Request for the Taking of Marine Mammals Incidental to Site Characterization of Lease Area OCS-A 0508

Prepared for:

Avangrid Renewables, LLC

Two Radnor Corporate Center, Suite 200
100 Matsonford Rd.
Radnor, PA 19087

Prepared by:

Tetra Tech, Inc.

160 Federal Street
Boston, MA 02110

February 21, 2019

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

ACRONYMS AND ABBREVIATIONS

Applicant	Avangrid Renewables, LLC
Avangrid Renewables	Avangrid Renewables, LLC
BOEM	Bureau of Ocean Energy Management
CeTAP	Cetacean and Turtles Assessment Program
FAQ	frequently asked questions
CFR	Code of Federal Regulations
dB	decibel
ESA	Endangered Species Act
ft	foot
GPS	global positioning system
HF	high-frequency
HRG	high-resolution geophysical
Hz	hertz
IHA	Incidental Harassment Authorization
kHz	kilohertz
km	kilometers
km/hr	kilometers per hour
knot	nautical mile per hour
Lease	Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0508)
LF	Low-Frequency
m	meter
m/s	meters per second
MF	Mid-Frequency
mi	mile
MMPA	Marine Mammal Protection Act
ms	millisecond
nm	nautical mile
NMFS	National Marine Fisheries Services
NOAA	National Oceanic and Atmospheric Administration
NUWC	Naval Undersea Warfare Center
OCS	Outer Continental Shelf
OPAREA	Operations Area
PAM	Passive Acoustic Monitoring
PSO	Protected Species Observer
Project	Kitty Hawk Offshore Wind Project
PTS	permanent threshold shift
RMS	root mean square
SELcum	cumulative sound exposure level
SMA	Seasonal Management Area
SPUE	sightings per unit effort
Tetra Tech	Tetra Tech, Inc.
TTS	temporary threshold shift
USBL	ultra-short baseline positioning system

ZOI	Zone of Influence
μPa	microPascal

1.0 DESCRIPTION OF SPECIFIED ACTIVITY

Avangrid Renewables, LLC (Avangrid Renewables) (the Applicant), is proposing to conduct marine site characterization surveys off the coast of North Carolina as part of the Kitty Hawk Offshore Wind Project (Project) in the area of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0508) (Lease) and coastal waters where one or more cable route corridors will be established prior to conducting the survey (Figure 1). The Applicant submits this request for Incidental Harassment Authorization (IHA) pursuant to Section 101(a)(5) of the Marine Mammal Protection Act (MMPA) and 50 Code of Federal Regulations (CFR) § 216 Subpart I to allow for the incidental harassment of small numbers of marine mammals resulting from the implementation of marine site characterization surveys specifically associated with the operation of high-resolution geophysical (HRG) survey equipment during upcoming field activities. Both the National Oceanic and Atmospheric Administration (NOAA) and the Bureau of Ocean Energy Management (BOEM) have advised that sound-producing survey equipment operating below 200 kilohertz (kHz) (e.g., sub-bottom profilers) has the potential to cause acoustic harassment to marine species, in particular marine mammals. This request is being submitted to specifically address survey sound-producing data acquisition equipment that operate below 200 kHz.

The regulations set forth in Section 101(a) (5) of the MMPA and 50 CFR § 216 Subpart I allow for the incidental taking of marine mammals by a specific activity if the activity is found to have a negligible impact on the species or stock(s) of marine mammals and will not result in immitigable adverse impact on the availability of the marine mammal species or stock(s) for certain subsistence uses. In order for the National Marine Fisheries Service (NMFS) to consider authorizing the taking by U.S. citizens of small numbers of marine mammals, incidental to a specified activity (other than commercial fishing), or to make a finding that incidental take is unlikely to occur, a written request must be submitted to the Assistant Administrator. Such a request is detailed in the following sections.

1.1 Survey Activities

The Applicant will conduct HRG surveys in the marine environment of the approximately 122,317-acre Lease Area, with the boundary of the Lease Area located approximately 31.3 nautical miles off the coast of Currituck, North Carolina in federal waters of the United States (see Figure 1). Multiple cable route corridors may be surveyed within the area noted in Figure 1. For the purpose of this application, the survey area is designated as the Lease Area and cable route corridors that will be established in advance of conducting the HRG survey activity.

Water depths across the Lease Area range from approximately 20 to 50 (m, 66 to 164 feet [ft]) and the cable route corridors will extend to shallow water areas near landfall locations. The purpose of the marine site characterization survey is to:

- Support the siting, design, and deployment of up to three meteorological data buoy deployment areas; and
- Obtain a baseline assessment of seabed/sub-surface soil conditions in the Lease Area and cable route corridors to support the siting of the proposed wind farm.

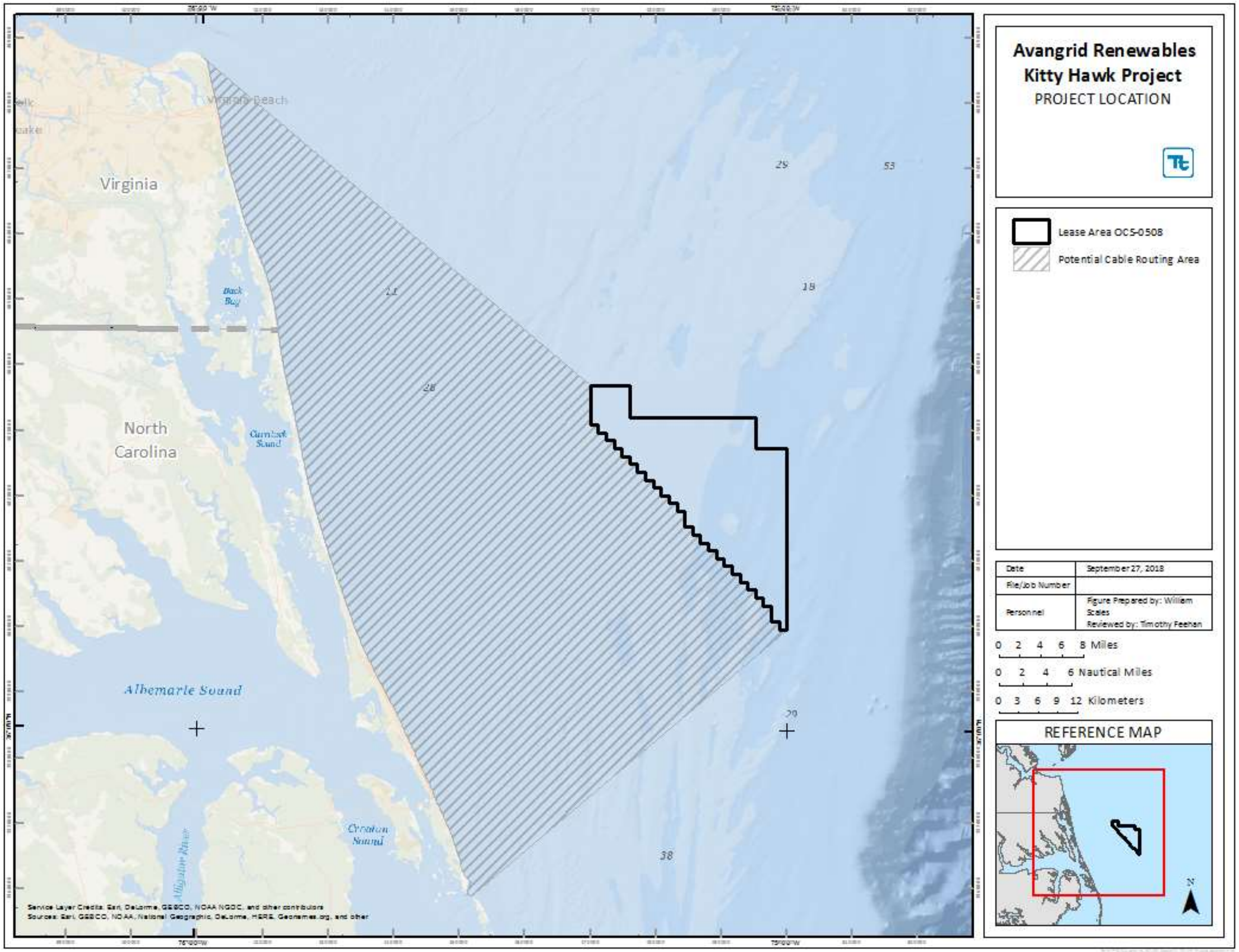


Figure 1. Project Area

The HRG survey activities will include the following:

- Depth sounding (multibeam echosounder) to determine site bathymetry and elevations;
- Magnetic intensity measurements for detecting local variations in regional magnetic field from geological strata and potential ferrous objects on and below the bottom;
- Seafloor imaging (sidescan sonar survey) for seabed sediment classification purposes, to identify natural and man-made acoustic targets resting on the bottom as well as any anomalous features;
- Shallow penetration sub-bottom profiler (pinger/chirp) to map the near surface stratigraphy (top 0 to 5 m [0 to 16 ft] of soils below seabed);
- Medium penetration sub-bottom profiler (sparker) to map deeper subsurface stratigraphy as needed (soils down to 75 to 100 m [246 to 328 ft] below seabed); and
- Benthic Drop-down Video (DDV) and Grab Samples to inform and confirm geophysical interpretations and to provide further detail on areas of potential benthic and ecological interest.

1.1.1 HRG Survey

The HRG surveys are anticipated to begin no earlier than May 1, 2019. The survey equipment will be equivalent to the representative survey equipment identified in Table 1.The make and model of the listed HRG equipment may vary depending on availability but will be finalized as part of the survey preparations and contract negotiations with the survey contractor.

A recent technical report conducted by the Naval Undersea Warfare Center (NUWC), through support from BOEM and United States Geological Survey, published measurement data from the sounds emitted during HRG surveys (Crocker and Fratantonio, 2016). The HRG test equipment were operated over a wide range of settings with different acoustic levels measured. As a conservative measure, the highest sound source levels and pulse duration for each piece of equipment were applied. Representative equipment and source level characteristics are listed in Table 1.

.

Table 1. Measured Source Levels of Representative HRG Survey Equipment

HRG System	Representative HRG Survey Equipment	Operating Frequencies	Peak Source Level	RMS Source Level	Pulse Duration (ms)	Beam Width (degree)	Signal Type
Subsea Positioning / USBL a/	Sonardyne Ranger 2 USBL	35-50 kHz	200 dB_{peak}	188 dB_{RMS}	16	180	FM Chirp
Sidescan Sonar	Klein 3900 Sidescan Sonar	445 kHz/ 900 kHz	226 dB_{peak}	220 dB_{RMS}	0.016 to 0.100	1 to 2	Impulse
Shallow penetration sub-bottom profiler	EdgeTech 512i	0.4 to 12 kHz	186 dB_{peak}	179 dB_{RMS}	1.8 to 65.8	51 to 80	FM Chirp
Parametric Shallow penetration sub-bottom profiler	Innomar parametric SES-2000 Standard	85 to 115 kHz	243 dB_{peak}	236 dB_{RMS}	0.07 to 2	1	FM Chirp
Medium penetration sub-bottom profiler	SIG ELC 820 Sparker	0.9 to 1.4 kHz	215 dB_{peak}	206 dB_{RMS}	0.8	30 b/	Impulse

HRG System	Representative HRG Survey Equipment	Operating Frequencies	Peak Source Level	RMS Source Level	Pulse Duration (ms)	Beam Width (degree)	Signal Type
Multibeam Echo Sounder	Reson T20-P	200/300/400 kHz	227 dB_{peak}	221 dB_{RMS}	2 to 6	1.8 ±0.2°	Impulse
a/: Equipment information not provided in Crocker and Fratantonio, 2016. Information provided is based on manufacturer specifications. b/: A beamwidth of 30 degrees from horizontal is considered typical for electrode sparker technologies. Specific beamwidth information is not readily available from the equipment manufacturer.							

The primary operating frequency was used for calculations using the NMFS Technical Guidance's Companion User Spreadsheet (Appendix A). The primary operating frequency is defined by the HRG equipment manufacturer as the frequency at which the highest sound intensity is produced and is therefore the most conservative approach when calculating distance to thresholds. While the operating range (Table 1) describes the full range of detectable sound generated, it includes secondary sound fields and harmonics which have much lower amplitudes, typically 10-30dB lower than the primary operating frequency.

The survey activities will be supported by a vessel, or vessels, capable of maintaining course and a survey speed of approximately 4 nautical miles per hour (knots, 7 kilometers per hour [km/hr]) while transiting survey lines. Surveys will be conducted along tracklines spaced 150 m (98 ft) apart, with tie-lines spaced every 500 m (1640 ft). Given the competitive bidding process that needs to occur to secure contractors that will ultimately conduct the geophysical survey and the very limited fleet of vessels that exists to service a growing number of projects along the U.S. East Coast, the number of vessels to be used is completely dependent on vessel availability during the proposed survey period, and the need to complete the survey in a timely manner. The Applicant desires the flexibility to: (1) utilize vessels available during the survey period, and (2) have the ability to include additional vessels should the need arise, or as survey vessels become available. Recently approved IHA applications have been granted this same operational flexibility as far as anticipated range of vessels needed (see Deepwater Wind RIMA 2019 Application; GSOE Skipjack 2018 IHA Application). The Applicant understands the need to evaluate vessel transits associated with the proposed survey; however, final vessel choices will vary depending on the final survey design, vessel availability, and survey contractor selection.

To minimize cost, the duration of survey activities, and the period of potential impact on marine species while surveying, the Applicant has proposed conducting continuous HRG survey operations 24 hours per day. Based on 24-hour operations, the estimated duration of the HRG survey activities would be approximately 37 days (including estimated weather down time). Additional time may be required to obtain full multibeam coverage in shallow water areas, however the multibeam sensor operates at frequencies above the hearing threshold of marine mammals and therefore multibeam only survey activity is not included in the estimate of take calculations provided below.

As noted previously, both NOAA and BOEM have advised that the deployment of HRG survey equipment including the use of sound-producing equipment operating below 200 kHz (e.g., sub-bottom profilers) has the potential to cause acoustic harassment to marine species, in particular marine mammals. Based on the frequency ranges of the potential equipment to be used in support of the HRG survey activities (Table 1), the ultra-short baseline (USBL) positioning system and the sub-bottom profilers (shallow and medium penetration) operate within the established marine mammal hearing ranges and have the potential to result in Level A and B Harassment of marine mammals.

1.2 Survey Activities Resulting in the Potential Incidental Taking of Marine Mammals

The potential effects of underwater noise resulting in takes on marine mammals are federally managed by NOAA under the MMPA to minimize the potential for both harm and harassment. Under the MMPA, Level A harassment is statutorily defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild; however, the actionable sound pressure level is not identified in the statute. Level B harassment is defined as any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

In July of 2016, NMFS finalized the Technical Guidance for *Assessing the Effect of Anthropogenic Sound on Marine Mammals - Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts*. Under this guidance, Level A harassment is said to occur as a result of exposure to high noise levels and at the onset of permanent hearing sensitivity loss, known as a permanent threshold shift (PTS). This revision to earlier NMFS guidelines is based on findings published by the Noise Criteria Group (Southall et al., 2007). For transient and continuous sounds, it was concluded that the potential for injury is not just related to the level of the underwater sound and the hearing bandwidth of the animal but is also influenced by the duration of exposure. The evaluation of the onset of PTS and temporary threshold shift (TTS) provides additional species-specific insight on the potential for affect that is not captured by evaluations completed using the previous NMFS thresholds for Level A and Level B harassment alone. The June 2018 Revision (NOAA Technical Memorandum NMFS-OPR-59) to its 2016 Technical Guidance largely reaffirmed these acoustic criteria.

Frequency weighting provides a sound level referenced to an animal's hearing ability either for individual species or classes of species, and therefore a measure of the potential of the sound to cause an effect. The measure that is obtained represents the perceived level of the sound for that animal. This is an important consideration because even apparently loud underwater sound may not affect an animal if it is at frequencies outside the animal's hearing range. In the NMFS final Guidance document, there are five hearing groups: Low-frequency (LF) cetaceans (baleen whales), Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales), High-frequency (HF) cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*), Phocid pinnipeds (true seals), and Otariid pinnipeds (sea lions and fur seals). It should be noted that Otariid pinnipeds do not occur in the survey area.

There are specific hearing criteria thresholds provided by NMFS for each of group. These criteria apply hearing adjustment curves for each animal group known as M-weighting.

Table 2. M-Weighted PTS and TTS Acoustic Criteria and Metrics for Marine Mammals (NMFS, 2016/2018)

Functional Hearing Group	PTS Onset Impulsive	PTS Onset Non Impulsive	Functional Hearing Range
LF cetaceans	219 dB_{peak} & 183 dB SEL_{cum}	199 dB SEL_{cum}	7 Hz to 35 kHz
MF cetaceans	230 dB_{peak} & 185 dB SEL_{cum}	198 dB SEL_{cum}	150 Hz to 160 kHz
HF cetaceans	202 dB_{peak} & 155 dB SEL_{cum}	173 dB SEL_{cum}	275 Hz to 160 kHz
Phocid pinnipeds	218 dB_{peak} & 185 dB SEL_{cum}	201 dB SEL_{cum}	50 Hz to 86 kHz

Functional Hearing Group	PTS Onset Impulsive	PTS Onset Non Impulsive	Functional Hearing Range
Otariid pinnipeds	232 dB_{peak} & 203 dB SEL_{cum}	219 dB SEL_{cum}	60 Hz to 39 kHz

NOAA has defined the threshold level for Level B harassment at 120 dB_{RMS} re 1 µPa for continuous non-impulsive noise and 160 $dB_{RMS90\%}$ re 1 µPa non-continuous pulsed noise. Within this zone, the sound produced by the site investigation equipment may approach or exceed ambient sound levels (i.e., threshold of perception or zone of audibility); however, actual perceptibility will be dependent on the hearing thresholds of the species under consideration and the inherent masking effects of ambient sound levels.

