Alpine Ocean Seismic Survey Inc on behalf of US Wind Inc

Project:
PSO Report – *M.V. Ocean Discovery* for US Wind Maryland

Description:
Protected Species Observer Report

Survey Dates:
16th June to 9th July 2015

Project Number:
10505

Lease Reference Number
OCS-A-0489 & OCS-A-0490

REPORT AUTHORISATION AND DISTRIBUTION

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Revision	Date	Title
1	19th November 2015	Final

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EXECUTIVE SUMMARY

- Monitoring for marine mammals and sea turtles occurred during a geotechnical survey on the Maryland Wind Energy site, offshore Maryland, USA. This survey was conducted onboard the *M.V. Ocean Discovery* from 16th June to 9th July 2015.

- Weather conditions recorded during marine mammal and sea turtle monitoring were mostly good, but occasionally moderate. The sea state was mostly slight, with a predominantly low swell, and good visibility. Beaufort wind force was variable between Force 0 and 7 with Force 4 occurring most frequently and from a general southerly direction.

- The survey was run in accordance with the mitigation requirements stipulated in the lease (OSC-A-0489 & A-0490) and mitigation plan submitted to the Bureau of Ocean Energy Management (BOEM). Mitigation measures covered mitigation for vessel strike avoidance and for the avoidance of disturbance and harm from geotechnical activities.

- Watches for marine mammals and sea turtles occurred 19 days of the survey and resulted in 405 hours and 36 minutes of observer effort and 16 observations.

- During the survey, there were six encounters of delphinids including one sighting of a dead unidentified dolphin and ten sightings of marine turtle. There were no encounters of north Atlantic right whales or pinnipeds. A total two sightings were recorded during the hours of darkness using night vision binoculars whilst 14 sightings were during daylight hours.

- Acoustic monitoring for marine mammals occurred on 16 days of the survey and resulted in 277 hours and 3 minutes of monitoring effort and three acoustic detections.

- There was one detection of a probable humpback whale and two detections of unidentified dolphins. No visual detections were made in association with these.

- All appropriate separation distances and avoidance measures were maintained and implemented for marine mammals and sea turtles during the survey.

- There were no occasions where vessel speed was reduced to 10 knots or less due to large assemblages, mother/calf pairs, and designation of a Dynamic Management Zone or on entering a Seasonal Management Area.

- The geotechnical survey involved combined borehole drilling and Cone Penetration Testing (CPT) and was utilised on 13 days to complete a total of seven sampling stations.

- Geotechnical equipment was activated on 12 of occasions during the survey, all of which occurred during the hours of daylight. All start ups of geotechnical equipment were covered by full dedicated pre-start watches dedicated and acoustic monitoring.

- There were two delays to the start-up of geotechnical equipment due to marine mammals or sea turtle encounters during the survey.

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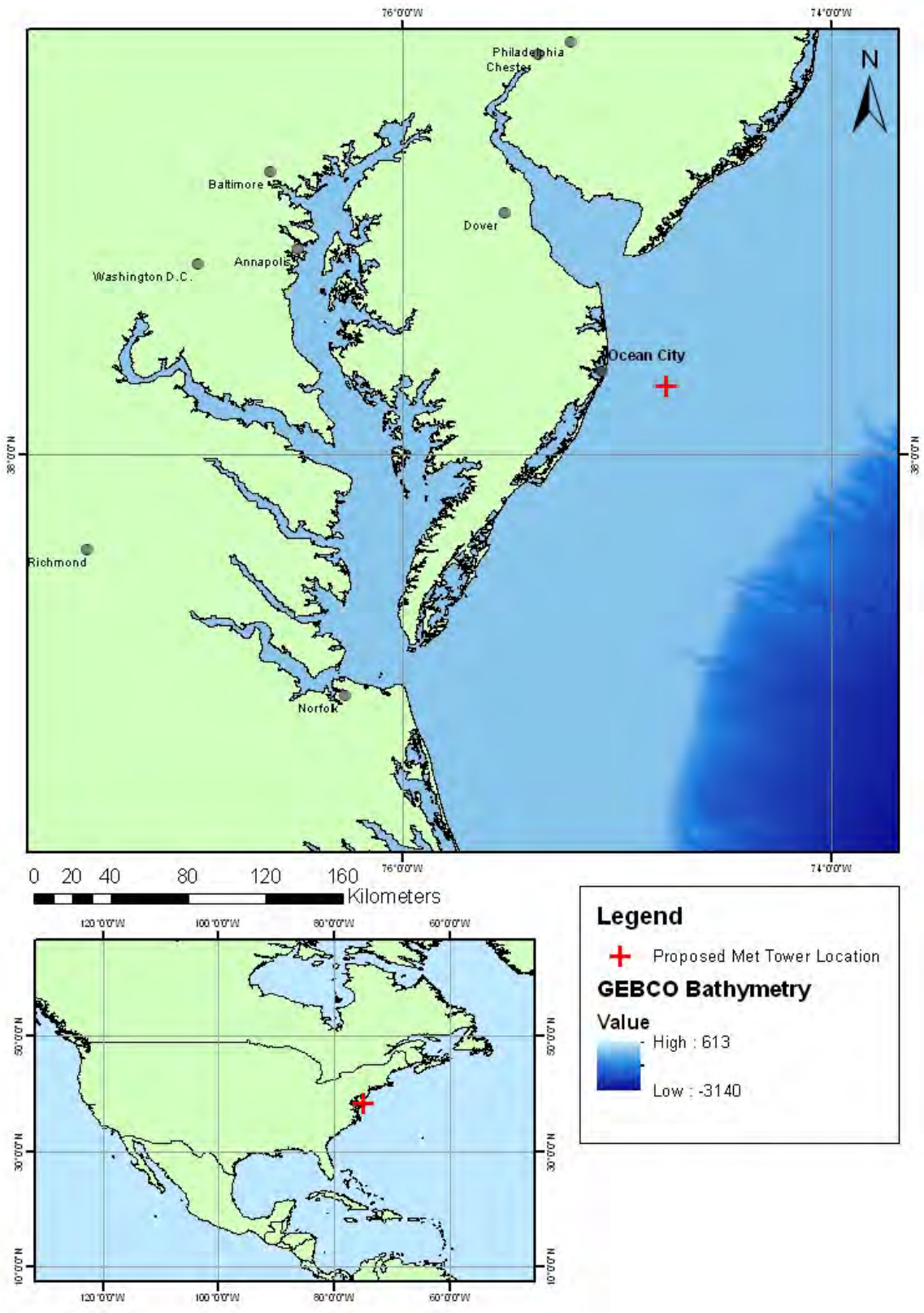
LOCATION MAP



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1. INTRODUCTION

1.1 Marine Geotechnical Surveys

Marine geotechnical surveys are being performed in order to characterise and investigate seabed conditions in the area to aid planning and development of a potential wind farm site. Little is known about the sound levels produced by equipment such as vibrocores, soil boring equipment and cone penetrometer equipment. Noise measurements recorded during a geotechnical survey in the Chukci Sea presented threshold distances of 1800 m for 120 dB re 1 µPa although this accounted for dynamic positioning systems onboard as well as coring activity (Hartin *et al*., 2011).

1.2 Sound and Marine Mammals and Sea Turtles

1.2.1 Marine mammals

Sound is conducted through water approximately 4.5 times faster than through air and is the most important sense for many marine organisms. This is especially true for marine mammals which use sound to communicate, navigate, forage and for predator avoidance (Richardson *et al*., 1995). The functional frequency range used by marine mammals varies between 7 Hz and 180 kHz, with the large baleen whales using the lower frequencies while smaller toothed whales use higher frequencies (Southall *et al*., 2007).

Anthropogenic sound can impact marine mammals in a number of ways from direct injury (physiological and auditory effects) and behavioural responses, to perceptual and indirect effects (Gotz *et al*., 2009; Southall *et al*., 2007).

