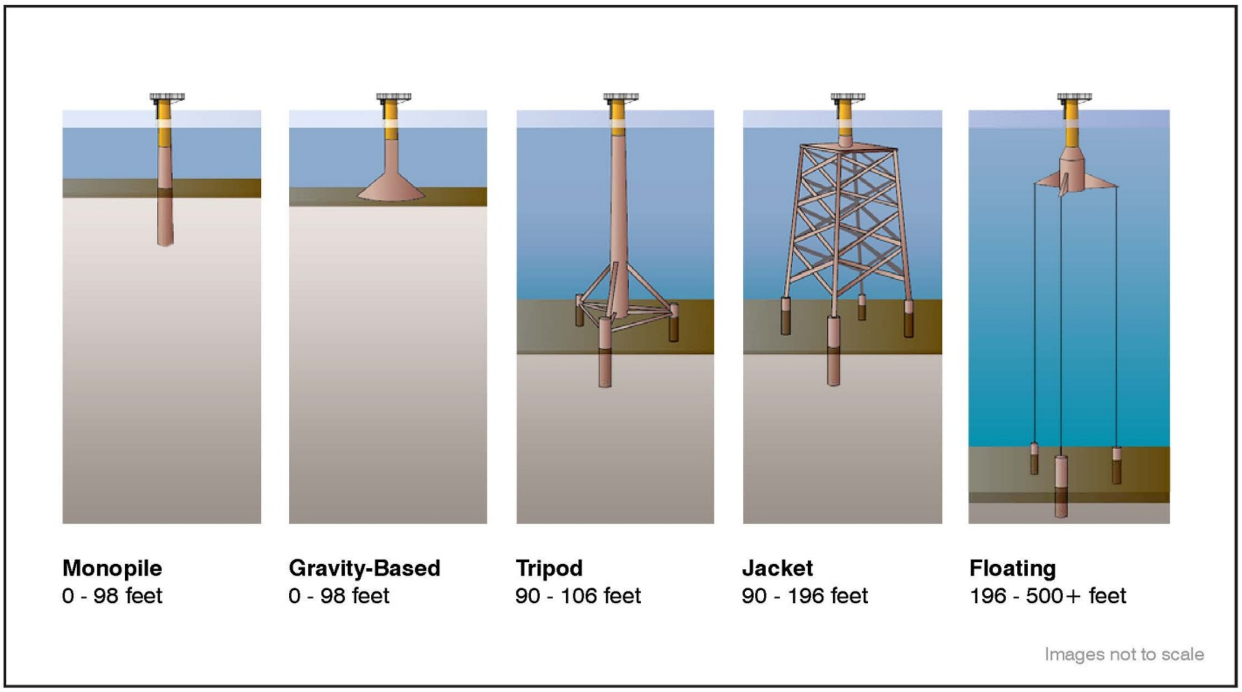


Source: Fishermen's Energy of New Jersey, LLC *as cited in* USDOI, BOEM, OREP 2012.

Figure 4.2(b).
Lattice-type Mast Mounted on a Monopile Foundation

Figure 4.2. Examples of Lattice Mast Meteorological Towers

In the case of fixed platforms, it is assumed that a deck would be supported by a single 10 foot-diameter (approximately 3 meter diameter) monopile, tripod, or a steel jacket with three to four 36-inch-diameter piles. The monopile or piles would be driven anywhere from 25 to 100 feet (7.6 to 30.5 meters) into the seafloor depending on subsea geotechnical properties. The foundation structure and a scour-control system, if required based on potential seabed scour anticipated at the site, would occupy less than 2 acres (0.81 hectare). Once installed, the top of a meteorological tower would be 295 to 328 feet (90 to 100 meters) above mean sea level. The area of ocean bottom affected by a meteorological tower would range from about 200 square ft (approximately 18.6 square meters), if supported by a monopile, to 2,000 square ft (approximately 184.1 meters) if supported by a jacket foundation.



SOURCE: Adapted from Musial, Butterfield, and Ram 2006, as cited in TetraTech EC, Inc. 2010.

Figure 4.3. Types of Foundations for Meteorological Towers

Scour Control Systems

Wave action, tidal circulation, and storm waves interact with sediments on the surface of the OCS, inducing sediment reworking and/or transport. Episodic sediment movement caused by ocean currents and waves can cause erosion or scour around the tower bases. Erosion caused by scour may undermine meteorological tower structural foundations leading to potential failure. BOEM assumes that scour control systems would be installed, based on potential seabed scour anticipated at sites. There are several methods for minimizing scour around piles, such as the placement of rock armoring and mattresses of artificial (polypropylene) seagrass.

Artificial grass mats have been found to be effective in both shallow and deep waters, therefore this is the most likely scour control system to be used for the proposed meteorological towers. These mats are made of synthetic fronds that mimic seafloor vegetation to trap sediment and become buried over time. If used, these mats would be installed by divers or underwater remotely operated vehicle (ROV). Each mat would be anchored at 8 to 16 locations, about 1 foot into the sand. Once installed the mats would not require future maintenance. Monitoring of scouring at the Cape Wind meteorological tower found that at one pile where two artificial seagrass scour mats were installed, there was a net increase of 12 inches (30.5 centimeters) of sand, and at another pile with artificial seagrass scour mats, there was a net scour of 7 inch (18 centimeter) pilings; both occurred over a three-year timeframe (Ocean and Coastal Consultants Inc. 2006).

It is anticipated that for a pile-supported platform, four mats each of about 16.4 by 8.2 feet (5 by 2.5 meters) would be placed around each pile. Including the extending sediment bank, a total area disturbance of about 5,200 to 5,900 square ft (approximately 483 to 548 square meters) for a three-pile structure and 5,900 to 7,800 square ft (approximately 548 to 724.6 square meters) for a four-pile structure is estimated. For a monopile, it is anticipated that eight mats 16.4feet by 16.4 feet (5 meters by 5 meters) would be used, and thus there would be a total disturbance area of about 3,700 to 4,000 square feet (343.74 by 371.61 square meters) per foundation.

A rock armor scour protection system may also be used to stabilize a structure's foundation area. Rock armor and filter layer material would be placed on the seabed using a clamshell bucket or a chute. The filter layer would help prevent the loss of underlying sediments and sinking of the rock armor (ESS Group, Inc. 2006). In water depths greater than 15 feet (4.5 meters), the median stone size would be about 50 pounds (approximately 22.6 kilograms) with a stone layer thickness of about 3 feet (approximately 0.9 meters) ft). The rock armor for a monopile foundation for a wind turbine has been estimated to occupy 16,000 square feet (0.37 acre [0.15 hectares]) of the seabed (ESS Group, Inc. 2006). While the piles of meteorological tower would be much smaller than those of a wind turbine, a meteorological tower may be supported by up to four piles. Therefore, the maximum area of the seabed impacted by rock armor for a single meteorological tower is estimated to also be 16,000 square feet (0.37 acre [0.15 hectares]).

A scour control system would be monitored throughout the lease term. It is expected that the foundation would be visually inspected monthly for the first year of installation, and then every year after that or after each significant storm activity. Inspections would be carried out by divers or ROV's.

Removal of the scour control system is discussed in Section 4.8.2, Removal of Scour Control System.

Installation of the Foundation Structure

A jacket or monopile foundation and deck would be fabricated onshore, transferred to barge(s) and the carried or towed to the offshore site. This equipment would typically be deployed from two barges, one containing the pile-driving equipment and a second containing a small crane, support equipment, and the balance of materials needed to erect the platform deck. These barges would be tended by appropriate tugs and workboats, as needed.

The foundation pile(s) for a fixed platform could range from either a single 10-foot (3 meter)-diameter monopile or three to four 36-inch (0.9-meter)-diameter piles (jacket). These piles would be driven anywhere from 25 to 100 feet (7.6 to 30.5 meters) below the seafloor with a pile-driving hammer typically used in marine construction operations. After approximately three days, when the pile-driving is complete, the pile-driver barge would be removed. In its place, a jack-up barge equipped with a crane would be used to assist in the mounting of the platform decking, tower, and instrumentation onto the foundation. Depending on the type of structure installed and the weather and sea conditions, the in-water construction of the foundation pilings and platform would range from several days (monopile construction in good weather) to six weeks (jacket foundation in bad weather) (USDOI, MMS 2009a). The mast sections would be raised using a separate barge-mounted crane; installation would likely be complete within a few weeks.

Piles are generally driven into the substrate using one of two methods: impact hammers or vibratory hammers (Nedwell and Howell 2004; Hansen *et al.*, 2003). Impact hammers use a heavy weight to repeatedly strike the pile and dive it into the substrate. Vibratory hammers use a combination of vibration and a heavy weight to force the pile into the sediment. Impact hammers produce sharp striking sounds, whereas vibratory hammers produce more continuous, low frequency sounds (Nedwell and Howell 2004; Hanson *et al.*, 2003). The type of hammer used depends on a variety of factors, such as the material the pile is composed of, and the sediment the pile will be driven into. Impact hammers can be used for any type of pile, and can drive piles into most all substrates. Vibratory hammers are more useful when driving a pile that has a sharp edge that can cut into the sediment (i.e. an open ended steel pile); as opposed to one that displaces the sediment (i.e. closed ended steel pile, wood, or cement). Also, vibratory hammers are most useful in softer sediments such as sand or mud (Hanson *et al.*, 2003). A combination of vibratory hammers and impact hammers can also be used, again, depending on the substrate. This method can be used when there is softer substrate in the upper layers, where the vibratory hammer is more useful at positioning the pile while hammering. The impact hammer can then be used to drive the pile the remainder of the depth when harder, more resistance substrates are encountered (Hanson *et al.*, 2003). This method may also be useful in the case of meteorological towers which must meet seismic stability criteria, which required that the supporting piles are either attached to, or driven into, the underlying hard sediment (Hanson *et al.*, 2003).

During installation, a radius of approximately 1,500 feet (457 meters) around the site would be needed for the movement and anchoring of support vessels. Total installation time for one meteorological tower would take eight days to ten weeks, depending on the type of structure to be installed and the weather and ocean conditions (USDOI, MMS 2009a).

Foundation Hammering Sounds

As with any sound in the marine environment, the type and intensity of the sound is greatly dependent on multiple factors and can vary greatly. These factors include the type and size of the pile, the type of substrate, the depth of the water, and the type and size of the impact hammer (Madsen *et al.*, 2006). Wood and concrete piles appear to produce lower sound pressures than hollow steel piles of a similar size. Firmer substrates require more energy to drive piles, and produce more intense sound pressures.

Driving hollow steel piles using the impact hammer method produces intense sharp spikes of sound. Using vibratory hammers to drive piles produces a more continuous, lower intensity sound. When comparing the two methods, vibratory hammers produce longer duration sounds with more energy in the lower frequencies (15 to 26 Hz vs. 100 to 800 Hz) (Würsig *et al.*, 2000; Carlson *et al.*, 2001; Nedwell 2007). The environmental impacts of this sound production are discussed further in Section 5.

Meteorological Tower Operation and Maintenance Activities

The length of time a meteorological tower may be present on a leasehold would be influenced by a number of factors, including how long it takes to install the tower, whether the lessee has submitted a COP, and/or how long the subsequent BOEM review of the COP takes. For the proposed action, BOEM anticipates that a tower may be present for approximately five years before the final decision is made to either allow the tower to remain or be decommissioned.

During the life of the meteorological tower, the structure and instrumentation would be accessible by boat for routine maintenance. As indicated in previous site assessment proposals submitted to BOEM, lessees with towers powered by solar panels or small wind turbines would conduct monthly or quarterly vessel trips for operation and maintenance activity over the five-year life of a meteorological tower (USDOI, MMS 2009a). However, if a diesel generator is used to power the meteorological tower's lighting and equipment, a maintenance vessel would make a trip at least once every other week, if not weekly, to provide fuel, change oil, and perform maintenance on the generator. Depending on the frequency of the trips, support for the meteorological towers in the Project Area would result in anywhere from of 36 quarterly to 468 weekly round trips per year for up to nine meteorological towers. No additional or expansion of onshore facilities would be required to conduct these tasks. It is projected that crew boats 51 to 57 feet in length with 400 to 1,000 horsepower engines and 1,800-gallon fuel capacity would be used for routine maintenance and generator refueling if diesel generators are used.

Meteorological Tower Lighting

All meteorological towers and buoys, regardless of height, would have lighting and marking for aviation and navigational purposes. Meteorological towers and buoys would be considered Private Aids to Navigation, and are required to be maintained by the individual owner under the regulations of the USCG. The USCG lighting for navigation safety would consist of two amber lights (USCG Class C) mounted on the platform deck. In accordance with FAA guidelines, the tower would be equipped with a light system consisting of a low intensity flashing red light (FAA designated L-864) for night use.

4.2.4.3 Meteorological Buoys

While a meteorological tower has been the traditional device for characterizing wind conditions, several companies have expressed their interest in installing one or two meteorological buoys per lease instead. Meteorological buoys can be used as an alternative to a meteorological tower in the offshore environment for meteorological resource data collection (i.e., wind, wave, and current). These meteorological buoys would be anchored at fixed locations and would regularly collect observations from many different atmospheric and oceanographic sensors.

These meteorological buoys, of varying designs, utilize LIDAR and/or SODAR. These may be used instead of, or in addition to, anemometers to obtain meteorological data. LIDAR is a surface-based remote sensing technology that operates via the transmission and detection of light. SODAR is also a surface-based remote sensing technology; however it operates via the transmission and detection of sound.

A meteorological buoy can vary in height, hull type, and anchoring method. NOAA has successfully used discus-shaped hull buoys and boat-shaped hull buoys for weather data collection for many years. In addition, spar buoy and tension-leg platform buoy designs have been recently submitted to BOEM for approval. All of these buoy types will likely be utilized for offshore wind data collection. A large discus buoy has a circular hull range between 32 and 39 feet (10 and 12 meters) in diameter and is designed for many years of service (USDOC, NOAA, National Data Buoy Center [NBDC], 2008). The boat-shaped hull buoy (known as a 'NOMAD' [Naval Oceanographic and Meteorological Automated Device]) is an aluminum-hulled, boat-shaped buoy that provides long-term survivability in severe seas (USDOC, NOAA, NBDC, 2008). This buoy design could be utilized to mount a LIDAR wind assessment system. A typical NOMAD is a 19.6 feet by 10.2 feet (6 meters by 3.1 meters) aluminum hulled buoy with a draft of 10.5 ft (3.2 m). Originally designed by the U.S. Navy in the 1940s, the NOMAD has since been adopted and widely used by researchers, including NOAA's National Data Buoy Center. The following description is from Fishermen's Energy SAP (Fishermen's Energy 2011 *as cited in* USDOI, BOEM, OREP, 2012a).

Primary electrical (DC) power for all equipment on a NOMAD-type buoy could be provided by four deep cycle 12 volt batteries. Batteries will be charged by renewable sources which include two wind generators and four 40-watt solar panels. In the event that the renewable power sources fail to keep the batteries adequately charged (extended heavy cloud cover with little wind), the power monitoring system could prompt an onboard diesel fuel powered generator to start and run until the batteries reach the required charge level. The system would revert back to renewable charging once these systems return to proper operation (Fishermen's Energy 2011 *as cited in* USDOI, BOEM, OREP, 2012a). Up to 500 gallons of diesel fuel could be stored on board the buoy to operate the generator.

The anchoring system for the NOMAD-type buoy could be a via a standard ¾ inch steel chain to a 10,000 pounds (4,536 kilograms) steel or concrete block (s). The footprint of the anchor itself is conservatively estimated at 16 square feet (1.49 square meters). Fishermen's Energy conservatively estimates the total bottom-disturbing footprint from the anchor and anchor chain sweep of a disc-shaped or a boat-shaped buoy to range from 121,613 square feet (approximately 11,298 square meters) to 372440 square feet (approximately 34,600 square meters) assuming approximately 100 feet (30.5 meters) of slack chain at low tide.

Because of its size, a buoy of the NOMAD design would likely be towed by a single vessel to the site in the lease area at speeds of around 3 knots. Although USCG buoy tending vessels greater than or equal to 180 feet (approximately 55 meters) are known to be able to transport and deploy a buoy of this size from its deck, a wind developer may not have access to a vessel of this size.

Buoys can use a wide range of moorings to attach to the seabed. On the OCS, a larger discus-type or boat-shaped hull buoy may require a combination of a chain, nylon, cable and/or buoyant polypropylene materials designed for many years of ocean service. Some deep-ocean moorings have operated without failure for over 10 years (USDOC, NOAA, NBDC 2008).

A spar-type buoy can be stabilized through an on-board ballasting mechanism approximately 60 feet (18.3 meters) below the sea surface. Approximately 30 to 40 feet (approximately 9 to 12 meters) of the spar-type buoy would be above the ocean surface where meteorological and other equipment would be located. A spar buoy is a long, thin, typically cylindrical buoy, ballasted at one end so that it floats in a vertical position. This design maintains tension in the anchor chain between the buoy and the anchor, thus eliminating slack in the chain that results in chain sweep around the anchor. Tension-leg platforms use the same tension in the mooring chain, but may utilize a more traditional discus-shaped buoy with a larger mast for mounting data collection instrumentation.

