Appendix 5.5-B

Pinniped Assessment for the Cape Wind Project

PINNIPED ASSESSMENT
FOR THE CAPE WIND PROJECT

NANTUCKET SOUND

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Prepared for the U.S. Army Corps of Engineers

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1 INTRODUCTION

This Pinniped Assessment (PA) was developed in accordance with the Massachusetts Environmental Policy Act (MEPA) Office request to evaluate the potential adverse impacts of the Cape Wind Energy Project on two species of pinnipeds: the gray seal (*Halichoerus grypus*) and the harbor seal (*Phoca vitulina concolor*). These species are known to reside in and visit Nantucket Sound and the barge routes to be used during project construction, maintenance, and decommissioning. The gray seal is listed as a Species of Special Concern by the Commonwealth of Massachusetts. Certain areas in Nantucket Sound serve as important overwintering, breeding, or haul-out habitat for harbor and gray seals. Life history information for the two species considered, including population status and trends, seasonal distribution in North Atlantic waters, preferred food and feeding behaviors, and known disturbances and mortality factors, is included in Section 2 of the PA. Potential impacts of the proposed action on the two species, and the management practices to minimize those impacts are discussed in Section 3. Literature cited in this document and other relevant references are presented in Section 4.

2 PINNIPEDS IN NANTUCKET SOUND

This section summarizes the natural history of gray and harbor seals, pinnipeds known to occur in Nantucket Sound.

2.1 Gray Seal (*Halichoerus grypus*)

Gray seals (*Halichoerus grypus*) inhabit temperate and sub-arctic waters and, in the United States, are found from Maine to Long Island Sound, N.Y. Gray seals are relatively large animals. Males grow to be 3.1 m in length and up to 450 kg, while females are smaller, reaching up to 2.3 m in length and 270 kg (Katona *et al*. 1993). Although the name implies that they are gray in color, gray seals can also be dark brown or almost black when wet and have a bold, large, irregular pattern of spots. Female gray seals have been reported to be tan with a yellowish white belly. Gray seals have a distinct Roman nose, gaping W-shaped nostrils, and eyes set back toward the ear openings. They can be distinguished from harbor seals by their "W" shaped nostrils and their size (NHESP, 2002).

Gray seals live on remote, exposed islands, shoals, and unstable sandbars, and are the second most common pinniped along the Atlantic coast of the United States, living as long as 30 to 40 years. These seals are generally gregarious, but live in loose colonies while breeding. Males reach sexual maturity between six and seven years of age and females at three years. Pupping occurs on land or ice from late December through mid-February, and peaks around mid-January. There are no regular seasonal migrations, but young individuals wander extensively during their first two years of life. Movement is largely a general dispersal in all directions after the breeding season (NHESP, 2002).

2.1.1 Population Status and Trends

Gray seals form three populations in the Atlantic. The western North Atlantic population ranges from New England to Labrador, is centered at Sable Island, Nova Scotia, and breeds primarily at Sable Island and on pack ice in the Gulf of St. Lawrence (NMFS 2001). Two year round breeding colonies have been identified in the United States: at Monomoy and Muskeget Islands in Nantucket Sound (approximately 10.5 nautical miles and 7.0 nautical miles, respectively, from the WTG site – see Figure 1), and on isolated islands off the coast of Maine.

Available data are insufficient to estimate the size of the entire western North Atlantic gray seal population, but estimates are available for the Sable Island, Maine coast, and Muskeget and Monomoy Island populations (NMFS 2001). The Sable Island/Gulf of St. Lawrence population was estimated at 143,000 in 1993. The Maine islands population increased from approximately 30 in the early 1980s to 500-1000 seals by 1993. The Muskeget and Monomoy population was estimated at 2,010 in the spring of 1994 (Rough 1995), and rose to 5,611 by the spring of 1999 (Barlas 1999). It is not known whether this increase represents population growth or immigration (NMFS 2001). Gray seal counts from winter/spring surveys in 1998-1999, 1999-2000, and 2002 at Monomoy, Muskeget, and Tuckernuck Islands in Nantucket Sound (approximately 10.5, 7.0, and 8.5 nautical miles, respectively, from the WTG site) are summarized in Table 1. The location of these islands with respect to the WTG site are shown in Figure 1, below.

Table 1. Recent Gray Seal Counts at Muskeget, Monomoy, and Tuckernuck Islands.

Year	Muskeget Count	Monomoy Count	Tuckernuck Count
1998-1999[1]	3,564	3,322	290
1999-2000[2]	4,751	3,113	461
2002[3]	1,599	16	1192 (not possible to determine if harbor or gray seals or both)