It is clear that behavioural responses to sound are highly variable and context specific, with spatial and temporal relationship, habitat quality, previous experience and similarity to biologically significant sounds, as well as the species, gender, age and behavioural state of the individual influencing the type and severity of the response or even if one is observed at all (Southall *et al*., 2007; Ellison *et al*., 2012).

The ability to perceive biologically important sounds is critical to marine mammals (Richardson *et al*., 1995). Masking by increased sound levels in the natural environment can reduce the range over which signals are perceived and reduced the signal's quality of information, which can have implications for survival, reproduction and foraging (Weilgart, 2007). In many cases changes in vocalisation rates and the frequencies used have been suggested to be compensatory behaviour to elevated background noise levels (Di Iorio & Clark, 2010).

1.2.2 Sea turtles

Sea turtles are another group potentially impacted by anthropogenic acoustic activity although their hearing sensitivity falls in the low frequency range (<1 kHz) (Bartol *et al*., 1999). Strong site fidelity to nesting sites, specific feeding grounds and migratory routes (Broderick *et al*., 2007) could mean marine turtles are unable to avoid particular areas and consequently acoustic activity.

1.3 Vessel Strikes

There is increasing evidence that collisions between vessels and cetaceans (whales, dolphins and porpoises) is occurring more frequently than previously thought, and that in some cases this may post a significant conservation threat particularly for geographically isolated and endangered populations (Dolman *et al.,* 2006; Van Waerebeek *et al*., 2007; Knowlton & Kraus, 2001). There are

several variables which may either make a collision more likely or influence the kind of injuries inflicted or whether the collision is fatal. These include vessel speed, with speeds >11 knots more likely to cause a fatality (Vanderlaan & Taggart, 2007), type and size of vessel, visibility, condition and behaviour of individual and species (Dolman *et al*., 2006; McKenna *et al*., 2015). In the north-west Atlantic the northern right whale (*Eubalaena glacialis*) is particularly vulnerable to vessel strikes (Knowlton & Kraus, 2001). A number of mitigation measures have been implemented in order to reduce the number of vessel strikes offshore of the northeast coast of the USA (Laist *et al*., 2014; NOAA, 2008).

1.4 Legislation

There are two US Federal Legislations appropriate to marine mammals and sea turtles, the Marine Mammal Protection Act (MMPA) (1972, and last amended in 2007) and the Endangered Species Act (ESA) (1973).

The MMPA was established to prevent species and populations from 'declining to the point where they cease to be significant functioning elements of the ecosystems of which they are a part'. The Act established a moratorium on the *taking* of marine mammals, with the word *take* defined as 'to hunt, harass, capture or kill any marine mammal or attempt to do so'. Under the MMPA, Incidental Harassment Authorisations (IHAs) were established to allow incidental 'takes' of small numbers of marine mammals by harassment. There are two levels of harassment defined under the IHAs: Level A covers any act with the potential to injure and Level B covers any act with the potential to disturb by causing disruption of behavioural patterns.

The ESA protects endangered and threatened species, which includes 22 species of marine mammal and all sea turtles, and their habitats by prohibiting the take of listed animals.

The Bureau of Ocean Energy Management (BOEM) considers all permit applications for geological and geophysical activities throughout the Mid-Atlantic and South Atlantic Planning Areas. Such permits are then subject to mitigation measures for avoidance of disturbance and injury to marine mammals and turtles. Such measures include, but are not limited to, guidance for vessel strike avoidance and measures to minimise disturbance and injury from acoustic surveys.

In accordance with the lease issued by BOEM the current survey was run in accordance with mitigation measures that cover vessel strike avoidance, reducing disturbance and harm from geotechncial activities and reporting (Appendix A).

1.5 Objective

This report presents the findings of dedicated marine mammal and sea turtle monitoring during a geotechnical survey on the Maryland Wind Energy Area site in the eastern Atlantic Ocean (see Location Map). This survey was conducted for Alpine Ocean Seismic Survey Inc on behalf of US Wind Inc. onboard the *M.V. Ocean Discovery* from 16th June to 9th July 2015.

The report provides a summary of geotechnical survey activities as well as compliance with measures implemented to reduce the risk of vessel strikes and disturbance and harm from geophysical survey activities. The report also includes an assessment of the methods of detection, equipment and includes any recommendations.

2. THE MARINE ENVIRONMENT

2.1 Physical Environment and Oceanographic Features

The ocean is a highly heterogeneous environment with large, intermediate and small-scale spatial and temporal patterns in physical, chemical and biological processes (Hunt & Schneider, 1987). Variation in such processes have an effect on primary production and therefore the abundance and distribution of plankton (Mackas *et al*., 1985), which in turn affects marine populations at higher trophic levels (Thompson & Ollason, 2001). Physical processes such as circulatory patterns may also have large-scale implications on the dispersion of marine life. Equally important small-scale features or localised episodes will also have an effect (Hunt & Schneider, 1987). Seasonal fluctuations in temperature, salinity and the formation of fronts will also influence dispersion and primary production (Le Fèvre, 1986; Ellett & Blindheim, 1992).

The distribution of marine animals is primarily related to the movement and abundance of their food source (e.g. Evans, 1990; Macleod *et al*., 2004; Friedlaender *et al*., 2006). Other behavioural, morphological and energetic constraints will also have an influence on the movement and distribution of marine species. For example many species of baleen whale migrate to low latitude breeding grounds during winter (Stern, 2002) while sea turtles migrate between feeding, nesting and developmental areas (Plotkin, 2003; Bolten, 2003). Such seasonal patterns in biology are likely to have evolved to take advantage of oceanographic conditions. As the distribution and abundance of marine animals is influenced by oceanographic characteristics, it is important to describe the marine processes in the survey area.

The survey area is located off the coast of the eastern coast of the U.S.A, encompassing the waters surrounding Maryland. The site is located 9 nm offshore in an area of water approximately 27 m (90 feet) deep. The bathymetry of the study site and surrounding area is comprised of a gently sloping outer continental shelf (the mid-Atlantic bight), that attains depths of up to 50 m before quickly descending to depths of over 1000 m past the shelf break (Firestone *et al*., 2010; Grothe *et al*., 2010).

The hydrographical regime of the waters of the Maryland reflects the currents that affect the Mid-Atlantic Bight further north (Vincent *et al*., 1981).. The currents along the New York Bight (a northern subsection of the Mid-Atlantic Bight) and surrounding waters generally flow in a south-westerly direction, although this is modulated by storm induced flows along the continental shelf (Vincent *et al*., 1981).The waters off the continental shelf are also highly affected by the gulf stream, with the direction of the gulf stream catalysing or slowing the current from 0 – 40 cm S^{-1} (Bane *et al.,* 1988).

2.2 Marine Communities

There is a strong correlation with phytoplankton productivity and depth in the Atlantic Ocean off eastern U.S.A. with areas close to freshwater inputs having productivity levels of approximately 430gC m^{-2} a $year^{-1}$, and the outer shelf waters maintaining productivity of between 100 – 160 gC m^{-2} a $year^{-1}$ (Malone, 1978). The density of phytoplankton and zooplankton is also seasonally driven, with annual spring blooms occurring throughout the Mid-Atlantic Bight (Flagg *et al.,* 1994).

The benthic communities of the Mid-Atlantic Bight are comprised of 149 species of polychaetes, crustaceans, molluscs and echinoderms *(*Maurer *et al., 1976)*. There is a seasonal shift in the abundance and biomass of species within the area, with polychaetes such as *Goniadella gracilis and Lumbrineris acuta* dominating in May, but *Polygordius sp.* dominating in November (Maurer *et*

al., 1976). The species that have been recorded in the area, are typical of those that are commonly recorded in clean sand areas along the inner continental shelf of the Mid-Atlantic Bight (Maurer *et al.,* 1976).