Buoy Installation

Boat-shaped, spar-type and discus-shaped buoys are typically towed or carried aboard a vessel to the installation location. Once at the location site, the buoy would be either lowered to the surface from the deck of the transport vessel or placed over the final location, and then the mooring anchor dropped. A boat-shaped buoy in shallower waters of the Project Area may be moored using an all-chain mooring, while a larger discus-type buoy would use a combination of chain, nylon, and buoyant polypropylene materials (USDOC, NOAA, NBDC, 2008). Based on previous proposals, anchors for boat-shaped and discus-shaped buoys would weigh about 6,000 to 10,000 pounds (2,721 to 4,536 kilograms) with a footprint of about 16 square feet (approximately 1.49 square meters) and an anchor sweep of about 8.5 acres (approximately 3.4 hectares). After installation, the transport vessel would remain in the area for several hours while technicians configure proper operation of all systems. Boat-shaped and discus-shaped buoys would typically take one day to install. Transport and installation vessel anchoring for one day is anticipated for these types of buoys (Fishermen's Energy 2011 *as cited in* USDOI, BOEM, OREP 2012).

Typically, a spar-type buoy would take two days to install. It would be towed to the installation location by a transport vessel after assembly at a land-based facility. Deployment would occur in two phases: deployment of a clump anchor to the seabed as a pre-set anchor (Phase 1) and deployment of the spar buoy and connection to the clump anchor (Phase 2). Phase 1 would take approximately one day and would include placement of the clump anchor on a barge and transporting it to the installation site. The monitoring buoy would be anchored to the seafloor using a clump weight anchor and mooring chain. Installation could take approximately two days. Spar-type buoys may have all-chain moorings or cables. Moorings for a spar-type buoy tension leg anchoring system may weigh up to 165 tons with a 26 by 26 foot (7.9 by 7.9 meter) footprint. The total area of bottom disturbance associated with buoy and vessel anchors would be 28 by 28 feet (8.5 by 8.5 meters), with a total area of 784 square feet (73 square meters) to a 1,200-foot (356.7 meter) radius anchor sweep for the installation vessel with a total of just over 100 acres of disturbance. The maximum area of disturbance to benthic sediments would occur during anchor deployment and removal (e.g., sediment resettlement, sediment extrusion, etc.) for this type of buoy.

4.2.4.4 Other Ocean Monitoring Equipment

In addition to the meteorological buoys described above, a small tethered buoy (typically 3 meters [approximately 10 feet] or less in diameter) and/or other instrumentation also could be installed on, or tethered to, a meteorological tower to monitor oceanographic parameters and to collect baseline information on the presence of certain marine life.

To measure the speed and direction of ocean currents, Acoustic Doppler Current Profilers (ADCPs) would likely be installed on each meteorological tower or buoy. The ADCP is a remote sensing technology that transmits sound waves at a constant frequency and measures the ricochet of the sound wave off fine particles or zooplanktons suspended in the water column.

The ADCPs may be mounted independently on the seafloor or to the legs of the platform, or attached to a buoy. A seafloor-mounted ADCP would likely be located near the meteorological tower (within approximately 500 feet [152 meters]) and would be connected by a wire that is hand-buried into the ocean bottom. A typical ADCP has three to four acoustic transducers that emit and receive acoustical pulses from different directions, with frequencies ranging from 300 to 600 kHz with a sampling rate of 1 to 60 minutes. A typical ADCP is about 1 to 2 feet tall (approximately 0.3 to 0.6 meters) and 1 to 2 feet wide (approximately 0.3 to 0.6 meters). Its mooring, base, or cage (surrounding frame) would be several feet wider.

A meteorological tower or buoy also could accommodate environmental monitoring equipment, such as avian monitoring equipment (e.g., radar units, thermal imaging cameras), acoustic monitoring for marine mammals, data-logging computers, power supplies, visibility sensors, water measurements (e.g., temperature, salinity), communications equipment, material hoist, and storage containers.

4.2.4.5 Timing of Wind Resource Assessment Equipment Installation

Total installation time for a single meteorological tower would take eight days to ten weeks depending on the type of structure installed and the weather and sea state conditions. It is anticipated that an average meteorological buoy installation would likely take one to two days. Installation of meteorological towers and buoys would likely occur in the spring and summer months during calmer weather, however, installation could potentially occur at any time of year when weather permits.

4.3 Vessel Traffic

Vessel traffic, both by air and by sea, occurs during all phases of the site characterization and assessment activities. Due to concerns with collisions and potential pollution, vessel traffic for all phases of the site assessment are addressed in this section.

In an effort to reduce ship strikes to endangered right whales, NOAA issued regulations requiring ships 65 feet (19.8 meters) or longer to travel at 10 knots or less in certain areas where right whales gather (Effective December 9, 2008 to December 9, 2013) (73 FR 60173). The Special Management Areas (SMAs) aim to reduce the likelihood of deaths and serious injuries to endangered North Atlantic right whales that result from collisions with ships, which also benefits other marine mammal species. These restrictions extend out to 20 NM (37 kilometers) around major mid-Atlantic ports. The Block Island Sound SMA includes all of the RI/MA WEA and a small portion of the MA WEA. Except for crew boats, which are typically smaller than 65 feet (19.8 meters), these restrictions would be applicable to most vessels associated with the proposed action. Speed restrictions are in effect from November 1st to April 30th. In addition to the seasonal restrictions, Dynamic Management Areas (DMAs) created by NMFS and based on recent right whale sightings (when a group of three or more right whales is confirmed) may be present within the Project Area or surrounding waters. Should a DMA become active encompassing all or a portion of the Project Area, NMFS would encourage vessel operators to voluntarily adhere to the seasonal restrictions, or, if possible, re-route their path outside of the designated DMA. Wind energy lessees would be required to abide by these otherwise voluntary restrictions (*See* Section 8.0).

4.3.1 HRG Survey Traffic

As detailed in Section 4.2.1.2, it is assumed that the HRG survey would cover the entire Project Area, and geophysical surveys for shallow hazards (492 feet [150 meters] line spacing) and archaeological resources (98 feet [30 meters] line spacing) would be conducted at the same time on the same vessels conducting sweeps at the finer line spacing array. This would result in about 500 NM of HRG surveys per OCS block (3 statute miles by 3 statute miles [approximately 5 kilometers by 5 kilometers]), not including turns. Assuming a vessel speed of 4.5 knots and 10-hour days (daylight hours minus transit time to the site), it would take about 11 days to survey one OCS block or about 100 days to survey an average-size lease of eight OCS blocks. To survey all of the Project Area, HRG surveys would have to be conducted by multiple vessels and/or over multiple years. Assuming 100 percent coverage of the Project Area, the proposed action would result in a total of approximately 79,000 NM or 17,490 hours/ 1900 round trips of HRG surveys (see Table 4.3 and 4.4).

Vessels would be required to maintain a vigilant watch for marine mammals and sea turtles during transit to and from the survey area, as well as during the HRG survey itself. Section 8.0 details the standard operating conditions that would be required for vessels.

4.3.2 Geotechnical Sampling Vessel Traffic

As described in the geotechnical sampling activity scenario, it is anticipated that there would be approximately 1048 – 4140 geotechnical samples taken within the Project Area. The amount of effort and vessel trips vary greatly by the type of technology used to retrieve the sample, and each work day would be associated within one round trip. The following details the type of vessels and collection time per sample:

Vibracores: Would be likely be advanced from a single small vessel (~45 feet [~14.7 meters]), and collect 1 sample per day.

CPT: Depending on the size of the CPT, it could be advanced from medium vessel (~65 feet [~19.8 meters]), a jack-up barge, a barge with a 4-point anchoring system, or a vessel with a dynamic positioning system. Each barge scenario would include a support vessel. This range of vessels could sample between 1 location per day.

Geologic boring: Would be advanced from a jack-up barge, a barge with a 4-point anchoring system, or a vessel with a dynamic positioning system. Each barge scenario would include a support vessel. Each deep geologic boring could take 1 day.

Based on the expected number of both HRG surveys and geotechnical samples, as well as, presumed independent avian surveys, approximately 3,672 to 6,812 vessel trips (round trips) associated with site characterization surveys are projected to occur as a result of the proposed action over five years (2013 to 2018).

4.3.3 Meteorological Tower Construction and Operation Traffic

The proposed action scenario estimates a maximum of nine meteorological towers to be constructed within the Project Area. During installation, a radius of approximately 1,500 feet (457.2 meters) around the site would be needed for the movement and anchoring of support vessels. A maximum of 40 round trip vessel trips are expected during construction of each meteorological tower or 360 rounds trips for up to nine meteorological towers.

Several vessels would be involved in installing and constructing a meteorological tower. Vessels delivering construction material or crews to the site will be present in the area between the mainland and the construction site, as well as vessel being present at the site during installation. The barges, tugs and vessels delivering construction materials will typically be 65 to 270 feet (19.8 to 82.3 meters) in length, while the vessel carrying construction crews will typically be 51 to 57 feet (15.5 to 17.4 meters) in length.

After installation data would be monitored and processed. The structure and instrumentation would be accessed by boat for routine maintenance. Assuming a single maintenance trip to each meteorological tower quarterly to weekly, the proposed action would result in an additional 36 to 468 vessel trips per year for up to nine meteorological towers, or 180 to 2340 vessel trips over a five-year period. These vessel trips would not require any additional or expansion of onshore facilities. It is projected that crew boats 51 to 57 feet (15.5 to 17.4 meters) in length would be used to service the structure.

Vessel usage during decommissioning will be similar to that during construction. Up to approximately 40 round trips by various vessels are expected during decommissioning of each meteorological tower. Similar to construction, this yields an average of 360 round trips for the decommissioning of up to nine meteorological towers.

4.3.4 Meteorological Buoy Deployment and Operation Traffic

The proposed action scenario estimates a maximum of 18 meteorological buoys could be deployed throughout the Project Area. As described in Section 4.3.5.3, the installation of each buoy could utilize 1-2 round trips per buoy deployment. The types of vessels involved in the deployment include barge/tug (for buoy and/or anchoring system), large work vessel (for towing and/or carrying the buoy), and an additional support vessel (for crew and other logistical needs).

Similar to the meteorological towers, it is expected that maintenance for the buoy would be required on a quarterly to weekly basis resulting in maximum of 72-936 to round-trips per year for up to 18 buoys, or 360-4680 vessel trips over a five year period. It should be noted that it is unlikely that all 18 meteorological buoys would be in service at the same time over the entire period. For meteorological buoys, the decommissioning is expected to be the reverse of the deployment, with one round trip required to retrieve each buoy.

Table 4.4
Total Number of Estimated Vessel Trips for Project Area Over a Five Year Period

WEA	HRG Survey	Geotechnical sample	Met tower install	Met buoy install	Met tower ops	Met buoy ops	Met tower decom	Met buoy decom
Rhode Island / Massachusetts	400	500 – 1,400	160	8-16	80-1040	160-2080	160	8-16
Massachusetts	1500	708 – 2900	200	10-20	100-1300	200-2600	200	10-20
Total	1900	1208 – 4300	360	18-36	180-2340	360-4680	360	18-36

Note:
Met = Meteorological
ops = operations
decom = decommissioning

4.4 Onshore Activity

Several southern New England ports would be used as a fabrication sites, staging areas and crew/cargo launch sites. Existing ports or industrial areas are expected to be used. The fabrication facilities in the relevant major port areas are large and have high capacities, therefore BOEM does not anticipate that the fabrication of meteorological towers or buoys associated with the proposed action would have any substantial effect on the operations of, transportation to or from, or conditions at these facilities.

Several major ports exist near the Project Area that are suitable to support the fabrication and staging of meteorological towers and buoys, including the ports of New Bedford, Massachusetts and Quonset Point, Rhode Island.

A meteorological tower platform or meteorological buoy would be constructed or fabricated onshore at an existing fabrication yard or final assembly of the tower could be completed offshore. The location of these fabrication yards is directly tied to the availability of a large enough channel that would allow the towing of these structures. The average bulkhead depth needed for water access to fabrications yards is 15 to 20 feet (4.6 to 6.1 meters).

4.5 Decommissioning

No later than two years after the cancellation, expiration, relinquishment, or other termination of the lease, the lessee would be required to remove all devices, works, and structures from the site and restore the leased area to its original condition before issuance of the lease (30 CFR 585, Subpart I).

It is estimated that the entire removal process of a meteorological tower would take one week or less. Decommissioning activities would begin with the removal of all meteorological instrumentation from the tower, typically using a single vessel. A derrick barge would be transported to the offshore site and anchored next to the structure. The mast would be removed from the deck and loaded onto the transport barge. The deck would be cut from the foundation structure and loaded onto the transport barge. The same number of vessels necessary for installation would likely be required for decommissioning. The sea bottom area beneath installed structures would be cleared of all materials that have been introduced to the area in support of the lessee's project.

Buoy decommissioning is the reverse of the installation process. Equipment recovery would be performed with support of a vessel(s) equivalent in size and capability to those used for installation. For small buoys, a crane lifting hook would be secured to the buoy. A water/air pump system would de-ballast the buoy into the horizontal position. The mooring chain(s)/cable(s) and anchor would be recovered to the deck using a winching system. The buoy would then be towed to shore by the barge. All buoy decommissioning is expected to be completed within one or two days. Buoys would be returned to shore and disassembled or reused in other applications. It is anticipated that the mooring devices and hardware would be reused or disposed of as scrap iron for recycling (Fishermen's Energy 2011 *as cited in* USDOI, BOEM, OREP, 2012a).

4.5.1 Cutting and Removing Piles

As required by BOEM, the lessee would sever bottom-founded structures and their related components at least 15 feet (5 meters) below the mud line to ensure that nothing would be exposed that could interfere with future lessees and other activities in the area (30 CFR 585.910(a)). The choice of severing tool depends on the target size and type, water depth, economics, environmental concerns, tool availability, and weather conditions (USDOI, MMS 2005). Meteorological tower piles in the Project Area would be removed using non-explosive severing methods.

Common non-explosive severing tools that may be used consist of abrasive cutters (e.g., sand cutters and abrasive water jets), mechanical (carbide) cutters, diver cutting (e.g., underwater arc cutters and oxyacetylene/oxyhydrogen torches), and diamond wire cutters. Of these, the most likely tools to be employed would be an internal cutting tool, such as a high-pressure water jet-cutting tool that would not require the use of divers to set up the system or jetting operations to access the required mud line (Kaiser *et al.,* 2005). To cut a pile internally, the sand that had been forced into the hollow pile during installation would be removed by hydraulic dredging/pumping and stored on a barge. Once cut, the steel pile would then be lifted onto a barge and transported to shore. Following the removal of the cut pile and the adjacent scour control system, the sediments would be returned to the excavated pile site using a vacuum pump and diver-assisted hoses. As a result, no excavation around the outside of the monopile or piles prior to the cutting is anticipated. Cutting and removing piles would take anywhere from several hours to one day per pile. After the foundation is severed, it would be lifted on the transport barge and towed to a decommissioning site onshore (USDOI, MMS 2009a).

4.5.2 Removal of Scour Control System

Any scour control system would be removed during the decommissioning process. Scour mats would be removed by divers or ROV and a support vessel in a similar manner to installation. Removal is expected to result in the suspension of sediments that were trapped in the mats. If rock armoring is used, armor stones would be removed using a clamshell dredge or similar equipment and placed on a barge. It is estimated that the removal of the scour control system would take a half-day per pile. Therefore, depending on the foundation structure, removal of the scour system would take from one half to two days to complete (USDOI, MMS 2009a).

4.5.3 Disposal

All materials would be removed by barge and transported to shore. The steel would be recycled and remaining materials would be disposed of in existing landfills, in accordance with applicable law.

4.5.4 Artificial Reefs

Obsolete materials have been used as artificial reefs along the coastline of the U.S. to provide valuable habitat for numerous species of fish in areas devoid of natural hard bottom. The meteorological tower structures and scour control systems may have the potential to serve as artificial reefs. However, the structure must not pose an unreasonable impediment to future development. If the lessee ultimately proposes to use the structure as an artificial reef, its plan must comply with the artificial reef permitting requirements of the USACE and the criteria in the National Artificial Reef Plan of 1985 (33 U.S.C. 35.2103). The state agency responsible for managing marine fisheries resources must accept liability for the structure before BOEM would release the federal lessee from the obligation to decommission and remove all structures from the lease area (USDOI, MMS 2009a).

5 Effects of the Proposed Action

The proposed action has five primary activities that will likely have environmental effects. These activities are: (1) HRG surveys; (2) geotechnical sampling; (3) deployment of a meteorological buoy or construction of a meteorological tower; (4) operation of a meteorological buoy or meteorological tower; and (5) other activities. The potential effects from these activities can be grouped into the following categories: (1) acoustic effects; (2) benthic habitat effects; (3) vessel and tower collision effects; (4) lighting effects; and (5) other effects (e.g., contact with waterborne pollution).