PTS criteria thresholds were assigned as prescribed in the Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals (NMFS 2016; Table 1-2) and reaffirmed in the 2018 Revision to the Technical Guidance (NMFS 2018). NOAA's threshold level for Level B harassment remains 160 $dB_{RMS90\%}$ re 1 µPa. As discussed further in Section 5.0, non-impulsive PTS Level A harassment thresholds were applied for shallow penetration SBP and USBL pingers, while the impulsive PTS Level A harassment threshold was applied to the medium penetration SBP. An important distinction between electromechanical and other acoustic sources employed in HRG survey systems is the determinism of the transmitted signal. Whereas electromechanical sources employ deterministic signals generated by piezoelectric transducers which are frequency modulated (FM chirp), non-electromechanical sources typically employ impulsive physical processes including the release of high-pressure air or electric field discharge at high voltage (i.e., sparkers) to generate high-intensity acoustic fields (Crocker and Farantino 2016). While classified as non-impulsive, given the short pulse duration and transient nature of a frequency modulated signal of the USBL and shallow penetration SBP pinger, the use of the continuous Level B criteria has been deemed inappropriate for assessing masking effects or predicting adverse auditory effects on marine mammals.

2.0 DATES, DURATION, AND SPECIFIC GEOGRAPHIC REGION

2.1 Dates and Duration

HRG Surveys are anticipated to commence no earlier than May 1, 2019 and will last for approximately 37 days. This survey schedule is based on 24-hour operations and includes estimated weather down time. Additional time may be required to obtain full multibeam coverage in shallow water areas, however the multibeam sensor operates at frequencies above the hearing threshold of marine mammals and therefore multibeam only survey activity is not included in the estimate of take calculations provided below. Up to 30 days of multibeam only survey may be required.

2.2 Specific Geographic Region

The Applicant's survey activities will occur in the approximately 122,317-acre Kitty Hawk Offshore Wind Project Lease Area and along cable route corridors to be established within the cable route area identified in Figure 1. Each survey corridor is anticipated to be 30 to 70 nautical miles and extend from the lease area to landfall locations to be determined.

3.0 SPECIES AND NUMBERS OF MARINE MAMMALS

The Mid-Atlantic Environmental Assessment (EA) (BOEM, 2012) reports 34 species of marine mammals (whales, dolphins, porpoise, and seals) that may occur in the Northwest Atlantic OCS region that are protected by the MMPA, 6 of which are listed under the Endangered Species Act (ESA) and are known to be present, at least seasonally, in the Lease Area (See Table 3). The North Carolina Environmental Assessment (EA) (BOEM, 2015) reports 16 species of marine mammals that may occur off the Virginia and North Carolina coast that are protected by the MMPA, 5 of which are listed under the ESA. A description of the status and distribution of these species are discussed in detail in Section 4.0.

Table 3. Marine Mammals Known to Occur in the Marine Waters in Coastal Offshore Virginia and North Carolina

Common Name	Scientific Name	ESA and MMPA Status	Estimated Population	Stock
Oodntocetes (Toothed Whales)				
Phocoenidae				
Harbor Porpoise	*Phocoena phocoena*	MMPA	79,833	Gulf of Main/Bay of Fundy
Delphinidae				
White-Sided Dolphin	*Lagenorhynchus acutus*	MMPA	48,819	W. North Atlantic
Short-beaked Common Dolphin	*Delphinus delphis*	MMPA	70,184	W. North Atlantic
Bottlenose Dolphin	*Tursiops truncatus*	MMPA	3,751	W. North Atlantic, Southern Migratory Coastal
			77,532	W. North Atlantic Offshore
			823	N. North Carolina Estuarine System
Clymene Dolphin	*Stenella clymene*	MMPA	Unknown	W. North Atlantic
Pan-Tropical Spotted Dolphin	*Stenella attenuata*	MMPA	3,333	W. North Atlantic
Atlantic Spotted Dolphin	*Stenella frontalis*	MMPA	44,715	W. North Atlantic
Striped Dolphin	*Stenella coeruleoalba*	MMPA	54,807	W. North Atlantic
Risso's Dolphin	*Grampus griseus*	MMPA	18,250	W. North Atlantic
Spinner Dolphin	*Stenella longirostris*	MMPA	Unknown	W. North Atlantic
Killer Whale	*Orcinus orca*	MMPA	Unknown	W. North Atlantic
False Killer Whale	*Pseudorca crassidens*	MMPA	442	W. North Atlantic
Melon-headed whale	*Peponocephala electra*	MMPA	Unknown	W. North Atlantic
Sperm Whale	*Physeter macrocephalus*	ESA: Endangered	2,288	North Atlantic
Dwarf Sperm Whale	*Kogia sima*	MMPA	3,785 a/	W. North Atlantic
Pygmy Sperm Whale	*Kogia breviceps*	MMPA	3,785 a/	W. North Atlantic
Long-finned Pilot Whale	*Globicephala melas*	MMPA	5,636	W. North Atlantic
Short-finned Pilot Whale	*Globicephala macrorhynchus*	MMPA	21,515	W. North Atlantic
Ziphiidae				
Blainville's Beaked Whale	*Mesoplodon densirostris*	MMPA	7,092 b/	W. North Atlantic
True's Beaked Whale	*Mesoplodon mirus*	MMPA	7,092 b/	W. North Atlantic
Gervais' Beaked Whale	*Mesoplodon europaeus*	MMPA	7,092 b/	W. North Atlantic

Table 3. Marine Mammals Known to Occur in the Marine Waters in Coastal Offshore Virginia and North Carolina

Common Name	Scientific Name	ESA and MMPA Status	Estimated Population	Stock
Cuvier's Beaked Whale	*Ziphius cavirostris*	MMPA	6,532	W. North Atlantic
Sowerby's Beaked Whale	*Mesoplodon bidens*	MMPA	7,092 b/	W. North Atlantic
Mysticetes (Baleen Whales)				
Balaenopteridae				
Fin Whale	*Balaenoptera physalus*	ESA: Endangered	1,618	W. North Atlantic
Sei Whale	*Balaenoptera borealis*	ESA: Endangered	357	Nova Scotia
Minke Whale	*Balaenoptera acutorostrata*	MMPA	2,591	Canadian East Coast
Blue Whale	*Balaenoptera musculus*	ESA: Endangered	Unknown	W. North Atlantic
Bryde's Whale	*Balaenoptera edeni*	MMPA	33	Gulf of Mexico
Balaenidae				
North Atlantic Right Whale	*Eubalaena glacialis*	ESA: Endangered	440 d/	W. North Atlantic
Pinnipeds				
Phocidae				
Harbor Seal	*Phoca vitulina*	MMPA	75,834	W. North Atlantic
Gray Seal	*Halichoerus grypus*	MMPA	27,131	W. North Atlantic
Harp Seal	*Pagophilus groenlandicus*	MMPA	Unknown	W. North Atlantic
Hooded Seal	*Cystophora cristata*	MMPA	Unknown	W. North Atlantic
Sirenia				
Trichechidae				
West Indian Manatee	*Trichechus manatus*	ESA: Threatened	Unknown	Florida

a/ This estimate may include both the dwarf and pygmy sperm whales.

b/ This estimate includes Gervais' and Blainville's beaked whales and undifferentiated Mesoplodon spp. beaked whales.

c/ A strategic stock is defined as any marine mammal stock: 1) for which the level of direct human-caused mortality exceeds the potential biological removal level; 2) which is declining and likely to be listed as threatened under the ESA; or 3) which is listed as threatened or endangered under the ESA or as depleted under the MMPA (http://www.ncseonline.org/nle/crsreports/biodiversity/biodv-11.cfm).

Sources: Hayes et al. 2018; Hayes et al. 2017; Waring et al. 2016; Waring et al. 2015; Waring et al 2013; Waring et al 2011; Waring et al 2010; RI SAMP 2011; Kenney and Vigness-Raposa 2009; NMFS 2012

d/ According to Pace *et. al.* 2017, the estimated population was 458 in 2015 with 17 mortalities in 2017.

4.0 AFFECTED SPECIES STATUS AND DISTRIBUTION

As described in Section 3.0, there are up to 34 marine mammal species (whales, dolphins, porpoise, manatee, and seals) which are known to be present (some year-round, and some seasonally) in the Northwest Atlantic OCS region. NOAA uses Operating Area Density Estimates developed by the U.S. Navy (2007), supplemented by data from other sources, to update species Stock Assessment Reports. These reports suggest that marine mammal density in the Mid-Atlantic region is patchy and seasonally variable.

All 34 marine mammal species identified in Table 3 are protected by the MMPA and some are also listed under the ESA. The 6 ESA-listed marine mammal species known to be present year-round or seasonally in the waters of the Mid-Atlantic are the sperm whale, right whale, fin whale, blue whale, sei whale, and the West Indian manatee. The humpback whale, which may occur year-round, was recently delisted as an endangered species. Generally, many of these species are highly migratory and do not spend extended periods of time in a localized area. The offshore waters of Virginia and North Carolina, including the Project Area, are primarily used as a migration corridor for these species, particularly by right whales, during seasonal movements north or south between important feeding and breeding grounds (Knowlton et al. 2002; Firestone et al. 2008). As of January 26, 2016, NOAA Fisheries expanded the North Atlantic Right Whale Critical Habitat Southeastern U.S. Calving Area from Cape Fear, North Carolina, southward to 29°N latitude (approximately 43 miles north of Cape Canaveral, Florida). However, this expanded area is well south of the proposed Project Area. While the fin, humpback, and sei, and right whales have the potential to occur within the Project Area, the sperm, and blue whales are more pelagic and/or northern species, and their presence within the Project Area is unlikely (Waring et al. 2007; 2010; 2012; 2013). While the BOEM Environmental Assessment (EA) for the North Carolina Wind Energy Areas (2015) indicates that Bryde's whale may be present during fall and winter, the majority of sightings of this species has occurred within the northeastern Gulf of Mexico (Waring et al. 2016). It is possible that the rare Bryde's whale sightings off southeastern U.S. states are strays from Gulf of Mexico, and their presence in the Project Area is unlikely during the summer and fall (BOEM 2015). The West Indian manatee has been sighted in Virginia and North Carolina waters; however, such events are infrequent. Because the potential for the sperm whale, blue whale, Bryde's whale, and West Indian manatee to occur within the Project Area is unlikely, these species will not be described further in this analysis. In addition, while strandings data exists for harbor and gray seals along the Mid-Atlantic coast south of New Jersey, their preference for colder, northern waters during the survey period makes their presence in the Project Area unlikely during the summer and fall (Hayes et al 2018; 2017). Winter haul-out sites for harbor seals have been identified within the Chesapeake Bay region and Outer Banks beaches, however the seals are only occasionally sited as far south as the Carolinas and are not likely to be present during spring and summer months during which survey activities are planned (Hayes et al 2018; 2017). In addition, coastal Virginia and North Carolina represent the southern extent of the habitat range for gray seals, with few stranding records reported for the even more southern waters of North Carolina and sightings occurring only during winter months as far south as New Jersey (Waring et al. 2016). Harp and hooded seals are also occasionally sighted as far south as the Carolinas, but only during winter months. Therefore, these seal species will not be described further in this analysis.

The following subsections provide additional information on the biology, habitat use, abundance, distribution, and the existing threats to the non-endangered or threatened and endangered marine mammals that are both common in both Virginia and North Carolina waters and have the likelihood of occurring, at least seasonally, in the Project Area. These species include the harbor porpoise, Atlantic white-sided dolphin, short-beaked common dolphin, bottlenose dolphin, Atlantic spotted dolphin, Risso's dolphin, and the long-finned pilot, short-finned pilot, minke, fin, sei, humpback and right whales. In general, the range of the remaining non-ESA whale species listed in Table 3 is outside the Project Area; they are usually found in more pelagic shelf-break waters, have a preference for northern latitudes, or are so rarely sighted that their presence in the Project Area is unlikely. Because the potential presence of these species in the Project Area is considered extremely low, they are not further addressed in this analysis.

4.1 Toothed Whales (Odontonceti)

Harbor Porpoise (*Phocoena phocoena*) – Non-Strategic

The harbor porpoise inhabits shallow, coastal waters, often found in bays, estuaries, and harbors. In the western Atlantic, they are found from Cape Hatteras north to Greenland. They are likely to occur frequently in southern New England waters within all seasons but are most likely to reach their highest densities in spring when migration brings them toward the Gulf of Maine feeding grounds from their wintering areas offshore and in the mid-Atlantic (Kenney and Vigness-Raposa 2009). After April, they migrate north towards the Gulf of Maine and Bay of Fundy. Kenney and Vigness-Raposa (2009) report that harbor porpoises are among the most abundant cetaceans in southern New England coastal waters. Harbor porpoises are the smallest North Atlantic cetacean, measuring at only 1.4 to 1.9 m, and feed primarily on fish, but also prey on squid and crustaceans (Reeves and Read 2003; Kenney and Vigness-Raposa 2009). Sighting records from the 1978 to 1981 Cetacean and Turtle Assessment Program (CeTAP) surveys showed porpoises in spring exhibited highest densities in the southwestern Gulf of Maine in proximity to the Nantucket Shoals and western Georges Bank, with presence throughout the southern New England shelf and Gulf of Maine (CeTAP 1982). While strandings have occurred throughout the south shore of Long Island and coastal Rhode Island, many sightings have occurred offshore in the OCS area (Kenney and Vigness-Raposa 2009). The North Atlantic harbor porpoise population is likely to be over 500,000 (Kenney and Vigness-Raposa 2009). The current population estimate for harbor porpoise in the Gulf of Maine/Bay of Fundy is 79,833 (Hayes et al. 2018; 2017).

The most common threat to the harbor porpoise is from incidental mortality from fishing activities, especially from bottom-set gillnets. It has been demonstrated that the porpoise echolocation system is capable of detecting net fibers, but they either must not have the “system activated” or else they fail to recognize the nets (Reeves et al. 2002). Roughly 437 harbor porpoises are killed by human-related activities in U.S. and Canadian waters each year (Hayes et al. 2017). In 1999, a Take Reduction Plan to reduce harbor porpoise bycatch in U.S. Atlantic gillnets was implemented. The plan that pertains to the Gulf of Maine focuses on sink gillnets and other gillnets that can catch groundfish in New England waters. The ruling implements time and area closures, some of which are complete closures, as well as requiring pingers on multispecies gillnets. In 2001, the harbor porpoise was removed from the candidate species list for the ESA; a review of the biological status of the stock indicated that a classification of “Threatened” was not warranted (Waring et al. 2009). This species has been listed as “non-strategic” because average annual human-related mortality and injury does not exceed the potential biological removal (Waring et al. 2015).

Bottlenose Dolphin (*Tursiops truncatus*) – Non-Strategic Offshore Migratory Stock; Non-Endangered Southern Coastal Migratory Stock; Strategic Northern North Carolina Estuarine System Stock: Strategic

The bottlenose dolphin is a light- to slate-gray dolphin, roughly 8 to 12 ft (2.4 to 3.7 m) long with a short, stubby beak. Because this species occupies a wide variety of habitats, it is regarded as possibly the most adaptable cetacean (Reeves et al. 2002). It occurs in oceans and peripheral seas at both tropical and temperate latitudes. In North America, bottlenose dolphins are found in surface waters with temperatures ranging from 10 to 32°C (50 to 90°F). Its hearing is in the mid-frequency range (Southall et al. 2007).

There are two distinct bottlenose dolphin morphotypes: migratory coastal and offshore. The migratory coastal morphotype resides in waters typically less than 65.6 ft (20 m) deep, along the inner continental shelf (within 7.5 km (4.6 miles) of shore), around islands, and is continuously distributed south of Long Island, New York into the Gulf of Mexico. This migratory coastal population is subdivided into 7 stocks based largely upon spatial distribution (Waring et al. 2016). Of these 7 coastal stocks, the Western North Atlantic migratory coastal stock is common in the coastal continental shelf waters off the coast of Virginia and North Carolina (Waring et al. 2016). These animals often move into or reside in bays, estuaries, the lower reaches of rivers, and coastal waters within the approximate 25 m depth isobath north of Cape Hatteras (Reeves et al. 2002; Waring et al. 2016). There is also the potential, though unlikely, of the Northern North Carolina estuarine system stock occurring. This morphotype is considered locally coastal, continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, and can be found in inshore waters of the bays, sounds and estuaries (Waring et al. 2016).

Generally, the offshore migratory morphotype is found exclusively seaward of 34 km (21 miles) and in waters deeper than 34 m (111.5 feet). This morphotype is most expected in waters north of Long Island, New York (Waring et al. 2016; Hayes et al. 2017). The offshore population extends along the entire continental shelf-break from Georges Bank to Florida during the spring and summer months and has been observed in the Gulf of Maine during the late summer and fall. However, the range of the offshore morphotype south of Cape Hatteras has recently been found to overlap with that of the migratory coastal morphotype, sampled as close as 7.3 km (4.5 miles) from the shore in water depths of 13 m (42.7 feet) (Waring et al. 2016; Hayes et al. 2018; 2017). The Northern North Carolina estuarine system stock animals primarily occur in estuarine waters of Pamlico Sound during warm water months (July-August) and coastal waters (<1 km from shore) of North Carolina from Beaufort north to southern Virginia and the lower Chesapeake (Waring et al. 2016). NMFS species stock assessment report estimates the population of Western North Atlantic offshore bottlenose dolphin stock at approximately 77,532 individuals; the Western North Atlantic southern migratory coastal stock at approximately 3,751 individuals; and the Northern North Carolina estuarine system stock is 823 animals (Waring et al. 2016; Hayes et al. 2018; 2017).

Bottlenose dolphins feed on a large variety of organisms, depending on their habitat. The coastal, shallow population tends to feed on benthic fish and invertebrates, while deepwater populations consume pelagic or mesopelagic fish such as croakers, sea trout, mackerel, mullet, and squid (Reeves et al. 2002). Bottlenose dolphins appear to be active both during the day and night. Their activities are influenced by the seasons, time of day, tidal state, and physiological factors such as reproductive seasonality (Wells and Scott 2002).

The biggest threat to the population is bycatch because they are frequently caught in fishing gear, gillnets, purse seines, and shrimp trawls (Waring et al. 2016). They have also been adversely impacted by pollution, habitat alteration, boat collisions, human disturbance, and are subject to bioaccumulation of toxins. Scientists have found a strong correlation between dolphins with elevated levels of PCBs and illness, indicating certain pollutants may weaken their immune system (ACSonline 2004). Total U.S. fishery related mortality and serious injury for this stock is less than 10 percent of the calculated potential biological removal and, therefore, can be considered to be insignificant and approaching the zero mortality and serious injury rate. NMFS considers this species as “non-strategic” (Hayes et al. 2018; 2017).