The pelagic fish assemblages of the Mid-Atlantic Bight are comprised of over 300 species (Martin *et al.,* 1978). This primarily includes the Percifromes (perch (*Percidae*), mackerel (*Scombridae*), tuna and bass (*Serranidae*)) and especially the commercially viable skipjack (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), albacore (*Thunnus alalunga*) and Atlantic mackerel (*Scomber scombrus*). The most numerous benthic fish species in the area include spotted hake (*Urophycis regius*), fourspot flounder (*Hippoglossina oblonga*) and butterfish (*Stromateidae sp.)* (Gabriel, 1994). The waters surrounding Maryland are also inhabited by Basking sharks (*Cetorhinus maximus*), they have been recorded in the area from both boat & aerial surveys (Kenney *et al*., 1985) and through tagging experiments (Skomal *et al*., 2004).

There have been 26 species of marine mammal recorded along the Maryland coast (this is comprised of 19 odontocetes, five mysticetes and two pinniped species) (Kenney *et al.,* 1997; Marine Mammal and Sea Turtle Stranding, 2014; NOAA 2014; IUCN 2015) (Table 2.1). All species of cetacean are listed under the Marine Mammal Protection Act (MMPA) (1972). Cetaceans listed as endangered or threatened under the Endangered Species Act (ESA) and found within the region include, humpback whale (*Megaptera novaeangliae*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*) and the North Atlantic right whale (*Eubalaena glacialis*). Of particular concern is the North Atlantic right whale, whose population numbered at a minimum of 444 individuals in 2009, although the population is exhibiting a positive and slowly accelerating trend (Waring *et al*., 2009). The north Atlantic right whale is most likely to be seen on transit, as the waters of Maryland form part of the bi-annual migratory corridor used by this species (Brown and Marx, 2000) The bottlenose dolphin (*Lagenorhynchus acutus*) is the most abundant species of odontocetes recorded off the Maryland coast. The north-west Atlantic stock is estimated to be around 77,500 (NOAA, 2014).

There are two species of pinniped that have been recorded in the area. The harbour seal (*Phoca vitulina*) is the most common and are often found in near shore waters year round off Maine and seasonally off southern New England to Virginia (Thompson & Härkönen, 2008). Grey seals (*Halichoerus grypus*) range from New York to Labrador, with three established breeding colonies off Maine and Massachusetts, these individuals occasionally stray further south and in to the survey area.

Table 2.1 Marine mammal species recorded off the Maryland coast

Species	Scientific Name	IUCN Status
Humpback whale	*Megaptera novaeangliae*	Least concern
North Atlantic right whale	*Eubalaena glacialis*	Endangered
Minke whale	*Balaenoptera acutorostrata*	Least concern
Sei whale	*Balaenoptera borealis*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Gervais' beaked whale	*Mesoplodon europaeus*	Data deficient
Cuvier's beaked whale	*Ziphius cavirostris*	Least concern
Sowerby's beaked whale	*Mesoplodon bidens*	Data deficient
Blainville's Beaked whale	*Mesoplodon densirostris*	Data deficient
True's beaked whale	*Mesoplodon mirus*	Data deficient
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Least concern

Bottlenose dolphin	*Tursiops truncates*	Least concern
Short-beaked common dolphin	*Delphinus delphis*	Least concern
Striped dolphin	*Stenella coeruleoalba*	Least concern
Pantropical spotted dolphin	*Stenella attenuata*	Least concern
Atlantic spotted dolphin	*Stenella frontalis*	Data deficient
Spinner dolphin	*Stenella longirostris*	Data deficient
Pygmy sperm whale	*Kogia breviceps*	Data deficient
Dwarf sperm whale	*Kogia sima*	Data deficient
Sperm whale	*Physeter catodon*	Vulnerable
Long-finned pilot whale	*Globicephala melas*	Data deficient
Short-finned pilot whale	*Globicephala macrorhynchus*	Data deficient
False killer whale	*Pseudorca crassidens*	Data deficient
Risso's dolphin	*Grampus griseus*	Least concern
Harbour seal	*Phoca vitulina*	Least concern
Grey seal	*Halichoerus grypus*	Least concern

This table is created through strandings recorded completed in the last 20 years, NOAA stock assessments and extrapolated from species recorded in the mid-Atlantic bight south of south New England (Kenney *et al.,* 1997; Marine Mammal & Sea Turtle Stranding, 2014; NOAA 2014; IUCN 2015).

All species of sea turtle are listed on the Endangered Species Act. Four species of turtle have been recorded in the area: the loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*) green (*Chelonia mydas*) and leatherback turtle (*Dermochelys coriacea*) (Marine Mammal & Sea Turtle Stranding, 2015). All turtle species are migrants that come to forage along the coastal shelves (Shoop, 1987).

3. METHODOLOGY

3.1 Survey Area

The Maryland Wind Energy Area geotechnical survey was carried out for Alpine Ocean Seismic Survey Inc on behalf of US Wind Inc. The site was located offshore Maryland in the eastern North Atlantic (see Location Map) in an area of water approximately 20-30 m deep and 27 km west from Ocean City, Maryland. The position of the site can be found in Table 3.1.

Table 3.1 Survey location

Site	Latitude	Longitude	Coordinate System
Meteorology (Met) Tower	38°19.230 N	74°46.309 W	UTM 18N

3.2 Survey Vessel

The geotechnical survey was carried out onboard the *M.V. Ocean Discovery* from16th June to 9th July 2015. The vessel details are as displayed in Table 3.2.

Table 3.2 Vessel specifications

M.V. Ocean Discovery	Specifications
Owner	Gardline Marine Sciences
Flag	UK
Class	I+hull+MACH+Special service+DynaPos AT+AUT-UMS
Built / Re-configured	1983 / 2010
Length Overall	86.9 m
Breadth Overall	18 m
Draft	7 m
Gross Tonnage	4027
Main Engine	Bergen diesel
Propulsion	Single Controllable Pitch Propellor, 2x Schottel azimuths
Bow Thrusters	2x Brunvoll tunnel
Maximum Speed	12 Knots
Endurance	28 days
Accommodation	50 Berths

3.3 Survey Parameters

The survey comprised of geotechnical sampling and data acquisition whilst stationary on a four point anchor mooring system.

The purpose of the survey was to characterize geological, archaeological, and benthic habitat resources to support design, engineering, construction and operation of the Met Tower and to support the assessment of potential environmental impacts as required in the Site Assessment Plan to gain BOEM approval of the proposed wind facility development.

Geotechnical data were collected using soil boring and CPT equipment. The survey comprised seven borehole locations with the Meteorological (Met) Tower location being the main priority. The

survey was conducted in an area covering 184 km2 within the lease areas. The preliminary sampling plan is shown in Figure 3.1.