5.1 Description of the Environment

Section 4.2 of the Programmatic EIS (USDOI, MMS 2007) gives a thorough description of the geology, biology, meteorology, and acoustics of the entire BOEM Atlantic planning area. Regardless, a brief description of the physical environment is included here. Section 3.0 of this document gives a description of the species of concern that inhabit this area. The Project Area is located in southern New England waters, which are considered a sub-region of the mid-Atlantic Bight (MAB) (also referred to as the Southern New England/ New York Bight in this document) of the Northeast Continental Shelf Large Marine Ecosystem. The following Southern New England characterization and tables are adopted from *Characterization of the Fishing Practices and Marine Benthic Ecosystems of the Northeast U.S. Shelf* (Stevenson *et al.*, 2004). The Project Area is located on the continental shelf system that extends from the Gulf of Maine south to Cape Hatteras and east of the Gulf Stream (Stevenson *et al.*, 2004). As in the rest of the continental shelf, the MAB topography was largely shaped by sea-level changes during the last ice age. The retreat of the last ice sheet deposited shaped the profile of the continental shelf and deposited sediments. These are being continuously reworked today by currents, tides and waves (Stevenson *et al.*, 2004).

Extending out from shore between 54 to 108 NM (100 and 200 kilometers) the continental shelf gently slopes until it transitions to the slope at the shelf break in approximately 328 to 656 feet (100 to 200 meters) of water. Offshore around Georges Bank the primary morphological features of the shelf include shelf valleys ad channels, scarps, and sand ridges and swales. The sediment type covering most of MAB shelf is sand with some relatively small, localized areas of sand-shell and gravel. Silty sand, silt and clay become predominant once on the slope.

Table 5.1
Mid-Atlantic Habitat Types (Including Southern New England)

Habitat Type [after Boesch (1979)]	Depth (meters)	Characterization (Pratt (1973) faunal zone)	Characteristic Benthic Macrofauna
Inner Shelf	0-30	Coarse sands with finer sands off MD and VA (sand zone)	Polychaetes: *Polygordius*, *Goniadella*,and *Spiophanes*
Central Shelf	30-50	(sand zone)	Polychaetes: *Goniadella* and *Spiophanes* Amphipods: *Pseudunciola*
Central and inner shelf swales	0-50	Occurs in swales between sand ridges (sand zone)	Polychaetes: *Polygordius*, *Lumbrineris*, and *Spiophanes*
Outer shelf	50-100	(silty-sand zone)	Polychaetes: *Spiophanes* Amphipods: *Ampelisca vadrum* and *Erichthonius*
Outer shelf swales	50-100	Occurs in swales between sand ridges (silty-sand zone)	Amphipods: *Ampelisca agassizi*, *Unciola*, and *Erichthoniu*
Shelf break	100-200	(silt-clay zone)	NA
Continental slope	>200	(none)	NA

Source: Stevenson *et al.,* 2004

5.2 Acoustic Effects

This acoustic effects section summarizes the currently existing information on marine mammal hearing sensitivity and potential noise production resulting from site characterization and assessment activity in the Project Area.

5.2.1 Current Understanding of Noise Sensitivity in Marine Fauna

The information provided in this section is derived from previous ESA consultations issued by NMFS and BOEM for the proposed commercial wind energy lease issuance, associated site characterization activities, and subsequent site assessment activities in the mid-Atlantic WEAs, as well as the most relevant sources on marine mammal hearing sensitivity.

Sound is a major component of marine mammal survival. It is used for communication (of social and survival importance), foraging and navigation. It is also thought that marine mammals also use sound to gather information about their surrounding environment which can originate from natural sources such as sounds produced by other animals (inter- or intra- specific species), or natural occurring phenomenon such as wind or rain activity at the surface, or naturally occurring seismic activity such as earthquakes (Richardson *et al.,* 1995). Anthropogenic sound in the marine environment is increasing which has led to growing concern of the effects of such sound on marine mammals. Marine organisms can be affected by exposure to anthropogenic noise behaviorally, acoustically and physiologically (Richardson *et al.,* 1995).

Behavioral reactions can include:

- a flight response,
- change in response to predators,

- changes in diving patterns,
- changes in foraging,
- changes in breathing patterns,
- avoidance of important habitat or migration areas, and
- disruption of social relationships and interactions (Tyack 2009, Nowacek *et al.*, 2007; Richardson *et al.*, 1995).

Acoustic responses to anthropogenic noise can include:

- masking (the decreased ability for an animal to detect relevant sounds due to an increase in background noise),
- changes in call rates, and
- changes in call frequency.

Physiological responses can include:

- Temporary Threshold Shift (TTS) (temporary, fully recoverable reduction in hearing sensitivity due to exposure of higher than normal intensity sounds),
- Permanent Threshold Shift (PTS) (permanent, non-recoverable reduction in hearing sensitivity due to damage or injury caused by either a prolonged exposure to sound or a temporary exposure to very intense sound),
- increased stress, and
- direct or indirect tissue damage (such as hemorrhaging or gas bubbles developing in body fluids) (Nowacek *et al.*, 2007; Southall *et al.*, 2007; Wright *et al.*, 2007; Richardson *et al.*, 1995).

5.2.1.1 Marine Mammals

Currently, impacts to marine mammals from acoustic sources are based on levels than can cause behavioral harassment and/or physiological damage or injury. Under the Marine Mammal Protect Act (MMPA) NMFS has established "do not exceed" thresholds that determine these impacts which are based on the root-mean-squared (RMS) metric. The RMS received levels for threshold criteria as established by NMFS are:

- 180 dB re 1 µPa or greater for potential injury to cetaceans and
- 190 dB re 1µPa for pinnipeds in water for potential injury to pinnipeds;
- 160 dB re 1 µPa for behavioral disturbance / harassment for non-continuous / impulsive noise to pinnipeds (in water) and cetaceans; and
- 120 dB re 1 µPa for behavioral disturbance / harassment from continuous noise to pinnipeds (in water) and cetaceans (70 FR 1871, *Marine Mammal Hearing*).

These thresholds have been developed based on limited experimental studies on captive odontocetes, controlled field experiments on wild animals, behavioral observations of wild animals exposed to anthropogenic sounds, and inferences from marine mammal vocalizations as well as inferences on hearing studies in terrestrial animals. Despite the current threshold criteria, individual marine mammal reactions to sound can vary, depending on a variety of factors such as, age and sex of the animal, prior noise exposure history of the animals which may have caused habituation or sensitization, the behavioral and motivational state of the animal at the time of exposure (i.e. if the animal is feeding and does not find it advantageous to leave its location), habitat characteristics, environmental factors that affect sound transmission, and location of the animal (i.e. distance from the shoreline) (NRC 2003). Nonetheless, the threshold levels referred to above are considered conservative based on the best available scientific information.

Marine Mammal Hearing

As discussed in Section 3.0, North Atlantic right, humpback, sei, sperm, and fin whales are the ESA-listed species likely to be affected by site assessment and characterization activities in the Project Area. Therefore, this section will primarily address these species. In order for sound to illicit some form of response or create an impact on a marine mammal, it is important to note that the sound produced must be within the auditory threshold of that animal, meaning that the animal must be able to perceive the sound at the given frequency and sound pressure level (Gotz *et al.*, 2009).

Because of the obstacles in directly studying baleen whale hearing, hearing ranges, sensitivity, frequency, and localization of large open ocean whales, it is assumed that the sound production range of the species is an indicator of the species' hearing range (Richardson *et al.*, 1995; Ketten 1998).

Large, baleen whales generally produce low frequencies, concentrating their vocalizations at frequencies less than 1 kHz (Richardson *et al.*, 1995). However, some species, such as humpback whales, are known to be able to produce songs up to 8 kHz (Payne and Payne 1985). Large baleen whales are assumed to be most sensitive to frequencies below 1 kHz, however can hear sounds up to higher, yet unknown frequencies. The majority of anthropogenic sounds produced in the marine environment are below 1 kHz, therefore creating a potential overlap between whales and manmade sounds (Richardson *et al.,* 1995). It is thought that some or all baleen whales may hear infrasounds. These are sounds at frequencies well below those detectable by humans. Based on functional models it is expected that the functional hearing of baleen whales extends as low as 20 Hz, with an upper range of 30 Hz. Even if the range of sensitive hearing does not extend below 20-50 Hz, whales may hear strong infrasounds at considerably lower frequencies. Based on work with other marine mammals, if hearing sensitivity is good at 50 Hz, strong infrasounds at 5 Hz might be detected (Richardson *et al.,* 1995). Fin whales hearing range may extend to frequencies as low as 10-15 Hz. The right whale has been reported to produce tonal signals in the frequency range from roughly 20 to 1000 Hz (Parks & Tyack 2005). Mellinger (2004) reported right whales producing vocalizations in the 50-200 Hz range. The sounds produced were reported as the "up call," which is a frequency-modulated upsweep and were one of the more common sounds made by right whales. Table 5.2 summarizes the range of sounds produced by right, humpback, sei, sperm, and fin whales (from Richardson *et al.,* 1995):

Table 5.2
Summary of Known Right, Humpback, and Fin Whale Vocalizations

Species	Signal Type	Frequency Limits (Hz)	Dominant Frequencies (Hz)	Source Level (dB re 1μPa RMS)	References
North Atlantic Right	Moans	< 400	--	--	Watkins and Schevill (1972)
	Tonal	20-1000	100-2500	137-162	Parks and Tyack (2005)
	Gunshots		50-2000	174-192	Parks *et al.,* (2005)
Humpback	Grunts	25-1900	25-1900	--	Thompson, Cummings, and Ha (1986)
	Pulses	25-89	25-80	176	Thompson, Cummings, and Ha (1986)
	Songs	30-8000	120-4000	144-174	Payne and Payne (1985)
Fin	FM moans	14-118	20	160-186	Watkins (1981), Edds (1988), Cummings and Thompson (1994)
		34-150	34-150		Edds (1988)
	Tonal Songs	17-25	17-25	186	Watkins (1981)
Sei	FM Sweeps	1500-3500	-	-	T. Thompson et al 1979; Knowlton et al 1991
Sperm	Clicks	0.1 – 30 kHz 5-20 kHz	2-4 kHz 10-16 kHz	160-180	Backus & Shevill 1996; Levenson 1974; Watkins 1980; Ridgeway & Carter 2001

Most species also have the ability to hear beyond their region of best sensitivity. This broader range of hearing is most likely related to their need to detect other important environmental phenomena, such as the locations of predators or prey. Among marine mammal species, there is considerable variation in hearing sensitivity and absolute hearing range (Richardson *et al.*, 1995; Ketten 1998). However, from what is known of right, humpback, sei, sperm, and fin whale hearing and the source levels and frequencies of site assessment and characterization activities (*see* Section 4.3), it is expected that if these whales are present in the area where the underwater noise occurs they would be capable of perceiving those anthropogenic noises. The baleen whales have hearing ranges that are likely to have peak sensitivities with low frequencies (below 1 kHz) while the sperm whale is characterized as a mid-frequency cetacean (above 1kHz) that overlap with frequencies of site assessment and site characterization sounds. This assessment assumes that frequencies above 200 kHz are not able to be perceived by marine mammals in the Project Area.

5.2.1.2 Sea Turtles

The hearing capabilities of sea turtles are not as well studied or as well-known as those of marine mammals. There are limited experimental studies exploring the hearing ranges of sea turtles. It is not possible to infer potential hearing ranges based on frequencies of vocalizations, as sea turtles do not vocalize. Therefore, the information that does exist is based on studies that explored the physiological and behavioral reactions of sea turtles exposed to various sounds as well as direct hearing measurements. Ridgeway *et al.*, (1969) reported that Pacific green sea turtles displayed hearing sensitivity in air from 30-500 Hz with an effective hearing range of 60 - 1,000 Hz. Lenhardt (1994) expanded on this in-air sensitivity by suggesting that in-water sensitivity for sea turtles was 10 dB less than air. Using auditory evoked potentials, Bartol *et al.*, (1999) found that juvenile loggerheads exhibit an effective hearing range of 250–750 Hz with peak sensitivity at 250 Hz. This is similar to what Lendhardt (1994) has found by invoking a startle response from loggerhead sea turtles using a low frequency source (20-80 Hz). He determined that sea turtles have an effective hearing range of 100-800 Hz with an upper limit of 2,000 Hz. Most recently, Ketten and Bartol (2005) reported hearing ranges similar to these previous studies, however they noted some minor differences when comparing juveniles and adults, and across species. They found that the smallest of their turtles tested, which were hatchling loggerheads had the greatest range (100-900Hz), and the largest turtles tested, sub-adult green sea turtles, had the narrowest range (100-500Hz). This limited research indicates that sea turtles are capable of hearing low frequency sounds, with some variation in size, age and species of turtle.

As the hearing frequencies of sea turtles fall within the frequencies produced by construction and survey activities, these animals may be affected by exposure. In regards to source levels required by sea turtles to perceive sounds, Ridgeway *et al.*, (1969) reported that 110-126 dB re 1 µPa were required for animals to hear sounds. Further, McCauley *et al.*, (2000) reported that source levels of 166 dB re 1 µPa were required to evoke behavioral reactions from captive sea turtles. Sea turtles are not expected to perceive sounds above above 1 kHz. Thus, regarding HRG survey equipment, only boomers would be heard.

5.2.1.3 Marine Fish

This section on acoustic effects is a brief summary of what is known about sound sensitivity in marine fish, particularly demersal fish that may hold some similarities to Atlantic sturgeon, and the impacts of sound that could be produced as a result of site characterization and assessment activity in the Project Area.

Fishes produce sounds that are associated with behaviors that include territoriality, mate search, courtship and aggression. It has also been speculated that sound production may provide the means for long distance communication and communication under poor underwater visibility conditions (Zelick *et al.*, 1999). Although, the fact that fish communicate at low frequency sound levels where the masking effects of ambient noise are naturally highest, suggests that very long distance communication would rarely be possible. Fishes have evolved a diversity of sound-generating organs and acoustic signals of various temporal and spectral contents. Myrberg (1980) states that members of more than 50 fish families produce some kind of sound using special muscles or other structures that have evolved for this role, or by grinding teeth, rasping spines and fin rays, burping, expelling gas, or gulping air.

Ladich (2000) measured the hearing sensitivities of closely related species that use different channels (acoustic vs. non-acoustic) for communication. Major differences in auditory sensitivity were indicated but they did not show any apparent correspondence to the ability to produce sounds. Fish sounds vary in structure, depending on the mechanism used to produce them. Generally, fish sounds are predominantly composed of low frequencies (<3 kHz). Most of the sounds are probably produced in a social context that involves interaction among individuals (i.e., communication). One of the most common contexts of sound production by fish is during reproductive behavior (Hawkins 1993). Recent research in Canada investigated the reproductive function of sound production by Atlantic cod (Rowe and Hutchings 2004). In support of other studies on cod sound production (e.g., Finstad and Nordeide 2004), Rowe and Hutchings (2004) concluded that sound production by cod could potentially be important to spawning behavior by acting as a sexually selected indicator of male size, condition and fertilization potential.

Since objects in the water scatter sound, fish are able to detect these objects through monitoring the ambient noise. Therefore, fish are probably able to detect prey, predators, conspecifics, and physical features by listening to the environmental sounds (Hawkins 1981). Lagardère *et al.*, (1994) concluded from their experiment with sole (*Solea solea*) that this species perceives and reacts to horizontal variability in ambient noise levels. Studies have also been done on the abilities of larval fish to detect sound and respond to it in order to achieve successful settlement (Leis *et al.*, 2002). There are two sensory systems that enable fish to monitor the vibration-based information of their surroundings. These two sensory systems, the inner ear and the lateral line, constitute the acoustico-lateralis system. A fishes' inner ear and the lateral line overlap in the frequency range to which they respond. Most bony fishes and elasmobranchs (e.g., sharks, skates) possess lateral lines that detect water particle motion. The essential stimulus for the lateral line consists of differential water movement between the body surface and the surrounding water and this stimulus is detected by organs known as "neuromasts" that are located on the skin or just under the skin in fluid-filled canals (Denton and Gray 1988). As is the case with the inner ear, neuromasts have sensory hair cells that move in response to the particle displacement. Generally, fish use the neuromasts to detect low frequency acoustic signals (150 to 200 Hz) over a distance of one to two body lengths (Coombs *et al.*, 1991). The ear responds to frequencies from about 20 Hz to several thousand Hz in some species (Popper and Fay 1993; Popper *et al.*, 2003).

Although the hearing sensitivities of very few fish species have been studied to date, it is becoming obvious that the intra- and inter-specific variability is considerable (Coombs and Popper 1979). A non-invasive electrophysiological recording method known as 'auditory brainstem response' (ABR) is now commonly used in the production of fish audiograms (Yan 2004). Generally, most fish have their best hearing (lowest auditory thresholds) in the low frequency range (i.e., <1 kHz). Even though some fish are able to detect sounds in the ultrasonic frequency range, the thresholds at these higher frequencies tend to be considerably higher than those at the lower end of the auditory frequency range. This generalization applies to the fish species occurring in the Project Area and its surrounding waters.