[1]Barlas, 1999
[2]Waring, unpublished data
[3]Wood, unpublished data

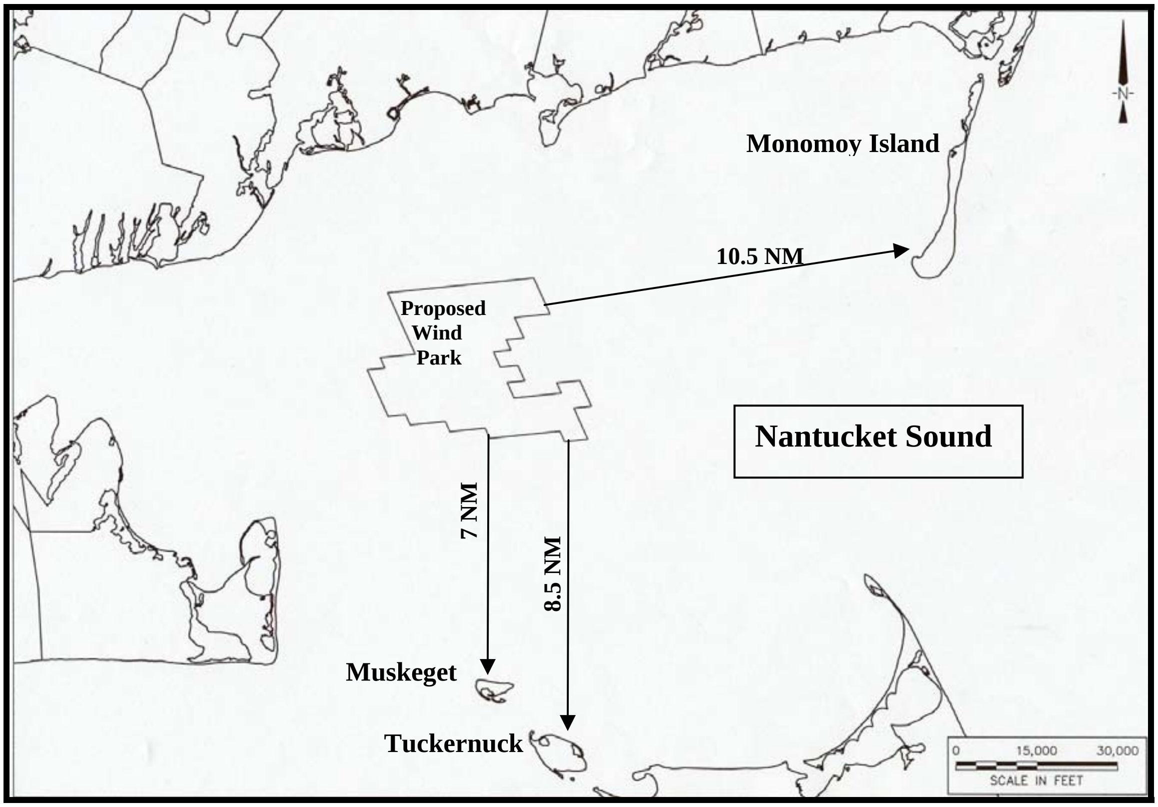

FIGURE 1. LOCATION OF PROPOSED WIND PARK SITE WITH RESPECT TO MONOMOY, MUSKEGET AND TUCKERNUCK ISLANDS IN NANTUCKET SOUND.

2.1.2 Seasonal Distribution in North Atlantic Waters

Though year-round breeding populations have been identified on islands in Nantucket Sound (Waring *et al.* 2001), winter and spring use of these areas is highest (NHESP 2002). Gray seals presently use Muskeget Island and Monomoy National Wildlife Refuge within Nantucket Sound as an area to give birth and raise their pups. Since there is no defined migratory behavior, a large portion of the population may be present in the Sound year-round, although the actual numbers are not as plentiful as harbor seals. According to the Massachusetts Division of Fisheries and Wildlife, the herd in Massachusetts waters represents the southernmost breeding gray seal colony in the world, and the only one known in the United States south of the Gulf of Maine (NHESP 2002). Generally, there is some adult seal movement north during spring and summer out of Nantucket Sound to the waters of Maine and Canada for pupping, as seen with harbor seals (Waring *et al.*2001).

2.1.3 Food and Feeding Behavior

All pinnipeds are highly agile and successful marine predators. Much of their diet depends on the most abundant fish and invertebrate species in the area, foraging at various depths to at least 70 m for their prey. Gray seals have an extensive fish diet that consists of lampsuckers, pollock, conger eel, skates and rays, wrasse, whiting, herring, cod, flounder, squid, mackerel, capelin, lumpfish, silver hake, and sand lance (Katona *et al.* 1993). Nantucket Sound and the areas surrounding it support large populations of these prey species. Newly born pups are nursed for a few short weeks after birth and then abandoned. Their food is most likely the same as adults, although early on, crustaceans and mollusks may comprise most of their diet. Large populations of these crustaceans and mollusks are present in southern Cape Cod waters.

2.1.4 Mortality Factors

Little is known about the natural causes of mortality for gray seals. Major causes of human-induced gray seal mortality include marine pollution and habitat destruction, but mortality mainly stems from drowning in active or abandoned fishing nets. For the period of 1995 to 1999, the average annual estimated human caused mortality and serious injury to gray seals in U.S. waters was estimated at 110 seals per year; 103 of these 110 mortalities per year were attributable to the Northeast multispecies sink gillnet fishery, which covers the Gulf of Maine and southern New England (Waring *et al.* 2001). Between 1997 and 1998, 28 gray seals were stranded in Massachusetts, thirteen of which showed human causes (*i.e.*, fishery interactions, power plant entrainment, oil spill, shootings, etc.) (Waring *et al.* 2001). Gray seals were hunted for bounty until the late 1960s, likely resulting in severe stock depletion in New England waters (Rough 1995). At present, mortality levels attributable to deliberate shooting of seals by fishermen and aquaculture farmers, who view seals as pests as they compete for the same valuable fish stocks or farmed fish, is unknown (Waring *et al.* 2001).

2.2 Harbor Seal (Phoca vitulina concolor)

The harbor seal (*Phoca vitulina concolor*), or the common seal, is found throughout coastal waters of the Atlantic Ocean and adjoining seas (Waring *et al.* 2001), and is the most abundant pinniped on the east coast of the United States. Harbor seals commonly occur in coastal waters and on coastal islands, ledges, and sandbars above 30° N latitude. The harbor seal can be identified from its short, concave muzzle, which has a slightly upturned tip, and a broad V-shaped nostril. In addition, the eye of the harbor seal is equidistant between the nose and the ear opening. Male harbor seals average 1.5 m in length and 90 kg, but may reach 1.7 m and 115 kg. Female harbor seals are slightly smaller in size, averaging 1.4 m and 70 kg, but may reach 1.7 m and 90 kg. Harbor seals range in color from bluish gray with small dark spots to tan, brown, black, and even reddish in color. Maturity is reached at five to six years for males and three to four years for females. Harbor seals have been known to live as long as 30 to 40 years (Katona *et al*. 1993).

2.2.1 Population Status and Trends

Overall, since the passing of the Marine Mammal Protection Act in 1972, the number of harbor seals along the New England coast has increased nearly fivefold (Waring *et al.* 2001). Coastwide aerial surveys conducted off the coast of Maine during pupping season counted a minimum of 28,810 harbor seals in 1993. In 1997 this number rose to 30,990, which at present is considered the best available minimum estimate of the harbor seal population along the New England coast (Waring *et al.* 2001).

2.2.2 Seasonal Distribution in North Atlantic Waters

The harbor seal is commonly found in waters above 30° N latitude. They range seasonally from the Arctic to as far south as Cape Cod and Nantucket Sound. Harbor seals spend the late spring, summer, and early fall between New Hampshire and the Arctic where they breed and care for newly born pups. A general southward movement from the Bay of Fundy to southern New England waters occurs in fall and early winter, mostly consisting of juveniles and sub-adults. Whitman and Payne (1990) have suggested that this age-related dispersal may reflect the higher energy requirements of younger individuals. Harbor seal counts from winter/spring surveys in 1998-1999, 1999-2000, and 2002 at Monomoy, Muskeget, and Tuckernuck Islands in Nantucket Sound (approximately 10.5, 7.0, and 8.5 nautical miles, respectively, from the Project Area) are summarized in Table 2. The location of these islands with respect to the WTG site are shown in Figure 1.