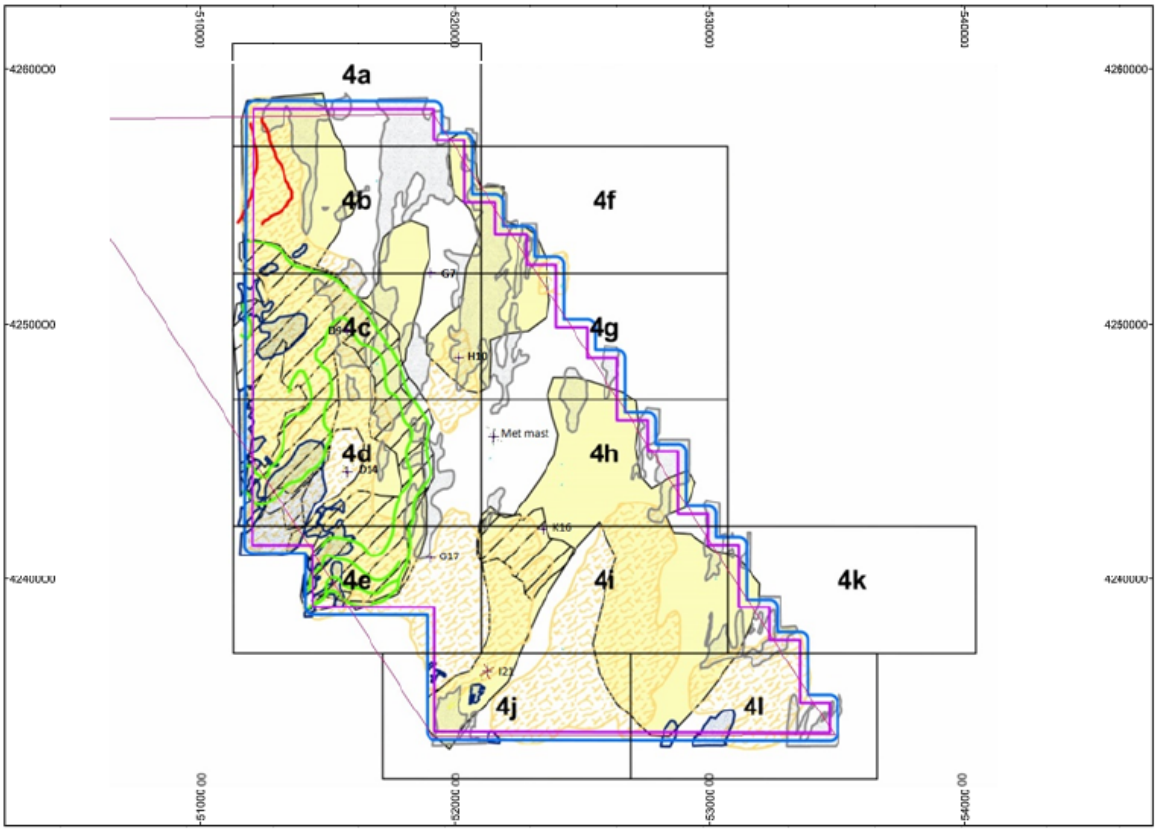

Figure 3.1 Preliminary geotechnical sampling plan for the Geotechnical survey

3.4 Operators Procedures

In line with the requirements stipulated in the lease OCS-A-0489 and OCS-A-0490 the survey was run in accordance with a number of mitigation measures which covered vessel strike avoidance, the reduction of the risk of disturbance and injury from geophysical survey operations and reporting requirements.

3.4.1 Vessel strike avoidance

In order to avoid causing injury or death to marine mammals and sea turtles the following measures were implemented.

Protected Species Observers (PSOs) and the vessel operator maintained a vigilant watch for marine mammals and turtles, and either slowed down or stopped the vessel in order to avoid striking any sighted individuals.

Vessel speed was reduced to 10 knots or less when groups including mother and calf pairs or large groups of cetaceans were encountered. Vessel speed was also reduced to 10 knots or less in any Dynamic Management Areas (DMAs) and Seasonal Management Areas (SMAs) implemented for North Atlantic right whales.

During the survey the National Marine Fisheries Service (NMFS) North Atlantic Right Whale Reporting Systems were monitored for the presence of North Atlantic right whales within or adjacent to the survey area. This includes the following:

- Early Warning System
- Sightings Advisory System
- Mandatory Ship Reporting System

A minimum separation distance of 500 m was maintained between the vessel and any North Atlantic right whales encountered. If a North Atlantic right whale was encountered within 500 m, the vessel steered a course away from the whale at 10 knots or less until it was more than 500 m from the vessel. If North Atlantic right whales were encountered within 100 m of the vessel the following avoidance measures were taken:

- Vessel speed was reduced and the vessel engine shifted to neutral.
- Engines were not engaged until the whale was more than 100 m away.
- Vessel then steered a course at 10 knots or less away from the individual/s until the 500 m minimum separation distance was established.

A minimum separation distance of 100 m was maintained between the vessel and any other non-delphinid cetaceans encountered. If individuals were encountered within 100 m, the vessel reduced speed and shifted engines into neutral. Engines were only engaged once the individual/s was more than 100 m away.

For delphinid cetaceans a minimum separation distance of 50 m was maintained. If delphinids were encountered within 50 m the vessel maintained a parallel course with the group wherever possible, avoiding abrupt changes in direction and excessive speed. Course and speed were only adjusted once the animals moved more than 50 m from the vessel or they had moved abeam.

For all marine turtle and pinniped encounters a minimum distance of 50 m was maintained.

3.4.2 Reporting injured or dead protected species

During the survey PSOs reported any sightings of dead or injured protected species (including all marine mammals and sea turtles) regardless of whether the injury or death was caused by the survey vessel. All such incidences were reported to BOEM and the NMFS Northeast Regional Stranding Hotline (866-755-6622) within 24-hours. Any sightings of dead, injured or entangled North Atlantic right whales were also reported to the US Coast Guard via VHF Channel 16. A standardised incident report was also completed for all injured or dead protected species sighted (Appendix B).

3.4.3 Mitigation for the geotechnical survey

PSOs and PAMS Operators maintained dedicated monitoring for marine mammals and sea turtles for a minimum of 60 minutes prior to geotechnical equipment starting. Following this period with no marine mammal or sea turtle recorded within the 200 m mitigation zone the equipment was activated.

If a marine mammal or sea turtle was detected within the 200 m mitigation zone surrounding the geotechnical equipment during the 60 minute pre-start period a delay to the activation of the equipment was implemented. Start up was delayed by 60 minutes from the last time the marine mammal or sea turtle was detected within the mitigation zone, or until the animals were successfully tracked outside of the mitigation zone.

If low frequency vocalisations were detected by the PAMS but range could not be determined and the animal not detected visually then a delay to start-up operations was implemented.

Due to operational constraints and health and safety considerations, once geotechnical equipment was active equipment was not shut-down if a marine mammal or sea turtle was sighted or detected within the 200 m mitigation zone.

No geotechnical survey operations were conducted in any established DMAs.

If there were any breaks in geotechnical operations (other than those caused by a non-delphinid or sea turtle shut-down), operations resumed as soon as practically possible providing the PSO and PAMS Operator had been conducting monitoring during the break and no marine mammals or sea turtles were detected within the mitigation zone. For breaks where the seabed frame was removed from the seabed, operations could not resume until a full dedicated pre-start watch had been completed once the vessel had moved to its new location.

3.5 Observation Methods

The PSOs carried out dedicated watches for marine mammals and sea turtles during all operations, including transit to and from site. Watches were conducted 24-hours, with night–vision binoculars and thermal imaging technology utilised during the hours of darkness. The Joint Nature Conservation Committee (JNCC) standardised recording forms were completed by the PSOs during all operations and transit.

Watches were carried out from the bridge and bridge wings. Prior to beginning a watch, the time (UTC) and weather conditions were recorded on the JNCC Location and Effort Form (Appendix C). Weather conditions (Beaufort wind force and direction, sea state, swell height and visibility) were noted every hour and whenever a change in conditions occurred. The used definitions of Beaufort wind force and sea state are provided in Appendix D. In addition, the start and end times of marine mammal and sea turtle watches and the start and end times of geotechnical operations were recorded each day on the JNCC Record of Operations Form (Appendix C).

The primary observation technique used to detect marine mammals and sea turtles during daylight hours was to scan the visible area of sea using the naked eye, and scanning areas of interest with binoculars (magnification x 8) (e.g. waves going against the prevailing direction, white water during calm periods, bird activity, bird transiting direction etc.). This technique gave both a wide field of view and the ability to have a sufficient range of 3-4 km in ideal conditions. Reticule binoculars and a range-finder stick (Heinemann, 1981) were used to establish the distance to all marine mammal and sea turtles sighted.

During the hours of darkness the PSOs used night-vision binoculars (PVS-7 night vision goggle Generation 3 Pinnacle) with additional clip-on thermal imaging (COTI) technology. All watches with night-vision optics were carried out from a platform with no visual barriers.

PSOs calibrated reticule binoculars and range-finder sticks using standard methods (Appendix E). Calibrations were conducted during mobilisation and a minimum of once a week throughout the survey.

Identifications were based on a combination of the observer's previous experience, aided by the field guide Whales, Dolphins and Seals: A field guide to the marine mammals of the world by Shirihai and Jarrett (2006).