Literature relating to the impacts of sound on marine fish species can be conveniently divided into the following categories: (1) pathological effects, (2) physiological effects, and (3) behavioral effects. Pathological effects include lethal and sublethal physical damage to fish; physiological effects include primary and secondary stress responses; and behavioral effects include changes in exhibited behaviors of fish. Behavioral changes might be a direct reaction to a detected sound or as a result of the anthropogenic sound masking natural sounds that the fish normally detect and to which they respond. The three types of effects are often interrelated in complex ways. For example, some physiological and behavioral effects could potentially lead to the ultimate pathological effect of mortality. Popper and Hastings (2009) recently reviewed what is known about the effects of sound on fishes and identified studies needed to address areas of uncertainty relative to measurement of sound and the responses of fishes.

Hastings *et al.*, (1996) suggested that sounds 90 to 140 dB above a fish's hearing threshold may potentially injure the inner ear of a fish. Hastings *et al.*, (1996) exposed oscar fish (*Astronotus ocellatus*) to synthesized sounds with characteristics similar to those of commonly encountered man-made sources. The only damage observed was in fish exposed for one hour to 300 Hz continuous tones at 180 dB re 1 μPa at 1 meter (UMT), and sacrificed four days post-exposure. Enger (1981) provided the earliest evidence of the potential of loud sounds to pathologically affect fish hearing. He demonstrated that the sensory cells of the ears of Atlantic cod (*Gadus morhua*) were damaged after one to five hours of exposure to continuous synthesized sounds with a source SPL of 180 dB re 1 μPa at 1 meter (UMT). The frequencies tested included 50, 100 200, and various frequencies between 300 and 400 Hz. The cod were exposed at less than one meter from the sound source. Chapman and Hawkins (1973) found that ambient noise at higher sea states in the ocean have masking effects in cod, haddock, and pollock. Additionally, sound could also produce generalized stress (Wysocki *et al.*, 2006). Thus, based on limited data, it appears that for fish in general, communication masking and stress may occur depending on the species, sound pressure level, frequency, and duration of exposure. Specific acoustic thresholds for behavioral impacts to Atlantic sturgeon have not been established.

5.2.1.3 Avifauna

Loud noises including pile driving and construction noise can disturb nesting birds. However, the activity of constructing met towers on the Atlantic OCS is far from nesting roseate tern colonies and piping plovers on the coast. Thus, noise from these activities will have no impact on nesting roseate terns and piping plovers. Sound attenuates much more quickly in air than it does in water, given that and the fact that acoustic energy from met tower construction is directed downward through the water column, the acoustic effects to birds and bats is considered negligible.

5.2.2 High Resolution Geologic Survey Acoustic Effects

High resolution geologic (HRG) surveys will be used to characterize ocean-bottom topography and subsurface geology. The HRG surveys would also investigate potential benthic biological communities and archaeological resources. The high resolution surveys would be used to characterize the potential site of the meteorological tower/buoy and potential placement of wind turbines in the future. As stated in Section 4.3.1, HRG surveys and sub-bottom profiling methods used for site characterization use less intense sounds as those used for deep penetrating seismic surveys in the oil and gas industry. Therefore, HRG surveys for siting of meteorological towers and later, wind turbines, would result in shallower seafloor penetration and less sound energy introduced in the marine environment.

A detailed proposed action scenario for HRG surveys is described in Section 4.3. The survey would likely consist of a vessel towing an acoustic source behind the ship with a streamer cable and tail buoy. Surveys would be conducted during daylight hours over a lengthy (several years) but unspecified period of time as lessees respond to requests to develop the Project Area and secure financing to conduct surveys. The total Project Area survey area includes the entire project footprint where wind turbines could be installed. Total HRG survey time is conservatively estimated at 79,000 NM or 17,490 hours for the entire Project Area (see Table 4.3).

The sound levels of the source will depend on the types of survey equipment used (i.e. boomer, sidescan sonar, etc.). A description of the potential source levels for the varying survey equipment can be found in Table 4.1 (*see* Section 4.2.1.1). It is important to indicate that the acoustic energy generated from these sources is directed downward, not horizontally. However it is also important to note that horizontal spreading of sound will occur within the water column, dependent on varying factors such as the source level, the sub-bottom acoustics, and the environmental conditions of the area (Richardson *et al.*, 1995). The surveys would likely use the full daylight hours available, approximately 10 hours per day. However, the time that any particular area would experience elevated sound levels would be significantly shorter as the vessel would be ensonifying a limited area along each transect.

The sub-bottom profilers (e.g., boomers, sparkers, and chirpers) generate sound within the hearing thresholds of most marine mammals that may occur in the action area. The chirp has an estimated broadband sound source level of 222 dB re 1µPa rms with a typical pulse length of 64 milliseconds. A typical boomer has a sound source level of around 212 dB re 1µPa rms with the pulse duration of 180 microseconds(*see* Table 4.1 in Section 4.2.1.1). However, actual specifications may vary by manufacturer and the environment where it is to be deployed.

HRG survey method source levels and pulse lengths were used to model threshold radii for the various profiler methods for the Atlantic OCS Proposed G&G Activities Mid-Atlantic and South Atlantic Planning Areas DPEIS (USDOI, BOEM 2012, Appendix D). These profilers include a boomer, side-scan sonar, chirp sub-bottom profiler, and a multi-beam depth sounder. Three of the four profiler methods have operating frequencies that are within the range of cetacean hearing (Table 4.1 in Section 4.2.1.1). The pulse length and peak source level that were used for each profiler method modeling scenario can be assumed to be representative of profiler sources that could be used for the proposed action.

Based on these modeling results, threshold radii for each HRG survey method potentially used for the proposed action are displayed in Table 4.1 (*see* Section 4.2.1.1). As displayed in the modeling results the threshold radii for 180 dB re 1 µPa rms (NMFS Level A harassment threshold) from any of the survey methods is not expected to be greater than 200 meters and not greater than 700m for 160dB re 1 µPa rms (NMFS Level B harassment threshold). Therefore this is the exclusion zone that has been developed for all whales(*see* Section 8.0). The exclusion zones are based on preventing any whales from experiencing Level A and Level B harassmentfrom noise under the MMPA.

5.2.2.1 Marine Mammals

ESA-listed marine mammals are expected to be present within the Project Area and/or its surrounding waters during all seasons of the year (*see* Section 3.1). Taking into account the standard operating conditions that are planned (*see* Section 8), effects on whale behavior are generally expected to be limited to avoidance of the area around the HRG survey.As whales are mobile species, they have the ability to move away from the sound should disturbance occur. It is expected that areas avoided by whales during noise producing activity would be available and used byby whales after the survey had left the area. Once an area has been surveyed, it is not likely that it will be surveyed again, therefore reducing the likelihood of repeated HRG-related impacts within the Project Area.

As congregations of whales have been observed in and around the Project Area, there is the potential that the ESA-listed animals may be present within the Project Area. However, it is anticipated that they will be distributed throughout the area and not congregated in any specific location within the Project Area for periods of time greater than a day or two (based upon lack of repeat sightings in the same location over short periods of time). Based on the modeled maximum ranges of the 160 dB re 1µPa isopleth (no greater than 700 meters), it is unlikely that any whales within the Project Area or its surrounding waters would be exposed to harassing levels of sound associated with the survey.

Based on the standard operating conditions, mobility of the sound source, the variable locations and times of the surveys over several years, and the likelihood that any whales present within the area would avoid any disturbing sound levels associated with the survey while migrating through the area, it is expected that few individuals are expected to be affected by HRG surveys. Therefore, HRG survey noise exposure to ESA-listed marine mammals is expected to be negligible.

5.2.2.2 Sea Turtles

If surveys occur between June and November, it is likely that listed sea turtles will be present within the Project Area and its surrounding waters and could be exposed to sound from HRG surveys. BOEM would require that an exclusion zone of 45 m for sea turtles by lessees during any survey activity. Monitoring of the exclusion zone would be required to begin 60 minutes prior to the ramp up of the survey equipment. The 60-minute monitoring period is specifically to allow for the sighting of turtles between dives. The normal duration of sea turtle dives ranges from 5-40 minutes depending on species, with a maximum duration of 45-66 minutes depending on species (Spotila 2004).

A survey vessel would not likely travel at speeds greater than 4.5 knots while surveying. The observer will monitor the exclusion zone while the survey equipment is operating, and should any sea turtle enter within 45 m of the source, the equipment will be shut down. It is expected that as the survey vessel travels along the transect lines, sea turtles would be able to perceive the low frequency sound and avoid it as necessary. Potentially harassing levels of sound (i.e. greater than 160 dB re 1 µPa) will be experienced only within 45 meters of the survey equipment (*see* Section 5.2.2).

It is not expected that sea turtles would swim towards the noise source, given evidence that they exhibit behavioral responses, such as increased swimming rates indicating an attempt at avoidance when exposed to 160 dB re 1 µPa (McCauley *et al.*, 2000). Therefore it is unlikely that sea turtles would be exposed to harassing levels of noise as they are likely to avoid areas with harassing sound levels (O'Hara and Wilcox 1990).

It is expected that sea turtles that avoided ensonified areas would return to the those areas after cessation of those activities. The surveys would likely use the full daylight hours available, approximately 10 hours per day. However, the time that any particular area would experience elevated sound levels would be significantly shorter as the vessel would be ensonifying a limited area along each transect. Available information indicates that sea turtle forage items may be present in the action area, therefore if sea turtles were present and feeding or resting in an area where HRG surveys were passing through, it is expected that they could find alternative forage and resting locations within the Project Area, thereby reducing impacts to these activities. Additionally, should sea turtles be migrating through the area, (i.e. leatherbacks migrating to or from the Gulf of Maine) it is expected that they would avoid disturbing noises within the Project Area, therefore decreasing the potential for impacts from survey activities. Sea turtles are not expected to be excluded from large areas due to the temporary nature of HRG activities. The avoidance of ensonified areas will be temporary and localized. It is not expected that any impacts would result in injury or overall behavioral impairment to an individual. Major shifts in habitat use, interruption of foraging or major displacement of migration pathways, are not expected. Changes to individual movements are expected to be minor, short-term, and localized therefore HRG survey impacts are anticipated to be negligible.

5.2.2.3 Marine Fish

Section 4.3.1 details a proposed action scenario for HRG surveys, which is not repeated herein. The potential for impact of HRG survey noise on ESA-listed marine fish and species of concern that could occur in the Project Area and its surrounding waters is not well understood. The ESA-listed Atlantic sturgeon is primarily found in coastal waters, and the Project Area is not within its naturally preferred habitat. Although HRG survey work will be conducted along potential electric cable routes from the lease blocks to shore, this area is limited compared to the actual lease blocks in the Project Area.

The sound levels at the source (i.e., the boomer,) will depend on the type of equipment used for the survey. Examples of the type of equipment potentially used is provided in Table 4.1 (*see* Section 4.2.1.1). Estimated broadband sound pressure levels during HRG surveys are expected to range from 212 to 226 dB re 1µPa RMS at 1 meter. Generally, noise generated by HRG surveys may be detected by and may mask some communication by fish. Hastings *et al.*, (1996), in their review of their study and others, suggested that sounds 90 to 140 dB above a fish's hearing threshold may potentially injure the inner ear of a fish. Enger (1981) found similar results in which injury occurred only when the stimulus was 100 to 110 dB above the threshold at 200 to 250 Hz for cod. Hearing thresholds for Atlantic sturgeon have not yet been established. However, studies have shown that sturgeon do not generally detect sounds above 800 Hz (Lovell et al., 2005; Meyer et al., 2010). Thus, Atlantic sturgeon are only expected to detect sound from the boomer. Chapman and Hawkins (1973) found that ambient noise at higher sea states can mask effects in cod, haddock and pollock.

Acoustic modeling of HRG survey methods (i.e. boomer, side scan sonar, or chirper) for the OCS G&G DPEIS reported that noise levels of 160 dB re 1 µPa did not extend beyond 700 meters from the source (Table 4.1 in Section 4.2.1.1). Within this zone it is expected that Atlantic sturgeon may be able to perceive noise from the boomer sound source. Although broadband sound exposure levels from pile driving have been shown to cause injury to fish (salmon) above 210 dB, no such studies exist for Atlantic sturgeon. It is expected that Atlantic sturgeon will be able to swim away from any disturbing level of sound from the boomer. This would be facilitated by the ramp up of the boomer, and the slow approach speed of the vessel during survey activities.

Effects on fish are generally expected to be limited to avoidance of the area around the HRG survey activities. The region of best hearing in the majority of fish for which there are data available is from 100 to 200 Hz up to 800 Hz. The mobility of adult fish and their innate tendency to quickly leave a disturbed area should result in limited impacts. Surveys associated with the proposed action are not expected to result in detectible levels of impact from the survey equipment. Individuals displaced by the transient noise source would be able to return to the areaafter the survey has ceased.

Fish are not expected to be exposed to sound pressure levels that could cause hearing damage. Because of the limited immediate area of ensonification and duration of individual HRG surveys that may be conducted during site assessment, in most cases, few fish may be expected to be present within the survey areas. Thus, potential impacts on ESA-listed (e.g. the 5 Atlantic sturgeon DPSs) and candidate fish from HRG surveys are expected to be negligible.

5.2.2.4 Avifauna

Roseate terns, piping plovers, and red knots are unlikely to be on the OCS during HRG surveys, therefore no impacts are anticipated.

5.2.3 Geotechnical Sampling Acoustic Effects

Limited information is available on underwater noise from underwater construction drilling operations. Richardson *et al.*, (1990) reported that shallow water measurements (19.6 to 22.9 feet [6 to 7 meters] deep) taken in the vicinity of a drill rig on an ice pad produced approximately 125 dB re 1 µPa at 130 meters, and 86 dB re 1 µPa at 480 meters. Hall *et al.*,'s (1991, as cited in Nedwell and Howell 2004) measurements of drilling from a concrete caisson showed little difference in levels of frequencies above 30 Hz between drilling and background noise. Drill ships and semi-submersible drill rigs have been reported to have a source level from 145 (Gales 1982) to 191 dB re 1 µPa at 1 meter (Greene 1987), but are unlikely to be used during windfarm development.

It is anticipated that the majority of the work will be accomplished by CPT which does not require deep borehole drilling. However, should CPT be found to be an inappropriate technique given the conditions encountered, borehole drilling may be required. Previous estimates submitted to BOEM have source sound levels not exceeding 145 dB re 1 µPa at a frequency of 120Hz (USDOI, BOEM, OREP 2012), which are similar to those from historical drilling studies cited previously. Previous submissions to BOEM also indicated that boring sound should attenuate to below 120 dB re 1 µPa by the 492 foot (150 meter) isopleth.

According to NMFS, drilling is considered a continuous, but yet temporary, noise source. Therefore, any noise that exceeds 120 dB re 1 µPa from a drilling source would be considered behavioral harassment under the MMPA. Therefore, BOEM will require a 656 foot (200 meter) exclusion zone for whales and sea turtles during geotechnical drilling activity. It is expected that the activity of setting up the drilling equipment would generate enough disturbance to deter marine mammals, sea turtles and fish from the general work area. Animals would freely be able to leave or avoid the area where drilling would take place. It is expected that other geotechnical sampling activities, such as CPT or vibracore would only have minor acoustic effects, which would primarily be from vessel engine noise.

Maintenance of the exclusion zone during drilling would ensure that no whales or sea turtles would come within 656 feet (200 meters) of the geotechnical drilling activity therefore no whale or sea turtles will be exposed to sound levels greater than 120 dB re 1 µPa. It is expected that Atlantic sturgeon would be able to sense the sound, but the impacts are anticipated to be negligible due to short durations, low sound levels (not greater than 145 dB), and the ability of the fish to leave the immediate area of the drilling.

5.2.4 Meteorological Tower Pile-Driving Noise

As with any sound in the marine environment, the type and intensity of the sound is greatly dependent on multiple factors and can vary greatly. These factors include the type and size of the pile, the type of substrate, the depth of the water, and the type and size of the impact hammer (Madsen *et al.,* 2006). Despite the potential for variance between areas and equipment, this section attempts to capture the range of acoustic impacts from pile driving.

Studies have reported that pile driving can generate sound levels greater than 200 dB re 1 µPa with a relatively broad bandwidth of 20 Hz to > 20kHz (Madsen *et al.*, 2006; Thomsen *et al.,* 2006; Nedwell and Howell 2004; Tougaard *et al.,* 2008). In the Cape Wind Draft EIS, modeling for a commercial wind turbine foundation was presented in Appendix 5-11A (Noise Report) indicating that the underwater noise levels from pile driving may be greater than the NMFS MMPA threshold for behavioral disturbance/harassment (160 dB re 1 µPa) from a non-continuous source (i.e. pulsed) within approximately 3.4 kilometers from the source. Actual measures of underwater sound levels during the construction of the Cape Wind meteorological tower in 2003 were reported between 145-167 dB re 1 µPa at 500 meters (see Table 5.3). Peak energy was reported around 500 Hz (USDOI, BOEM, OREP 2012).