Table 2. Recent Harbor Seal Counts at Muskeget, Monomoy, and Tuckernuck Islands.

Year	Muskeget Count	Monomoy Count	Tuckernuck Count
1998-1999[1]	24	610	272
1999-2000[2]	778	2154	405
2002[3]	harbor seals not counted	harbor seals not counted	1192 (not possible to determine if harbor or gray seals or both)

[1]Barlas, 1999
[2]Waring, unpublished data
[3]Wood, unpublished data

After overwintering in southern New England waters, including Nantucket Sound, the vast majority of the population migrates in the spring to the northern waters of New Hampshire, Maine, and Canada for pupping season. No pupping areas have been identified in southern New England.

The greatest summer concentrations of harbor seals are along the coast islands and ledges of Maine, but they can occur year round in waters adjacent to Cape Cod and Nantucket Island (Payne and Selzer 1989). Extensive sand spits on Muskeget, Tuckernuck, and Skiff Islands (west side of Muskeget Channel off Martha's Vineyard) have been identified by the U.S. Fish and Wildlife Service (USFWS) as preferred haul-out points for large numbers of harbor seals. This outer-Sound area may support larger numbers of fish for seals to prey on, since many species of finfish migrate to deeper waters during their overwintering periods.

2.2.3 Food and Feeding Behavior

All pinnipeds are highly agile and successful marine predators. Much of their diet depends on the most abundant fish and invertebrate species in the area. Harbor seals eat invertebrates and fish as available including herring, squid, alewife, flounder, hake, sand lance, and mackerel (Katona *et al.* 1993). The waters of Massachusetts support large populations of these fish, which may entice the younger juveniles to migrate south and stay longer throughout the year. During late summer, harbor seals move offshore to deeper waters, presumably following winter offshore finfish migrations.

2.2.4 Mortality Factors

Despite its abundance throughout New England, little is known about natural mortality in this species (Katona *et al.* 1993). Major causes of human-induced harbor seal mortality include marine pollution and habitat destruction, but mortality mainly stems from drowning in active or abandoned fishing nets. In recent years, harbor seal mortality has been related to the Northeast multispecies sink gillnet fishery, which covers the Gulf of Maine and southern New England, and the Mid-Atlantic coastal gillnet fishery. The total estimated average fishery-related mortality or serious injury in the Northeast multispecies sink gillnet fishery for the period of 1995 to 1999 was 893 harbor seals. The estimated annual mortality attributed to the mid-Atlantic coastal gillnet fishery for the period of 1995 to 1999 is two harbor seals (Waring *et al.* 2001).

Harbor seal strandings occur in southern New England during the winter period, and have been attributed to vessel strikes, fishing gear entanglement, entrainment in power plant intakes, oils spills, storms, abandonment, and disease (Waring *et al.* 2001). In 1980, more than 350 harbor seals stranded on Cape Cod due to an influenza outbreak (Geraci *et al.* 1981). Harbor seals were hunted for bounty until the mid 1960s, likely resulting in stock depletion in New England waters (Katona *et al.* 1993). At present, mortality levels attributable to deliberate shooting of seals by fishermen and aquaculture farmers, who view seals as pests as they compete for the same valuable fish stocks or farmed fish, is unknown (Waring *et al.* 2001).

3 POTENTIAL IMPACTS TO PINNIPEDS IN NANTUCKET SOUND

3.1 Summary of Construction, Operation/Maintenance and Decommissioning Methodology

3.1.1 Project Construction

The construction of the Project will involve the installation of 130 wind turbine generators (WTGs) in Nantucket Sound, an Electrical Service Platform (ESP) within the WTG array, inner-array cables to connect each WTG to the ESP, and two submarine cable circuits to connect the ESP to the landfall area in Yarmouth, Massachusetts. One monopile foundation will be constructed to support each of the 130 WTGs and six smaller monopile foundations will support the ESP. The monopiles will be installed using pile driving hammer technology and will be driven approximately 85 feet into the seabed. To prevent scour around the monopiles, seabed scour control systems will be installed. These systems consist of mats of seagrass-like polypropylene "fronds" that serve to reduce the velocity of water circulation around the foundations, thereby preventing scour at the base of the monopiles. Anchors and jack-up barges will be used to facilitate the installation of the monopiles.

The two submarine cable circuits connecting the Wind Park to the landfall location and the inner-array cables connecting each WTG to the ESP will be installed in the seabed using hydraulic jet-plow embedment technology. This method utilizes pressurized water jets to create a localized path along the seafloor into which the cable system is immediately positioned. The sediment displaced by the jet-plow then begins to settle over the created path, thereby burying and protecting the cable. The localized pathway disturbed to install each circuit will be approximately four to six feet wide and eight feet deep to reach an approximate 6 foot burial depth. Additionally, anchoring will be required for cable installation barge positioning.

The transition of the interconnecting submarine cable system from water to land will be accomplished through the use of Horizontal Directional Drill (HDD) methodology in order to minimize disturbance within the intertidal zone and near shore area. HDD would be staged at the upland landfall area and involve the drilling of the boreholes from land toward the offshore exit point. Conduits would then be installed the length of the boreholes and the transmission line would be pulled through the conduits from the seaward end toward the land.

The offshore end of the conduits will terminate in a pre-excavated pit where the jet plow cable burial machine will start. To further facilitate the HDD operation, a temporary cofferdam will be constructed using steel sheet piles at the end of the boreholes. Approximately 840 cubic yards of sediment will be excavated from the area inside the cofferdam to expose the seaward end of the borehole. The top of the sheet piles will be cut-off approximately 2 feet above mean high water to contain any turbidity associated with the dredging. The excavated material will be disposed of at an approved upland disposal location. The area enclosed by the cofferdam will be approximately 2,925 square feet, a small area compared to surrounding habitat in Lewis Bay. See Section 4.0 of the DEIS for more detailed information on construction and installation methodologies.

3.1.2 Project Operation/Maintenance

As previously discussed, the Project will consist of 130 WTGs on Horseshoe Shoal in Nantucket Sound. Wind-generated energy produced by the WTGs will be transmitted via a 33 kV submarine transmission cable system (inner-array cables) to the Electric Service Platform (ESP) centrally located within the WTG array. The ESP will then take the wind-generated energy from each of the WTGs and transform and transmit this electric power to the mainland electric transmission system via two 115 kV alternating current (AC) cable circuits.