PSOs were also equipped with bearing finding equipment and a digital stills camera with 70-300 mm lens.

The JNCC Marine Mammal Recording Forms were available to record sightings made by the PSOs (Appendix C). The information recorded included the date and time, the vessels position, course, depth and geotechnical activity. The species, certainty of identification, number of animals, behaviour, distance from the vessel and direction of travel were also recorded. Any additional information, such as details on the features used to identify the animals and the reaction of the animals to the geotechnical equipment was also noted.

3.6 Acoustic Monitoring Methods

Passive Acoustic Monitoring (PAM) uses hydrophones (underwater microphones) to detect and monitor the presence of marine mammals through the detection of their vocalisations. Most cetaceans (whales, dolphins and porpoises) vocalise regularly and produce a variety of sounds ranging from low frequency vocalisations of baleen whales (down to about 15 Hz) to relatively high frequency echolocation clicks of some toothed whales (up to about 160 kHz) (Sturtivant *et al*., 1994; Richardson *et al*., 1995; Berchok *et al*., 2006). Non vocalising animals cannot be detected using PAMS.

During the project a Passive Acoustic Monitoring System (PAMS) was used to acoustically monitor for marine mammals 24-hours a day during all drilling operations. However this was not possible during short transits between drilling locations and whilst anchoring for safety reasons. Details of the PAMS used during the survey are provided below.

Prior to commencing monitoring the time (UTC) and weather conditions were recorded on the JNCC Location and Effort Form (Appendix C). Weather conditions were recorded every hour and whenever a change in conditions or source activity occurred. The used definitions of Beaufort wind force and sea state are provided in Appendix D. In addition the start and end times of dedicated pre-shoot monitoring and the start and end times of geotechnical operations was recorded on the JNCC Record of Operations Form (Appendix C).

The JNCC Sightings Form (Appendix C) was available to record detections made by the PAMS Operator. The information recorded included the date and time, the vessels position, course, depth, geotechnical operations, range and bearing to marine mammals and a description of the detection. Where possible the species and number of individuals were also recorded.

PAMS Operators could not calibrate the PAMS due to the vertical deployment method necessary as the vessel was stationary. The difference in time of arrival of sound sources could not be calculated as the site was in shallow water and the hydrophone positions were not spaced laterally in the water column.

3.6.1 The PAMS

The PAMS comprised of a vertically deployed hydrophone array connected to a data processing system, enabling the acquired sound to be inspected both aurally and visually. The hydrophones are connected to dry-end hardware which digitises the analogue signal allowing it to then be read by the laptop computers. The computers run analysis software which highlights the number of varied clicks and whistles produced by different species of marine mammals.

The system utilised low and broadband frequency hydrophones in order to cover the frequency range of vocalising marine mammals, from low frequency mysticete (baleen whale) moans to high frequency odontocete (toothed whale and dolphin) clicks. The signal receive by the hydrophones is then monitored in real-time by the dedicated software PAMGuard, which through the use of click detectors, whistle and moan detectors, and filters allows the automatic detection of the presence of marine mammals. Detectors and filters can be adjusted manually by the PAMS Operator in order to increase positive detections. The detections were then stored in a database (Figure 3.2).

The data processing system comprises the following sub systems:

a) High frequency data acquisition for cetacean clicks up to 250 kHz (max sample rate 500 kHz).
b) Medium/low frequency data acquisition for cetacean click and whistles up to 48 kHz (max sample rate 96 kHz) and cetacean moans down to 10 Hz.
c) Depth data acquisition.
d) Computer based sound acquisition, display and analysis software.

The directionality and range of the marine mammal is determined by the time difference of the arrival of the acoustic signal (vocalisation) to each hydrophone of the array.

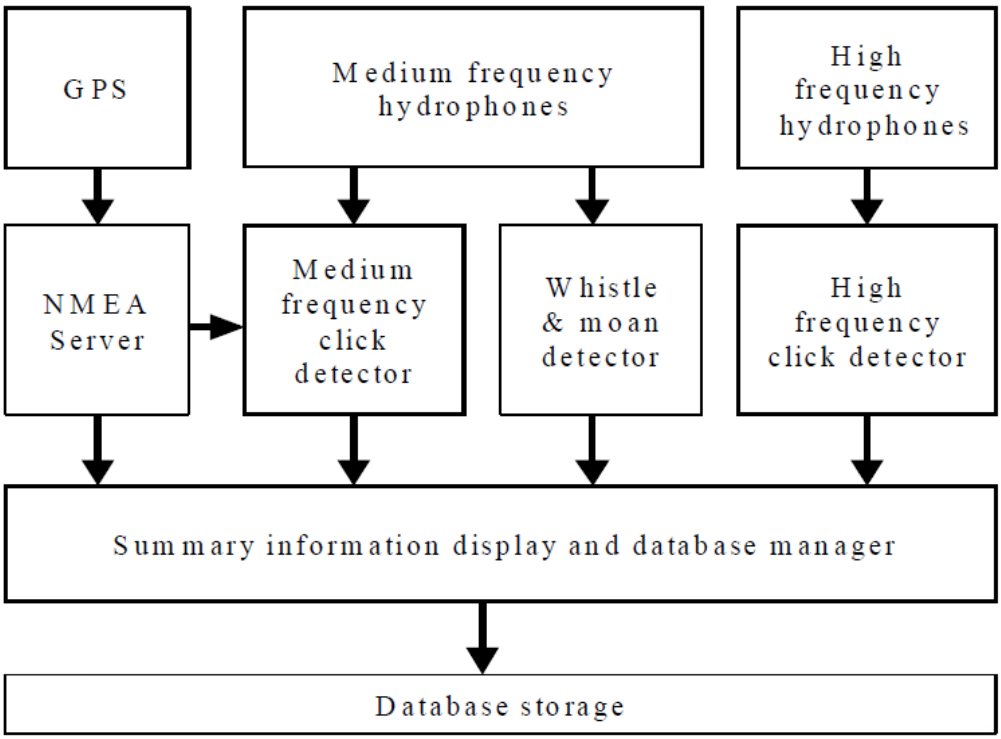

Figure 3.2 Schematic set up of PAMS

3.6.2 The hydrophone array

The PAMS used during the survey was a GEL MK3 system and consisted of four hydrophones; one low frequency and three broadband frequency. The manufacturer's specification for the PAMS can be found in Appendix F. The hydrophone array was wired into a tow cable, an electric cable of 250 m in length, and deployed vertically from the vessel to a depth appropriate to the site depth.

3.6.3 The monitoring system

The latest version of PAMGuard software (Version 1.13.02 Beta) was utilised as a graphical display for sound acquisition, visualisation and detection of marine mammal vocalisations. PAMGuard is an

open-source software, that is platform-independent (e.g. Windows or Linux), flexible and built in a modular architecture.

For mitigation purposes, during the current survey the PAMS used a specific data model configuration created by Gardline Environmental Ltd. Using the most appropriate modules and specifications, a low/medium frequency and a high frequency data module configuration was utilised simultaneously using a single computer interface (Figure 3.3).