Modeling was also conducted for proposed meteorological tower sites located offshore of New Jersey and Delaware under IP leases by Bluewater Wind, LLC. The 160 dB re 1µPa isopleth was modeled at 23,720.5 feet (7,230 meters) for Delaware and 21,653.5 feet (6,600 meters) for New Jersey (USDOI, BOEM, OREP 2012). It is expected that pile-driving would last 4 to 8 hours per pile being driven within the Project Area, dependent on the sediment type. Generally, during pile driving activities, the blows are delivered at 1 second intervals (Madsen *et al.,* 2006). The information from Cape Wind Associates and the Bluewater Wind are a good representation of the potential range of enosonified area with both the 180 dB re 1 µPa and 160 dB re 1 µPa sound levels (Table 5.2). However it should be noted that the sources are different sizes, the monopile diameters differ, and the environmental characteristics are likely different, causing the isopleths to vary.

Table 5.3
Modeled Areas of Ensonification from Pile-Driving

Project (modeled)	Additional Info	180 dB re 1µPa (rms)	160 dB re 1µPa (rms)
Bluewater Wind (Interim Policy Lease offshore Delaware)	3.0-meter diameter monopile; 900 kJ hammer	760 meters	7,230 meters
Bluewater Wind (Interim Policy Lease offshore New Jersey)	3.0-meter diameter monopole; 900 kJ hammer	1,000 meters	6,600 meters
Cape Wind Energy Project (Lease in Nantucket Sound)	5.05-meter monopole; 1,200 kJ hammer	500 meters	3,400 meters

Source: USDOI, BOEM, OREP 2012.
Key: kJ = kilojoule

Unmitigated pulsed noises greater than 160 dB re 1 µPa (i.e. pile driving) could cause behavioral disturbance/ harassment temporarily (4 to 8 hours over three days per lease) during meteorological tower construction. To minimize the effects of pile driving on listed species, BOEM will require lessees to follow several mitigating standard operating conditions as part of their lease or as terms and conditions on a SAP. These measures are detailed in Section 8. These measures include a "soft start" procedure and the cessation of all pile driving activity should a whale or sea turtle be found within 4 mile (7 kilometers) of the pile driving activity. It is expected that noise levels outside of 4 mile (7 kilometers) will be less than 160 dB re 1 µPa.

5.2.4.1 Marine Mammals

During meteorological tower construction noise generated by pile driving may be audible to marine mammals within the Project Area. Unmitigated acoustic interference and disturbance could cause behavioral changes, masking of inter- and intra-specifics calls, and disrupt echolocation capabilities. The potential for behavioral reactions may extend out many miles (Madsen *et al.*, 2006; Tougaard *et al.*, 2008). Near-field behavioral reactions withoust BOEM's standad operating conditions could result in, avoidance of, or flight from the sound source, avoidance of feeding habitat, changes in breathing patterns, or changes in response to predators (Watkins and Sheville 1975; Malme et al 1984; Richardson *et al.*, 1995; Mate *et al.*, 1995; Nowacek *et al.*, 2007; Tyack 2009). Depending on the frequency and source level of the noise generated during pile driving, physiological effects such as TTS and PTS could occur at close range to the source (Richardson *et al.*, 1995; Madsen *et al.*, 2006). Currently, the biological consequences of hearing loss or behavioral responses to construction noise are not fully known (Tougaard *et al.*, 2008), and there is little information regarding short-term and long-term impacts to marine mammal populations from such activity. A recent study in a large embayment (Moray Firth) in Northeast Scotland suggested that mid- and low frequency cetaceans, such as minke whales and bottlenose dolphins, could experience behavioral disturbance (at 160 dB re 1 µPa or greater according to NMFS MMPA criteria) up to approximately 30 NM (50 kilometers) away from the source and potential injury such as PTS or TTS (at 180 dB re 1 µPa or greater according to NMFS MMPA criteria) within 328 feet (100 m) of the source (Bailey *et al.*, 2010). Although it is important to note this study, the geology of Moray Firth and size of the piles (5 MW wind turbine foundations) are not directly transferable to meteorological tower construction in the Southern New England/New York Bight Project Area. While there is the potential for individual animals to perceive the pile driving activity at great distances it is not expected to rise to a level of harassment nor is it expected to affect entire populations of marine mammals. It is expected that some species of marine mammals will leave the area when construction vessels arrive and begin their activities. This would greatly reduce their exposure to the pulsed noise source. It is expected that marine mammals that left the area during construction would be able to return to the area following the completion of the work (i.e. three days).

It is expected that harassment to ESA-listed marine mammals would only occur within the immediate vicinity of the pile driving activity (i.e. within 328 feet [100 meters]). Construction of a meteorological tower would take place over a relatively short duration and would be limited to a maximum of 9 locations within the Project Area which would be constructed at any time within an approximately five year period outside of the spring migration prohibition period (see Section 8). The prohibition on pile driving between November and April is based upon the NMFS special management area in effect over a portion of the Project Area.

It is expected that disturbance/harassment levels of sound (i.e. 160 dB re 1 µPa) would occur within 4 miles (7 kilometers) of the activity. Therefore, BOEM anticipates that no whales will be exposed to sound level greater than 160dB as pile driving would not occur should a whale enter within 4 miles (7 kilometers) of the active source. Also, no whales are expected to be exposed to sound levels that would cause injury (i.e. 180 dB re 1µPA). Should future field-verified acoustic data indicate the 160 dB isopleth is greater than 4 miles (7 kilometers), then future mitigation measures in lease stipulations would be modified to reflect the new data. In the case where more than one monopole is being installed per meteorological tower (e.g. tripod structure), then field verifications could modify the mitigation measures for the installation of additional monopoles (*see* Section 8.0).

Large whales present within the Project Area and it surrounding waters are expected to be transiting between summer feeding grounds in the north, and winter calving grounds in the south, however there are also observations of large whales feeding within the vicinity of the Project Area. While large whales may be present within the Project Area or its surrounding waters throughout the year the location of these whales can be monitored and pile driving can be delayed (outside of the pile driving prohibition period of November-April) until any whales leave the potential area of influence. Based on the best available information and the standard operating conditions in Section 8.0, no right, humpback, fin, sei, or sperm whales are expected to be exposed to noise levels greater than 160 dB re 1µPa. Therefore, no whales will be exposed to noise levels resulting in behavioral disturbance or harassment.

5.2.4.2 Sea Turtles

During meteorological tower construction noise generated by pile driving may be audible to sea turtles within the Project Area and its surrounding waters. Loggerhead, leatherback, green, and Kemp's ridley sea turtles are known to occur within southern New England between June and November, during which time construction may occur. Therefore there is the potential for exposure to construction-related noise outside the pile driving prohibition period. Similar to marine mammals, noise from pile driving could cause some animals to move away from or avoid the construction area. Currently, the biological consequences of hearing loss or behavioral responses to construction noise are not known and there is little information regarding short-term and long-term impacts to sea turtle populations from pile driving noise exposure It is expected that avoidance of ensonified areas would be short term and not result in population-level effects. Large numbers of individuals are not expected to be exposed to construction noise due to the short-term duration of the construction activities, the limited spatial scale of construction, and the low density of of sea turtles, as a whole, within the project area. Also, mitigation measures (as detailed in Section 8) are expected to further reduce any impacts from construction related acoustics by prohibiting pile driving in the Spring,requiring a 60-minute observation period before pile driving begins. And requiring a soft start procedure to allow animals to leave the area prior to harassing levels of sound.

Little information is available addressing sea turtle behavioral reactions to levels of sound below the estimated TTS and injury levels. The existing studies related to sea turtle hearing have found that sea turtles may have a limited capacity to detect sound, however this is based on a limited number of individuals and should be interpreted with caution. Ridgeway *et al.*, (1969) reported that Pacific green sea turtles displayed hearing sensitivity in air from 30-500 Hz with an effective hearing range of 60-1,000 Hz. Whereas, Bartol *et al.*, (1999) found that juvenile loggerheads exhibit an effective hearing range of 250 – 750 Hz with peak sensitivity at 250 Hz. Ridgeway *et al.*, (1969) reported that 110-126 dB re 1 µPa were required for sea turtles to hear sounds. However, McCauley *et al.*, (2000) reported that source levels of 166 dB re 1 µPa were required to evoke behavioral reactions from captive sea turtles

According to available information on sea turtle behavioral response to intense pulsed sounds (i.e. pile driving), sea turtles are likely to actively avoid disturbing levels of sound (O'Hara and Wilcox 1990; McCauley *et al.*, 2000). While avoidance may aid in reducing exposure to disturbing sounds, it may also result in the alteration of normal behaviors such as migration and foraging. However, these alterations are expected to be localized and temporary due to the nature of the pile-driving activities within the Project Area.

Sea turtles would be expected to return areas previously avoided due to sound levels following the cessation of pile-driving activities. As pile driving would occur for approximately 4 to 8 hours a day, it is likely that sea turtles would only be excluded from the area with disturbing levels of sound for at least this period each day. Information indicates that sea turtle forage items are present throughout the action area. Therefore, could sea turtles be present and feeding or resting in an area where pile-driving occurred, it is expected that they could find alternative forage and resting locations elsewhere within the Project Area and its surrounding waters.

Additionally, should sea turtles be migrating through the area, (i.e. leatherbacks migrating to or from the Gulf of Maine) it is expected that they would avoid disturbing noises within the Project Area, therefore decreasing the potential for impacts from the survey activities. The avoidance of the area due to sound would therefore affect individuals, however it is expected that these effect would be temporary and localized. It is expected that foraging, migrating or resting sea turtles would only be minimally impacted, and no injury or impairment of an individual's ability to complete essential behavioral functions is expected.

As explained in the marine mammal discussion above, a 4 mile (7 kilometer) exclusion zone will be monitored by trained protected species observers for at least 60 minutes prior to the start of any pile driving. It is expected that the observers will be able to detect the presence of sea turtles within the 4 mile (7 kilometers) exclusion zone. Sea turtle dive durations range from 5-40 minutes depending on the species, with a maximum duration of 45 – 66 minutes depending on the species (Spotila, 2004). Based on this information it is reasonable to expect that monitoring the exclusion zone for at least 60 minutes will allow protected species observers to detect any sea turtle within the exclusion zone prior to the start of construction activities. Sound levels during pile driving are expected to dissipate below 160 dB re 1µPa within 4 miles (7 kilometers) from the source. It is expected that the pile driving activity while following the standard operating conditions would result in short term avoidance of some ensonified areas, resulting in neglible impacts to individual sea turtles..

5.2.4.3 Marine Fish

Sections 4.3.5.2 detail a proposed action scenario and acoustic effects for pile driving, which is not repeated herein. Nedwell and Howell (2004) provide information on three paths (airborne, waterborne and groundborne) for noise propagation in underwater environments during pile-driving. The pulsive sounds during pile-driving are expected to be less than the pulses from the air guns used in offshore seismic surveys by the oil and gas industry. Such surveys routinely have source levels of 250 dB re 1 µPa at 1 meter. Available information suggests that seismic exploration has minimal effects on fish and fisheries.

Unmitigated construction noise could disturb normal behaviors (e.g., feeding) of ESA-listed and candidate fish if they occur within the area during these activities. However, the soft start procedure for pile driving (see Section 8) is expected to allow fish, including Atlantic sturgeon, that may be impacted to leave the area.

The standard operating conditions required by BOEM, primarily the pile driving “soft start” provision, will reduce impacts to ESA-listed and ESA candidate marine fish. This measure will be included as a condition on any leases and/or term and condition of SAPs approved under this proposed action. Due to the “soft start” procedure, it is anticipated that the majority of fish would flee the area during the period of disturbance and return to normal activity in the area post-construction. All 5 DPSs of the ESA-listed Atlantic sturgeon, which typically occurs more often in coastal areas, are not anticipated to occur in large densities in the offshore areas of the Project Area where pile driving may occur thus greatly reducing the likelihood of their exposure to pile driving noise.

5.2.4.4 Avifauna

Loud noises, including pile driving can disturb nesting birds. However, the noise associated with these activities will occur far from the nesting habitat of piping plovers in Massachusetts and Rhode Island and the nesting colonies of roseate terns in Massachusetts. Additionally, noise from these activities is not anticipated to impact the migratory movement or migratory behavior of the piping plover, roseate tern, or the red knot through the two WEAs. Therefore, acoustic effects to ESA-listed and candidate bird species are considered negligible.

5.2.5 Vessel Traffic Noise

Marine mammals, sea turtles, and marine fish may also be affected by noise generated by surface vessels traveling to and from the Project Area, as well as operating within the Project Area. Underwater noise associated with vessel traffic is attributed to the low frequency reverberation of the engines and its propellers. As the propeller moves through the water small bubbles are produced and collapse (a process known as cavitation). As these bubbles collapse a low frequency sound is produced (Jasney *et al.*, 2005). Larger vessels, such as commercial container ships, produce sounds at approximately 180 – 190 dB re 1 µPa rms at less than 200-500 Hz (Thomsen *et al.*, 2009; Jasney *et al.*, 2005). Smaller vessels produce less intense sounds at 160 – 180 dB re 1 µPa rms at less than 1,000 Hz (Thomsen *et al.*, 2009). Vessels associated with the proposed action are anticipated to produce sounds within the range of 150-170 dB re 1 μPa-meter at less than 1,000 Hz.

Vessels would mainly be traveling to and from the Project Area with limited activity within the Project Area, therefore it is expected that exposure of marine mammals to vessel noise would be transient. Because individual vessels produce unique acoustic signatures (Hildebrand 2009), and the physical characteristics of the marine environment determine how that sound will travel (Richardson *et al.*, 1995), the intensity of noise from various vessels can differ greatly; therefore, exposures to individual marine mammals can differ as well. Marine mammals can exhibit various reactions when exposed to vessel noise. Potential reactions include indifference to the sound, temporary altered breathing patterns, heading during travel, and swimming speed when interacting with smaller vessels, or avoidance of the vessel (Nowacek *et al.*, 2001; Richardson *et al.*, 1995; Nowacek *et al.*, 2001). Exposure to individual vessel noise by ESA-listed marine mammals, sea turtles, and fish within the Project Area or in the surrounding waters would be transient and temporary as vessels passed through the area. ESA-listed marine mammal, sea turtle, and fish behavior and use of the habitat would be expected to return to normal following the passing of a vessel. Therefore, impacts from vessel noise would be short term and negligible.

5.3 Benthic Effects

Effects to endangered and threatened species from impacts associated with benthic communities are anticipated to be negligible due to the limited amount of utilization of benthos, and the expected limited impact to the benthos. Potential benthic forage items for ESA-listed species may occur within the Project Area; sand lance (forage for cetaceans), and seagrass, macroalgae, and benthic invertebrates (forage for sea turtles). Benthic invertebrates and small fish, serve as forage for Atlantic sturgeon.

As a result, effects to benthic communities could cause indirect, short-term effects to these species. The following sections discuss those impacts in relation to Atlantic sturgeon, sea turtles and marine mammals and their habitat. It is not anticipated that impacts to benthic communities would result insignificant negative impacts to Atlantic sturgeon, sea turtle or marine mammal populations.

5.3.1 Geotechnical Sampling

Sub-bottom sampling will result in small areas of the seafloor being disturbed. This may occur at the bore hole, grab-sample area, or vessel anchor placement locations. It is expected that this effect would result in a negligible, temporary loss of some benthic organisms (i.e., less than one ft diameter would be disturbed in the areas where cores are taken), and a localized increase in disturbance due to vessel activity, including noise and anchor cable placement and retrieval. This activity could impact ESA-listed marine mammals, sea turtles, and Atlantic sturgeon by removing a small amount of forage items. Atlantic sturgeon, however, are not expected to forage in offshore marine environments on a regular basis. Little information was found regarding the species’ use of offshore benthic environments as feeding areas. Therefore, due to the small footprint, the temporary nature of the action, and extensive availability of similar benthic habitat regionally, it is expected that this activity would have negligible impacts on the ESA-listed species.

5.3.2 Meteorological Tower / Meteorological Buoy Installation

The installation of a meteorological buoy and/or the construction of a meteorological tower would have benthic effects that are temporary in nature. Construction of the tower would result in direct effects to benthic invertebrates by burying or crushing them. Also, it is anticipated that sediment would become suspended around deployed anchoring systems and around monopoles during the installation activity, however this sediment would quickly disperse and settle onto the surrounding seafloor. Depending upon the currents, benthic organisms could be smothered. However, the Southern New England-New York Bight is considered a high energy environment where sediment transport occurs under normal conditions. It is expected that any sedimentation that would occur around an installed tower or buoy would have only minor temporary effects on the benthic community and food availability for ESA-listed species.

The loss of benthic habitat as a result of scour and/or scour control systems around foundations and moorings is discussed in Section 4.3.5.2 of this BA. Sessile marine invertebrates, including molluscan shellfish, would be lost in the footprint of the foundation/mooring and any scour control system. However, a single meteorological tower or buoy within a lease area is not expected to result in significant changes to the availability of habitat and forage items for marine mammals, sea turtles or Atlantic sturgeon in the Project Area. Therefore, negligible impacts to the ESA-listed species are expected from installation of meteorological buoys and/or construction of meteorological towers within the Project Area.