Maintenance required for the 130 WTGs would be distributed among two to three crews, thus likely resulting in daily trips to the Wind Park estimated to be at least 250 days per year. In the event that a WTG or a section of the inner-array or submarine cable systems require repair during operation, methodologies for conducting this repair are expected to be similar to those used during construction; however, impacts would be limited to the immediate vicinity of the WTG or portion of the cable system requiring repair. See Section 4.0 of the DEIS for a more detailed description of operation and maintenance procedures.

3.1.3 Project Decommissioning

The approximate design life of the Project is 20 years, after which the decommissioning of the Project will occur. Decommissioning the Project involves dismantling the WTGs and ESP, removing scour control mats, removing the inner-array cables and submarine cable system, and transporting all parts to shore for recycling. In deconstructing the WTGs down to the transition piece, the blades, hub, nacelle and tower would come apart in the same manner that they were put together utilizing similar equipment. The parts would be brought to shore for reuse or recycling. The monopile, with the transition piece, would be removed by airlifting the sand within it to a suitable depth (approximately two meters (6.5 feet) below the level of the seabed) then cutting and removing the monopile. The objective of the decommissioning process will be to return the Project Area to its pre-Project state (see Section 4.0 of the DEIS for a complete discussion of the decommissioning process). Following decommissioning, there should be no interferences with normal uses of the region nor should there be any adverse environmental impacts.

3.2 Analysis of Impacts

This section discusses potential water quality, biological, and physical impacts to gray and harbor seals that could occur during construction, operation/maintenance, and decommissioning of the Project. The level of effect - direct, indirect, or cumulative - is indicated for each impact. Because gray and harbor seals are similar species and likely to respond to project effects similarly, impact discussions address both species simultaneously.

3.2.1 Total Suspended Solids

The primary water quality concern to the listed species addressed in this PA is elevated concentrations of Total Suspended Solids (TSS) associated with construction and decommissioning of the project. Sustained elevated concentrations of TSS may deter seals (direct impact) and may potentially affect their finfish prey species (indirect impact). However, as indicated below, construction and decommissioning activities are expected to result in only temporary and localized increases in TSS and therefore will have minimal impacts to seals.

Construction activities associated with installing the monopile foundations, scour control mats, and submarine cables will result in a temporary and localized increase in suspended sediment concentrations. Decommissioning-related impacts will be short-term and localized and are expected to be similar to or less than impacts during construction. The pile driving hammer and jet plow technology that will be used to install the monopile foundations and the submarine cables, respectively, were selected specifically for their ability to keep sediment disturbance to a minimum. Due to the predominant presence of fine to coarse-grained sands in Nantucket Sound, localized turbidity associated with Project construction or decommissioning is anticipated to be minimal and confined to the area immediately surrounding the monopiles and the submarine cable route. Sediments disturbed by construction or decommissioning activities are expected to settle back to the sea floor within a short period of time (one to two tidal cycles). In addition, the Project Area is situated in a dynamic environment that is subject to naturally high suspended sediment concentrations in near-bottom waters as a result of relatively strong tidal currents and wind and storm generated waves, particularly in shoal areas. Therefore, marine organisms in this area are accustomed to substantial amounts of suspended sediment on an irregular basis and should not be substantially impacted by a temporary increase in turbidity from Project activities.

Sediment suspension during construction and decommissioning activities will not result in environmentally significant elevations in water column TSS. Finfish species may be temporarily displaced in the immediate vicinity of the area of activity; however, they are likely to rapidly return to these areas once construction in the specific area is ceased or completed. Seals that may be present in the vicinity of the Project Area during construction are not expected to be adversely affected by temporary increases in TSS and since they are mobile, are capable of avoiding or moving away from the disturbances associated with construction.

Sediment suspension during excavation of the HDD borehole ends in Lewis Bay will be minimal since these activities will be contained within the cofferdam and the top of the sheet piles for the cofferdam will contain turbidity associated with dredging for the HDD borehole end transition. Therefore, no impacts to seals or their prey are expected to occur from the limited, contained sediment suspension during excavation of the HDD borehole ends in Lewis Bay.

3.2.2 Sediment Contaminants

Seals bioaccumulate contaminants from their ocean environment almost exclusively through their food sources. As air-breathing animals, seals have an outer integument that is much less permeable than the gills of fish or the body wall of most marine invertebrates. Therefore, passive or active uptake of chemical contaminants directly from solution across permeable body surfaces is much less important than bioaccumulation of chemical contaminants from food. The potential mechanism by which sediments suspended during Project construction and decommissioning can harm seals is through bioaccumulation of sediment-associated chemicals through ingestion of contaminated prey (indirect impact).

There is little potential for seals to bioaccumulate chemical contaminants in their tissues from consuming prey in the Project Area because analysis of sediment core samples obtained from the Project Area indicated that sediment contaminant levels were below established thresholds in reference sediment guidelines. Specifically, all of the chemical constituents detected in the sediment core samples obtained from the WTG site and along the submarine cable route had concentrations below Effects Range-Low (ER-L) and Effects Range-Median (ER-M) marine sediment quality guidelines (Long et al., 1995) (see Section 5.1 of the DEIS). Therefore, the temporary and localized disturbance and suspension of these sediments during project construction and decommissioning activities is not likely to result in increased incorporation of contaminants at low trophic levels. Seals are unlikely to experience increased bioaccumulation of chemical contaminants in their tissues from the consumption of prey items in the Project vicinity.

During the nearshore installation, the release of contaminants from the HDD operation within Lewis Bay will be minimized through a drilling fluid fracture or overburden breakout monitoring program. This program will minimize the potential of drilling fluid breakout into waters of Lewis Bay. Although it is anticipated that drilling depths in the overburden will be sufficiently deep to avoid pressure-induced breakout of drilling fluids through the seafloor bottom, a bentonite monitoring program will be implemented for the detection of possible fluid loss (see Section 4.3.5 of the DEIS). In the unlikely event of drilling fluid release, the bentonite fluid density and composition will cause it to remain as a cohesive mass on the seafloor in a localized slurry pile similar to the consistency of gelatin. This cohesive mass can be quickly cleaned up and removed by divers and appropriate diver-operated vacuum equipment; thereby minimizing any long-term impacts to seals or their prey.

3.2.3 Vessel harassment

Several shipping lanes transect Nantucket Sound, which like the rest of the Atlantic seaboard, has experienced an increase in vessel traffic independent of the larger vessels (*e.g.*, fishing boats, recreational boats from nearby areas). This Project will introduce additional vessel traffic traveling from Quonset, RI to the Project Area during construction and decommissioning and from New Bedford, MA to the Project Area during operation/maintenance. There have been many studies of the effects of vessels on marine mammals, particularly the underwater noises they make (Richardson *et al*. 1985; 1991; 1995). It is likely that seals react primarily to the sound generated by vessels, and not to their physical presence.