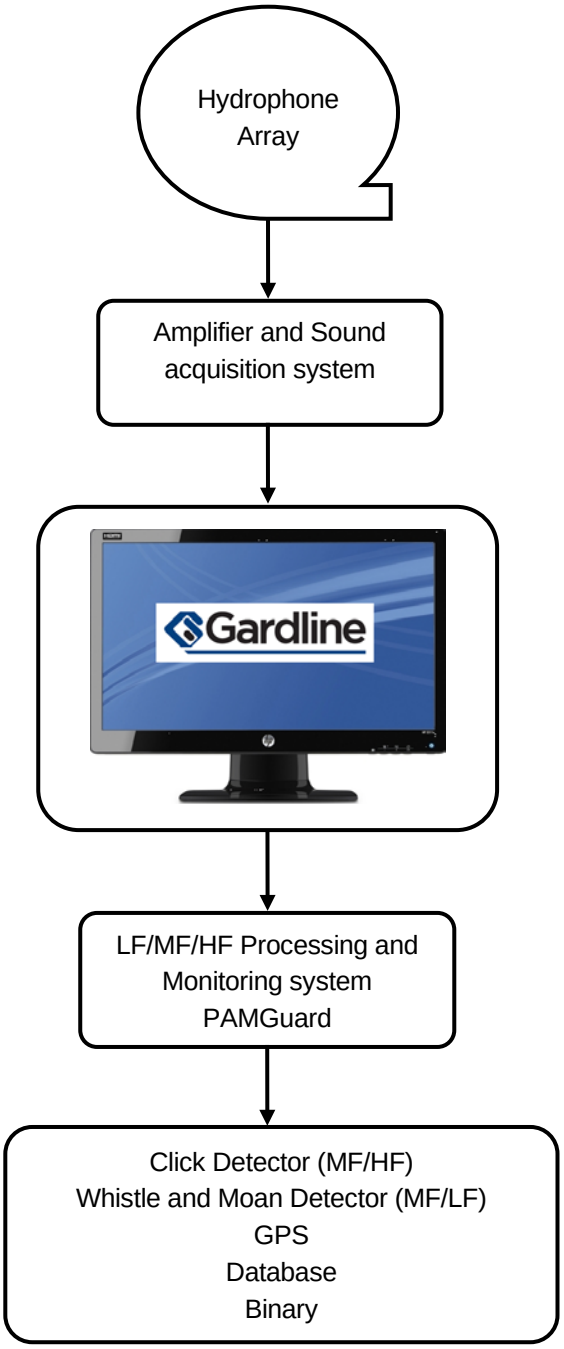

Figure 3.3 Schematic plug-in modules used in PAMGuard

The medium/low frequency configuration is programmed to specifically track and localise clicks, whistles and moans produced by cetaceans in the vicinity of the hydrophones. This includes odontocete clicks and whistles up to 48 kHz and mysticete moans down to 10 Hz.

The high frequency configuration is programmed to detect the clicks of odontocetes (including dolphins and porpoises) up to 175 kHz.

All of the detection modules were run in real time and monitored by a dedicated PAMS Operator, with audio recordings and screenshots taken for any detections during the survey.

4. RESULTS

4.1 Survey Coverage

The *M.V. Ocean Discovery* mobilised on 16th June 2015 in Baltimore, with MMO's arriving on the vessel on the 17th June. Once completed at on 18th July the vessel began transit to the Maryland Wind Energy Area (MWEA) location at 15:00h (UTC). Prior to arrival at the MWEA site, the PAMS cable was deployed at 07:00h on 19th June to carry out a 30 minute acoustic recording. On arrival at the location of the first bore hole, the Met Tower, at 8:00h on 19th June, the vessel conducted Dynamic Positioning trials and a weather assessment. At 14:20h, the vessel began deploying the four point mooring anchors. Operations were suspended due to equipment damage, and the ship left site at 04:00h on 20th June arriving in Baltimore 20:42h.

The vessel departed Baltimore to transit to site at 18:08h on 21st June, arriving at location I21 at 14:33h on the 22nd June. Drilling operations began at 21:45h the same day. At 02:15h on 23rd June drilling operations on this borehole were suspended. Operations recommenced at this location at 12:00h. At 02:56h on 24th June, equipment was recovered due to weather and operations were suspended. At 13:20h the same day, operations resumed with the final stage of drilling at this location taking place between 11:20h and 13:35h on 25th June.

The vessel transited to the Met tower location at 16:15h on 25th June, with drilling operations at this location taking place between 20:50h on 25th and 08:47h on 27th June. After moving to the next borehole location (D14), the vessel waited on weather until 07:24h on 29th June. Drilling on this site commenced at 17:50h however operations were delayed due to equipment damage at 15:50h. The equipment was redeployed at 20:53h on 30th June and operations resumed. Geotechnical operations at this location were completed at 19:57h on 1st July, and the vessel moved to the next location.

Geotechnical operations began at location G17 at 23:35h on 1st July and were suspended at 16:30h on 2nd July due to weather. Drilling resumed at 22:57h on 2nd July and geotechnical operations at this location were completed at 12:37h on 3rd July. The vessel arrived on location K16 at 13:07h, and at 16:40h drilling commenced. Geotechnical operations at this location were complete at 04:18h on 5th July. The vessel relocated to H10, with geotechnical operations taking place between 11:08h on 5th July and 11:54h on 6th July. The vessel moved on to location G7, geotechnical operations began at 20:09h on 6th July, and were deemed complete at 22:09h on 7th July. Once all seabed equipment was recovered, the vessel began the transit to the port of Baltimore and arrived alongside at 21:00h on 8th July. The vessel completed demobilisation on 9th July.

During survey a total of seven geotechnical sampling stations were completed over 13 days. Table 4.1 provides a summary of data acquisition during the survey.

Table 4.1 Summary of data acquisition for the geotechnical survey

Data acquisition	Name
Number of sampling stations	7
Total hours of geotechnical equipment active (hrs:mm)	239:65
Number of start ups	12
Number of daylight start ups	12

4.2 Protected Species Observer Effort

A total of 405 hours and 36 minutes of dedicated marine mammal and sea turtle watches and 277 hours and 3 minutes of dedicated acoustic monitoring effort were carried out by the PSOs between 19th June and 8th July 2015 this included 18 hours and 37 minutes of dedicated pre-start watch and 18 hours and 20 minutes of dedicated pre-start acoustic monitoring.

4.3 Weather Conditions

Weather conditions recorded during the survey were mostly good, but occasionally moderate. The sea state was mostly slight, often choppy and occasionally rough or glassy (Figure 4.1), with a predominantly low swell, i.e. ≤2m (94%) and medium for the rest of the time (6%). Visibility was good for the majority of the survey however it was moderate and poor at times, this included observations taken during hours of darkness (Figure 4.2). Beaufort wind force was variable between Force 0 and Force 7 with a Force 4 occurring most frequently (Figure 4.3) from a general southerly direction (Figure 4.4).

It should be noted that weather observations were only made during dedicated marine mammal and sea turtle monitoring and hence may not fully reflect weather throughout the survey.

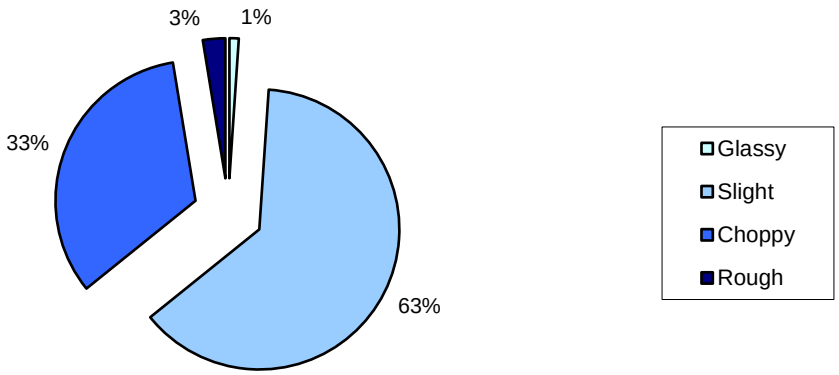

Figure 4.1 Sea state recorded during dedicated marine mammal and sea turtle monitoring during the geotechnical survey

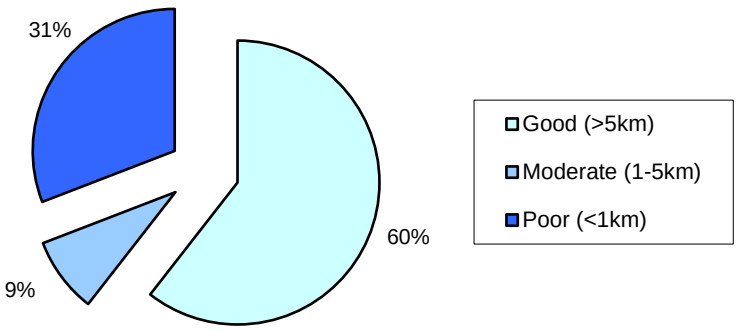

Figure 4.2 Visibility recorded during dedicated marine mammal and sea turtle monitoring during the geotechnical survey