5.3.3 Meteorological Tower / Meteorological Buoy Operation

Occurrence of a meteorological tower and anchoring system in soft sediments would create artificial ‘hard bottom’ substrate for potential colonization by fauna that prefer such substrates. In addition, minor, temporary changes in benthic assemblages associated with soft sediments would occur due to scouring around the pilings (Hiscock *et al.*, 2002). Although some marine fish species would likely be attracted to the newly formed habitat complex on hard structure, the Atlantic sturgeon’s feeding mechanism (benthic foraging) would not be affected by increased epibenthic community densities. Long-term changes to the local benthic community assemblage and diversity are not expected from a single meteorological tower / meteorological buoy, nor are the availability of habitat and forge items for ESA-listed species expected to be altered in the long-term. Therefore, negligible impact to marine mammals, sea turtles, and Atlantic sturgeon are expected from operation of meteorological buoys and/or meteorological towers within the Project Area.

5.4 Collision Effects

This section discusses the potential for impacts to protected species resulting from collisions with vessels and structures associated with the proposed action. Collisions with vessels and/or structures associated with the proposed action could result in injury to the animal and/or damage to the vessel or structure. BOEM anticipates that marine animals will avoid fixed structures, such as meteorological towers, reducing the risk of collisions with these structures.

Vessels associated with site characterization and assessment activities could collide with marine mammals, sea turtles and other marine animals present in the area during transit. However, BOEM’s required standard operating conditions include vessel strike avoidance measures to reduce this possibility. This would limit the likelihood of collisions between vessels and marine mammals. The guidelines contain vessel approach protocols and navigational practices when encountering marine mammals that are based on speed and distance restrictions. Two primary driving factors in marine mammal, sea turtle or other marine animals and vessel collisions are the spatial and temporal relationships between vessels and marine animal abundance, and the speed of vessels (Merrick and Cole, 2007). The amount of vessel traffic and navigational visibility are also factors.

5.4.1 Marine Mammals

Vessel traffic providing support to the meteorological tower construction site (i.e. carrying equipment or personnel) may affect marine mammals through either direct collision or disturbance from their presence. According to Laist *et al.*, (2001), eleven species of whales are known to have been struck by a vessel throughout the world's oceans. Of those eleven, the most frequently struck species is the fin whale, followed by the North Atlantic right whale, humpback whale, sperm whale and grey whale (Laist *et al.,* 2001). Of these, the fin, North Atlantic right whale and the humpback whale are of concern for potential encounters with vessels in the Project Area and its surrounding waters. Feeding aggregations of North Atlantic right whales have recently been reported within the Project Area waters during the spring months. Humpback and fin whales are commonly sighted off the coast of Rhode Island and southern Massachusetts. Therefore, these three species are considered the most likely to encounter vessels supporting meteorological tower construction in the Project Area, and have the greatest potential risk for collision.

Ship strikes have been recorded in almost every coastal state in the U.S., as well as within three National Marine Sanctuaries (NMS) (Stellwagen Bank NMS, Channel Islands NMS and the Hawaiian Islands Humpback Whales NMS). Vessel strikes are most common on the east coast of the U.S.. Strikes on the west coast of the U.S. and Alaska/Hawaii are the second most common, and strikes in the Gulf of Mexico are the least common (Jensen and Silber 2004). Also, most strikes tend to occur over or near the continental shelf (Laist *et al.,* 2001).

The majority of whale interactions with vessels that have been reported as lethal are with vessels greater than 260 feet (80 meters). However whale strikes can occur with any size vessel from large tankers to small recreational boats (Jensen and Silber, 2004). Vessels associated with the proposed action are not anticipated to be greater than 80 m, therefore reducing the potential for a lethal vessel-whale interaction. Strike information has also been reported in relation to the speed of the vessel at the time of collision. Strikes have been reported for vessels traveling between 2 and 51 knots (2 and 59 miles per hour [mph]), with most lethal or severe injuries occurring when vessels are traveling 14 knots (16 mph) or more (Jensen and Silber, 2004; Laist *et al.*, 2001; Vanderlaan and Taggart, 2006).

All vessels associated with the proposed action and construction activity under their lease are subject to NMFS vessel speed restriction for vessels 65 feet (19.8 meters) or longer. Under these restrictions vessels will travel at no greater than 10 knots (11.5 mph) in certain areas where right whales gather (SMAs). These regulations are in place to reduce the likelihood of death or serious injury to the endangered North Atlantic right whales that could result from a vessel collision. These regulations also benefit other marine mammals in the area by reducing the overall speed of transiting vessels. The restrictions extend out to 20 NM (37 kilometers) around major mid-Atlantic ports, (of which Rhode Island is included). With the exception of crew boats, which generally are smaller than 65 feet (19.8 meters), these restrictions would be applicable to most vessels associated with the proposed action. In addition to the SMA speed restrictions, vessels associated with the proposed action would be required to check with NOAA's Sighting Advisory System and abide by dynamic management areas (DMAs) speed limits when they are in effect. Based on the current regulatory measures in place, and the intermittent travel of vessels associated with the proposed action, the potential for a vessel strike is greatly reduced. Therefore, no significant impacts due to vessel collisions are anticipated.

5.4.2 Sea Turtles

Similar to marine mammals, sea turtles have been killed or injured due to collisions with vessels. Hatchlings and juveniles are more susceptible to vessel interactions than adults due to their limited swimming ability. The small size and darker coloration of hatchlings also makes them difficult to spot from transiting vessels. While adults and juveniles are larger in size and may be easier to spot when at the surface than hatchlings, they often spend time below the surface of the water, which makes them difficult to spot from a moving vessel. Due to the lack of nesting habitat present within the northeast, hatchlings are not likely to be present in the Project Area and its surrounding waters, therefore there would be no impacts to this life stage.

While adults and juveniles are more likely to be present within the Project Area and its surrounding waters, should HRG surveys occur between June and November, the slow speed of the survey vessels (typically about 4.5 knots) reduces the potential for interaction with vessels and the associated towed survey gear. At these speeds, sea turtles are expected to be able to avoid the vessels and gear. Hazel *et al.*, (2007) reported that green sea turtles ability to avoid an approaching vessel decreases significantly as the vessel speed increases. The amount of vessel traffic associated with meteorological tower/buoy construction, operation and decommissioning is expected to be low, occurring during a short duration and operating at slow speeds. Therefore, potential for vessel collisions is discountable.

5.4.3 Marine Fish

Impacts to Atlantic sturgeon as a result of vessel strikes would primarily be expected only in coastal, nearshore areas where wind energy-associated vessels transit during Project Area site assessment activities. The most current analysis of these types of impacts to Atlantic sturgeon is presented by Brown and Murphy (2010) for the Delaware Estuary. They reported that 28 sturgeon were killed between 2005 and 2008 in the Delaware Estuary. Sixty one percent of the mortalities were of adult size and 50 percent were too decomposed to determine the cause of death. Water depths in navigable waters throughout the estuary ranged from 12 to 40 feet (3.6 to 12.2 meters). Brown and Murphy reported that sturgeon mortalities in the Delaware Estuary, and others in Virginia, appeared to be the result of long vessel transits through narrow shipping channels to ports in upstream areas of estuaries.

The Taunton River is the only local estuarine system noted for historical occurrences of Atlantic sturgeon near the Project Area. Recent historical records (ASSRT 2007) indicate that, sporadically, Atlantic sturgeon have been found within the Taunton River Estuary or in offshore state and federal waters. Also, within the Taunton River Estuary, studies showed that spawning adults were not found during the expected spawning period of May and June, and thus it is unlikely that a spawning population of Atlantic sturgeon occurs in the Taunton River. However, the occurrence in nearshore state and federal waters indicates that vessel strikes could potentially occur.

The Project Area site assessment activities as proposed in this BA (see Section 4.3.5) suggest that vessel traffic volume would be limited, and thus it is predicted that the potential for Atlantic sturgeon strikes would be unlikely. Although vessel ports have yet to be determined, it is expected that selected locations would be at coastal ports most accessible to the Project Area, and not in upstream estuarine locations. Since most strikes noted by Brown and Murphy (2010) were within channelized, shallow estuarine areas, it is expected that any vessel-sturgeon interactions under the proposed action is discountable.

5.4.4 Avifauna

A bird that collides into meteorological tower maybe injured or killed. However such events are rare and due to the small number of meteorological towers proposed will be distant from shore where roseate terns and piping plover nest, thus the impact due to collisions during nesting season would be negligible. Piping plovers on the Atlantic coast mostly migrate along the coast but do cross open water to winter in the Bahamas. Roseate terns and red knots may pass through the Project Area during spring and fall migration. Given the small number of meteorological towers proposed, the chance of collision for piping plover, roseate tern, or red knot are likely to be very small and the impact would be negligible.

5.5 Lighting Effects

Under poor visibility conditions (fog and rain), migrating birds become disoriented and circle lighted communication towers instead of continuing on their migratory path, greatly increasing their risk of collision (Huppop *et al.*, 2006). Meteorological tower lighting would have the greatest impact on bird species during evening hours when nocturnal migration occurs. However, red flashing lights are commonly used at land-based wind facilities without any observed increase in avian mortality compared with unlit turbine towers (Kerlinger *et al.*, 2010). Thus, red flashing lights would be used at the meteorological towers to reduce the risk of bird collisions. Though there is the potential for the lighting of the meteorological towers to affect the collision probability of the piping plover, roseate tern, and red knot during migration, the anticipated small number of meteorological towers that will be present will greatly decrease the likelihood of these species being in proximity of a tower. Finally, it is anticipated that any additional lights (e.g., work lights) on towers and support vessels will be used only when necessary and be hooded downward and directed when possible to reduce upward illumination and illumination of adjacent waters. Therefore, the potential impacts from the artificial lighting of the meteorological towers on federally listed or ESA candidate bird species would be negligible.

5.6 Discharge of Waste Materials and Accidental Fuel Leaks

Operational waste generated from all vessels associated with the proposed action includes bilge and ballast waters, trash and debris, and sanitary and domestic wastes. A vessel collision with a meteorological tower or other vessel has the potential to result in the spillage of diesel fuel into the marine environment. Vessels associated with the proposed action are expected to comply with the USCG requirements for the prevention and control or oil and fuel spills. Approximately 10 percent of vessel collisions with fixed structures on the OCS caused diesel spills.

Most equipment on the meteorological towers and buoys would be powered by batteries charged by small wind turbines or solar panels. However, there is a possibility that diesel generators may be used on some of the meteorological towers and buoys, which may cause minor diesel fuel spills during refueling of generators. If a diesel fuel spill were to occur it would be expected to be small and dissipate quickly, then evaporate and biodegrade within a few days (USDOI, MMS 2007).

5.6.1 Marine Mammals

Marine mammals could be adversely impacted by the presence of pollutants (i.e. spilled diesel fuel) or accidentally released solid debris in the water column. Both pollutants and solid debris could be ingested by the animals. Sanitary and domestic wastes would be processed through on-site waste treatment facilities however would not be discharged in state waters. Domestic waste such as gray water could be discharged overboard outside of state waters, however sanitary waste would be retained and disposed of at shore-side facilities. Deck drainage would also be processed prior to discharge. Therefore, waste discharges from construction vessels would not be expected to directly affect marine mammals.

Should marine mammals come in contact with solid debris, such as plastics, ingestion could lead to internal blockage and later starvation, damage the stomach lining, or lessen the drive to forage and feed (Laist 1987). Ingested plastics could also contain or be composed of toxic substances that could have lethal or sub-lethal effects on the animal. Solid debris could also cause entanglement that can lead to drowning, abrasions (which could potentially be lethal), reduced mobility, and reduced ability to forage and avoid predators (Laist 1987). The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by BOEM (30 CFR 250.300) and the USCG (MARPOL, Annex V, Pub. L.100−220 (101 Stat. 1458). Therefore, the risk of ingestion of or entanglement in solid debris produced as a result of the proposed action would not be expected during normal circumstances.

During the course of site characterizations and site assessments vessel traffic and offshore activity associated with surveys and the construction/installation of meteorological tower/buoys would be minimal. Therefore the release of liquid wastes would be infrequent. During the time frame of the proposed action, collisions leading to accidental discharges would be more likely to occur during active construction/installation or decommissioning period, as there would be more than one vessel operating in close proximity. Collisions are less likely during surveys as only single vessels traveling at slow speeds would be operating at any one time. Therefore, impacts to marine mammals from the discharge of liquid and solid waste or the accidental release of fuel are expected to be negligible.

5.6.2 Sea Turtles

Sea turtles could be exposed to pollutants, sanitary waste and other fluids, as well as miscellaneous trash and debris generated during meteorological tower construction. Juvenile and adult sea turtles may be exposed to these waste discharges during periods of meteorological tower construction. If operational discharges such as diesel fuel were to occur it would be expected to be small and dissipate quickly, then evaporate and biodegrade within a few days. Also, domestic waste such as gray water could be discharged overboard outside of state waters, however sanitary waste would be retained and disposed of at shore-side facilities. Deck drainage would also be processed prior to discharge.

There is the potential for sea turtle ingestion of solid debris, as the ingestion of marine debris is widely reported among species of sea turtle worldwide (Tourinho *et al.*, 2010; Lazar &

Gracen 2011). Ingestion of marine debris can lead to starvation, malnutrition, and absorption of chemicals (US EPA 2012; McCauly and Bjorndal 1999). Loggerheads are known to ingest all types of marine debris with little discrimination on size of debris ingested (Thomas *et al.*, 2002). Leatherbacks, whose primary prey item is jellyfish, commonly ingest floating surface and subsurface translucent plastic material and sheeting which is believed to be mistaken for these prey items. Sub-lethal quantities of ingested plastic can also result in positive buoyancy, causing the sea turtles to be at a greater risk for vessel collisions by reducing their ability to dive (Lutcavage *et al.*, 1997). Also of concern regarding debris is the risk of entanglement, which can result in reduced mobility, suffocation, starvation, and increased vulnerability to predators (USEPA 2012).

The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by BOEM (30 CFR 250.300) and the USCG (MARPOL, Annex V, Pub. L. 100−220 (101 Stat. 1458)). Therefore, the risk of ingestion of or entanglement in solid debris produced as a result of the proposed action would not be expected during normal circumstances.

5.6.3 Marine Fish

Fish could be exposed to operational discharges or accidental fuel releases near construction sites and construction vessels and to accidentally released solid debris. Non-toxic operational discharges from construction vessels would be released into the open ocean where they would rapidly dilute and disperse, or they would be collected and taken to shore for treatment and disposal. Domestic waste such as gray water could be discharged overboard outside of state waters, however sanitary waste would be retained and disposed of at shore-side facilities. Thus, waste discharges from construction vessels would not be expected to directly affect ESA-listed fish or their habitat.

Fish can be adversely impacted by the ingestion of, or entanglement with, solid debris. Fish that have ingested debris, such as plastic, may experience intestinal blockage, which in turn may lead to starvation, while toxic substances present in the ingested materials (especially in plastics) could lead to a variety of lethal and sub-lethal toxic effects. Entanglement in plastic debris can result in reduced mobility, starvation, exhaustion, drowning, and constriction of, and subsequent damage to, limbs caused by tightening of the entangling material. The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by BOEM (30 CFR 250.300) and the USCG (MARPOL, Annex V, Pub. L. 100−220 (101 Stat. 1458)). Thus, entanglement in, or ingestion of, OCS-related trash and debris by fish would not be expected during normal operations. Because of the limited duration and area for vessel traffic and construction activity that might occur with construction, operation, and decommissioning of a meteorological tower and/or meteorological buoy, the release of debris and liquid wastes would be infrequent and impacts to ESA-listed fish (Atlantic sturgeon) negligible.

Although collisions or allisions between wind energy vessels / meteorological towers and buoys are considered unlikely, if one were to occur, and in the unlikely event that it resulted in a discharge, the most likely pollutant to be discharged would be diesel fuel. If a minor diesel spill were to occur, it would be expected to dissipate very rapidly in the water column, then evaporate and biodegrade within a few days (*see* Section 3.2.3 of this EA). Potentially, higher fish densities near meteorological towers and buoys could attract recreational fishermen to the area. As a result, a potential exists for collision of recreational fishing boats with towers and thus the accidental release of fuels (diesel or gas). A spill from this potential scenario would be expected to be small and dissipate quickly. The impacts to ESA-listed fish (Atlantic sturgeon) as a result of a fuel spill are expected to be temporary and minor.

5.6.4 Avifauna

Marine and coastal birds could be exposed to operational discharges or accidental fuel releases from construction sites and construction vessels and to accidentally released solid debris. Many species of marine birds (such as gulls) often follow ships to forage on fish and other prey inured or disoriented by the passing vessel. In doing so, these birds may be affected by discharges of waste fluids (such as bilge water) generated by the vessels. Operational discharges from construction vessels would be released into the open ocean where they would be rapidly diluted and dispersed, or collected and taken to shore for treatment and disposal. Sanitary and domestic wastes would be processed through on-site waste treatment facilities before being discharged overboard. Deck drainage would also be processed prior to discharge. Thus, impacts to marine and coastal birds from waste discharges from construction vessels are expected to be negligible.