Short-Beaked Common Dolphin (*Delphinus delphis*) – Non-Strategic

The short-beaked dolphin is one of the most widely distributed cetaceans and occurs in temperate, tropical, and subtropical regions (Jefferson et al. 2008). Short-beaked dolphins feed on squids and small fish, including species that school in proximity to surface waters as well as mesopelagic species found near the surface at night (World Conservation Union [IUCN] 2010; NatureServe 2010). They have been known to feed on fish escaping from fishermen’s nets or fish that are discarded from boats (NOAA 1993). This species is found between Cape Hatteras and Georges Bank from mid-January to May, although they migrate onto Georges Bank and the Scotian Shelf between mid-summer and fall, where large aggregations occur on Georges Bank in fall (Waring et al. 2007). These dolphins can gather in schools of hundreds or thousands, although the schools generally consist of smaller groups of 30 or fewer. They are eager bow riders and are active at the surface (Reeves et al. 2002). The short-beaked common dolphin feeds on small schooling fish and squid. While this dolphin species can occupy a variety of habitats, short-beaked common dolphins occur in greatest abundance within a broad band of the northeast edge of Georges Bank in the fall (Kenney and Vigness-Raposa 2009). According to the species stock report, the best population estimate for the western North Atlantic common dolphin is approximately 70,184 individuals (Hayes et al. 2018; 2017).

Short-beaked common dolphins can be found either along the 650- to 6,500-ft (200- to 2,000-m) isobaths over the continental shelf and in pelagic waters of the Atlantic and Pacific Oceans. They are present in the western Atlantic from Newfoundland to Florida. The short-beaked common dolphin is especially common along shelf edges and in areas with sharp bottom relief such as seamounts and escarpments (Reeves et al. 2002). They show a strong affinity for areas with warm, saline surface waters. Off the coast of the eastern United States, they are particularly abundant in continental slope waters from Georges Bank southward to about 35 degrees north (Reeves et al. 2002) and usually inhabit tropical, subtropical, and warm-temperate waters (Waring et al. 2009).

The short-beaked common dolphin is also subject to bycatch. It has been caught in gillnets, pelagic trawls, and during longline fishery activities. During 2008 to 2012, it was estimated that on average approximately 289 dolphins were killed each year by human activities (Waring et al. 2015). This number increased to 409 dolphins during 2010 to 2014 (Hayes et al. 2018; 2017). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al. 2009; 2010; 2015).

White-Sided Dolphin (*Lagenorhynchus acutus*) – Non-Strategic

The Atlantic white-sided dolphin is typically found at a depth of 330 ft (100 m) in the cool temperate and subpolar waters of the North Atlantic, generally along the continental shelf between the Gulf Stream and the Labrador current to as far south as North Carolina (Bulloch 1993; Reeves et al. 2002; Jefferson et al. 2008). They are the most abundant dolphin in the Gulf of Maine and the Gulf of St. Lawrence but seem relatively rare along the North Atlantic coast of Nova Scotia (Kenney and Vigness-Raposa 2009).

Atlantic white-sided dolphins range between 8 and 9 ft (2.5 and 2.8 m) in length, with females being approximately 20 centimeters shorter than males (Kenney and Vigness-Raposa 2009). This species is highly social and is commonly seen feeding with fin whales (NOAA 1993). White-sided dolphins feed on a variety of small species, such as herring, hake, smelt, capelin, cod, and squid, with regional and seasonal changes in the species consumed (Kenney and Vigness-Raposa 2009). Sand lance is an important prey species for these dolphins in the Gulf of Maine during the spring. Other fish prey include mackerel, silver hake, herring, smelt, and several other varieties of gadoids (Kenney and Vigness-Raposa 2009). In the western North Atlantic, this species occurs from Labrador and southern Greenland to the coast of Virginia and North Carolina (Jefferson et al. 2008). During winter and spring, concentrations of Atlantic white-sided dolphins can be found in the Mid-Atlantic region, particularly in deeper waters along the continental slope (Waring et al. 2012). Recent population estimates for Atlantic white-sided dolphins in the Western North Atlantic Ocean places this species at 48,819 individuals (Hayes et al. 2018; 2017). This species could range south into Virginia and North Carolina waters during summer months but is usually most numerous in areas farther offshore at depth range of 330 ft (100 m) (Bulloch 1993; Reeves et al. 2002; Hayes et al. 2018; 2017).

The biggest human-induced threat to the Atlantic white-sided dolphin is bycatch, because they are occasionally caught in fishing gillnets and trawling equipment. An estimated average of 328 dolphins each year were killed by fishery-related activities during 2003 to 2007 (Waring et al. 2010). From 2008 through 2012, an estimated annual average of 116 dolphins per year were killed (Waring et al. 2015), and from 2010 through 2014, the estimate decreased to 74 individuals annually (Hayes et al. 2017). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al. 2011; 2015).

Atlantic Spotted Dolphin (*Stenella frontalis*) – Non-Strategic

There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*S. attenuata*) (Perrin et al. 1987). In addition, two forms of the Atlantic spotted dolphin exist: one that is large and heavily spotted and usually inhabits the continental shelf, and the other is smaller in size with less spots and occurs in the Atlantic Ocean but is not known to occur in the Gulf of Mexico (Fulling et al.

2003; Mullin and Fulling 2003; Mullin and Fulling 2004; Viricel and Rosel 2014). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate (Waring et al. 2016).

The Atlantic spotted dolphin prefers tropical to warm temperate waters along the continental shelf 10 to 200 meters (33 to 650 feet) deep to slope waters greater than 500 meters (1640 feet) deep. It has been suggested that the species may move inshore seasonally during the spring, but data to support this theory is limited (Caldwell and Caldwell 1966; Fritts et al. 1983). The Atlantic spotted dolphin diet consists of a wide variety of fish and squid, as well as benthic invertebrates (Herzing 1997). Its hearing is in the mid-frequency range (Southall et al. 2007). According to the species stock report, the best population estimate for the Atlantic spotted dolphin is approximately 44,715 individuals (Hayes et al. 2018; 2017).

No fishing-related mortality of spotted dolphin was reported for 1998 through 2003 (Yeung, 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004). From 2007 through 2011, the estimated mean annual fishery-related mortality and serious injury for this story was 42 Atlantic spotted dolphins (Waring et. al 2016). More recent observer data are not available. The commercial fisheries that interact or potentially interact with the Atlantic spotted dolphin are the pelagic longline fishery and the shrimp trawl fishery (Waring et. al 2016). A total of 16 Atlantic spotted dolphins were reported stranded in the Gulf of Mexico between 2009 and 2013. NOAA Fisheries considers this species as “non-strategic” (Waring et al. 2016).

Risso’s Dolphin (*Grampus griseus*) – Non-Strategic

Risso’s dolphins are commonly found in the deeper waters of the U.S. east coast continental shelf edge and oceanic waters ranging from Cape Hatteras to Georges Bank, mainly during spring, summer and autumn (Cetacean and Turtles Assessment Program [CETAP] 1982; Payne et al. 1984). There is currently no information on stock structure of this species for western North Atlantic; therefore, it is not possible to determine if separate stocks exist in the Gulf of Mexico and Atlantic (Hayes et al. 2018; 2017). The best estimate of abundance for the stock of Risso’s dolphins is 18,250 animals (Hayes et al. 2018; 2017; Waring et al. 2014; 2016). There are insufficient data to determine the population trend for this stock.

Risso’s dolphins have been subject to bycatch during squid and mackerel trawl activities, pelagic drift gillnet activities, pelagic pair trawl fishery, and mid-Atlantic gillnet fishery (Hayes et al. 2018; 2017). Average annual fishery-related mortality and serious injury between 2007 and 2011 was 62 dolphins (Waring et al. 2014). From 2009 to 2013, the average annual fishery-related mortality and serious injury was 54 dolphins (Waring et al. 2016). From 2010 to 2014, the estimated annual average fishery-related mortality or serious injury was 53.6 Risso’s dolphins (Hayes et al. 2018; 2017). Risso’s dolphin strandings have also been observed, and between 2010 and 2014 30 strandings were recorded along the U.S. Atlantic coast. NOAA Fisheries does not consider this species as “strategic.”

Long-Finned and Short-Finned Pilot Whale (*Globicephala melas* and *Globicephala macrorhynchus*) – Non-Endangered Strategic Western North Atlantic Stocks

The long-finned pilot whale is more generally found along the edge of the continental shelf (a depth of 330 to 3,300 feet [100 to 1,000 meters]), choosing areas of high relief or submerged banks in cold or temperate shoreline waters. This species is split between two subspecies: the Northern and Southern subspecies. The Southern subspecies is circumpolar with northern limits of Brazil and South Africa. The Northern subspecies, which could be encountered during survey operations, ranges from North Carolina to Greenland (Reeves et al. 2002; Wilson and Ruff 1999). In the western North Atlantic, long-finned pilot whales are pelagic, occurring in especially high densities in winter and spring over the continental slope, then moving inshore and onto the shelf in summer and autumn following squid and mackerel populations (Reeves et al. 2002). They frequently travel into the central and northern Georges Bank, Great

South Channel, and Gulf of Maine areas during the late spring and remain through early fall (May and October) (CETAP 1982; Payne and Heinemann 1993). The best population estimate for long-finned pilot whales in the western North Atlantic is 5,636 individuals (Hayes et al. 2018; 2017; Waring et al. 2016).

They feed preferentially on squid but will eat fish (e.g., herring) and invertebrates (e.g., octopus, cuttlefish) if squid are not available. They also ingest shrimp (particularly younger whales) and various other fish species occasionally. These whales probably take most of their prey at depths of 600 to 1,650 feet (200 to 500 meters), although they can forage deeper if necessary (Reeves et al. 2002). A very social species, long-finned pilot whales travel in pods of roughly 20 individuals while following prey. These small pods are thought to be formed around adult females and their offspring. Behaviors of long-finned pilot whales range from quiet rafting or milling on the surface, to purposeful diving, to bouts of playfulness.

The long-finned pilot whales are subject to bycatch during sink gillnet fishing, pelagic trawling, and pelagic longline fishing. Approximately 215 pilot whales were killed or seriously injured each year by human activities during 1997 to 2001 (Waring et al. 2010). From 2007 through 2011, the total observed fishery-related mortality was 44 individuals (Waring et al. 2014). From 2009 through 2013, the total observed fishery-related mortality was 31 individuals (Waring et al. 2016). From 2010 to 2014, the total annual observed average fishery-related mortality or serious injury is 38 pilot whales (Hayes et al. 2018; 2017). Strandings involving hundreds of individuals are not unusual and demonstrate that these large schools have a high degree of social cohesion (Reeves et al. 2002). From 2010 through 2014, 27 long-finned pilot whales, and 5 unspecified pilot whales were reported as stranded between Maine and Florida (Hayes et al. 2017). The species is considered “strategic” under the MMPA by NOAA Fisheries because the mean annual human-cause mortality and serious injury exceeds the Potential Biological Removal (Hayes et al. 2018; 2017).

4.2 Baleen Whales (Mysticeti)

North Atlantic Right Whale (*Eubalaena glacialis*) – Endangered

The North Atlantic right whale was listed as a federal endangered species in 1970. The North Atlantic right whale has seen a nominal 2 percent recovery rate since it was listed as a protected species (NOAA 2015). This is a drastic difference from the stock found in the Southern Hemisphere, which has increased at a rate of 7 to 8 percent (Knowlton and Kraus 2001). Right whales are considered grazers as they swim slowly with their mouths open. They are the slowest swimming whales and can only reach speeds up to 10 miles (mi) (16 km) per hour. They can dive at least 1,000 ft (300 m) and stay submerged for typically 10 to 15 minutes, feeding on their prey below the surface (ACSonline 2004). Right whales’ hearing is in the low-frequency range (Southall et al. 2007).

The right whale is a strongly migratory species that moves annually between high-latitude feeding grounds and low-latitude calving and breeding grounds. The present range of the western North Atlantic right whale population extends from the southeastern United States, which is utilized for wintering and calving, to summer feeding and nursery grounds between New England and the Bay of Fundy and the Gulf of St. Lawrence (Kenney 2002; Waring et al. 2011). The winter distribution of North Atlantic right whales is largely unknown, although offshore surveys have reported 1 to 13 detections annually in northeastern Florida and southeastern Georgia (Waring et al. 2013). A few events of right whale calving have been documented from shallow coastal areas and bays (Kenney 2002). Some evidence provided through acoustic monitoring suggests that not all individuals of the population participate in annual migrations, with a continuous presence of right whales occupying their entire habitat range throughout the year, particularly north of Cape Hatteras (Davis et al. 2017). These data also recognize changes in population distribution throughout the right whale habitat range that could be due to environmental or anthropogenic effects, a response to short-term changes in the environment, or a longer-term shift in the right whale distribution cycle (Davis et al. 2017).

Observations in December 2008 noted congregations of more than 40 individual right whales in the Jordan Basin area of the Gulf of Maine, leading researchers to believe this may be a wintering ground (NOAA 2008). A right whale satellite tracking study within the northeast Atlantic (Baumgartner and Mate 2005) reported that this species often visited waters exhibiting low bottom water temperatures, high surface salinity, and high surface stratification, most likely for higher food densities. The winter distribution of North Atlantic right whales is largely unknown, although offshore surveys have reported between one and 13 detections annually in northeastern Florida and southeastern Georgia (Waring et al. 2007). A few documented events of right whale calving have been from shallow coastal areas and bays (Kenney 2002). As of January 26, 2016, NOAA Fisheries expanded the North Atlantic Right Whale Critical Habitat Southeastern U.S. Calving Area from Cape Fear, North Carolina, southward to 29°N latitude (approximately 43 miles north of Cape Canaveral, Florida). North Atlantic right whales may be found in feeding grounds within New England waters between February and May, with peak abundance in late March (NOAA 2005). While in New England, right whales feed mostly on copepods belonging to the *Calanus* and *Pseudocalanus* genus (Waring et al. 2015).

The North Atlantic right whale was the first species targeted during commercial whaling operations and was the first species to be greatly depleted as a result of whaling operations (Kenney 2002). North Atlantic right whales were hunted until the early twentieth century. Shore-based whaling in Long Island involved catches of right whales year-round, with peak catches in spring during the northbound migration from calving grounds off the southeastern United States to feeding grounds in the Gulf of Maine (Kenney and Vigness-Raposa 2009). Abundance estimates for the North Atlantic right whale population vary. From the 2003 United States Atlantic and Gulf of Mexico Marine Mammal Stock Assessments, there were only 291 North Atlantic right whales in existence, which is less than what was reported in the Northern Right Whale Recovery Plan written in 1991 (NMFS 1991a; Waring et al. 2004). This is a tremendous difference from pre-exploitation numbers, which are thought to be more than 1,000 individuals. When the right whale was finally protected in the 1930s, it is believed that the North Atlantic right whale population was roughly 100 individuals (Waring et al. 2004). In 2015, the Western North Atlantic population size was estimated to be at least 476 individuals (Waring et al. 2016). That population size estimate decreased to 458 individuals in 2017 (Hayes et al. 2018). Additional information provided by Pace et al. (2017), confirms that the probability that the North Atlantic right whale population has declined since 2010 is 99.99 percent. Data indicates that the number of adult females dropped from 200 in 2010 down to 186 in 2015 while males dropped from 283 to 272 in the same timeframe. Also cause for concern is the confirmed mortality of 17 individuals so far in 2017 alone (NOAA 2017; Pace et al. 2017).

Contemporary anthropogenic threats to right whale populations include fishery entanglements and vessel strikes, although habitat loss, pollution, anthropogenic noise, and intense commercial fishing may also negatively impact their populations (Kenney 2002). Entanglements can represent a significant energy expenditure for large whales, leading to injury or death if disentanglement efforts are not successful within a critical time period (van der Hoop et al. 2017; van der Hoop et al. 2016). Such energy expenditures can have significant sub-lethal impacts to right whales, particularly reproductive females where time for reproduction could be delayed for months or years (van der Hoop et al. 2016). Recovery from entanglements and subsequent energy losses resulting in physiological stress could limit reproductive success and contribute to fluctuations in population growth (van der Hoop et al. 2016). Unfortunately, evidence suggests that recent efforts to reduce entanglement through fishing gear modification have not resulted in decline of frequencies of entanglement or serious injury due to entanglement (Pace et al. 2014). Between 2002 and 2006, a study of marine mammal stranding and human-induced interactions reported that right whales in the western Atlantic were subject to the highest proportion of entanglements (25 of 145 confirmed events) and ship strikes (16 of 43 confirmed occurrences) of any marine mammal studied (Glass et al. 2008). Bycatch of North Atlantic right whale has also been reported in pelagic drift gillnet operations by the Northeast Fisheries Observer Program, however, no mortalities have been reported (Glass et al. 2008). From 2010 through 2014, the minimum rate of annual human-caused mortality and serious injury to this species from fishing entanglements averaged 5.66 per year, while ship strikes averaged 1.01 whales per year (Hayes et al. 2017). Environmental fluctuations and anthropogenic disturbance may be contributing to a decline in overall health of individual North Atlantic right whales that has been occurring for the last 3 decades (Rolland et al. 2016). The NOAA marine mammal stock assessment for 2014 reports that the low annual reproductive rate of right whales, coupled with small population size, suggests anthropogenic mortality may have a greater impact on population growth rates for the species than for other whales (Waring et al. 2016).