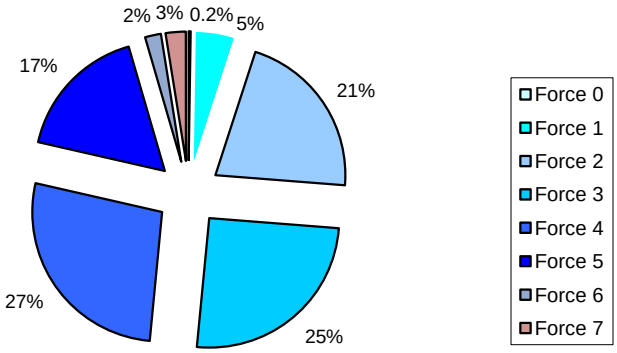

Figure 4.3 Beaufort wind force recorded during dedicated marine mammal and sea turtle monitoring during the geotechnical survey

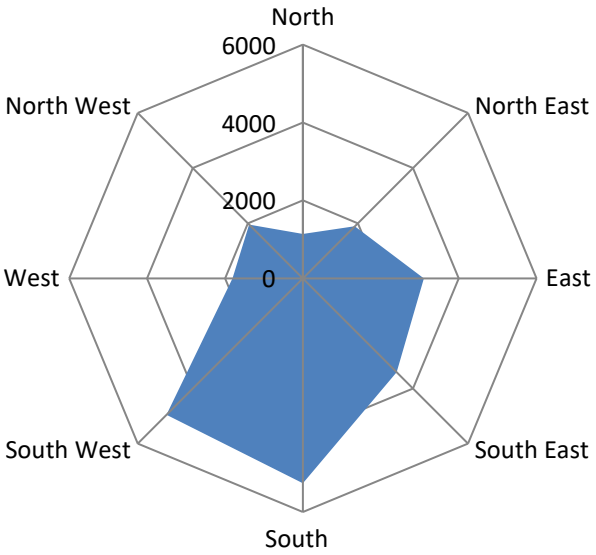

Figure 4.4 Wind direction recorded during dedicated marine mammal and sea turtle monitoring during the geotechnical survey

4.4 Compliance with Mitigation Measures

The Maryland Wind Energy Area geotechnical survey was run in accordance with a specific mitigation measures stipulated in the lease OCS-A489 and OCS-A490. PSOs conducted dedicated watches and acoustic monitoring during all survey operations and during transit to and from site.

There were no encounters with North Atlantic right whale during the survey.

There was one encounter with a non-delphinid cetacean during the survey, when a low frequency detection was made on PAMS during drilling operations. The non-delphinid cetacean was encountered when the vessel was stationary therefore no avoidance or mitigation was required.

There were eight encounters with delphinid cetaceans during the survey. A minimum separation distance of 50 m was maintained during all encounters.

There were ten encounters with sea turtles and no encounters with pinnipeds during the survey. A minimum separation distance of 50 m was maintained during all encounters during transits. There were five encounters when turtles were observed within 50m whilst the vessel was stationary on site.

Full details of all the marine mammal and sea turtle encounters during the survey are provided in Sections 4.5 and 4.6 below.

During the survey there were no incidences of vessel strikes with marine mammals or sea turtles. There was one sighting of a dead protected species, which was reported to the NOAA NMFS Northeast Region Stranding Hotline within 24-hours and a full incident report completed (Appendix B).

Vessel speed was maintained below eight knots throughout the geotechnical survey. During transit there were no occasions where vessel speed was reduced due to the presence of mother and calf pairs, large groups of cetaceans, due to the designation of a DMA or on entering a SMA for North Atlantic right whales.

Although the survey was not within the designated period of 1st November to 30th April stipulated in the lease, the Early Warning System, Sighting Advisory System and Mandatory Ship Recording System were monitored for the presence of North Atlantic right whales throughout operations and transit.

During the survey there were 12 start-ups of the geotechnical equipment, all of which occurred during daylight hours. Full dedicated pre-start monitoring (visual and acoustic) was completed prior to all start-ups of geotechnical equipment.

During the survey there were two occasions where the start-up of geotechnical equipment was delayed due to the close proximity of turtles.

Both delays occurred on 6th June during the pre-start monitoring period. The first occasion occurred at 18:17h when a leatherback turtle was visually sighted entering the 200 m mitigation zone with its closest approach to the vessel 150 m. A delay of one hour was implemented from 18:18h, the time the turtle was last seen within the mitigation zone.

The second occasion occurred at 19:01h on the same day whilst a delay was being implemented for the previous sighting. A loggerhead turtle was visually detected at 15 m from the vessel within the 200 m mitigation zone. A delay of one hour was implemented from 19:08h, the time the turtle was last seen within the mitigation zone. Survey operations commenced at 20:09h after the PSO on watch gave the all clear to start operations.

4.5 Marine Mammal and Sea Turtle Encounters

There were 16 sightings of marine mammals and sea turtles included one sighting of a dead protected species, and three acoustic detections of marine mammals throughout the duration of the survey, from 16th June to 9th July 2015. Encounters comprised of bottlenose dolphins, humpback whale, loggerhead turtles, leatherback turtles, as well as unidentified dolphins and turtle species. There were no encounters of north Atlantic right whales during the survey. A summary of the species encountered is provided in Table 4.2; full details of the sightings and acoustic detections are provided in the sections below.

Table 4.2 Summary of marine mammal and sea turtle encounters during the geotechnical survey

Species	Daylight		Night time	
	Number of Sightings	Number of Acoustic Detections	Number of Sightings	Number of Acoustic Detections
Bottlenose Dolphin	2	0	0	0
Loggerhead turtle	4	0	1	0
Leatherback turtle	1	0	0	0
Unidentified turtle sp.	3	0	1	0
Unidentified dolphin sp.	4	1	0	1
Humpback whale	0	0	0	1

4.6 Marine Mammal and Turtle Sightings

4.6.1 Bottlenose Dolphin (Tursiops truncatus)

The common bottlenose dolphin is widely-distributed occurring in coastal and continental shelf waters of tropical and temperate regions. Although population density appears higher in near-shore areas, there are also pelagic populations (Culik, 2011). The common bottlenose dolphin is a large, robust dolphin, with a moderate stocky beak sharply demarcated from the melon. The dorsal fin is tall and falcate, set near the middle of the back. Colour varies from light grey to nearly black on back and sides fading to white on the belly. There is however extensive geographical variation in size, shape, appendages and colouration of this species, and confusion remains as to its taxonomy. In many areas markedly differentiated inshore and offshore populations occur in close proximity (Jefferson et al., 2008). Common bottlenose dolphins range in size from 1.9 to 4.1 m, and weigh between 150 and 650 kg (Shirihai & Jarrett, 2006). The species is found in a range of habitats, from rocky reefs, to calm lagoons and open waters. They are generalist feeders, preying on a wide variety of prey, mostly fish and squid, and are known to feed cooperatively (Jefferson et al., 2008). Group size is commonly between two and 15 animals, although they can be encountered individually and in groups of several hundred to thousands offshore. They commonly associate with other species of cetacean, although some interactions are reported to be aggressive (Culik, 2011). Based on regional population estimates, the world-wide population abundance is estimated to be a minimum of 600,000 (Hammond et al., 2012). The species is listed as 'Least Concern' on the IUCN Red List (IUCN, 2015).

On the 22nd June, between 10:08h and 10:18h, a group of bottlenose dolphins were seen during vessel transit to site (Figure 4.5). The dolphins were spotted 1000 m from the vessel, with closest distance of 400 m at 10:14h, engaging in feeding type behaviour and slow swimming in a north westerly direction. The pod was estimated to be comprised of 40 individuals with at least 10 juveniles and 5 calves present within the group. No mitigation was required.