Coastal and pelagic birds may become entangled in or ingest floating, submerged, and beached debris. Entanglement may result in strangulation, the injury or loss of limbs, entrapment, or the prevention or hindrance of the ability to fly or swim, and all of these effects may be considered lethal (Ryan, 1990; Gregory, 2009). However, the discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by the BOEM (30 CFR 250.300) and the USCG (MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]), Thus, entanglement or ingestion of OCS-related trash and debris by marine and coastal birds is not expected, and impacts to marine and coastal birds would be negligible.

Because of the very limited amount of vessel traffic and construction activity that might occur with construction and operation of a meteorological tower, the release of wastes, debris, hazardous materials, or fuels would occur infrequently and would cease following completion of the geological and geophysical surveys, meteorological tower construction, and meteorological tower decommissioning. The likelihood of an accidental fuel release would also be limited to the active construction and decommissioning periods of the site characterization. Piping plovers and red knots are strictly terrestrial foragers, and roseate terns typically feed only in shallow waters, so these species are not expected to follow vessels to forage. In addition, the areas where these impacts could occur do not strictly overlap with the foraging range of breeding piping plovers and roseate terns and only encompass a very small proportion of the migratory range of the piping plover, roseate tern, and red knot. As such, impacts to ESA-listed and candidate bird species from the discharge of waste materials or the accidental release of fuels are expected to be negligible.

5.7 Meteorological Tower and Buoy Decommissioning

Section 4.6 discusses in detail the proposed scenario for the decommissioning of meteorological towers and buoys. This section focuses on the decommissioning of a meteorological tower as it is a more extensive process than that of a meteorological buoy. The decommissioning of a meteorological tower involves more than potential impacts from vessel trips (which are addressed separately in Section 5.4). Decommissioning activities are not expected to have any impacts on ESA-listed birds or bats.

5.7.1 Marine Mammals

Upon completion of site assessment activities, the meteorological tower would be removed and transported by barge to shore. During this activity, marine mammals may be exposed to sound and/or operational discharges as described for meteorological tower construction. Removal of piles would be accomplished by cutting the pile (using mechanical cutting or high-pressure water jets) at a depth of 15 feet (4.6 meters) below the mudline (30 CFR 585.910). Marine mammals could be affected by noise produced by pile-cutting activities; however, sound levels for these activities have not yet been tested for Atlantic wind energy projects. Despite this lack of information, it is expected that pile cutting activities would produce less noise than pile driving. It is also expected that only marine mammals within the immediate vicinity of pile cutting (i.e. those that had not left the area upon the arrival of decommission vessels) would be expected to be affected during tower removal, transport, and pile-cutting. Disturbance of marine mammals is expected to be lower than that of construction activities, and impacts from vessel disturbance associated with decommissioning are expected to negligible.

5.7.2 Sea Turtles

Upon completion of site assessment activities, the meteorological tower would be removed and transported by barge to shore. During this activity, sea turtles may be affected by sound and/or operational discharges as described for meteorological tower construction. Removal of piles would be accomplished by cutting the pile (using mechanical cutting or high-pressure water jets) at a depth of 15 feet (4.6 meters) below the sea bed. Sea turtles could be affected by noise produced by pile cutting activities, however sound levels for these activities have not yet been tested for Atlantic wind energy projects. It is expected that only sea turtles within the immediate vicinity of pile cutting (i.e. those that had not left the area upon the arrival of decommission vessels) would be expected to be affected during tower removal, transport, and pile cutting. Disturbance of sea turtles is expected to be lower than that of construction activities, and impacts from vessel disturbance associated with decommissioning are expected to be negligible.

5.7.3 Marine Fish

The decommissioning of meteorological towers and buoys is described in Section 4.6 of this BA. Upon completion of site assessment activities, the meteorological tower would be removed and transported by barge to shore. During this activity, if present, Atlantic sturgeon may be affected by noise and operational discharges as described for meteorological tower construction. Removal of the piles would be accomplished by cutting the piles (using mechanical cutting or high-pressure water jet) at a depth of 15 feet (4.6 meters) below the seabed. Fish could be affected by noise produced by pile-cutting equipment, although cutting produces less intense noise than pile driving. Only fish in the immediate vicinity of the site (those that had not moved away from the area upon arrival of decommissioning vessels) would be expected to be exposed to noise during tower removal and transport, and pile cutting. Again, Atlantic sturgeon is not expected to occur regularly in offshore marine environments thus impacts to the species from decommissioning activities is expected to be negligible.

6 Natural and Unanticipated Events

The potential exists for natural and/or unanticipated events to cause environmental impacts during site assessment or characterization activities. A natural event such as a hurricane or severe storm could impact meteorological towers or buoys at some point during their operation. Depending on the severity of the event, components of the facility could be damaged, destroyed or lost from the structure. These could cause temporary sea hazards and would be retrieved, removed or repaired as soon as possible. Buoys are equipped with GPS systems that alert operators when they have moved outside their operating area. Mariners would be alerted if this were to happen, or if a tower had experienced severe damage.

A vessel collision with the meteorological structures or collision with other vessels may result in the spillage of diesel fuel. Vessels are expected to comply with USCG requirements relating to prevention and control of oil spills. Spills are not projected to have significant impacts due to the small size of a projected spill. A vessel spill could occur while en route to and from the Project Area, but this is considered unlikely. If a spill were to occur, either inside or outside of the Project Area, the spill size would likely be small. From 2000 to 2009, the average spill size for vessels similar to those anticipated to be used during activities associated with the proposed action was 88.36 gallons (USCG, 2011). Vessel allision with a meteorological buoy containing diesel powered generator may also occur. It is estimated that a buoy generator could contain 240 gallons of diesel fuel (Fishermen's Energy 2011 *as cited in* USDOI, BOEM, OREP 2012). If a diesel spill of this size were to occur, it would be expected to dissipate very rapidly in the water column of the open ocean, then evaporate and biodegrade within a few days.

It is also possible that larger vessels, such as tankers or container ships, could collide with meteorological structures within the Project Area. Such a collision is considered unlikely, as these structures would be sparsely placed on the OCS offshore Massachusetts and Rhode Island, and will be lit and marked for navigational purposes (*see* Section 5 of this BA). If a larger vessel should collide with a meteorological facility/structure, a large spill would be extremely unlikely (*see* Section 5 of this BA). Thus, the largest spill that could result in the unlikely event that a larger ship were to collide with a meteorological facility is on the order of 240 gallons (as indicated above for a buoy-mounted generator).

Birds – Non-Routine or Accidental Activities

Non-routine activities also include hurricanes or severe storms impacting meteorological towers or buoys and/or blowing birds into the two WEAs, resulting in an increased risk of collision with a meteorological tower or buoy. These events are anticipated to be infrequent. In addition, given the small number of structures, their small footprint size, and their distance from shore and each other, impacts to federally listed and ESA candidate bird species resulting from this type of non-routine activity are expected to be negligible.

Accidental activities that could cause impacts to the environment during site assessment activities might include vessel collision with meteorological towers or buoys, causing damage to the structure and/or vessel and resulting in the discharge of the vessel's cargo (i.e., oil, liquefied natural gas, chemicals, or other commodities). Vessel collision is unanticipated since it would require a loss of vessel power or steerage, high winds, or a sea state that would drive the vessel toward the structure, and failure of the vessel's and/or structure's design to withstand the impact.

As such, impacts to federally listed and ESA candidate bird species resulting from accidental activities are also expected to be negligible.

7 Conclusions

The following are the conclusions reached by BOEM regarding the anticipated impacts of lease issuance, site assessment, and site characterization activities described herein for the Project Area to ESA-listed marine mammals, sea turtles, marine fish, and birds / bats. There is no critical habitat for any ESA-listed species in the Project Area or its surrounding waters.

7.1 Marine Mammals

The proposed action and the potential effects of HRG survey noise on ESA-listed marine mammals, specifically North Atlantic right, humpback, fin, sei, and sperm whales are expected to be limited to short-term behavior changes, such as avoidance of the HRG survey activities during migration. No long-term changes or physiological effects are expected. Therefore, impacts to marine mammals from HRG surveys are expected to be negligible. Meteorological tower construction noise could also result in short-term behavioral change such as avoidance of, or flight from, the sound source. Also, if marine mammals were to be in close enough proximity to the sound source, the potential for more serious injury could exist. However, it is highly unlikely that this would happen due to the standard operating conditions such as the seasonal prohibition on pile driving that would be put in place, as well as an exclusion zones when noise producing activity is occuring (see Section 8).

Due to the limited geotechnical sampling footprint expected, this activity would have negligible effects on the benthic community that could impact ESA-listed marine mammals. Impacts related to meteorological tower/buoy installation, operation and decommissioning are expected to be minor. Marine mammals could be exposed to operational discharges or accidental fuel releases from construction equipment or construction vessels, as well as accidentally released solid debris. The entanglement in or ingestion of OCS-related trash and debris by marine mammals would not be expected during normal operations. Impacts to marine mammals from the discharge of waste materials or the accidental release of fuels are expected to be minor due to the limited number of structures and vessels involved with their construction, operation, and decommissioning.

Site assessment activities for the proposed action are not expected to generate a large volume of vessel traffic. Due to the vessel speed restriction currently in place, and the standard operating conditions detailed in Section 8, it is expected the whale/ ship interactions will be rare and therefore impacts would be negligible.

As a result, BOEM concludes that the effects of the proposed action on ESA-listed marine mammals are discountable and not likely to adversely affect North Atlantic right, humpback, fin, sei, or sperm whales.

7.2 Sea Turtles

The proposed action and the potential effects of HRG survey noise on ESA-listed sea turtles, specifically leatherback, loggerhead, green and Kemp's ridely, are expected to be limited to avoidance of the HRG survey activities and short-term changes in behavior. No long-term changes or physiological effects are expected. Therefore impacts to sea turtles from HRG surveys are expected to be negligible. Meteorological tower construction noise could cause avoidance of, or avoidance of, the sound source. Also, if sea turtles were to be in close enough proximity to the sound source, the potential for more serious injury could exist. However, it is very unlikely that this would happen due to the required standard operating conditions (see Section 8).

Due to the limited geotechnical sampling footprint expected, this activity would have negligible effects on the benthic community that could impact ESA-listed sea turtles. Impacts related to meteorological tower/buoy installation, operation and decommissioning are expected to be minor. Sea turtles could be exposed to operational discharges or accidental fuel releases from construction equipment or construction vessels, as well as accidentally released solid debris. The entanglement in or ingestion of OCS-related trash and debris by sea turtles would not be expected during normal operations. Impacts to sea turtles from the discharge of waste materials or the accidental release of fuels are expected to be minor due to the limited number of structures and vessels involved with their construction, operation, and decommissioning.

Site assessment activities for the proposed action are not expected to generate a large volume of vessel traffic. Due to the vessel speed restriction currently in place, and the mitigation measures detailed in Section 8, it is expected the sea turtle / ship interactions will be rare and therefore impacts would be negligible.

As a result, BOEM concludes that the effects of the proposed action on ESA-listed sea turtles are discountable and not likely to adversely affect the ESA-listed leatherback, loggerhead, green, or Kemp's ridley sea turtle.

7.3 Marine Fish

The proposed action and the potential effects of HRG survey noise on ESA-listed marine fish are generally expected to be limited to avoidance around the HRG survey activities and short-term changes in behavior. As such, impacts to Atlantic sturgeon from HRG surveys are expected to be negligible. Meteorological tower construction noise could disturb normal behavior including avoidance of, or flight from, the sound source. However, mitigation measures employed (*see* Section 8), including the implementation of a "soft start" procedure, will minimize the possibility of exposure to lethal sound levels by prompting any Atlantic Sturgeon to leave the area prior to exposure to disturbing levels of sound.

Due to the limited geotechnical sampling footprint expected, this activity would have negligible benthic community effects that could impact Atlantic sturgeon that may occur in the Project Area. Impacts related to meteorological towers/buoys installation, operation and decommissioning is expected to be minor. If found in the area, Atlantic sturgeon could be exposed to operational discharges or accidental fuel releases from construction sites and construction vessels, and to accidentally released solid debris. The entanglement in or ingestion of OCS-related trash and debris by fish would not be expected during normal operations. Impacts to fish from the discharge of waste materials or the accidental release of fuels are expected to be minor due to the limited number of structures and vessels involved with their construction, operation, and decommissioning.

Site assessment activities as proposed in this BA suggest that vessel traffic volume would be limited. Because the predominant historical information on sturgeon mortalities is from channelized, shallow estuarine areas, and because the majority of the vessel traffic will be in the offshore Project Area, it is expected that vessel-sturgeon interactions would be remote, and thus impacts negligible.

As a result, BOEM concludes that the effects of the proposed action on Atlantic sturgeon are discountable and not likely to adversely affect the ESA-listed Atlantic Sturgeon.

7.4 Avifauna

The proposed action is not anticipated to impact the ESA-listed piping plover and roseate tern and the ESA candidate species red knot as the action area has no overlap with both species' nesting and foraging areas. Due to the small number of structures, the anticipated use of flashing red aviation hazard lights on towers, and the restricted time period of exposure during migration, BOEM concludes that the effects of the proposed action are discountable and is not likely to adversely affect the piping plover, roseate tern, or red knot.

8 Standard Operating Conditions for Protected Species

This section outlines the standard operating conditions that are part of the proposed action and which minimize or eliminate potential impacts to protected species including ESA-listed species of whales, sea turtles, fish and birds. Additional conditions, including mitigation, monitoring or reporting measures, may be included in any issued BOEM lease or other authorization, including those that may be developed during the Federal ESA Section 7 consultation process.

8.1 Conditions for ESA-Listed Marine Mammals and Sea Turtles

The following conditions are part of the proposed action and are meant to minimize or eliminate the potential for adverse impacts to ESA-listed marine mammals and sea turtles. These mitigations also facilitate reduced impacts to ESA-listed marine fish and non-ESA listed marine mammals, sea turtles, and marine fish. They are divided into five sections: (1) those required during all phases of the project; (2) those required during pre-construction site assessment: (3) those required during construction; (4) those required during operation/maintenance; and (5) those required during decommissioning.

8.1.1 Requirements for All Phases of the Project

As noted in Section 4 of this BA, the proposed action will temporarily increase the number of vessels and vessel traffic within the Project Area and in the route between the Project Area and port facilities. Section 4.3 of the BA provides detail on the vessel activity associated with the proposed action.

Vessel Strike Avoidance Measures and Reporting for Mariners

BOEM will require as a stipulation of its lease that the lessee abide by the following vessel strike avoidance measures which are based on the Joint BOEM-BSEE Notice To Lessees and Operators (NTL) of Federal Oil, Gas, and Sulphur Leases in the OCS, Gulf of Mexico of Mexico OCS Region on "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting" (NTL 2012-JOINT-G01) (see http://www.bsee.gov/Regulations-and-Guidance/Notices-to-Lessees-and-Operators.aspx), which in turn is based upon the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service's (NMFS) Vessel Strike Avoidance Measures and Reporting for Mariners. These measures shall be applicable to all vessel activity conducted under the authorizations of a lease.

The requirements are as follows:

1. The lessee must ensure that vessel operators and crews must maintain a vigilant watch for marine mammals and sea turtles and slow down or stop their vessel to avoid striking protected species.
2. When whales are sighted, maintain a distance of 91 m (300 ft) or greater from the whale. If the whale is believed to be a North Atlantic right whale, the lessee must ensure that the vessel must maintain a minimum distance of 457 m (1,500 ft) from the animal (50 CFR 224.103).
3. When sea turtles or small cetaceans are sighted, the vessel must maintain a distance of 45 m (150 ft) or greater whenever possible.

4. When cetaceans are sighted while a vessel is underway, the lessee must ensure that the vessel must remain parallel to the animal's course whenever possible. The lessee must ensure that the vessel must avoid excessive speed or abrupt changes in direction until the cetacean has left the area.
5. Reduce vessel speed to 10 kn (18.5 km/h) or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel when safety permits. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity of the vessel; therefore, precautionary measures should always be exercised.
6. Whales may surface in unpredictable locations or approach slowly moving vessels. When animals are sighted in the vessel's path or in close proximity to a moving vessel, the lessee must ensure that the vessel must reduce speed and shift the engine to neutral. The engines must not be engaged until the animals are clear of the area.
7. The lessee must report sightings of any injured or dead marine mammals or sea turtles to BOEM at and NMFS (see below) within 24 hr, regardless of whether the injury or death was caused by their vessel as provided in the lease.

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National Marine Fisheries Service
Northeast Regional Office, Protected Resources Division
Section 7 Incidental Take Coordinator
Phone: 978-281-9328
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Also the following conditions apply to all phases of the project:

- All vessel operators must comply with vessel strike reduction measures for North Atlantic right whales implemented by NMFS, including Special Management Areas (SMAs) and Dynamic Management Areas (DMAs). Adherence to vessel restrictions in DMAs is not voluntary for vessels operating under authorizations or regulations under the terms of a BOEM-issued renewable energy lease. Compliance documents are located at: http://www.nero.noaa.gov/shipstrike/.