Ship strikes of individuals can impact northern right whales on a population level due to the intrinsically small remnant population that persists in the North Atlantic (Laist et al. 2001). Most ship strikes are fatal to the North Atlantic right whales (Jensen and Silber 2004). Right whales have difficulty maneuvering around boats and spend most of their time at the surface, feeding, resting, mating, and nursing, increasing their vulnerability to collisions. Mariners should assume that North Atlantic right whales will not move out of their way nor will they be easy to detect from the bow of a ship for they are dark in color and maintain a low profile while swimming (World Wildlife Fund 2005). To address potential for ship strike, NMFS designated the nearshore waters of the Mid-Atlantic Bight as the Mid-Atlantic U.S. Seasonal Management Area (SMA) for right whales. NMFS requires that all vessels 65 ft (19.8 m) or longer must travel at 10 knots or less within the right whale SMA from November 1 through April 30 when right whales are most likely to pass through these waters (NOAA 2010). The most recent stock assessment report noted that studies by van der Hoop et al. (2015) have concluded large whale vessel strike mortalities decreased inside active SMAs but have increased outside inactive SMAs. The proposed survey area has components located both within and outside of the right whale Chesapeake Bay SMA located in the waters off the southern Virginia coast marking the mouth of the Chesapeake Bay.Other SMAs in the region, but not within proposed survey areas, include the Delaware Bay SMA, Morehead City SMA and North Carolina-Georgia Coast SMA.

Right whales have been observed in or near Virginia and North Carolina waters from October through December, as well as in February and March, which coincides with the migratory time frame for this species (Knowlton et al. 2002). Based on the migratory pattern and the establishment of an SMA around approaches to Chesapeake Bay, right whales have the potential to occur in the Project Area, particularly during peak migration times, and overall likelihood of occurrence in the Project Area is rated as high, except for summer months.

Humpback Whale (*Megaptera novaeangliae*) – Strategic/Non-Endangered for West Indies Distinct Population Segment

The humpback whale was listed as endangered in 1970 due to population decrease resulting from overharvesting; however, this species was delisted as threatened or endangered as of September 8, 2016 (81 FR 62259). Humpback whales feed on small prey that is often found in large concentrations, including krill and fish such as herring and sand lance (Waring et al. 2007; Kenney and Vigness-Raposa 2009). Humpback whales are thought to feed mainly while migrating and in summer feeding areas; little feeding is known to occur in their wintering grounds. Humpbacks feed over the continental shelf in the North Atlantic between New Jersey and Greenland, consuming roughly 95 percent small schooling fish and 5 percent zooplankton (i.e., krill), and they will migrate throughout their summer habitat to locate prey (Kenney and Winn 1986). They swim below the thermocline to pursue their prey, so even though the surface temperatures might be warm, they are frequently swimming in cold water (NMFS 1991b). Humpback whales from all of the North Atlantic migrate to the Caribbean in winter, where calves are born between January and March (Blaylock et al. 1995).

Humpback whales exhibit consistent fidelity to feeding areas within the northern hemisphere (Stevick et al. 2006). There are six subpopulations of humpback whales that feed in six different areas during spring, summer, and fall. These feeding populations can be found in the Gulf of Maine, the Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and Norway (Waring et al. 2015). The highest abundance for humpback whales is distributed primarily along a relatively narrow corridor following the 328-ft (100-m) isobath across the southern Gulf of Maine from the northwestern slope of Georges Bank, south to the Great South Channel, and northward alongside Cape Cod to Stellwagen Bank and Jeffreys Ledge. In winter, whales from waters off New England, Canada, Greenland, Iceland, and Norway migrate to mate and calve primarily in the West Indies (including the Antilles, the Dominican Republic, the Virgin Islands and Puerto Rico), where spatial and genetic mixing among these groups occurs (Waring et al. 2015). While migrating, humpback whales utilize the mid-Atlantic as a migration pathway between calving/mating grounds to the south and feeding grounds in the north (Waring et al. 2007). Since 1989, observations of juvenile humpbacks in the Mid-Atlantic have been increasing during the winter months, peaking January through March (Swingle et al. 1993). Biologists theorize that non-reproductive animals may be establishing a winter feeding range in the Mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. Swingle et al. (1993) identified a shift in distribution of juvenile humpback whales in the nearshore waters of Virginia, primarily in winter months.

Humpback whales were hunted as early as the seventeenth century, with most whaling operations having occurred in the nineteenth century (Kenney and Vigness-Raposa 2009). Before whaling activities, it was thought that the abundance of whales in the North Atlantic stock was in excess of 15,000 (Nowak 2002). By 1932, commercial hunting within the North Atlantic may have reduced the humpback whale population to as little as 700 individuals (Breiwick et al. 1983). Humpback whales were commercially exploited by whalers throughout their whole range until they were protected in the North Atlantic in 1955 by the International Whaling Commission (IWC) ban. Humpback whaling ended worldwide in 1966 (NatureServe 2010). Contemporary anthropogenic threats to humpback whales include fishery entanglements and vessel strikes. Glass et al. (2008) reported that between 2002 and 2006, humpback whales belonging to the Gulf of Maine population were involved in 77 confirmed entanglements with fishery equipment and nine confirmed ship strikes. Humpback whales that were entangled exhibited the highest number of serious injury events of the six species of whale studied by Glass et al. (2008). A whale mortality and serious injury study conducted by Nelson et al. (2007) reported that the minimum annual rate of anthropogenic mortality and serious injury to humpback whales occupying the Gulf of Maine was 4.2 individuals per year. During this study period, humpback whales were involved in 70 reported entanglements and 12 vessel strikes, and were the most common dead species reported. This number has increased to 9.05 animals per year between 2010 and 2014 (Hayes et al. 2017). Entanglements can represent a significant energy expenditure for large whales, leading to injury or death if disentanglement efforts are not successful within a critical time period (van der Hoop et al. 2017; van der Hoop et al. 2016). Such energy expenditures can have significant sub-lethal impacts, particularly to reproductive females where time for reproduction could be delayed for months or years (van der Hoop et al. 2016). Recovery from entanglements and subsequent energy losses resulting in physiological stress could limit reproductive success and contribute to fluctuations in population growth (van der Hoop et al. 2016). Unfortunately, evidence suggests that recent efforts to reduce large whale entanglement through fishing gear modification have not resulted in decline of frequencies of entanglement or serious injury due to entanglement (Pace et al. 2014). The humpback whale population within the North Atlantic has been estimated to include approximately 11,570 individuals (Waring et al. 2015). Through photographic population estimates, humpback whales within the Gulf of Maine (the only region where these whales summer in the United States) have been estimated to consist of 600 individuals in 1979 (NMFS 1991b). According to the species stock assessment report, the best estimate of abundance for the Gulf of Maine stock of humpback whales is, at a minimum, 823 individuals (Hayes et al. 2018; 2017).

While migrating, humpback whales utilize the Mid-Atlantic as a migration pathway between calving/mating grounds to the south and feeding grounds in the north (Waring et al. 2013). Humpbacks typically occur within the Mid-Atlantic region during fall, winter, and spring months (Waring et al. 2012). Therefore, humpback whales have the potential to occur in the Project Area during these seasons, and overall likelihood of occurrence in the Project Area is rated as high.

Fin Whale (*Balaenoptera physalus*) – Endangered

The fin whale was listed as federally endangered in 1970. Fin whales' range in the North Atlantic extends from the Gulf of Mexico, Caribbean Sea, and Mediterranean Sea in the south to Greenland, Iceland, and Norway in the north (Jonsgård 1966; Gambell 1985a). They are the most commonly sighted large whales in continental shelf waters from the Mid-Atlantic coast of the United States to Nova Scotia (Sergeant 1977; Sutcliffe and Brodie 1977; CETAP 1982; Hain et al. 1992; Waring et al. 2008). Fin whales, much like humpback whales, seem to exhibit habitat fidelity (Waring et al. 2007; Kenney and Vigness-Raposa 2009). However, fin whales' habitat use has shifted in the southern Gulf of Maine, most likely due to changes in the abundance of sand lance and herring, both of which are major prey species along with squid, krill, and copepods (Kenney and Vigness-Raposa 2009). While fin whales typically feed in the Gulf of Maine and the waters surrounding New England, mating and calving (and general wintering) areas are largely unknown (Waring et al. 2007). The overall pattern of fin whale movement is complex, consisting of a less obvious north-south pattern of migration than that of right and humpback whales. Based on acoustic recordings from hydrophone arrays, Clark (1995) reported a general southward flow pattern of fin whales in the fall from the Labrador/Newfoundland region, past Bermuda, and into the West Indies. The overall distribution may be based on prey availability, as this species preys opportunistically on both invertebrates and fish (Watkins et al. 1984). Fin whale abundance off the coast of the northeastern United States is highest between spring and fall, with some individuals remaining during the winter (Hain et al. 1992). A recent estimate of fin whale abundance conducted between Georges Bank and the Gulf of St. Lawrence during the feeding season in August 2006 places the western North Atlantic fin whale populations at 2,269 individuals (Waring et al. 2007). Fin whales are the second largest living whale species on the planet (Kenney and Vigness-Raposa 2009). The gestation period for fin whales is approximately 11 months and calve births occur between late fall and winter. Females can give birth every two to three years.

Present threats to fin whales are similar to other whale species, namely fishery entanglements and vessel strikes. Fin whales seem less likely to become entangled than other whale species. Glass et al. (2008) reported that between 2002 and 2006, fin whales belonging to the Gulf of Maine population were involved in only eight confirmed entanglements with fishery equipment. Furthermore, Nelson et al. (2007) reported that fin whales exhibited a low proportion of entanglements (eight reported events) during their 2001 to 2005 study along the western Atlantic. On the other hand, vessel strikes may be a more serious threat to fin whales. Eight and 10 confirmed vessel strikes with fin whales were reported by Glass et al. (2008) and Nelson et al. (2007), respectively. This level of incidence was similar to that exhibited by the other whales studied. Conversely, a study compiling whale/vessel strike reports from historical accounts, recent whale strandings, and anecdotal records by Laist et al. (2001) reported that of the 11 great whale species studied, fin whales were involved in collisions most frequently (31 in the United States and 16 in France). From 2008 to 2012, the minimum annual rate of mortality for the North Atlantic stock from anthropogenic causes was approximately 3.35 per year (Waring et al. 2015) while from 2010 to 2014, this number has increased to 3.8 per year (Hayes et al. 2017). Increase in ambient noise has also impacted fin whales, for whales in the Mediterranean have demonstrated at least two different avoidance strategies after being disturbed by tracking vessels (Jahoda et al. 2003). The best abundance estimate available for the western North Atlantic fin whale stock is 1,618 (Hayes et al. 2018; 2017).

Fin whales are present in the Mid-Atlantic region during all four seasons, although sightings data indicate that they are more prevalent during winter, spring, and summer (Waring et al 2012). While fall is the season of lowest overall abundance off Virginia and North Carolina, they do not depart the area entirely. Consequently, the likelihood of occurrence in the Project Area is rated as high. The species is listed as Endangered due to the depletion of its population from whaling (Reeves et al. 1998). A recovery plan has been written and is available from the NMFS for review (Waring et al. 2010; 2011).

Sei Whale (*Balaenoptera Borealis*) – Endangered

The sei whale is a widespread species in the world's temperate, subpolar, subtropical, and tropical marine waters. NOAA Fisheries considers sei whales occurring from the U.S. East Coast to Cape Breton, Nova Scotia, and east to 42°W as the "Nova Scotia stock" of sei whales (Waring et al. 2016; Hayes et al. 2017). Sei whales occur in deep water characteristic of the continental shelf edge throughout their range (Hain et al. 1985). In the Northwest Atlantic, it is speculated that the whales migrate from south of Cape Cod along the eastern Canadian coast in June and July, and return on a southward migration again in September and October (Waring et al. 2014; 2016). The sei whale is most common on Georges Bank and into the Gulf of Maine/Bay of Fundy region during spring and summer, primarily in deeper waters.

Although sei whales may prey upon small schooling fish and squid, available information suggests that calanoid copepods and euphausiids are the primary prey of this species (Flinn et al. 2002). Sei whales are occasionally seen feeding in association with right whales in the southern Gulf of Maine and in the Bay of Fundy. However, there is no evidence to demonstrate interspecies competition between these species for food resources. Sei whales reach sexual maturity at 5-15 years of age. The calving interval is believed to be two to three years (Perry et al. 1999).

There is limited information on the stock identity of sei whales in the North Atlantic (Hayes et al. 2018; 2017). The best abundance estimate for the Nova Scotia stock of sei whales is 357; however, this estimate must be considered low and limited given the known range of the sei whale (Hayes et al. 2018; 2017; Waring et al. 2014; 2016). There are insufficient data to determine trends of the Nova Scotian sei whale population. From 2007 to 2011, the minimum annual rate of confirmed human-caused serious injury and mortality to Nova Scotian sei whales was 1.0 (Waring et al. 2014). From 2009 to 2013, this mortality rate was estimated 0.4 (Waring et al. 2016). From 2010 through 2014, the minimum annual rate of human-caused mortality and serious injury was 0.8 (Hayes et al. 2017). This species is listed as endangered under the ESA and is designated as depleted under the MMPA. A final recovery plan for the sei whale was published in 2011 (NOAA Fisheries 2011).

Minke Whale (*Balaenoptera acutorostrata*) – Non-Strategic

Minke whales are among the most widely distributed of all the baleen whales. They occur in the North Atlantic and North Pacific, from tropical to polar waters. Common minke whales range between 20 and 30 ft (6 and 9 m, with maximum lengths of 30 to 33 ft [9 to 10 m]) and are the smallest of the North Atlantic baleen whales (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2009). The primary prey species for minke whales are most likely sand lance, clupeids, gadoids, and mackerel (Kenney and Vigness-Raposa 2009). These whales basically feed below the surface of the water, and calves are usually not seen in adult feeding areas. Minke whales are almost absent from OCS waters off the western Atlantic in winter; however, they are common in the fall and abundant in spring and summer (CeTAP 1982; Kenney and Vigness-Raposa 2009). In the 2015 stock assessment, the estimate for minke whales in the Canadian East Coast stock was 20,741 (Waring et al. 2015). This population estimate substantially decreased to 2,591 individuals in the most recent stock assessment because estimates older than eight years were excluded from the newest estimate (Hayes et al., 2018; 2017). This new estimate should not be interpreted as a decline in abundance of this stock, as previous estimates are not directly comparable (Hayes et al., 2017). Minke whales have been observed in southern New England waters during all four seasons.

As is typical of the baleen whales, minke whales are usually seen either alone or in small groups, although large aggregations sometimes occur in feeding areas (Reeves et al. 2002). Minke populations are often segregated by sex, age, or reproductive condition. Known for their curiosity, minke whales often approach boats.

Minke whales are impacted by ship strikes and bycatch from bottom trawls, lobster trap/pot, gillnet, and purse seine fisheries. From 2008 to 2012, the minimum annual rate of mortality for the North Atlantic stock from anthropogenic causes was approximately 9.9 per year (Waring et al. 2015), while from 2010 to 2014 this decreased to 8.25 per year (Hayes et al. 2017). In addition, hunting for Minke whales continues today, by Norway in the northeastern North Atlantic and by Japan in the North Pacific and Antarctic (Reeves et al. 2002). International trade in the species is currently banned. The best recent abundance estimate for this stock is 8,987 (Waring et al. 2011). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al. 2010; 2011; 2015).

5.0 TYPE OF INCIDENTAL TAKING REQUESTED

The Applicant is requesting the authorization for potential non-lethal "taking" of small numbers of marine mammals to allow for incidental harassment resulting from the marine site characterization surveys. The request is based upon projected HRG survey activities during the anticipated survey schedule as stated in Section 2.1.

The noise levels of HRG survey equipment were evaluated against the criteria prescribed in the Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0) - Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. Under this revised guidance document, Level A harassment is said to occur as a result of exposure to high noise levels and the onset of permanent hearing sensitivity loss, known as a permanent threshold shift (PTS), based on findings published by the Noise Criteria Group (Southall et al., 2007). The acoustic thresholds are presented using dual metrics of cumulative sound exposure level (SEL$_{cum}$) and peak sound level. The cumulative PTS criteria was applied to the formulaic spreadsheet provided by NMFS (see Table 4). This spreadsheet incorporates the different hearing abilities of marine mammal groups (also see Appendix A). The instantaneous peak criteria was calculated by applying a practical spreading model to the peak source levels in Table 1 (see Appendix A). No marine mammal weighting correction is applied for evaluation of the peak criteria.

The Innomar SES-2000 is a specialized type of HGR low sub-bottom profiler that uses e the principle of "parametric" or "nonlinear" acoustics to generate short narrow-beam sound pulses. Additionally, due to the short sound pulses and the highly directional sound pulse transmission of parametric sub-bottom profilers, the volume of area affected is much lower than using conventional (linear) acoustics devices such as sparker and chirp systems. The modeling analysis results presented in IHA Applications of Ocean Wind and Baystate wind (NOAA 2017; NOAA 2018) indicate the water volume insonified by the Innomar sub-bottom profiler is rather small due to the narrow sound beams produced and distances were found to range from 120 to 135 meters. Similar Level A zones of 5 meters for HF cetaceans are expected during operation of this HRG equipment in the Ocean Wind Study Area.

Table 4. Distances to Regulatory Level A Thresholds

Representative HRG Survey Equipment	Marine Mammal Group	PTS Onset	Lateral Distance (m)
USBL/GAPS Positioning Systems			
Sonardyne Ranger 2 USBL HPT 5/7000	LF cetaceans	199 dB SEL$_{cum}$	---
	MF cetaceans	198 dB SEL$_{cum}$	---
	HF cetaceans	173 dB SEL$_{cum}$	3
	Phocid pinnipeds	201 dB SEL$_{cum}$	---
Parametric Sub-bottom Profiler			
Innomar parametric SES-2000 Standard	LF cetaceans	199 dB SEL$_{cum}$	N/A
	MF cetaceans	198 dB SEL$_{cum}$	---
	HF cetaceans	173 dB SEL$_{cum}$	< 5

Table 4. Distances to Regulatory Level A Thresholds

Representative HRG Survey Equipment	Marine Mammal Group	PTS Onset	Lateral Distance (m)
	Phocid pinnipeds	201 dB SEL_{cum}	N/A
Shallow Penetration Sub-bottom Profiler			
EdgeTech 512i	LF cetaceans	199 dB SEL_{cum}	---
	MF cetaceans	198 dB SEL_{cum}	---
	HF cetaceans	173 dB SEL_{cum}	---
	Phocid pinnipeds	201 dB SEL_{cum}	---
Medium Penetration Sub-bottom Profiler			
SIG ELC 820 Sparker	LF cetaceans	219 dBpeak 183 dB SEL_{cum}	--- 10
	MF cetaceans	230 dBpeak 185 dB SEL_{cum}	--- ---
	HF cetaceans	202 dBpeak 155 dB SEL_{cum}	5 4
	Phocid pinnipeds	218 dBpeak 185 dB SEL_{cum}	--- 3

Notes:
The peak SPL criterion is un-weighted (i.e., flat weighted), whereas the cumulative SEL criterion is weighted for the given marine mammal functional hearing group.
The calculated sound levels and results are based on NMFS Technical Guidance's companion User Spreadsheet except as indicated in this IHA application.
--- indicates that no injury was predicted for the given HRG equipment noise profile.
N/A indicates not applicable as the HRG sound source operates outside the effective marine mammal hearing range.