It has been reported that vessel traffic may displace some seals from feeding areas and may disturb breeding, pupping, and haul out activities if the vessel makes repeated approaches or if vessel traffic is heavy. However, seals have been know to avoid vessel traffic and approach vessels, especially fishing vessels, and appear to habituate to most anthropogenic noises and activities, such as those at harbors and coastal airports (Vella et al., 2001). Gray seals were observed to habituate to construction activities, including pile installation, during construction of the Näsrevet Wind Farm in Sweden (Westerberg 1999).

Important coastal habitat for gray and harbor seals exists in Nantucket Sound, but at distances from the Project Area that will prevent harassment from Project-related vessel traffic and interaction with humans near Project activities. Gray seal breeding and pupping grounds in Nantucket Sound occur at Monomoy and Muskeget Islands (approximately 10.5 miles and 7.0 miles, respectively from the WTG site). Tuckernuck and Muskeget Islands (approximately 8.5 miles and 7.0 miles, respectively from the WTG site) are important haul out sites for harbor seals (Figure 1). If seals are present in the Project Area or along the vessel routes, initial avoidance behavior is expected, though behavior changes will be short-term and will likely be similar to the avoidance behaviors observed during pleasure boat activity, ferry traffic, or fishing activity in the area. Seal habituation to Project activities may occur following initial avoidance behavior.

3.2.4 Vessel strikes

As previously mentioned, this Project will introduce additional vessel traffic steaming from Quonset, RI (construction and decommissioning) and New Bedford, MA (operation/maintenance) to the Project Area in Nantucket Sound, as barges and other vessels construct, maintain, and decommission the project. Seals may be at risk of collisions with Project-related vessels; however, as stated above, important coastal habitat for gray and harbor seals are not located in the immediate vicinity of the Project Area or vessel routes.

Vessel strikes were determined to be the cause of death in some stranded harbor seals in New England waters (Waring *et al.* 2001). Because seals readily habituate to vessels, they may be more susceptible to ship collisions. However, seals are extremely agile and aware of their surroundings in the water. Vessels moving at slower speeds, such as the tugs and barges that will be used for Project construction, will be clearly audible and can be avoided easily by seals. Thus, close encounters between Project vessels and seals are likely to be rare and result in minimal physical disturbance to the animals.

3.2.5 Acoustic harassment

Section 5.11 of the DEIS discusses the anticipated acoustic effects and potential impacts of the Project. Based on modeling and results from other wind projects, it is concluded that the Project will have no adverse impacts to wildlife. A small amount of localized and temporary noise will be generated in the marine environment from construction of the Project. The operation and maintenance phases will have very low-level acoustic effects, and underwater sound will not be measurable above background levels beyond a short distance from each monopile.

Sound can be measured in many terms, including frequency and sound pressure. Frequency is the rate of the sound wave vibration and is measured in cycles per second or hertz (Hz) (Richardson et al., 1995). For airborne and underwater sound pressure, the standard unit of measurement is the decibel (dB), a logarithmic scale formed by taking 20 times the $\log_{10}$ of a ratio of two pressures: the measured sound pressure divided by a reference sound pressure. Above air sound is referenced to 20 µPa[1], while underwater sound is referenced to 1 µPA. As a result, an identical sound pressure wave in air and underwater is recorded differently in the two fluids. For example, a sound pressure of 80 dB in air is equivalent to 106 dB underwater, i.e., the underwater scale is shifted 26 dB higher than the air scale. There are also substantial differences in ambient (background) sound levels in air and in the ocean, and in the frequency weighting that is used in the two media. Thus, the reader should not try to equate dB levels reported for water with those in air, or vice-versa.

A sound can also be transient or continuous. A transient sound (i.e., an explosion) has an obvious starting and stopping point while a continuous sound (e.g., offshore oil drill) is more or less persistent. The monopiles for the Project will be installed using pile driver technology and a pile driver is categorized as a repeating transient sound.

The total background ambient sound in the open ocean is about 74 to 100 dB re 1 μPa. However, several natural sound sources, such as earthquakes, lightning strikes, and some biological sounds, such as vocalizations of baleen whales and some swimbladder sounds of fish, may temporarily increase natural ambient sound above these levels. Sound pressure source levels for several different types of natural ambient sound in the marine environment are presented in Table 3. In comparison, vessel sounds generally fall in the range of 150 to 200 dB re 1 μPa at a distance of 1 meter (3.3 feet) with peak frequencies in the 5 to 2000 Hz range and highest intensities below 100 Hz (Scrimger and Hietmeyer 1991). Table 4 lists estimated sound pressure source levels for vessels of different sizes and at different speeds. Sound intensity, particularly at higher frequencies, tends to increase with the size of the vessel. Supertankers and large container ships may have a maximum broad-band sound source level of 190 to 200 dB re 1 μPa at 1m from the source (Table 6). Small outboard motor vessels produce broad-band sounds of about 150 dB re 1 μPa at 1 m (3.3 feet); these sounds are attenuated to the range of 85 to 140 dB re 1 μPa at a distance of 50 meters (164 feet) from the source (Richardson *et al*. 1991).

Table 3. Maximum Broad-Band (20-1000 Hz) Sound Pressure Source Levels for Different Types of Natural Ambient Noise in the Marine Environment.

Noise Source	Maximum Source Level (dB re 1 μPa @ 1 m)	Remarks
Undersea Earthquake	272	Magnitude 4.0 on Richter scale (energy integrated over 50-Hz band width)
Seafloor Volcanic Eruption	255+	Massive steam explosions
Lightning Strike on Water Surface	250	Random events during storm at sea
Baleen Whales	to 188	<2000 Hz simple and complex calls, clicks, pulses, knocks, grunts, moans
Swimbladder Sounds of Fish	140	Marked spectral peaks in 50-3000 Hz range
Dugong	<90	2000-5000 Hz simple chirps and squeaks
Total Open-Ocean Ambient Noise	74-100	Estimate for offshore central California, sea state 3-5; expected to be higher (120 dB) when vessels are present
Rain Storm	80	Heavy rain shower, flat frequency spectrum
Wind	66	Force 3 wind over water

Sources: Richardson *et al*. (1991), McCauley (1994), and Advanced Research Projects Agency (1995).

[1] MicroPascals = 10^{-6} Newton/m^2.