- All vessel operators must be briefed to ensure they are familiar with the above requirements. Adherence to these requirements must be written into any contractor agreements.

- All vessel operators, employees and contractors actively engaged in offshore operations must be briefed on marine trash and debris awareness elimination as described in the BOEM Gulf of Mexico Region's NTL No. 2007-G03 (http://www.gomr.mms.gov/homepg/regulate/regs/ntls/2007NTLs/07-g03.pdf), except that BOEM will not require the applicant to undergo formal training or post placards, as described under this NTL. The applicant must ensure that its employees and contractors are made aware of the environmental and socioeconomic impacts associated with marine trash and debris and their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into the marine environment. The above referenced NTL provides information the applicant may use for this awareness training.

8.1.2 Requirements During Pre-Construction Site Characterization Surveys

Section 4 of this BA describes the pre-construction high-resolution geophysical (HRG) surveys and geotechnical sampling the applicant would likely undertake under the proposed action. These field investigations would be conducted prior to construction.

8.1.2.1 HRG Surveys

a. The lessee must ensure that a 700 meter radius exclusion zone will be monitored around the survey vessel. This exclusion zone is extended to 500-m (1640 –ft) for North Atlantic right whales. If the exclusion zone does not encompass the 160-dB Level B harassment radius calculated for the acoustic source having the highest source level, BOEM will consult with NMFS about additional requirements. BOEM may authorize surveys having an exclusion zone larger than 200 m (656 ft) to encompass the 160-dB radius if the lessee demonstrates that it can be effectively monitored.
b. The lessee must ensure that active acoustic sound sources must not be activated until the protected species observer has reported the exclusion zone clear of all marine mammals and sea turtles for 30 minutes.
c. Except as noted in (d) below, if any marine mammal is sighted within or transiting towards the exclusion zone, an immediate shutdown of the equipment is required. Subsequent restart of the equipment may only occur following clearance of the exclusion zone for 60 minutes.
d. Shutdown is not required for dolphins approaching the vessel or towed equipment at a speed and vector that indicates voluntary approach to bow-ride or chase towed equipment.

Visual Monitoring of Exclusion Zone: Monitoring of the zones will be conducted by a qualified NMFS-approved observer. Visual observations will be made using binoculars or other suitable equipment during daylight hours. Data on all observations will be recorded based on standard marine mammal observer collection data. This will include: dates and locations of construction operations; time of observation, location and weather; details of marine mammal sightings (e.g., species, numbers, behavior); and details of any observed taking (behavioral disturbances or injury/mortality). Any significant observations concerning impacts on listed marine mammals or sea turtles will be transmitted to NMFS and BOEM within 48 hours (see contact information in Section 8.1.1). Any observed takes of listed marine mammals or sea turtles resulting in injury or mortality will be immediately (within 24 hours) reported to NMFS and BOEM.

Visual monitoring will begin no less than 60 minutes prior to the beginning of ramp-up and continue until HRG operations cease or sighting conditions do not allow observation of the sea surface (e.g., fog, rain, darkness). If a marine mammal or sea turtle is observed, the observer should note and monitor the position (including lat./long. of vessel and relative bearing and estimated distance to the animal) until the animal dives or moves out of visual range of the observer. You must continue to observe for additional animals that may surface in the area, as often there are numerous animals that may surface at varying time intervals. At any time a north Atlantic right whale is observed within an estimated 1,640 feet (500 meters) of the sound source array ("exclusion zone") or any other marine mammal or sea turtle is observed within 656 feet (200 meters) of the sound source array, whether due to the animal's movement, the vessel's movement, or because the animal surfaced inside the exclusion zone, the observer will call for the immediate shut-down of the HRG survey operation. The vessel operator must comply immediately with such a call by an on-watch visual observer. Any disagreement or discussion should occur only after shut-down. When no marine mammals or sea turtles are sighted for at least a 30-minute period, ramp-up of the sound source may begin. Ramp-up cannot begin unless conditions allow the sea surface to be visually inspected for marine mammals and sea turtles for 30 minutes prior to commencement of ramp-up. Thus, ramp-up cannot begin after dark or in conditions that prohibit visual inspection (fog, rain, etc.) of the exclusion zone. Any shut-down due to a protected species sighting within the exclusion zone must be followed by a 30-minute all-clear period and then a standard, full ramp-up. Any shut-down for other reasons, including, but not limited to, mechanical or electronic failure, resulting in the cessation of the sound source for a period greater than 20 minutes, must also be followed by full ramp-up procedures. In recognition of occasional, short periods of the cessation of survey equipment for a variety of reasons, periods of silence not exceeding 20 minutes in duration will not require ramp-up for the resumption of HRG survey operations if: (1) visual surveys are continued diligently throughout the silent period (requiring daylight and reasonable sighting conditions), and (2) no whales, other marine mammals, or sea turtles are observed in the exclusion zone. If whales, other marine mammals, or sea turtles are observed in the exclusion zone during the short silent period, resumption of HRG survey operations must be preceded by ramp-up.

Implementation of Ramp-Up: A "ramp-up" (if allowable depending on specific sound source) will be required at the beginning of each HRG survey in order to allow marine mammals and sea turtles to vacate the area prior to the commencement of activities. HRG surveys may not commence (i.e., ramp up) at night time or when the exclusion zone cannot be effectively monitored (i.e., reduced visibility).

Shut Down: Continuous (day and night) HRG survey operations will be allowed if sufficient lighting is provided to monitor the 1,640 foot (500 meter) exclusion zone for North Atlantic right whales. If sufficient lighting is not available, survey activity must be limited to daylight hours. If a listed marine mammal or sea turtle is spotted within or transiting towards the exclusion zone surrounding the sub-bottom profiler and the survey vessel, an immediate shutdown of the equipment will be required. Subsequent restart of the profiler may only occur following clearance of the exclusion zone and the implementation of ramp up procedures (if applicable).

Compliance with Equipment Noise Standards: All HRG surveying equipment must comply as much as possible with applicable equipment noise standards of the U.S. Environmental Protection Agency.

Reporting for HRG Survey Activities: The following reports must be submitted during the conduct of HRG surveys:

- A report must be provided to BOEM and NMFS within 90 days of the commencement of HRG survey activities that includes a summary of the HRG surveying and monitoring activities and an estimate of the number of listed marine mammals and sea turtles that may have been taken as a result of HRG survey activities. The report will include information, such as: dates and locations of operations, details of listed marine mammal or sea turtle sightings (dates, times, locations, activities, associated HRG activities), and estimates of the amount and nature of listed marine mammal or sea turtle takings.

- Any observed injury or mortality to a listed marine mammal or sea turtle must be reported to NMFS and BOEM immediately (within 24 hours). Any significant observations concerning impacts on listed marine mammals or sea turtles will be transmitted to NMFS and BOEM within 48 hours.

8.1.2.2 Geotechnical Sampling

The following mitigation, monitoring and reporting requirements will be implemented during the conduct of all geotechnical sampling work.

Establishment of Exclusion Zone: A 656 foot (200 meter) radius exclusion zone for listed marine mammals and sea turtles must be established around any vessel conducting the geotechnical sampling in order to reduce the potential for serious injury or mortality of these species.

Visual Monitoring of Exclusion Zone: The exclusion zone around the vessel must be monitored for the presence of listed marine mammals or sea turtles using the protocol detailed above for HRG survey work absent ramp-up procedures.

8.1.3 Requirements During Construction of Meteorological Towers

Section 4 of this BA describes the pile driving process in detail. Section 5.0 of this BA outlines the potential effects of pile-driving activities on listed marine mammals and sea turtles.

BOEM has included the following conditions are part of the proposed action and are meant to reduce or eliminate the potential for adverse impacts on listed marine mammals, sea turtles, and fish during met tower construction.

Pre-Construction Briefing: Prior to the start of construction, the lessee(s) must hold a briefing to establish responsibilities of each involved party, define the chains of command, discuss communication procedures, provide an overview of monitoring purposes, and review operational procedures. This briefing must include construction supervisors and crews, the marine mammal and sea turtle visual observer(s) (see further below). The Resident Engineer (or other authorized individual) will have the authority to stop or delay any construction activity, if deemed necessary. New personnel must be briefed as they join the work in progress.

Prohibition on Pile Driving: No pile-driving activities (e.g. pneumatic, hydraulic, or vibratory installation of foundation piles) may occur from November 1 – April 30 nor during an active Dynamic Management Area if the pile driving location is within the boundaries of the DMA or within 7 kilometers of the boundaries of the DMA**.**

Requirements for Pile Driving: The following measures will be implemented during the conduct of pile driving activities related to meteorological towers:

- *Establishment of Exclusion Zone*: A preliminary 4 mile (7 kilometer) radius exclusion zone for listed marine mammals and sea turtles must be established around each pile driving site in order to reduce the potential for serious injury or mortality of these species. The 4 mile (7 kilometer) exclusion zone is based upon the field of ensonification at the 160 dB level. The 4 mile (7 kilometers) exclusion zone must be monitored from two locations. One observer must be based at or near the sound source and responsible for monitoring the 180 dB field of ensonification out to 3281 feet (1,000 meters) from the sound source. An additional observer must be located on a separate vessel navigating approximately 2.5 to 3 miles (4 to 5 kilometers) around the pile hammer monitoring 360 degrees out to 4 miles (7 kilometers) from the sound source. If multiple piles are being driven, the field verification method may be used to modify the exclusion zone. Any new exclusion zone radius must be based on the most conservative measurement (i.e., the largest safety zone configuration), include an additional 'buffer' area extending out of the 160 dB zone, and

- *Field Verification of Exclusion Zone*: Field verification of the exclusion zone must take place during pile driving of the first pile if the meteorological tower design includes multiple piles. The results of the measurements from the first pile must be used to establish a new exclusion zone which may be greater than or less than the 4 miles (7 kilometer) default exclusion zone depending on the results of the field tests. Acoustic measurements must take place during the driving of the last half (deepest pile segment) for any given open-water pile. Two reference locations must be established at a distance of 1,640 feet (500 meters) and 3 miles (5 kilometers) from the pile driving. Sound measurements must be taken at the reference locations at two depths (a depth at mid-water and a depth at approximately 1m above the seafloor). Sound pressure levels must be measured and reported in the field in dB re 1 μPa rms (impulse). An infrared range finder may be used to determine distance from the pile to the reference location.

- *Visual Monitoring of Exclusion Zone*: Monitoring of the zones must be conducted by a qualified NMFS-approved observer. Visual observations must be made using binoculars or other suitable equipment during daylight hours. Data on all observations must be recorded based on standard marine mammal observer collection data. This must include: dates and locations of construction operations; time of observation, location and weather; details of marine mammal sightings (e.g., species, numbers, behavior); and details of any observed taking (behavioral disturbances or injury/mortality). Any significant observations concerning impacts on listed marine mammals or sea turtles must be transmitted to NMFS and BOEM within 48 hours (see reporting addresses in Section 8.1). Any observed takes of listed marine mammals or sea turtles resulting in injury or mortality will be immediately (within 24 hours) reported to NMFS and BOEM (see contact information in 8.1).

  Visual monitoring must begin no less than 60 minutes prior to the beginning of soft start and continue until pile driving operations cease or sighting conditions do not allow observation of the sea surface (e.g., fog, rain, darkness). If a marine mammal or sea turtle is observed, the observer must note and monitor the position, relative bearing and estimated distance to the animal until the animal dives or moves out of visual range of the observer. You must continue to observe for additional animals that may surface in the area, as often there are numerous animals that may surface at varying time intervals.

At any time a marine mammal or sea turtles is observed within the exclusion zone, whether due to the animals's movement, the vessel's movement, or because the animal surfaced inside the exclusion zone, the observer must notify the Resident Engineer (or other authorized individual). BOEM recognizes that once the pile driving of a segment begins it cannot be stopped until that segment has reached its predetermined depth. If pile driving stops and then resumes, it would potentially have to occur for a longer time and at increased energy levels. In sum, this would simply amplify impacts to listed marine mammals and sea turtles, as they would endure potentially higher SPLs for longer periods of time. If listed marine mammals or sea turtles enter the zone after pile driving of a segment has begun, pile driving may continue and observers must monitor and record listed marine mammal and sea turtle numbers and behavior. However, if pile driving of a segment ceases for 30 minutes or more and a listed marine mammal or sea turtle is sighted within the designated zone prior to commencement of pile driving, the observer(s) must notify the Resident Engineer (or other authorized individual) that an additional 30 minute visual and acoustic observation period will be completed, as described above, before restarting pile driving activities. In addition, pile driving may not begin during night hours or when the safety radius cannot be adequately monitored (i.e., obscured by fog, inclement weather, poor lighting conditions) unless the applicant implements an alternative monitoring method that is agreed to by BOEM and NMFS. However, if a soft start has been initiated before dark or the onset of inclement weather, the pile driving of that segment may continue through these periods. Once that pile has been driven, the pile driving of the next segment cannot begin until the exclusion zone can be visually or otherwise monitored.

- *Implementation of Soft Start*: A "soft start" must be implemented at the beginning of each pile installation in order to provide additional protection to listed marine mammals and sea turtles near the project area by allowing them to vacate the area prior to the commencement of pile driving activities. The soft start requires an initial set of 3 strikes from the impact hammer at 40 percent energy with a one minute waiting period between subsequent 3 strike sets. If listed marine mammals or sea turtles are sighted within the exclusion zone prior to pile-driving, or during the soft start, the Resident Engineer (or other authorized individual) must delay pile-driving until the animal has moved outside the exclusion zone.
- *Compliance with Equipment Noise Standards*: All construction equipment must comply as much as possible with applicable equipment noise standards of the U.S. Environmental Protection Agency, and all construction equipment must have noise control devices no less effective than those provided on the original equipment.
- *Reporting for Construction Activities*: The following reports must be submitted during construction:

- Data on all observations must be recorded based on standard marine mammal observer collection data. This must include: dates and locations of construction operations; time of observation, location and weather; details of marine mammal sightings (e.g., species, numbers, behavior); and details of any observed taking (behavioral disturbances or injury/mortality). Any significant observations concerning impacts on listed marine mammals or sea turtles will be transmitted to NMFS and BOEM within 48 hours. Any observed takes of listed marine mammals or sea turtles resulting in injury or mortality will be immediately (within 24 hours) reported to NMFS and BOEM.
- A final technical report within 120 days after completion of the pile driving and construction activities must be provided to BOEM and NMFS, and that provides full documentation of methods and monitoring protocols, summarizes the data recorded during monitoring, estimates the number of listed marine mammals and sea turtles that may have been taken during construction activities, and provides an interpretation of the results and effectiveness of all monitoring tasks.

8.2 Measures for ESA-Listed Birds and Bats

Based on the following assumptions regarding the Proposed Action (see Section 1.2) within the Project Area (Figure 1.1), no additional mitigations for ESA-listed and ESA candidate species are necessary.

- It is anticipated that metrological towers constructed for site assessment activities would be self-supported structures and would not require guy wires for support or stability.
- It is anticipated that only red flashing strobe-like lights metrological towers will be used for metrological towers to meet FAA requirements. In addition, it also anticipated that navigation lights for towers and buoys will be compliance with USGC requirements. Finally, it is anticipated that any additional lights (e.g., work lights) on towers and support vessels will be used only when necessary and be hooded downward and directed when possible to reduce upward illumination and illumination of adjacent waters.

8.3 Requirements During Decommissioning

Section 4 of this BA contains detail on the proposed scenario for decommissioning and removal of the meteorological towers and buoys. Essentially, the decommissioning process is the reverse of the construction process (absent pile driving), and the impacts from decommissioning would likely mirror those of construction. In addition, vessel activity during decommissioning would be essentially the same as that required during construction. Therefore, the vessel mitigation measures outlined in Section 8.1.1 of this BA will be required.

Foundation structures must be removed by cutting at least 15 feet (4.6 meters) below mudline (see 30 CFR 585.910(a). BOEM assumes the meteorological towers to be constructed in southern New England can be removed using non-explosive severing methods. As detailed in 30 CFR Part 585.902, before the lessee decommissions the facilities under their SAP, the lessee must submit a decommissioning application and receive approval from the BOEM. Furthermore, the approval of the decommissioning concept/methodology in the SAP is not an approval of a decommissioning application.

8.4 Other Non-ESA Related Standard Operating Conditions

The regulations for site assessment plans found at 30 CFR Part 585.610 specify the requirements of a site assessment plan. These include a description of the measures the lessee will use to avoid or minimize adverse effects and any potential incidental take of endangered species before conducting activities on the lease, and how the lessee will mitigate environmental impacts from your proposed activities. 30 CFR 585.801 also specify requirements of the lessee to reduce impacts to protected species.

8.5 Site Characterization Data Collection

In addition to the collection of meteorological and oceanographic data, the purpose of these meteorological towers/buoys and site characterization surveys are to also collect biological and archaeological data. This data will assist in future analysis of proposed wind facilities. In addition to required reports, all site characterization data will be shared with NMFS, USFWS, and appropriate State agencies, upon request.

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