For the remaining HRG equipment types, acoustic parameters were entered into the formulaic NMFS user spreadsheet spreadsheets with a vessel speed set at 2.05 meters per second (m/s). The USBL was defined by applying the following parameters: source level of 188 dB_{RMS}, pulse duration of 16 milliseconds (ms), repetition rate of 3 pulses per second and a primary operating frequency weighting of 26.5 kHz based on manufacturer specifications. The resultant distance to potential Level A Harassment for the USBL were 3 m for HF cetaceans. No potential for injury was predicted for the other marine mammal hearing groups. The medium penetration sub-bottom profiler was defined with the following parameters: source level at 206 dB_{RMS}, repetition rate 4 pulses per second, a pulse duration of 8 ms and a primary operating frequency of 1.4 kHz based on the technical information reported in the NUWC study document. The maximum distance was 10 m (32.8 ft) for LF cetaceans.

For all HRG equipment types assessed, the 10 m (32.8 ft) distance for consideration of Level A harassment for LF cetaceans represents the maximum potential impact. Given the resulting Level A PTS harassment criteria (155 dB SEL_{cum}) distance of less than 13 ft (4 m) for harbor porpoise and the mitigations proposed in Section 11.3, the potential for Level A harassment of this species is so unlikely as to be discountable. In addition, it is common accepted that harbor porpoises display profound and sustained avoidance behavior to sound greater than 140 dB re 1 µPa and would be unlikely to occur within 4 m of a vessel.

The distances to the 160 dB RMS re 1 µPa isopleth for Level B harassment are presented in Table 5. The 200 m distance to the medium penetration sub-bottom profiler represents the largest distance and is likely a very conservative estimate based on sound source field verification assessments of similar sparker electrode equipment.

Table 5. Distances to Regulatory Level B Thresholds for Representative HRG Equipment

HRG System	Representative HRG Survey Equipment	Marine Mammal Level B Harassment 160 dBRMS90% re 1 µPa (m)
Subsea Positioning / USBL	Sonardyne Ranger 2 USBL	25
Shallow penetration sub-bottom profiler	Innomar parametric SES-2000 Standard	120 to 135
Shallow penetration sub-bottom profiler	EdgeTech 512i	10
Medium penetration sub-bottom profiler	SIG ELC 820 Sparker	200

To ensure that the potential for take by Level A and B harassment is avoided and/or minimized to the maximum extent possible, the Applicant has committed to the mitigation measures as outlined in Sections 11.0 and 13.0, which have been successfully implemented during similar activities in the North Atlantic.

As detailed in Section 1.2, HRG equipment use would generate underwater noise with sounds exceeding the 160 $dB_{RMS90\%}$ re 1 µPa threshold for Level B harassment for impulsive sound. The Applicant is requesting the authorization for the incidental take by harassment, of small numbers of marine mammals pursuant to Section 101 (a) (5) of the MMPA and in accordance with 50 CFR § 216 Subpart I, in support of the Applicant's survey activities. Both NOAA and BOEM have advised that some sound-producing survey equipment operating below 200 kHz (e.g., sub-bottom profilers and USBL positioning systems) have the potential to cause acoustic harassment to marine species, in particular marine mammals. This request is being submitted to specifically address survey sound-producing data acquisition equipment that operate below 200 kHz, in support of the Applicant's survey activities as further detailed in Section 6.0.

6.0 TAKE ESTIMATES FOR MARINE MAMMALS

The Applicant seeks authorization for potential "taking" of small numbers of marine mammals under the jurisdiction of NMFS in the proposed region of activity. Anticipated impacts to marine mammals from the proposed survey activities will be associated with noise propagation from the use of specific survey equipment. It should be noted that the estimates of exposure for marine mammals as presented in this section are conservative. Based on the review of protected species observer sightings reports for similar surveys conducted along the Atlantic coast, data suggests that with the application of the mitigation and monitoring actions as proposed in Section 11.0, that exposure of marine mammals to harassing level acoustic levels during survey activities can be effectively minimized (ESS 2013; Dominion 2013 and 2014).

6.1 Basis for Estimating Numbers of Marine Mammals that Might be "Taken by Harassment"

Marine animals can perceive underwater sounds over a broad range of frequencies from about 10 hertz (Hz) to more than 10,000 Hz (10 kHz). Many of the dolphins and porpoises use even higher frequency sound for echolocation and perceive these high frequency sounds with high acuity. Marine mammals respond to low-frequency sounds with broadband intensities of more than about 120 dB re 1 µPa, or about 10 to 20 dB above natural ambient noise at the same frequencies (Richardson et al. 1991). The functional hearing ranges for the marine mammals in this evaluation have a potential for acoustic take by Level B harassment, and high frequency cetaceans (harbor porpoise) have a potential for acoustic take by Level A harassment, at the time of the proposed surveys (see Table 2 for hearing ranges by functional hearing groups).

Sound is important to marine mammals for communication, individual recognition, predator avoidance, prey capture, orientation, navigation, mate selection, and mother-offspring bonding. Potential effects of anthropogenic sounds to marine mammals can include physical injury (e.g., temporary or permanent loss of hearing sensitivity), behavioral modification (e.g., changes in foraging or habitat-use patterns), and masking (the prevention of marine mammals from hearing important sounds).

An important distinction between electromechanical and other acoustic sources employed in HRG survey systems is the determinism of the transmitted signal. Whereas electromechanical sources (i.e. chirpers and pingers) employ deterministic signals generated by piezoelectric transducers, non-electromechanical sources typically employ impulsive physical processes including the release of high-pressure air or electric field discharge at high voltage (i.e., sparkers) to generate high-intensity acoustic fields (Crocker and Farantino 2016). The basis for the HRG survey take estimate is the number of marine mammals that would be exposed to sound levels in excess of Level B harassment criteria for impulsive noise (160 $dB_{RMS90\%}$ re 1 µPa) and Level A harassment criteria for impulsive noise (202 dB_{peak} & 155 dB SEL_{cum}) which includes sparkers and non-impulsive Level A noise criteria (173 dB SELcum).

Typically, this is determined by multiplying the Zone of Influence (ZOI) out to the harassment criteria isopleth by local marine mammal density estimates, and then correcting for seasonal use by marine mammals, seasonal duration of project-specific noise-generating activities, and estimated duration of individual activities when the maximum noise-generating activities are intermittent or occasional. In the absence of any part of this information, it becomes prudent to take a conservative approach to ensure the potential number of takes is not greatly underestimated.

Distances for noise thresholds are calculated using the conservative practical spreading model. As noted in Table 1, the Sig ELC 820 Sparker is the loudest sound source and therefore governs the Level B ZOI determination for the survey, which is considered 200 m (656.2 ft). The distance to the Level B harassment threshold is 25 m (82 ft) for the USBL system and 135 m (442.9 ft) for the shallow penetration sub-bottom profiler. Likewise, the Sig ELC 820 Sparker governs the Level A ZOI determination for the survey, which is 10 m (32.8 ft). As a conservative measure to account for some of the potential variation of operating conditions, the maximum distance to the harassment thresholds is used to determine estimated exposure for HRG survey equipment (i.e. 200 m for Level B and 10 m for Level A).

The estimated distance of the daily vessel trackline was determined using the estimated average speed of the vessel (4 knots) and the 24-hour operational period. Using the maximum distance to the Level B harassment threshold of 200 m (656 ft) and estimated daily vessel track of approximately 177.8 km (110.5 mi), estimates of take by survey equipment has been based on an ensonified area around the survey equipment of 71.2 km^2 (27.5 mi^2) per day over a projected survey period for each survey segment (see Table 6).

Table 6. Survey Segment Level B ZOIs

Survey Segment	Number of Active Survey Days	Estimated Total Line Distance (km)	Estimated Distances per Day (km)	Calculated ZOI per Day (km^2)
Lease Area	29	5,156	177.8	71.2
Cable Route Corridors	8	1,422	177.8	71.2
Note: Estimated duration does not include anticipated delays associated with weather delay or other equipment downtime, including shut down mitigation for marine mammals.				

Estimate of Numbers of Marine Mammals that Might be "Taken by Harassment"

Estimates of take are computed according to the following formula as provided by NOAA (Personal Communication, November 24, 2015):

Estimated Take = D x ZOI x (d)

Where:

D = average highest species density (number per km^2)
ZOI = maximum ensonified area to MMPA thresholds for impulsive noise (160 $dB_{RMS90\%}$ re 1 μPa); and
d = number of days

Per new NOAA guidance for mobile sound sources, the ZOI was calculated according to the following formula (Personal Communication, November 24, 2015):

ZOI = maximum ensonified area around the sound source x the line miles traveled over a 24-hr period.

It should be noted however, that this calculation will result in an over-conservative ZOI as it assumes that once an area along a survey trackline is ensonified by the sound source that the area will remain ensonified at a level that will result in Level B acoustic take (160 $dB_{RMS90\%}$ re 1 μPa) and Level A take for high frequency cetaceans (202 dB_{peak} & 155 dB SEL_{cum}) throughout the entire 24-hr period. As summarized in Section 1.2, the only time survey activities could result in take by Level B acoustic harassment is if a marine mammal were to enter into the ensonified area associated with the HRG survey equipment being operated.

The data used as the basis for estimating cetacean density ("D") for the survey area are sightings per unit effort (SPUE) derived by Duke University (Roberts et al. 2016a), updated with new modeling results (Roberts et al. 2016b; 2017; 2018). For pinnipeds, the only available comprehensive data for seal abundance continues to be the Northeast Navy OPAREA Density Estimates (DoN 2007). SPUE (or, the relative abundance of species) is derived by using a measure of survey effort and number of individual cetaceans sighted. SPUE allows for comparison between discrete units of time (i.e. seasons) and space within a project area (Shoop and Kenney, 1992). The Duke University (Roberts et al. 2016) cetacean density data represent models derived from aggregating line-transect surveys conducted over 23 years by five institutions (NOAA NMFS Northeast Fisheries Science Center, New Jersey Department of Environmental Protection, NOAA NMFS Southeast Fisheries Science Center, University of North Carolina Wilmington, and Virginia Aquarium & Marine Science Center), the results of which are freely available online at the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) repository. Monthly mean density values within the survey area were averaged by season (Winter [December, January, February], Spring [March, April, May], Summer [June, July, August], Fall [September, October, November]) to provide seasonal density estimates. The highest seasonal density estimates during the duration of the proposed survey were used to estimate take. All cetacean species analyzed had associated monthly abundance data as reported by Roberts et al (2016b; 2017; 2018). The OPAREA Density Estimates (DoN 2007) used for pinniped densities were based on data collected through NMFS Northeast Fisheries Science Center aerial surveys conducted between 1998 and 2005.

Due to the spatial distribution and transient nature of marine mammal species identified in the survey area; the relatively short duration of the activities, and the implementation of the mitigation measures as described in Section 11.0, these activities are not expected to result in Level A Harassment, and Level B harassment only on the species identified in Table 7. The take estimates as provided in Section 6.1.1 are based on an overly conservative ZOI and therefore are likely a significant overestimate of the actual potential for take by Level B acoustic harassment.

6.1.1 Estimate of Potential Project Survey Takes by Harassment

The parameters in Table 6 were used to estimate the potential take by incidental harassment for each segment of the HRG survey. Density data from Roberts et al. (2016b; 2017; 2018) were mapped within the boundary of the Survey Area for each segment (Figure 1) using geographic information systems. For both survey segments, species densities, as reported by Roberts et al. (2016) within the maximum survey area, were averaged by season (spring and summer) based on the proposed HRG survey schedule (commencing no earlier than May 1, 2019). Potential take calculations were then based on the maximum average seasonal species density (between spring and summer) within the maximum survey area, given the survey start date and duration. Results of the take calculations by survey segment are provided in Table 7. .

For bottlenose dolphin densities, Roberts et al. (2016b; 2017; 2018) does not differentiate by individual stock. Given the southern coastal migratory stock propensity to be found shallower than the 20 m depth isobath north of Cape Hatteras (Reeves et al. 2002; Waring et al. 2016), the Export Cable Corridor segment was roughly divided along the 20 m depth isobath. The Lease Area is located within depths exceeding 20 m, where the southern coastal migratory stock would be unlikely. Roughly 40 percent of the Export Cable Corridor is 20 m or less in depth. Given the Export Cable Corridor area is estimated to take 8 days to complete survey activity, 3 days have been estimated for depths shallower than 20 m. Therefore, to account for the potential for mixed stocks within the Export Cable Corridor, 3 days has been applied to the take estimation equation for the southern coastal migratory stock and the remaining applied to the offshore migratory stock (5 days). Bottlenose dolphin densities within the Lease Area have been considered part of the offshore migratory stock only. Additionally, while the potential exists for the Northern North Carolina estuarine system stock to occur, their low stock numbers and propensity for estuarine waters suggests encounters with individuals from this stock to be unlikely; therefore, this stock has been eliminated from consideration. In the instance of ESA-listed large whales, (North Atlantic right, Fin, and Sei whales), the Applicant has proposed a 1,640.4-ft (500-m) exclusion zone for the North Atlantic right whale and a 656.2-ft (200-m) exclusion zone for both Fin and Sei whales, for which both zones exceed the distance to the level B harassment isopleth. Given that the proposed mitigation effectively prevents level B harassment, take has been adjusted to 0 individuals for these species.

Table 7. Marine Mammal Density and Estimated Acoustic Harassment Take Numbers during Survey Activities

Species	Lease Area		Cable Route Corridor		Totals		Species Stock
	Maximum Average Seasonal Density a/ (No./100 km²)	Calculated Take (No.)	Maximum Average Seasonal Density a/ (No./100 km²)	Calculated Take (No.)	Total Take Authorization (No.)	Percent of Population	
North Atlantic right whale	0.051	1.063	0.051	0.288	0 /c	0.000	Western North Atlantic
Humpback whale	0.466	9.631	0.102	0.581	10	3.048	Gulf of Maine
Fin whale	0.328	6.773	0.128	0.729	0 /c	0.000	Western North Atlantic
Sei whale	0.020	0.406	0.003	0.018	0 /c	0.000	Nova Scotia
Minke whale	0.757	15.643	0.171	0.9722	17	0.641	Canadian east coast
Pilot whales	0.100	2.073	0.034	0.195	2	0.040	Western North Atlantic
Harbor porpoise	1.252	25.874	0.690	3.931	30	0.037	Gulf of Maine/Bay of Fundy
Bottlenose dolphin b/	0.000	0.000	49.102	104.944	105	2.798	Western North Atlantic, southern migratory coastal
	6.409	132.413	49.102	174.906	307	0.396	Western North Atlantic, offshore
Short beaked common dolphin	5.241	108.275	2.144	12.221	120	0.172	Western North Atlantic
Atlantic white-sided dolphin	2.482	51.288	0.320	1.826	53	0.109	Western North Atlantic
Atlantic spotted dolphin	8.895	183.772	3.493	19.910	204	0.456	Western North Atlantic
Risso's dolphin	0.074	1.525	0.074	0.421	2	0.011	Western North Atlantic

Notes:
a/ Density values from Duke University (Roberts et al. 2016b; 2017; 2018)
b/ Estimates split based on bottlenose dolphin stock preferred water depths (Reeves et al. 2002; Waring et al. 2016).
c/ Exclusion zone for selected species exceeds Level B isopleth. Take adjusted to 0 given that mitigation will prevent harassment.

7.0 ANTICIPATED IMPACTS OF THE ACTIVITY

Consideration of negligible impact is required for NMFS to authorize the incidental take of marine mammals. In 50 CFR § 216.103, NMFS defines negligible impact to be "an impact resulting from a specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stocks [of marine mammals] through effects on annual rates of recruitment or survival." Based upon best available data regarding the marine mammal species (including density, status, and distribution) that are likely to occur in the survey area, the Applicant concludes that exposure to marine mammal species and stocks during marine site characterization surveys would result in short-term minimal effects and would not affect the overall annual recruitment or survival for the following reasons:

- As detailed in Section 1.2, potential acoustic exposures from survey activities are within the non-injurious behavioral effects zone (Level B harassment);
- The potential for take as estimated in Section 0 represents a highly conservative estimate of harassment based upon typical HRG survey operations utilizing an overly conservative ZOI and without taking into consideration the effects of standard mitigation and monitoring measures; and
- The protective measures as described in Section 11.0 are designed to avoid and/or minimize the potential for interactions with and exposure to marine mammals.

Marine mammals are mobile free-ranging animals and have the capacity to exit an area when noise-producing survey activities are initiated. Based on the conservative take estimations, survey activities may disturb more than one individual for some species (mainly dolphins), but in conjunction with other aforementioned factors we conclude the short-term survey activities are not expected to result in population-level effects and that individuals will return to normal behavioral patterns after activities have ceased or after the animal has left the area under survey.

8.0 ANTICIPATED IMPACTS ON SUBSISTENCE USES

There are no traditional subsistence hunting areas in the survey area.

9.0 ANTICIPATED IMPACTS ON HABITAT

Bottom disturbance associated with the survey activities may include grab sampling to validate the seabed classification obtained from the multibeam echosounder/sidescan sonar data. This will typically be accomplished using a Mini-Harmon Grab with 0.1 m^2 sample area or the slightly larger Harmon Grab with a 0.2 m^2 sample area. The temporary and localized impact of the ZOI in relation to the comparatively vast area of surrounding open ocean would render any potential impacts to prey availability or potential avoidance by marine mammals insignificant and not likely to affect marine mammal species. The HRG survey equipment (towed equipment as listed in Table 1) will not contact the seafloor and would not be a source of air or water pollution. Impact to prey species is expected to be limited to avoidance of the area around the HRG survey activities and short-term changes in behavior. Such impacts are not expected to result in population-level effects on prey species (BOEM 2015). Individuals disturbed by a survey would likely return to normal behavioral patterns after the survey has ceased or after the animal has left the survey area.