Table 4. Estimated Peak 1/3-Octave Sound Pressure Source Levels for Vessels of Different Sizes and Speeds.

Vessel	Speed (knots)	Sound Pressure Level (dB re 1 μpa @ 1 m)	Reference
>250-m Large Oil Tanker	16	203	Cybulski 1977
274-m Container Ship (23 Hz)	--	198	Richardson *et al*. 1991
340-m Supertanker	20	190	Buck and Chalfant 1972
WWII Battleship	20	183	Urick 1984
337-m Tanker (20 Hz)	16	177	Cybulski 1977
Icebreaker	10	174	Malme *et al*. 1989
135-m Freighter	--	172	Richardson *et al*. 1991
Large Ferry	16	171	Malme *et al*. 1989
Tug and Loaded Barge	--	170	Miles *et al*. 1987
210-m Container Ship	19	169	Jennette *et al*. 1987
Cruise Ship	19	168	Malme *et al*. 1989
20-m Tug and Empty Barge	--	166	Buck and Chalfant 1972
200-m Roll On/Off	15	165	Jennette *et al*. 1987
190-m Car Carrier	16	162	Jennette *et al*. 1987
Tug and Barge	10	162	Malme *et al*. 1989
34-m Twin-Diesel Tour Boat	10	159	Malme *et al*. 1989
Fishing Trawler (transit)	10	158	Malme *et al*. 1989
Fishing Trawler (trawling)	5	147	Malme *et al*. 1989
16-m Crew Boat	--	156	Greene 1985
7-m Boat with 2 x 80-hp outdrive	20	156	Malme *et al*. 1982
8-m Boat with 260-hp outdrive	10	156	Malme *et al*. 1982
4-m Boston Whaler/20-hp outboard	20	153	Malme *et al*. 1982
5-m Zodiac with 20-hp outboard	20	152	Malme *et al*. 1982
4-m Boat with 25-hp outboard	20	152	Malme *et al*. 1982
20-m Tour Boat	10	150	Malme *et al*. 1989
Small Boat with 18-hp outboard	5	150	Evans 1982

The range of human hearing extends from about 20 Hz to 20,000 Hz (lowest to highest tones), though sensitivity falls off sharply at high and low frequencies. Most marine animals can perceive underwater sounds over a broad range of frequencies from 10 Hz to more than 10,000 Hz. Harbor seal hearing sensitivity ranges from 1kHz to 50 kHZ with an absolute hearing threshold (minimum sound pressure level required at a given frequency for a sound to be heard) of 60 to 82 dB re 1 μPa. Most underwater construction activities produce low frequency sound, usually less than 1kHz. Harbor seal hearing sensitivity shows an absolute hearing threshold of 96 dB re 1 μPa at 100Hz (Kastak and Schusterman 1995). Hearing sensitivity data is not available for gray seals, but is assumed to be similar to that of harbor seals as the two phocids share many physiological similarities.

Underwater sounds, if they are intense enough, may cause behavioral responses, injury to the ears of seals, or even death from concussion (Richardson *et al*. 1995). However, actual thresholds for behavioral responses to sounds in the natural environment depend on the level of natural ambient sound. The threshold intensity of constant or impulsive sounds for injury to the hearing apparatus of marine mammals is about 200 to 220 dB re 1 μPa (Greenlaw 1987; McCauley 1994). The present scientific consensus is that serious problems in a marine mammal's hearing capability will not arise at received transient sound levels of <180 dB re 1 μPa. At higher received levels or greatly extended continuous duration one cannot be certain, and the general consensus is that this 180 dB level should be considered as the point above which some potentially serious problems in marine mammals' hearing capability could start to occur (HESS 1997; ONR 1998; NMFS 1998).

The maximum submarine sound generated during construction of the Wind Park will occur during installation of the monopile foundations. The jet plow embedment process for laying the two submarine cable circuits and inner-array cables produces no sound beyond that produced by typical vessel traffic and the cable installation barge will produce sound typical of vessel traffic already occurring in Nantucket Sound. No substantial underwater sound will be generated during horizontal directional drilling (HDD) operations used to transition the submarine cable to the upland cable system in Lewis Bay. Due to the sound-insulating qualities of earthen materials (the sediment), and the fact that the drilling would take place through unconsolidated material, the HDD transition is not anticipated to transmit vibration from the sediment to the water (i.e. it would not add appreciable sound into the water column). As a result, the main underwater acoustical impacts during construction activities will be limited to that generated by installation of the monopile foundations and vessel traffic.

Sound levels measured during impact pile driving operations at the Utgrunden Wind Park in Sweden were used to model underwater sound impacts for this Project because the monopiles are similar in size and the same pile driving installation technique is proposed by the Applicant (see Section 2.3 of Appendix 5.11-A of the DEIS). The Utgrunden data show a maximum (L_{max}) sound level of 178 dBL at 500 m (1,640 feet). Frequency plots from the Utgrunden data show the peak energy from pile driving occurred between 200 and 1,000 Hz, with underwater sound levels falling below background levels (inaudible) for frequencies below 5 Hz. NMFS suggests that 180 dBL represents the threshold level for preventing injury or harassment to marine mammals[2]. The sound levels anticipated to occur during Project construction at and beyond the Initial 500 m Safety Radius[3] are below this level (see Section 5.11.2.6 of the DEIS). Therefore, construction of the Project is not anticipated to cause physical harm to seals. In addition, seals are likely to temporarily avoid the Project Area during construction activities. Gray seals were observed to leave an area where seismic surveys were producing underwater sound levels of 214 to 224 dB, but returned to the area following completion of the survey (Thompson *et al.* 1998). Other studies show that gray seals habituated to construction activities, including pile installation, during construction of the Näsrevet Wind Farm in Sweden (Westerberg, 1999). To date, there is no conclusive evidence that this short-term disturbance leads to long-term effects on individual marine mammals or populations (Richardson *et al.*, 1991).

Underwater sound monitoring will be performed during initial monopile construction (as was done to ensure protection of marine mammals during the installation of the SMDS foundation piles). This will include posting a NMFS-approved observer on-site during initial pile driving activities to monitor the area during construction. If listed species are observed by the NMFS-approved observer within the 500 m Safety Zone, the observer will ensure that work will cease until the animal is clear of the work area and safety zone (see Section 5.11.2.7 of the DEIS).