Impact on marine mammal habitat from these activities will be negligible.

10.0 ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

As stated in Section 9.0, the effects to marine mammals from loss or modification of habitat from the proposed survey activities will be insignificant and discountable.

11.0 MITIGATION MEASURES

The Applicant commits to engaging in ongoing consultations with NMFS. The mitigation procedures outlined in this section are based on protocols and procedures that have been previously approved by NMFS, successfully implemented, and resulted in no take of marine mammals for similar offshore projects and previously approved by NMFS (ESS 2013; Dominion 2013 and 2014).

11.1 Vessel Strike Avoidance Procedures

The Applicant will ensure that vessel operators and crew maintain a vigilant watch for cetaceans and pinnipeds by slowing down or stopping their vessels to avoid striking these protected species. Survey vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures. Vessel strike avoidance measures will include, but are not limited to, the following, except under extraordinary circumstances when complying with these requirements would put the safety of the vessel or crew at risk:

- All vessel operators and crew will maintain vigilant watch for marine mammals and sea turtles, and slow down or stop their vessel to avoid striking these protected species;
- All vessel operators will comply with 10 knot (18.5 km/hr) or less speed restrictions for vessels 19.8 meters (65 ft) in length or greater. This applies to all vessels operating from November 1 through April 30;
- All vessel operators will comply with 10 knot (18.5 km/hr) or less speed restrictions when operating in any mid-Atlantic SMA from November 1 through April 30;
- All vessel operators will comply with 10 knot (18.5 km/hr) or less speed restrictions when operating in any Dynamic Management Area (DMA);
- All vessel operators will monitor the North Atlantic Right Whale Reporting Systems (e.g. the Early Warning System, Sighting Advisory System, and Mandatory Ship Reporting System) from November 1 through July 31 for the presence of North Atlantic right whales during activities conducted in support of plan submittal;
- All survey vessels will maintain a separation distance of 500 m (1640 ft) or greater from any sighted North Atlantic right whale;
- If underway, vessels must steer a course away from any sited North Atlantic right whale at 10 knots (18.5 km/hr) or less until the 500 m (1640 ft) minimum separation distance has been established. If a North Atlantic right whale is sited in a vessel's path, or within 100 m (328 ft) to an underway vessel, the underway vessel must reduce speed and shift the engine to neutral. Engines will not be engaged until the North Atlantic right whale has moved outside of the vessel's path and beyond 100 m. If stationary, the vessel must not engage engines until the North Atlantic right whale has moved beyond 100 m;
- All vessels will maintain a separation distance of 100 m (328 ft) or greater from any sighted non-delphinid cetacean. If sighted, the vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the non-delphinid cetacean has moved outside of the vessel's path and beyond 100 m. If a survey vessel is stationary, the vessel will not engage engines until the non-delphinid cetacean has moved out of the vessel's path and beyond 100 m;
- All vessel operators will comply with 10 knot (18.5 km/hr) or less speed restrictions when mother/calf pairs, pods, or large assemblages of non-delphinid cetaceans are observed near an underway vessel;

- All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted delphinid cetacean and pinniped. Any vessel underway remain parallel to a sighted delphinid cetacean or pinniped's course whenever possible and avoid excessive speed or abrupt changes in direction. Any vessel underway reduces vessel speed to 10 knots (18.5 km/hr) or less when pods (including mother/calf pairs) or large assemblages of delphinid cetaceans are observed. Vessels may not adjust course and speed until the delphinid cetaceans have moved beyond 50 m and/or the abeam of the underway vessel;
- All vessels underway will not divert or alter course in order to approach any whale, delphinid cetacean, or pinniped. Any vessel underway will avoid excessive speed or abrupt changes in direction to avoid injury to the sighted cetacean or pinniped; and
- All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted sea turtle.

The training program will be provided to NMFS for review and approval prior to the start of surveys. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the survey event.

11.2 Seasonal Operating Requirements

Between watch shifts, members of the monitoring team will consult NMFS North Atlantic right whale reporting systems for the presence of North Atlantic right whales throughout survey operations. All vessel operations will comply with the 10 knot (18.5 km/hr) or less speed restrictions when operating in any mid-Atlantic SMA from November 1 through April 30.

11.3 Exclusion and Monitoring Zone Implementation

The Applicant proposes to employ the following exclusion and monitoring zones during all HRG survey activities:

- 1,640.4-ft (500-m) North Atlantic right whale exclusion zone;
- 656.2-ft (200-m) ESA-listed large cetacean exclusion zone for Fin and Sei whales;
- 328.1-ft (100-m) non-delphinid, non-ESA-listed large cetacean exclusion zone; and
- 656.2-ft (200-m) Level B monitoring zone for all marine mammals except for the North Atlantic right, Fin and Sei whales.

11.4 Visual Monitoring Program

Visual monitoring of the established exclusion zones and monitoring zones will be performed by qualified and NMFS-approved Protected Species Observers (PSOs). Protected Species Observer qualifications will include direct field experience on a marine mammal observation vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico. An observer team comprising a minimum of four NMFS-approved PSOs, operating in shifts, will be stationed aboard either the survey vessel or a dedicated PSO vessel. Protected Species Observers will work in shifts such that no one monitor will work more than 4 consecutive hours without a 2-hour break or longer than 12 hours during any 24-hour period. During daylight hours the PSOs will rotate in shifts of 1 on and 3 off, and while during nighttime operations PSOs will work in pairs. Each PSO will monitor 360 degrees of the field of vision. The Applicant will provide resumes of all proposed PSOs (including alternates) to BOEM for review and approval by NMFS prior to the start of survey operations.

The PSOs will begin observation of the exclusion zones and monitoring zone during all HRG survey operations. Observations of the zones will continue throughout the survey activity and/or while equipment operating below 200 kHz are in use. Protected Species Observers will be responsible for visually monitoring and identifying marine mammals approaching or entering the established exclusion zones during survey activities. It will be the responsibility of the Lead PSO on duty to communicate the presence of marine mammals as well as to communicate and enforce the action(s) that are necessary to ensure mitigation and monitoring requirements are implemented as appropriate. A PSO mitigation and monitoring communications flow diagram has been included as Appendix A.

Protected Species Observers will be equipped with binoculars and have the ability to estimate distances to marine mammals located in proximity to their established zones using range finders. Reticulated binoculars will also be available to PSOs for use as appropriate based on conditions and visibility to support the siting and monitoring of marine species. Digital single-lens reflex camera equipment will be used to record sightings and verify species identification. During night operations, night-vision equipment (night-vision goggles with thermal clip-ons) and infrared technology will be used. Position data will be recorded using hand-held or vessel global positioning system (GPS) units for each sighting. Recent studies have concluded that the use of IR (thermal) imaging technology may allow for the detection of marine mammals at night as well as improve the detection during all periods through the use of automated detection algorithms (Weissenberger 2011). Studies have indicated that IR performance is independent of daylight and exhibits an almost uniform, omnidirectional detection probability within a radius of 3.1 mi (5 km). Results of studies demonstrate that thermal imaging can be used for reliable and continuous marine mammal protection (Zitterbart 2013). For this reason, the Applicant finds that use of IR systems for mitigation purposes warrants additional application in the field as both a standalone tool and in conjunction with other alternative monitoring methods (e.g., night vision binoculars). Specifications for representative night-vision and infrared equipment are included in Appendix C and Appendix D, respectively. These equipment specifications are provided as examples of equipment most likely. Specific night-vision and infrared equipment models will be subject to availability.

Observations will take place from the highest available vantage point on the survey vessel. General 360-degree scanning will occur during the monitoring periods, and target scanning by the PSO will occur when alerted of a marine mammal presence.

Data on all PSO observations will be recorded based on standard PSO collection requirements. This will include dates and locations of construction operations; time of observation, location and weather; details of the sightings (e.g., species, age classification [if known], numbers, behavior); and details of any observed “taking” (behavioral disturbances or injury/mortality). The data sheet will be provided to both NMFS and BOEM for review and approval prior to the start of survey activities. In addition, prior to initiation of survey work, all crew members will undergo environmental training, a component of which will focus on the procedures for sighting and protection of marine mammals. A briefing will also be conducted between the survey supervisors and crews, the PSOs, and the Applicant. The purpose of the briefing will be to establish responsibilities of each party, define the chains of command, discuss communication procedures, provide an overview of monitoring purposes, and review operational procedures.

11.5 Pre-Clearance of the Exclusion Zone

For all HRG survey activities, the Applicant will implement a 30-minute clearance period of the exclusion zone prior to the initiation of ramp-up (Section 11.7). During this period the exclusion zones will be monitored by the PSOs, using the appropriate visual technology and for a 30-minute period. Ramp-up may not be initiated if any marine mammal is observed within its respective exclusion zone. If a marine mammal is observed within an exclusion zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting its respective zone or until an additional time period has elapsed with no further sightings (i.e. 15 minutes for delphinid cetaceans and pinnipeds and 30 minutes for all other marine mammal species and sea turtles). This condition is a modification to Lease stipulation 5.4.7.4 and thus the Avangrid Renewables is requesting a reduction in the exclusion zone clearance protocol in accordance with the precedent established by NMFS in recent IHAs issued on the Atlantic

OCS. PSOs would also continue to monitor the zone for 30 minutes after survey equipment is shut down or survey activity has concluded

11.6 Ramp-Up Procedures

Where technically feasible, a ramp-up procedure will be used for HRG survey equipment capable of adjusting energy levels at the start or re-start of HRG survey activities. A ramp-up procedure will be used at the beginning of HRG survey activities in order to provide additional protection to marine mammals near the survey area by allowing them to vacate the area prior to the commencement of survey equipment use. Ramp-up is not required to re-initiate survey activities following a shut-down as described in Section 11.5. The ramp-up procedure will not be initiated during periods of inclement conditions if the exclusion zone cannot be adequately monitored by the PSOs using the appropriate visual technology (e.g., reticulated binoculars, night vision equipment) for a 60-minute period. A ramp-up would begin with the power of the smallest acoustic equipment at its lowest practical power output appropriate for the survey. When technically feasible the power would then be gradually turned up and other acoustic sources added in way such that the source level would increase in steps not exceeding 6 dB per 5-minute period.

Ramp-up activities will be delayed if a marine mammal(s) enters an exclusion zone(s). Ramp-up will continue if the animal has been observed exiting the exclusion zone or until an additional time period has elapsed with no further sighting (i.e. 60 minutes for all marine mammals and sea turtles).

11.7 Shut-Down Procedures

The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement should be discussed only after shutdown. The following outlines the shut-down procedures:

- If a non-delphinid cetacean or delphinid cetacean or pinniped is sighted at or within the established exclusion zone, an immediate shutdown of the survey equipment is required. Subsequent restart of the electromechanical survey equipment must use the ramp-up procedures described above and may only occur following clearance of the exclusion zone as described in Section 11.5.
- If the HRG sound source (including the sub-bottom profiler) shuts down for reasons other than encroachment into the exclusion zone by a non-delphinid cetacean or delphinid cetacean or pinniped, including but not limited to a mechanical or electronic failure, resulting in in the cessation of sound source for a period greater than 20 minutes, a restart for the HRG survey equipment (including the sub-bottom profiler) is required using the full ramp-up procedures and clearance of the exclusion zone of all cetaceans and pinnipeds for 30 minutes. If the pause is less than less than 20 minutes, the equipment may be restarted as soon as practicable at its operational level as long as visual surveys were continued diligently throughout the silent period and the exclusion zone remained clear of cetaceans and pinnipeds. If the visual surveys were not continued diligently during the pause of 20 minutes or less, a restart for the HRG survey equipment (including the sub-bottom profiler) is required using the full ramp-up procedures and clearance of the exclusion zone for all cetaceans and pinniped for 60 minutes.
- If a species for which authorization has not been granted, or, a species for which authorization has been granted but the authorized number of takes have been met, approaches or is observed within an EZ or within the area encompassing the Level B harassment isopleth, shutdown will occur.

12.0 ARCTIC PLAN OF COOPERATION

Potential impacts to species or stocks of marine mammals will be limited to individuals of marine mammal species located in the northeast region of the United States and will not affect Arctic marine mammals. Given that the Project is not located in Arctic waters, the activities associated with the Applicant's marine characterization surveys will not have an adverse effect on the availability of marine mammals for subsistence uses allowable under the MMPA.

13.0 MONITORING AND REPORTING

13.1 Monitoring

A visual monitoring protocol is described in Section 11.0.

13.2 Reporting

The Applicant will provide the following reports as necessary during construction activities:

- The Applicant will contact BOEM and NMFS within 24 hours of the commencement of survey activities and again within 24 hours of the completion of the activity;
- Any observed significant behavioral reactions (e.g., animals departing the area) or injury or mortality to any marine mammals must be reported to BOEM and NMFS within 24 hours of observation. Dead or injured protected species (e.g., marine mammals, sea turtles, and sturgeon) are reported to NMFS Northeast Region's Stranding Hotline (800-900-3622) within 24 hours of sighting, regardless of whether the injury is caused by a vessel. In addition, if the injury of death was caused by a collision with a project related vessel, the Applicant must ensure that BOEM and NMFS are notified of the strike within 24 hours. The Applicant must use the form included as Appendix A to Addendum C of the Lease to report the sighting or incident. If the Applicant is responsible or the injury or death, the vessel must assist with any salvage effort as requested by NMFS; and
- Within 90 days after completion of the marine site characterization survey activities, a final technical report will be provided to BOEM, and NMFS that fully documents the 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 survey activities, and provides an interpretation of the results and effectiveness of all monitoring tasks.

14.0 SUGGESTED MEANS OF COORDINATION RESEARCH

All marine mammal data collected by the Applicant during marine characterization survey activities will be provided to NMFS, BOEM, and other interested government agencies, and be made available upon request to educational institutions and environmental groups. These organizations could use the data collected during this period to study ways to reduce incidental taking and evaluate its effects.

15.0 LIST OF PREPARERS

Alexandra Gibson
Tetra Tech, Inc.
Environmental Scientist

Timothy Feehan
Tetra Tech, Inc.
Environmental Scientist

Erik Kalapinski
Tetra Tech, Inc.
Acoustic Engineer

Scott Lundin
Tetra Tech, Inc.
Director of Offshore Energy - East

16.0 REFERENCES

ACSonline (American Cetacean Society). 2004. "Cetacean Fact Pack." Site visited February 12, 2005. http://www.ACSonline.org/factpack/index.html

Baumgartner, M.F., and B.R. Mate. 2005. Summer and fall habitat of North Atlantic right whales (Eubalaena glacialis) inferred from satellite telemetry. Canadian Journal of Fisheries and Aquatic Sciences 62:527-543.

Blaylock, R.A., J.W. Hain, L.J. Hansen, D.L. Palka, and G.T. Waring. 1995. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments. NOAA Technical Memorandum NMFS-SEFSC-363.

BOEM (U.S. Department of the Interior, Bureau of Ocean Energy Management). 2012a. Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound-Generating Activities, Literature Synthesis.

BOEM. 2012b. Underwater hearing sensitivity of the leatherback sea turtle (Dermochelys coriacea): Assessing the potential effect of anthropogenic noise. Office of Renewable Energy Programs. OCS Study BOEM 2012-01156

BOEM 2012c. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia. Final Environmental Assessment. BOEM 2012-003.

BOEM. 2013. NOAA's National Marine Fisheries Service Endangered Species Act Section 7 Consultation: Biological Opinion.

BOEM. 2015. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore North Carolina. Revised Environmental Assessment. BOEM 2015-038.

Breiwick, J.M., E. Mitchell and R.R. Reeves. 1983. Simulated population trajectories for northwest Atlantic humpback whales, 1865-1980. In Abstracts of the Fifth Biennial Conference on the Biology of Marine Mammals, Boston, MA.

Bulloch, D.K. 1993. The Whale-Watcher's Handbook, A Field Guide to the Whales, Dolphins, and Porpoises of North America.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Clark, C.W. 1995. Application of U.S. Navy underwater hydrophone arrays for scientific research on whales. Reports of the International Whaling Commission 45: 210-212.

Crocker and Fratantonio. 2016. Characteristics of Sounds Emitted During High-Resolution Marine Geophysical Surveys. Naval Undersea Warfare Center Division (Sponsored by BOEM & USGS).

Davis GE, Baumgartner MF, Bonnell JM, Bell J, Berchok C, Bort Thornton J, Brault S, Buchanan G, Charif RA, Cholewiak D, Clark CW, Corkeron P, Delarue J, Dudzinski K, Hatch L, Hildebrand J, Hodge L, Klinck H, Kraus S, Martin B, Mellinger DK, Moors-Murphy H, Nieukirk S, Nowacek DP, Parks S, Read AJ, Rice AN, Risch D, Širović A, Soldevilla M, Stafford K, Stanistreet JE, Summers E, Todd S, Warde A, Van Parijs SM. 2017. Long-term passive acoustic recordings track the changing distribution of North Atlantic right whales (Eubalaena glacialis) from 2004 to 2014. Sci Rep. 2017 Oct 18;7(1):13460. doi: 10.1038/s41598-017-13359-3.

Dominion (Dominion Resources Inc.). 2013. Virginia Offshore Wind Technology Advancement Project (VOWTAP) Site Characterization Survey Marine Mammal and Sea Turtle Harassment Avoidance Summary Report.

Dominion. 2014. Virginia Offshore Wind Technology Advancement Project (VOWTAP) Site Characterization Survey Marine Mammal and Sea Turtle Harassment Avoidance Nearshore Marine Geophysical and Geotechnical Surveys Summary Report.

DoN (Department of the Navy). 2005. Marine Resources Assessment for the Northeast Operating Areas: Atlantic City, Narragansett Bay, and Boston. Final Report. Contract Number N62470-02-D-9997, CTO 0018. Department of the Navy, US Fleet Forces Command, Norfolk, VA. Prepared by Geo-Marine, Inc., Newport

News, VA. xvi + 535 pp. Available at https://www.navfac.navy.mil/products_and_services/ev/products_and_services/marine_resources/marine_resource_assessments.html.

DoN. 2007. Navy OPAREA Density Estimates (NODE) for the Northeast OPAREAs: Boston, Naragansett Bay, and Atlantic City. Final report. Contract number N62470-02- D-9997, CTO 0045. Norfolk, Virginia: Atlantic Division, Naval Facilities Engineering Command. Prepared by Geo-Marine, Inc., Plano, Texas.

DoN. 2012. Final Marine Mammal Monitoring Plan Trident Support Facilities Explosives Handling Wharf (EHW-2). Naval Base Kitsap at Bangor Silverdale, WA. Available at: http://www.nmfs.noaa.gov/pr/pdfs/permits/kitsap_wharfconstruction_monitoring.pdf

ESS (ESS Group). 2013. Summary of Marine Mammal Monitoring Activities for Cape Wind Energy Project – Geophysical Survey 2012. Available at: http://www.nmfs.noaa.gov/pr/pdfs/permits/capewind_monitoring2012.pdf

Gambell, R. 1985. Fin whale Balaenoptera physalus (Linnaeus, 1758). Pp. 171B192 in S.H. Ridgway and R. Harrison (eds.), Handbook of marine mammals, Vol. 3. Academic Press, London.

Glass, A.H., T.V.N Cole, M. Garron, R.L. Merrick, and R.M. Pace III. 2008. Mortality and serious injury determinations for baleen whale stocks along the United States eastern seaboard and adjacent Canadian Maritimes, 2002-2006. U.S. Department of Commerce, Northeast Fisheries Science Center Ref Doc. 08-04; 18 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

Hain, J.H.W., M.J. Ratnaswamy, R.D. Kenney, and H.E. Winn. 1992. The fin whale, Balaenoptera physalus, in waters of the northeastern United States continental shelf. Rep. Int. Whal. Commn 42:653B669.

Hayes, S.A., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds.). 2018. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2017. NOAA Technical Memorandum NMFS-NE-245; 371 p. Available at https://www.nefsc.noaa.gov/publications/tm/tm245/.

Hayes, S.A., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds.). 2017. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2016. NOAA Technical Memorandum NMFS-NE-241. Available at https://www.nefsc.noaa.gov/publications/tm/tm241/tm241.pdf.

IUCN (The World Conservation Union). 2010. 2010 IUCN Red List of Threatened Species. Available at: http://www.iucnredlist.org (Accessed in February 2010).

Jahoda, M., Lafortuna, C.L., Biassoni, N., Almirante, C., Azzellino, A., Panigada, S., Zanardelli, M. & Notarbartolo di Sciara, G. 2003. Mediterranean fin whale's (Balaenoptera physalus) response to small vessel and biopsy sampling assessed through passive tracking and timing of respiration. Marine Mammal Science, 19, 96–110.

Jefferson, T.A., M.A. Webber, and R.L. Pitman. 2008. Marine mammals of the world: A comprehensive guide to their identification. Amsterdam: Elsevier. 573 pp. London, UK: Elsevier.

Jefferson, T.A., S. Leatherwood, and M.A. Webber. 1993. FAO Species Identification Guide; Marine Mammals of the World. United Nations Environment Programme, Food and Agriculture Organization of the United Nations, Rome. viii + 320 pp.

Jensen, A.S., and G.K. Silber. 2004. Large Whale Ship Strike Database. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-OPR-, 37 pp.

Jonsgård, Å. 1966. Biology of the North Atlantic fin whale Balaenoptera physalus (L): taxonomy, distribution, migration and food. Hvalrådets Skrifter 49:1B62.

Kenney, R.D. 1990. Bottlenose dolphins off the northeastern United States. Pp. 369–396 in: S. Leatherwood and R. R. Reeves, eds. The Bottlenose Dolphin. Academic Press, San Diego, CA.

Kenney, R.D. 2002. North Atlantic, North Pacific and Southern Right Whales. pp. 806-813, In: W.F. Perrin, B. Würsig, and J.G.M. Thewissen (eds.). Encyclopedia of Marine Mammals. Academic Press, San Diego, CA.

Kenney, R.D. and H.E. Winn. 1986. Cetacean high-use habitats of the northeast United States continental shelf. Fishery Bulletin 84(2): 345-357.

Kenney, R.D., and K.J. Vigness-Raposa. 2009. 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. Technical Report, May 31, 2009.

Knowlton A.R. and S.D. Kraus. 2001. “Mortality and serious injury of northern right whales (Eubalaena glacialis) in the western North Atlantic Ocean”. Journal of Cetacean Research and Management, Special Issue 2:193-208.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science 17 (1), 35–75. Lesage, V. and M.O. Hammill. 2001. The status of the grey seal, Halichoerus grypus, in the Northwest Atlantic. Can. Field-Nat. 115(4): 653-662.

Lesage, V. and M.O. Hammill. 2001. The status of the grey seal, Halichoerus grypus, in the Northwest Atlantic. Can. Field-Nat. 115(4): 653-662.

Lowry, L. 2016. Pusa hispida. The IUCN Red List of Threatened Species 2016: e.T41672A45231341. Available at http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T41672A45231341.en.

NatureServe. 2010. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. Accessed: January 5, 2010

Nelson, M., M. Garron, R.L. Merrick, R.M. Pace and T.V.N. Cole. 2007. Mortality and serious injury determinations for large whale stocks along the United States Eastern Seaboard and Adjacent Canadian Maritimes, 2001-2005. U. S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 07-05. 18 pp.

NMFS (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 1991a. Recovery Plan for the Northern Right Whale (Eubalaena glacialis). Prepared by the Right Whale Recovery Team for the National Marine Fisheries Service”, Silver Spring, Maryland. 86 pp.

NMFS. 1991b. Recovery Plan for the Humpback Whale (Megaptera novaeangliae). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service”, Silver Spring, Maryland. 105 pp.

NMFS. 2006. Recovery Plan for The Sperm Whale (Physeter macrocephalus) [Draft Report]. (pp. 92). Silver Spring, MD: National Marine Fisheries Service.

NMFS. 2009. Sperm Whale (Physeter macrocephalus): 5-Year Review: Summary and Evaluation. (pp. 41). Silver Spring, MD: National Marine Fisheries Service.

NMFS. 2016. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. (and companion spreadsheet) U.S. Dept. of Commerce., NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 p.

NOAA (National Oceanic and Atmospheric Administration). 2010. Reducing Ship Strikes to North Atlantic Right Whales. http://www.nmfs.noaa.gov/ pr/shipstrike/.

NOAA. 2015a. Office of Protected Resources, Marine Mammal Stock Assessment Reports. (SARs) by Species/Stock http://nefsc.noaa.gov/publications/tm/tm231/7_rightwhale_F2014July.pdf Accessed November 3, 2015.

NOAA. 2015b. NOAA Fisheries Species information for Bottlenose Dolphin (Tursiops truncatus). http://www.nmfs.noaa.gov/pr/species/mammals/dolphins/bottlenose-dolphin.html Accessed January 2016.

NOAA. 2018. Incidental Take Authorization: Bay State Wind LLC Marine Site Characterization Surveys for Renewable Energy off the Coast of Massachusetts in the Area of OCS-A 0500 July 24, 2018

NOAA 2017. Incidental Take Authorization: Ocean Wind Marine Site Characterization Surveys, Offshore New Jersey June 8, 2017

Nowak, R.M. 2002. Walker’s Mammals of the World 6th edition. John Hopkins University Press, Baltimore, MD.

Pace RM, PJ Corkeron, and SD Kraus. 2017. State space estimates reveal a recent decline in abundance of North Atlantic right whales. Ecol Evol 7: 8730–8741

Pace RM, TVN Cole, and AG Henry. 2014. Incremental fishing gear modifications fail to significantly reduce large whale serious injury rates. Endangered Species Research 26:115–126.

Reeves, R.R. and A.J. Reed. 2003. Bottlenose dolphin, harbor porpoise, sperm whale and other toothed cetaceans Tursiops truncatus, Phocoena phocoena,a nd Physeter macrocephalus). Pp. 397-424 in Wild mammals of

North American biology, management and conservation. (G.A. Feldhamer, B.C. Thomspon and J.A. Chapman, eds.). Johns Hopkins Univ. Press, Baltimore.

Reeves, R.R. G.K. Silber and P.M. Payne. 1998. “Draft recovery plan for the Fin Whale (Balaenoptera physalus) and Sei Whale (Balenoptera borealis).” Office of Protected Resources, National Marine Fisheries Service, Silver Spring, MD. 65pp.

Reeves, R.R., B.S. Stewart, P.J. Clapham, and J.A. Powell. 2002. Guide to Marine Mammals of the World. National Audubon Society.

Rice, D.W. 1998. Marine Mammals of the World: Systematics and Distribution D. Wartzok (Ed.), (Society for Marine Mammology Special Publication 4, pp. 231). Lawrence, KS: Allen Press.

Richardson, W.J, C.R. Greene, Jr., C.I. Malme, and D.H. Thomson with S.E. Moore and B. Wursig. 1991. Effects of noise on marine mammals. OCS Study MMS 90 0093. Report from LGL Ecol. Resl. Assoc. Inc., Bryan, TX for U.S. Minerals Management Service, Atlantic OCS Region, Herndon, Virginia. NTIS PB91 168914.

Right Whale Consortium. 2014. North Atlantic Right Whale Consortium Sightings Database. 03/11/2014. New England Aquarium, Boston, MA. USA.

Roberts et al. 2016a. Roberts JJ, Best BD, Mannocci L, Fujioka E, Halpin PN, Palka DL, Garrison LP, Mullin KD, Cole TVN, Khan CB, McLellan WM, Pabst DA, Lockhart GG. 2016. Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. Scientific Reports 6: 22615. doi: 10.1038/srep22615.

Roberts et al. 2016b. Roberts JJ, Mannocci L, Halpin PN (2016) Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2015-2016 (Base Year). Document version 1.0. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Roberts et al. 2017. Roberts JJ, Mannocci L, Halpin PN (2017) Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2016-2017 (Opt. Year 1). Document version 1.4. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Roberts et al. 2018. Roberts JJ, Mannocci L, Schick RS, Halpin PN (2018) Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2017-2018 (Opt. Year 2). Document version 1.2. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Rosalind M. Rolland, Robert S. Schick, Heather M. Pettis, Amy R. Knowlton, Philip K. Hamilton, James S. Clark, Scott D. Kraus. 2016. Health of North Atlantic right whales *Eubalaena glacialis* over three decades: from individual health to demographic and population health trends. Mar Ecol Prog Ser 542:265-282. https://doi.org/10.3354/meps11547.

Sergeant, D.E. 1977. Stocks of fin whales Balaenoptera physalus L. in the North Atlantic Ocean. Rep. int. Whal. Commn 27:460B473.

Shoop, C. R., and R. D. Kenney. 1992. Distributions and abundances of loggerhead and leatherback sea turtles in northeastern United States waters. Herpetological Monographs 6:43–67.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A, and P.L. Tyack. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, Volume 33, Number 4, ISSN 0167-5427. 521 pp.

Stevick, P.T., L. Pacheco de Godoy, M. McOsker, M.H. Engel, J. Allen. 2006. A note on the movement of a humpback whale from Abrolhos Bank, Brazil to South Georgia. J Cetacean Res Manage 8:297-300

Sutcliffe M.H., and P.F. Brodie. 1977. Whale distributions in Nova Scotia waters. Fish Mar Serv Tech Rep 722:1-89

Swingle, W.M., S.G. Barco, T.D. Pitchford, W.A. McLellan, and D.A. Pabst. 1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Mar. Mamm. Sci. 9:309-315.

Tetra Tech. 2014. Hydroacoustic Survey Report of Geotechnical Activities Virginia Offshore Wind Technology Advancement Project (VOWTAP) September 2014.

Van der Hoop, J.M., P. Corkeron, A.G. Henry, A.R. Knowlton and M.J. Moore. 2017. Predicting lethal entanglements as a consequence of drag from fishing gear. Marine Pollution Bulletin 115: 91-104

Van der Hoop Corkeron, J., 2016. Entanglement is a costly life-history stage in large whales. Ecology and Evolution 00:1–15. http://dx.doi.org/10.1002/ece3.2615.

Van der Hoop, J.M., A.S.M. Vanderlaan, T.V.N. Cole, A.G. Henry, L. Hall, B. Mase-Guthrie, T. Wimmer, and M.J. Moore. 2015. Vessel strikes to large whales before and after the 2008 Ship Strike Rule. Cons. Letters 8(1) 24–32.

Waring, G. T., Josephson, E., Maze-Foley, K. & Rosel, P. E. (eds.). 2009. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2009 [Technical Memorandum]. (NMFS NE 213, pp. 528). Woods Hole, MA: NOAA Retrieved from http://www.nefsc.noaa.gov/nefsc/ publications/tm/tm213/index.html

Waring GT, Josephson E, Maze-Foley K, and Rosel PE (eds.). 2010. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2009. NOAA Tech Memo NMFS NE 213; 528 p.

Waring, G., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds.). 2011. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2011, 330 pages. Available at: http://www.nmfs.noaa.gov/pr/pdfs/sars/ao2011.pdf.

Waring, G., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds). 2013. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2012, 419 pages. Available at: www.nmfs.noaa. gov/pr/sars/pdf/ao2012.pdf.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds.). 2015. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2014. NOAA Technical Memorandum. Available at: http://www.nmfs.noaa.gov/pr/sars/pdf/atl2014_final.pdf

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds.). 2016. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2015. NOAA Technical Memorandum. Available at: http://www.nmfs.noaa.gov/pr/sars/pdf/atlantic2015_final.pdf

Waring, G.T., E. Josephson, C.P. Fairfield, and K. Maze-Foley, eds., with contributions from: Dana Beldon, Timothy V. N. Cole, Lance P. Garrison, Keith D. Mullin, Christopher Orphanides, Richard M. Pace, Debra L. Palka, Marjorie C. Rossman, and Fredrick W. Wenzel. 2007. Technical Memorandum NMFS-NE-201. National Oceanic and Atmospheric Administration, U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2006.

Waring, G.T., R.M. Pace, J.M. Quintal, C.P. Fairfield, and K. Maze-Foley (eds.). 2004. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2003. NOAA Technical Memorandum NMFS-NE-182.

Waring, G.T., E. Josephson, C.P. Fairfield-Walsh, and K. Maze-Foley (eds.). 2009. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2008. NOAA Tech Memo NMFS NE 210; 440 p.

Waring, G.T., L. Nøttestad, E. Olsen, H. Skov, and G. Vikingsson. 2008. Distribution and density estimates of cetaceans along the mid-Atlantic ridge during summer 2004. J Cetacean Res Manage 10:137-46.

Watkins, W.A., K.E. Moore, J. Sigurjonsson, D. Wartzok, and G. Notarbartolo di Sciara. 1984. Fin whale (Balaenoptera physalus) tracked by radio in the Irminger Sea. Rit Fiskideildar 8(1):1-14

Whitehead, H. 2003. Sperm Whales: Social Evolution in the Ocean (pp. 431). University of Chicago Press.

Whitehead, H. 2008. Sperm whale Physeter macrocephalus. In W. F. Perrin, B. Wursig and J. G. M. Thewissen (Eds.), Encyclopedia of Marine Mammals (Second Edition) (pp. 1091-1097). Academic Press.

Whitehead, H., S. Brennan, and D. Grover. 1992. Distribution and behaviour of male sperm whales on the Scotian shelf. Canadian Journal of Zoology 70, 912-918.

Winn, H. E., C. A. Price, and P. W. Sorensen. 1986. The distributional ecology of the right whale Eubalaena glacialis in the western North Atlantic. Reports of the International Whaling Commission, Special Issue 10: 129–138.

Wynne, K., and M. Schwartz. 1999. Marine Mammals and Turtles of the U. S. Atlantic and Gulf of Mexico. Rhode Island Sea Grant. Narragansett, Rhode Island. 114 pp.

APPENDIX A - NATIONAL MARINE FISHERIES SERVICE SCREENING LEVEL METHODOLOGY CALCULATION SPREADSHEETS FOR THE DETERMINATION FOR ONSET OF PERMANENT AND TEMPORARY THRESHOLD SHIFTS (VERSION 2.0 APRIL 2018)

This page intentionally left blank.

USER SPREADSHEET INTRODUCTION

VERSION: 2.0 (2018)

Companion* User Spreadsheet to:

National Marine Fisheries Service (NMFS): 2018 Revision to: Technical Guidance For Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing: Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts (Version 2.0)

2018 Revised Technical Guidance web page

***For more information on the optional methodology provided within this User Spreadsheet, see Appendix D of Technical Guidance (2018)**

DISCLAIMER: NMFS has provided this spreadsheet as an optional tool to provide estimated effect distances (i.e., isopleths) where PTS onset thresholds may be exceeded. Results provided by this spreadsheet do not represent the entirety of the comprehensive effects analysis, but rather serve as one tool to help evaluate the effects of a proposed action on marine mammal hearing and make findings required by NOAA's various statutes. Input values are the responsibility of the individual user.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance.