Increased project-related vessel traffic will occur during all phases: construction, operation and maintenance, and decommissioning. Sounds produced by tugboats towing barges probably produce underwater sounds with peak intensities in the frequency range of seal auditory capability of about 165 dB re 1 μPa at 1 meter (3.3 feet) (Buck and Chalfant 1972; Miles et al. 1987; Malme et al. 1989). These sounds attenuate naturally in the water to about 120 dB re 1 μPa at about 2 nautical miles from the source. The sounds of tugs and barges will be clearly audible to seals in the vicinity of the Project site and transit routes. However, these sounds would be too weak to cause physical harm. As previously discussed, seals may avoid vessels initially, but often habituate to them (Vella et al., 2001). Seals in Nantucket Sound are frequently exposed to vessel traffic from a variety of vessels; therefore, the slight increase in vessel traffic caused by the Project should not substantially alter the acoustic environment in this area above the normal baseline sound.

Once installed, the operation of the WTGs is not expected to generate substantial sound levels above baseline sound in the area. Acoustic modeling of underwater operational sound at the Wind Park was performed for the design wind condition (see Section 5.11.2.4 of the DEIS). Baseline underwater sound levels under the design wind condition are 107.2 dBL (see Section 5.11.2.3.1 of the DEIS). The predicted sound level from operation of a WTG is 109.1 dBL at 20 m (65.6 feet) from the monopile (i.e., only 1.9 dBL above the baseline sound level), and

[2] National Marine Fisheries Service, letter from Ms. Patricia Kurkul, Regional Administrator to Ms. Christine Godfrey, U.S. Army Corps of Engineers, June 27, 2002.

[3] The 500 meter safety radius is based on a condition in the USACE Permit granted to Cape Wind for construction and operation of the Scientific Measurement Devices Station (SMDS) [Permit No. 199902477]. The condition requires that sound level monitoring during pile driving procedures be conducted at an initial safety zone radius of 500 meters to determine compliance with the 180 dBL NMFS threshold. A similar safety radius was established by NMFS for pile installation at the San Francisco-Oakland Bay Bridge [SRS Technologies. 2004. San Francisco-Oakland Bay Bridge East Span Seismic Safety Project. Revised Marine Mammal Monitoring Plan.] [Illingworth & Rodkin, Inc. 2001. Pile Installation Demonstration Project Construction Report. *In:* San Francisco-Oakland Bay Bridge East Span Seismic Safety Project.]

this total sound level falls off to 107.5 dBL at 50 m (164 feet) and declines to the baseline level at a relatively short distance of 110 m (361 feet). Since the WTGs will be spaced farther apart than 110 m (approximately 629 to 1,000 m or 0.34 to 0.54 nautical miles apart), no cumulative impacts from the operation of the 130 WTGs in the Wind Park are anticipated. The operational effects of the Project are anticipated to be minimal, with no adverse effects on marine mammals. Submarine sound levels in this range may be audible to seals that swim close to a monopile, but would not adversely affect them or their finfish prey.

In summary, sound levels produced during construction, operation, and decommissioning activities and by project-related vessels are not expected to be of sufficient intensity to cause physical damage to gray or harbor seals. Temporary avoidance behavior to project related noise and to vessel traffic is likely to occur. Sound levels expected from project related activities are not expected to cause lasting behavioral alterations to the protected species (Richardson *et al.* 1991), and seals are likely to habituate to project activities with time.

3.2.6 Electromagnetic/Thermal Emissions

Potential direct impacts to seals during the normal operation of the inner-array cables and the two submarine cable circuits are expected to be negligible. The cable system (for both the inner-array cables and each of the submarine cable circuits) is a three-core solid dielectric AC cable design, which was specifically chosen for its minimization of environmental impacts and its reduction of any electromagnetic field. The proposed inner-array and submarine cable systems for the Project will contain grounded metallic shielding that effectively blocks any electric field generated by the operating cabling system. Since the electric field will be completely contained within those shields, impacts are limited to those related to the magnetic field emitted from the submarine cable system and inner-array cables. As described in Section 5.13 of the DEIS, the magnetic fields associated with the operation of the inner-array cables or the submarine cable system are not anticipated to result in an adverse impact to seals (ICNIRP 2000; Adair, 1994; Valberg et al. 1997).

Because the inner-array cables and the two submarine cable circuits connecting the Wind Park to the landfall will be buried approximately 6 feet below the seabed, they will not pose a physical barrier to fish passage. The considerable depth to which the cables will be buried will allow benthic organisms to colonize and demersal fish species to utilize surface sediments without being affected by the cable operation. The burial depth of the cables also minimizes potential thermal impacts from operation of these cable systems. In addition, the inner-array and submarine cable systems utilize solid dielectric AC cable designed for use in the marine environment that does not require pressurized dielectric fluid circulation for insulating or cooling purposes. There will be no direct impacts to seals or their finfish prey species (indirect impact) during the normal operation of the inner-array or submarine cable systems.

3.2.7 WTGs as Fish Aggregating Devices

The WTG monopile foundations would represent a source of new hard substrate with vertical orientation in an area that has a limited amount of such habitat. Therefore, the WTG monopile foundations and ESP piles may attract finfish and benthic organisms, thereby acting as fish aggregating devices (FADs), potentially indirectly affecting seals by causing changes to prey distribution and/or abundance. Bohnsack (1989) found that fish species most likely to benefit from artificial structures, such as the monopiles, are those with demersal, philopatric (*i.e.,* non-dispersing), territorial, and reef-obligate life histories. Several finfish species within the Proposed Alternative Site and other alternative sites in Nantucket Sound display these characteristics in some or all of their life history stages, and thus may benefit from the presence of the WTG monopile foundations. These species include Atlantic cod, black sea bass, cunner, tautog, and scup. Should finfish aggregations at the monopiles occur, the individual WTGs may be attractive to seals as a feeding ground. However, due to the small amount of additional surface area being introduced in relation to the total Project area in Nantucket Sound and the large spacing between WTGs (0.34 to 0.54 nautical miles apart), the new additional structure is not expected to affect the overall environment, finfish species composition, or populations of foraging marine mammals in the area.

Finfish aggregations will likely disperse following project decommissioning, requiring seals to forage elsewhere in the Sound. However, the production of finfish is not expected to greatly increase due to the presence of the WTGs, and thus marine mammal populations that consume finfish prey are not likely to increase due solely to the presence of the WTGs. Therefore, these animals are not expected to be greatly affected by removal of the WTGs and the subsequent dispersal of finfish prey.