INSTRUCTIONS

STEP 1: Determine what spreadsheet is appropriate for activity

HOW TO DETERMINE WHICH SPREADSHEET TO USE

1) Is the sound source NON-IMPULSIVE or IMPULSIVE? (If it is unclear which category describes your source, consult NOAA)
- a) NON-IMPULSIVE (e.g., drilling, vibratory pile driving, tactical sonar): Go to Question 2
- b) IMPULSIVE (e.g., explosives, impact pile driving, seismic): Go to Question 5

2) Is the NON-IMPULSIVE sound source STATIONARY or MOBILE?
- a) STATIONARY: Go to Question 3
- b) MOBILE: Go to Question 4

3) Is the NON-IMPULSIVE, STATIONARY source CONTINUOUS or INTERMITTENT?
- a) CONTINUOUS: Use Spreadsheet A* — **RED**
- *If source is vibratory pile driving: Use Spreadsheet A.1 — **BRICK**
- b) INTERMITTENT: Use Spreadsheet B — **YELLOW**

4) Is the NON-IMPULSIVE, MOBILE source CONTINUOUS or INTERMITTENT?
- a) CONTINUOUS: Use Spreadsheet C ("safe distance" methodology from Sivle et al. 2014) — **BLUE**
- b) INTERMITTENT: Use Spreadsheet D ("safe distance" methodology from Sivle et al. 2014) — **ORANGE**

5) Is the IMPULSIVE sound source STATIONARY or MOBILE?
- a) STATIONARY: Use Spreadsheet E* — **GREEN**
- *If source is impact pile driving: Use Spreadsheet E.1 — **EVRGRN**
- *If source is multiple explosives: Use Spreadsheet E.2 — **SEAFM**
- *If source is single explosive: Use Spreadsheet E.3 — **LIME**
- b) MOBILE: Use Spreadsheet F ("safe distance" methodology from Sivle et al. 2014) — **PURPLE**

STEP 2: Within the appropriate spreadsheet, fill-in: **SAGE CELLS** specific to the activity
- a) Please provide information used to support values in provided in sage boxes (e.g., surrogate data, direct measurements, etc.)
- b) If information is unavailable to fill-out one or more of the sage boxes, please consult NMFS

STEP 3: Estimated PTS isopleths (meter) will be provided in: **SKY BLUE CELLS** by marine mammal hearing group

STEP 4: When using this spreadsheet to estimate marine mammal takes, please provide a copy of completed spreadsheet used to estimate isopleths

ASSUMPTIONS & ADDITIONAL INFORMATION

1) Marine mammals remain stationary during activity
2) Currently, recovery between intermittent sounds is not considered regardless of time between sounds (i.e., all sounds within the accumulation period are counted)

Suggested (Default*) Weighting Factor Adjustments (WFA), If Input Value is Unknown for Broadband Source:

Source	WFA	Example Supporting Sources
Seismic	1 kHz	Breitzke et al. 2008; Tashmukhambetov et al. 2008; Tolstoy et al. 2009
Impact pile driving	2 kHz	Blackwell 2005; Reinhall and Dahl 2011
Vibratory pile driving	2.5 kHz	Blackwell 2005; Dahl et al. 2015
Drilling	2 kHz	Greene 1987; Blackwell et al. 2004; Blackwell and Greene 2006

* NMFS acknowledges default WFAs are likely conservative

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW): true seals
Otariid pinnipeds (OW): sea lions and fur seals

Since spectra associated with underwater explosives vary by detonation size and depth (Urick 1983), a default WFA is not provided

Literature Cited

Blackwell, S.B. 2005. Underwater Measurements of Pile Driving Sounds during the Port MacKenzie Dock Modifications, 13-16 August 2004. Juneau, Alaska: Federal Highway Administration.

Blackwell, S.B., C.R. Greene, Jr., and W.J. Richardson. 2004. Drilling and operational sounds from an oil production island in the ice-covered Beaufort Sea. Journal of the Acoustical Society of America 116: 3199-3211.

Blackwell, S.B., and C.R. Green, Jr. 2006. Sounds from an oil production island in the Beaufort Sea in summer: Characteristics and contribution of vessels. Journal of the Acoustical Society of America 119: 182-196.

Breitzke, M., O. Boebel, S. El Naggar, W. Jokat, and B. Werner. 2008 Broad-band calibration of marine seismic sources used by R/V Polarstern for academic research in polar regions. Geophysical Journal International 174: 505-524.

Dahl, P.H., D.R. Dall'Osto, and D.M. Farrell. 2015. The underwater sound field from vibratory pile driving. Journal of the Acoustical Society of America 137: 3544–3554.

Madsen, P.T. 2005. Marine mammals and noise: Problems with root mean square sound pressure levels for transients. Journal of the Acoustical Society of America 117:3952–3957.

Greene, R. 1987. Characteristics of oil industry dredge and drilling sounds in the Beaufort Sea. Journal of the Acoustical Society of America 82: 1315-1324.

Reinhall, P.G., and P.H. Dahl. 2011. Underwater Mach wave radiation from impact pile driving: Theory and observation. Journal of the Acoustical Society of America 130: 1209–1216.

Sivle, L.D., P.H. Kvadsheim, and M.A. Ainslie. 2014. Potential for population-level disturbance by active sonar in herring. ICES Journal of Marine Science 72: 558-567.

Tashmukhambetov, A.M., G.E. Ioup, J.W. Ioup, N.A. Sidorovskaia, and J.J. Newcomb. 2008. Three-dimensional seismic array characterization study: Experiment and modeling. Journal of the Acoustical Society of America 123:4094–4108.

Tolstoy, M., J. Diebold, L. Doermann, S. Nooner, S.C. Webb, D.R. Bohnenstiehl, T.J. Crone, and R.C. Holmes. 2009. Broadband calibration of the R/V Marcus G. Langseth four-string seismic sources. Geochemistry Geophysics Geosystems 10: 1-15.

Urick, R.J. 1983. Principles of Underwater Sound. New York, New York: McGraw-Hill Book Company.

Technical questions or suggestion on User Spreadsheet: Please contact Amy Scholik-Schlomer (amy.scholik@noaa.gov)

UPDATES (w be posted when change resu ts n the need to reca cu ate an sop eth; other non-substant ve changes may be made period ca y but w not resu t n a vers on number change)

Original Version	Updated Version	Change	Date posted
1.0	1.1	Sheet A, error with formula for phocid pinniped	Aug. 22, 2016
1.1	2.0	Corresponds to 2.0 version of Revised Technical Guidance (2018). Added sheet specific to vibratory pile driving and explosives and added capabilities to calculate peak sound pressure level isopleths for impulsive sources	2018

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

(green)	User Provided Information
(pink)	NMFS Provided Information (Technical Guidance)
(blue)	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Kittyhawk Offshore Wind
PROJECT/SOURCE INFORMATION	USBL Positioning System
Please include any assumptions	
PROJECT CONTACT	Tetra Tech

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)[¥]	26.5	HRG equipment manufacturer

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD[‡] USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	188
Source Velocity (meters/second)	2.058
Pulse Duration (seconds)	0.016
1/Repetition rate^ (seconds)	0.33
Duty Cycle	0.05
Source Factor	3.0286E+17

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**0.0**	**0.0**	**2.1**	**0.0**	**0.0**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	**-9.25**	**-0.02**	**-0.40**	**-4.28**	**-5.91**

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

D: MOBILE SOURCE: Non-Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

(green)	**User Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Kittyhawk Offshore Wind
PROJECT/SOURCE INFORMATION	Shallow Penetration SBP
Please include any assumptions	
PROJECT CONTACT	Tetra Tech

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)¥	2.6	HRG equipment manufacturer

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 63), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either D1 OR D2 method to calculate isopleths (not required to fill in sage boxes for both)

D1: METHOD‡ USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	179
Source Velocity (meters/second)	2.058
Pulse Duration (seconds)	0.0658
1/Repetition rate^ (seconds)	0.25
Duty Cycle	0.26
Source Factor	2.09067E+17

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	0.0	0.0	0.0	0.0	0.0

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-0.06	-16.33	-22.91	-1.17	-0.52

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

F: MOBILE SOURCE: Impulsive, Intermittent ("SAFE DISTANCE" METHODOLOGY)

VERSION 2.0: 2018

KEY

(green)	**User Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Kittyhawk Offshore Wind
PROJECT/SOURCE INFORMATION	Medium Penetration SBP

Please include any assumptions

PROJECT CONTACT	Tetra Tech, Inc

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)[¥]	1.4	HRG equipment manufacturer

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 71), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

*** BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)**

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either F1 OR F2 method to calculate isopleths (not required to fill in sage boxes for both)

F1: METHOD[‡] TO CALCULATE PK and SEL_{cum} (USING RMS SPL SOURCE LEVEL)

SEL_{cum}

FV Source Level (RMS SPL)	206
Source Velocity (meters/second)	2.058
Pulse Duration[Δ] (seconds)	0.008
1/Repetition rate^ (seconds)	0.25
Duty Cycle	0.03
Source Factor	1.27394E+19

PK

Source Level (PK SPL)	215

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent

[Δ]Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

^Time between onset of successive pulses.

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS SEL_{cum} Isopleth to threshold (meters)	**9.7**	**0.0**	**3.6**	**2.6**	**0.1**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**4.5**	**NA**	**NA**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	**0.00**	**-24.52**	**-32.34**	**-3.80**	**-2.62**

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

WEIGHTING FACTOR ADJUSTMENTS (WFA) **VERSION 2.0, 2018**

Numerical criteria presented in the Technical Guidance consist of both an acoustic threshold and auditory weighting function associated with the SELcum metric. NMFS recognizes that the implementation of marine mammal weighting functions represents a new factor for consideration, which may extend beyond the capabilities of some action proponents. Thus, NMFS has developed simple weighting factor adjustments (WFA) for those who cannot fully apply auditory weighting functions associated with the SELcum metric.

WFAs consider marine mammal auditory weighting functions by focusing on a single frequency. This will typically result in similar, if not identical, predicted exposures for narrowband sounds or higher predicted exposures for broadband sounds, since only one frequency is being considered, compared to exposures associated with the ability to fully incorporate

WFAs have the advantage of allowing everyone to use the same acoustic thresholds and allows for adjustments to be made for each hearing group based on source-specific information.

For Narrowband Sounds: The selection of the appropriate frequency for consideration associated with WFAs is fairly straightforward. WFAs for a narrowband sound would take the weighting function amplitude, for each hearing group, associated with the particular frequency of interest and use it to make an adjustment to better reflect the hearing's group susceptibility to that narrowband sound.

For Broadband Sounds*: The selection of the appropriate frequency for consideration associated with WFAs is more complicated. The selection of WFAs associated with broadband sources is similar to the concept used for to determine the 90% total cumulative energy window (5 to 95%) for consideration of duration associated with the RMS metric and impulsive sounds (Madsen 2005) but considered in the frequency domain, rather than the time domain. This is typically referred to as the 95% frequency contour percentile (Upper frequency below which 95% of total cumulative energy is contained; Charif et al. 2010).

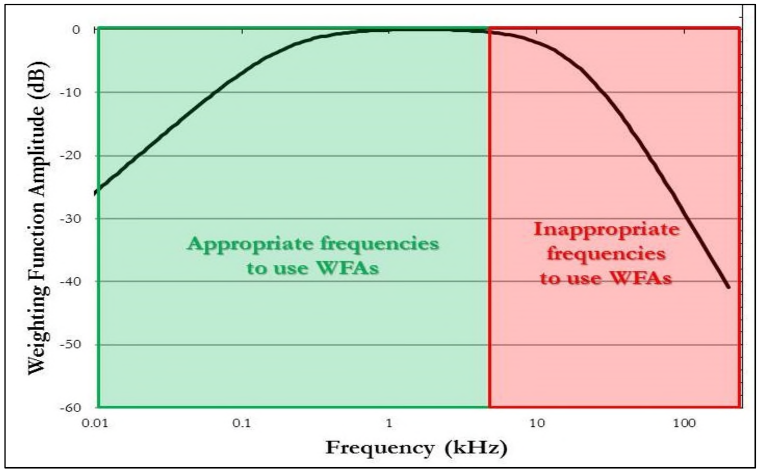
* Special Considerations for Broadband Sounds: Since the intent of WFAs is to broadly account for auditory weighting functions below the 95% frequency contour percentile, it is important that only frequencies on the "left side" of the weighting function be used to make adjustments (i.e., frequencies below those where the weighting function amplitude is zero or below where the function is essentially flat; resulting in every frequency below the WFA always having a more negative amplitude than the chosen WFA) (Figure below). It is inappropriate to use WFAs for frequencies on the "right side" of the weighting function (i.e., frequencies above those where the weighting function amplitude is zero). For a frequency on the "right side" of the weighting function (Table below), any adjustment is inappropriate and WFAs cannot be used (i.e., an action proponent would be advised to not use weighting functions and evaluate its source as essentially unweighted; see "Use" frequencies in Table below, which will result in a weighting function amplitude of 0 dB).

TABLE*

Hearing Group	Applicable Frequencies	Non-Applicable Frequencies*
Low-Frequency Cetaceans (LF)	4.8 kHz and lower	Above 4.8 kHz (Use: 1.7 kHz)
Mid-Frequency Cetaceans (MF)	43 kHz and lower	Above 43 kHz (Use: 28 kHz)
High-Frequency Cetaceans (HF)	59 kHz and lower	Above 59 kHz (Use: 42 kHz)
Phocid Pinnipeds (PW)	11 kHz and lower	Above 11 kHz (Use: 6.2 kHz)
Otariid Pinnipeds (OW)	8.5 kHz and lower	Above 8.5 kHz (Use: 4.9 kHz)

* With non-applicable frequencies, user should input the "use" frequency in the User Spreadsheet, which will result in a weighting function amplitude/adjustment of 0 dB (i.e., unweighted). NOTE: "use" frequency is only appropriate for that particular hearing group. Thus, if unweighted isopleths are required for more than one hearing group, users will need to provide multiple spreadsheets supporting isopleths (i.e., separate spreadsheets for each different WFA used) or override the Adjusment (dB) with 0.

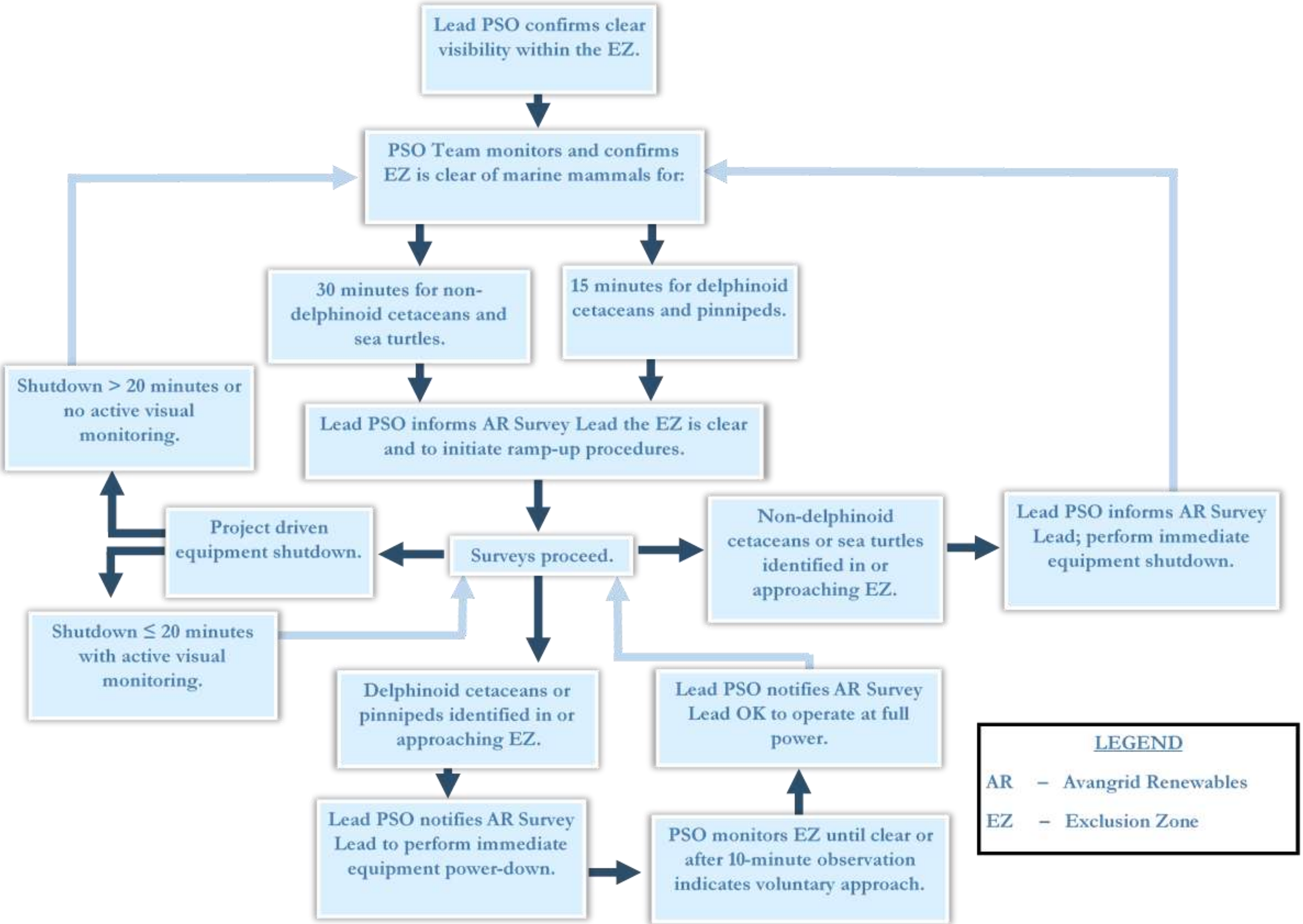
FIGURE



Example weighting function illustrating where the use of weighting function adjustments are (Green: "left side") and are not (Red: "right side") appropriate for broadband sources.

APPENDIX B - MITIGATION AND MONITORING COMMUNICATIONS FLOW DIAGRAM

This page intentionally left blank.


Lead PSO confirms clear visibility within the EZ.
PSO Team monitors and confirms EZ is clear of marine mammals for:
30 minutes for non-delphinoid cetaceans and sea turtles.
15 minutes for delphinoid cetaceans and pinnipeds.
Lead PSO informs AR Survey Lead the EZ is clear and to initiate ramp-up procedures.
Shutdown > 20 minutes or no active visual monitoring.
Project driven equipment shutdown.
Surveys proceed.
Non-delphinoid cetaceans or sea turtles identified in or approaching EZ.
Lead PSO informs AR Survey Lead; perform immediate equipment shutdown.
Shutdown ≤ 20 minutes with active visual monitoring.
Delphinoid cetaceans or pinnipeds identified in or approaching EZ.
Lead PSO notifies AR Survey Lead OK to operate at full power.
Lead PSO notifies AR Survey Lead to perform immediate equipment power-down.
PSO monitors EZ until clear or after 10-minute observation indicates voluntary approach.
LEGEND
AR – Avangrid Renewables
EZ – Exclusion Zone