3.2.8 Habitat Shift from Open Shoals to Structure-Oriented

The presence of 130 WTGs and 6 ESP piles in Nantucket Sound has the potential to shift the area immediately surrounding each WTG from a non-structured system to a structure-oriented system. Highly agile harbor and gray seals will easily be able to swim around the WTG monopile foundations, but there are potential implications of localized changes to finfish community assemblages that serve as prey for seals. Both pelagic and more demersal finfish species may tend to congregate around the WTGs; however, because the WTGs within the array will be spaced 0.34 by 0.54 nautical miles apart, the overall environment and finfish species composition in the Project Area and Nantucket Sound is not predicted to substantially change from pre-Project conditions. Furthermore, the additional amount of surface area being introduced is relatively inconsequential (approximately 1,200 square feet per tower assuming an average water dept of 30 feet below mean high water) in relation to the total Project area; therefore, the production of finfish and benthic invertebrates are not expected to substantially change from pre-Project conditions. Additionally, installation of scour control mats around the monopile foundations will help ensure that scour around the foundations and changes to the overall sediment transport within the array will be limited, further reducing potential effects to finfish use of the Project Area.

3.2.9 Cumulative Impacts

No cumulative impacts to the gray or harbor seal are expected from construction of the WTGs, the inner-array cables, or the two submarine cable circuits. Any impacts from construction activities are expected to be localized and temporary. In addition, the significant distances that Project activities will occur from seal haul-out and breeding sites further reduces any of these temporary or localized impacts. Other projects that are proposed to occur in the vicinity of the Project could contribute additional impacts to the gray and harbor seal. However, as discussed below, due to the location or anticipated schedule of these projects, they are not anticipated to contribute to cumulative impacts to these seals.

A new submarine transmission cable has been proposed by National Grid. Its proposed route may be in the vicinity of the Wind Park and its inner array cables in Nantucket Sound. Where the two projects may be in the near vicinity of one another, the impacts of each project may be coincident in nature. However, as discussed above, seal haul-out and breeding sites are not in close proximity to project activities and, individually, these projects are not likely result in impacts to seals. As such, there are no anticipated cumulative impacts that would result from the installation of both projects.

The submarine cable installation for the Cape Wind Project will cross Nantucket Sound's North Channel. North Channel is a naturally occurring and maintained passageway marked by USCG aids-to-navigation and is not designated as a Corps of Engineers Federal Navigation Project, and therefore is not subjected to maintenance dredging. Therefore, no cumulative effects are expected in the area of the North Channel crossing.

The submarine cable system will be placed adjacent to the eastern edge of the Federal Navigation Project in Hyannis Harbor. Maintenance dredging of the channel, if initiated at the same time as the jet plow installation of the cable system, could result in concurrent impacts. Hyannis Harbor was dredged in 1985, 1991, and 1998. No dredging is currently scheduled, but based on recent experience it could be needed in the next 3-4 years. However, as discussed above, seal haul-out and breeding sites are not common in the vicinity of Hyannis Harbor and, individually, these projects are not likely result in impacts to seals. If the cable installation is completed in 2006 as expected, these activities will not be concurrent. As such, there are no anticipated cumulative impacts that would result from the installation of both projects.

It is possible that additional dredging may occur at shore-based marinas supporting boating activities throughout the project area. However, these marina dredging projects are very localized and not likely to result in impacts to seals that would be coincident with the cable installation.

During operation, no cumulative impacts are expected. Based upon the lack of any other active USACE Section 10 Applications proposing similar large-scale offshore wind power generation projects or other offshore projects in Federal waters off the New England coast, it is anticipated that the cumulative impacts from this Project will be negligible. It is anticipated that smaller projects ranging from single turbines to less than ten turbines will make up the bulk of the offshore wind generation in the foreseeable near term. These are likely to be municipally sponsored, nearshore projects, and not developed in sufficient numbers to create any significant cumulative impacts.

3.3 Summary/Conclusion of Impacts

Based on the analysis of potential impacts, it is unlikely that significant adverse effects to gray and harbor seals will result from the construction, operation, maintenance, and decommissioning of this Project. Water quality impacts from elevated TSS are expected to be temporary and localized, and bioaccumulation in seals from consumption of contaminated food sources is not expected to occur. Although vessel traffic will increase during the period of the Project, collisions between seals and project tugboats and barges are unlikely. Seals can audibly detect barges and tugs, and because of the slow speed at which barges and tugs operate, seals will likely avoid them. Acoustic disturbance from the increased vessel traffic and Project construction is likely to cause only minor and temporary disturbance to seals. Design and placement of the inner-array and submarine cable systems will ensure that no impacts to seals or their prey occur during normal Wind Park operation. Seals may use the individual WTGs for feeding should the WTG monopile foundations act as fish aggregating devices. However, as noted above, because the WTGs within the array will be spaced 0.34 by 0.54 nautical miles apart, the overall environment and finfish species composition in the Project Area and Nantucket Sound is not predicted to substantially change from pre-Project conditions. The management actions discussed below in Section 3.4 will minimize potential vessel collisions and potential acoustic disturbance.

3.4 Management Alternatives for the Potential Impacts of the Proposed Action

1. **Possible event:** Collision with Project-related vessels
   Possible result: Injury or death of seal
   Management Action or Practice: Vessels transporting construction materials to the Project site in Nantucket Sound will travel at slow speeds, usually well below 14 knots. Nevertheless, potential vessel impacts to seals will be minimized by requiring that Project vessels follow *NOAA Fisheries Regional Viewing Regulations – Northeast Region Seal Watching Guidelines* (NOAA Fisheries, 2003) while in transit to and from the WTG site so as not to disturb any individuals that may be in the area.

2. **Possible event:** Acoustic harassment
   Possible result: Short-term: change in swimming direction and/or breathing patterns; Long-term: unknown
   Management Action or Practice: Little is known of the long-term effects of acoustic harassment, though seals seem to acclimate readily to underwater sounds produced by motor vessels. Barge traffic will not contribute significantly to the total underwater background sound in the area and is not likely to be disturbing to seals. Construction and operation sounds are not expected to reach levels known to be harmful to seals. Acoustic harassment during monopile construction may be minimized by conducting a "soft start" to each pile event. This will allow seals in the immediate vicinity of Project activities the opportunity to leave the area. In addition, underwater sound monitoring will be performed during initial monopile construction (as was done to ensure protection of marine mammals during the installation of the SMDS foundation piles). This will include posting a NMFS-certified observer on-site during initial pile driving activities to monitor the area during construction. If protected species are observed within the Safety Zone by the NMFS-approved observer, the observer will ensure that work will cease until the animal is clear of the work area and safety zone (see Section 5.11.2.7 of the DEIS). These measures should provide adequate protection to avoid and minimize acoustic impacts to seals and marine mammals.

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