On 28th June between 11:15h and 11:25h, a group of bottlenose dolphins were spotted on site whilst vessel was waiting on weather (Figure 4.6). The dolphins were 900 m from the vessel travelling in a south easterly direction (500 m at their closest point at 11:18h), engaging in milling, slow swimming and leaping behaviours. It was estimated 15 individuals including two juveniles were present within the group. No mitigation was required.

Figure 4.5 Bottlenose dolphins sighted on 22nd June 2015 during the geotechnical survey

Figure 4.6 Bottlenose dolphins sighted on 28th June 2015 during the geotechnical survey

4.6.2 Unidentified Dolphin species

On 19th June between 09:16h and 09:19h, three unidentified dolphins were seen 500 m from the vessel during transit to site. The dolphins were fast swimming in a south westerly direction crossing perpendicular ahead of the vessel. No mitigation was required.

Later on 19th June between 09:40h and 09:45h, a group of unidentified dolphins were spotted 1000 m from the vessel during transit to site (Figure 4.7). It was estimated the group consisted of 10 individuals including three juveniles, travelling in a south easterly direction in the opposite direction to the vessel. No mitigation was required.

On 3rd July between 10:30h and 10:35h, a group of unidentified dolphins were spotted 2000 m from the vessel when survey operations were active. It was estimated that the group was comprised of five adults displaying leaping behaviours whilst travelling in a south easterly direction away from the vessel. No mitigation was required.

Figure 4.7 Unidentified dolphin species sighted on 19th June 2015 during the geotechnical survey

On 22nd June at 10:49h, a dead unidentified dolphin was spotted 400 m from the vessel during transit to site (Figure 4.8). The dolphin had a pronounced beak, pale ventral side and darker flanks with a pointed pectoral fin. The sighting was reported to BOEM and NMFS. No mitigation was required.

Figure 4.8 unidentified dead dolphin sighted on 22nd June 2015 during the geotechnical survey

4.6.3 Loggerhead Turtle (Caretta caretta)

Loggerhead turtles are widely distributed in coastal tropical and subtropical waters ranging between 16 and 20°C, although it is also commonly recorded in temperate waters at the boundaries of warm currents (Márquez, 1990). The heart-shaped carapace is reddish brown in colour. Adults reach between 82 and 105.3 cm, with a mean weight of approximately 75 kg (Márquez, 1990). The species is distinguished by its large head and strong jaws. Adult loggerhead turtles are known to undertake long distance migrations between nesting beaches and foraging grounds (Polovina et al., 2004; Nichols et al., 2000). Loggerhead hatchlings and juveniles are frequently associated with sea fronts, down-wellings and eddies where they feed on epipelagic animals. Between 7 and 12 years old juveniles migrate from oceanic habitats to nertic zones to continue maturing until adulthood. The neritic zone also provides crucial foraging, inter-nesting and migratory habitat for adult loggerheads (NOAA, 2012). Recent reviews indicate only two loggerhead nesting aggregations have more than 10,000 females nesting annually. Intermediate sized nesting aggregations occur in the US, Mexico, Brazil, the Cape Verde Islands and Western Australia (US Fish & Wildlife, 2012). The primary threat to loggerhead populations is incidental capture in marine fisheries gear (NOAA, 2012). The species is listed under Appendix I CITES and under Appendices I and II of the CMS, and is listed as 'Endangered' on the IUCN Red List (IUCN, 2013).

There were five Loggerhead turtle sightings between17th June to 8th July of the Geotechnical survey.

On 28th June between 14:10h and 14:15h, a Loggerhead turtle was spotted surfacing 200 m from the vessel whilst on site waiting on weather. The turtle was travelling in a westerly direction away from the vessel. No mitigation action was required.

On 2nd July between 08:25h and 08:33h, a Loggerhead turtle was spotted during the hours of darkness using night vision binoculars. The turtle surfaced 10 m from the vessel whilst survey operations were active. No mitigation action was required.

On 4th July between 12:25h and 12:28h, a Loggerhead turtle was spotted surfacing 30 m from the vessel whilst survey operations were active. The turtle remained stationary at the surface before diving. No mitigation action was required.

On 6th July between 19:01h and 19:08h, a Loggerhead turtle was spotted surfacing 5 m from the vessel during the pre-shoot monitoring period (Figure 4.9). The turtle was within the 200 m mitigation zone and therefore a delay to start of operations was implemented.

Later the same day, between 21:40h and 21:58h, two Loggerhead turtles were spotted surfacing and displaying sexual behaviour 200 m from the vessel whilst survey operations were active (Figure 4.10). The two turtles were travelling in a westerly direction towards the vessel. No mitigation action was required.

Figure 4.9 Loggerhead turtle sighted at 19:01h on 6th July 2015 during the geotechnical survey

Figure 4.10 Two Loggerhead turtles displaying active sexual behaviour sighted at 21:40h on 6th July 2015 during the geotechnical survey

4.6.4 Leatherback Turtle (Dermochelys coriacea)

The leatherback turtle is the largest marine turtle, with the largest specimen recorded at 256.5 cm (Márquez, 1990). The body is large and spindle shaped, with a leathery, unscaled carapace. The colour is essentially black with scattered white patches (Márquez, 1990). Adult leatherbacks are adapted to colder water due to their protective thick and oily skin. Therefore the species is more widely distributed, with numerous records from higher latitudes in waters between 10°C and 20°C (Márquez, 1990). Leatherback turtles nest on sandy beaches in tropical waters, with hatchlings remaining in warm tropical coastal waters until they are more than 100 cm in length. As adults leatherbacks are pelagic, ranging widely in the open ocean although they will often forage in coastal habitats also (Sarti Martinez, 2000; NOAA, 2012). Leatherbacks are carnivorous, feeding on jellyfish and other soft-bodied animals. They are the deepest diving reptile, reaching depths of over 1200 m (Spotila, 2004) although in temperate regions dives tend to be shallower (McMahon & Hays, 2006; James et al., 2006). Global population size was estimated to be between 20,000 and 30,000 adult females in 1996, an estimated 78% reduction compared to previous estimations in 1982 (Sarti Martinez, 2000). The largest nesting populations are found within the eastern and western Atlantic and the Caribbean (Spotila et al., 1996). The species is listed under Appendix I of both CITES and CMS, and are listed as 'Critically Endangered' on the IUCN Red List (IUCN, 2015).

On 6th July between 18:17h and 18:18h, a Leatherback turtle was spotted surfacing 200 m from the vessel during the pre-shoot monitoring period (Figure 4.11). The turtle entered the 200 m mitigation zone; therefore a delay to start up operations was implemented. The turtle crossed perpendicular ahead of the vessel in a westerly direction.

Figure 4.11 Leatherback turtle sighted at 18:17h on 6th July 2015 during the geotechnical survey

4.6.5 Unidentified turtle species

On 28th June at 23:45h, an unidentified turtle species was spotted surfacing briefly 100 m from the vessel whilst on site waiting on weather. The turtle was crossing perpendicular ahead of the vessel in a south westerly direction. No mitigation action was required.

On 29th June between 03:32h and 03:34h, an unidentified turtle was spotted during the hours of darkness using night vision binoculars. The turtle surfaced 100 m from the vessel whilst on site waiting on weather, and was travelling towards the vessel in a westerly direction. No mitigation action was required.

On 3rd July at 11:38h, an unidentified turtle species was spotted surfacing 800 m from the vessel whilst survey operations were inactive. The turtle was stationary at the surface before diving. No mitigation action was required.

On 4th July between 18:55h and 18:59h, an unidentified turtle species was spotted surfacing 20 m from the vessel whilst survey operations were active. The turtle was travelling parallel to the vessel in a south easterly direction. No mitigation action was required.

4.7 Marine Mammal Acoustic Detections

4.7.1 Humpback whale (Megaptera novaeangliae)

The humpback whale is a widely distributed species, occurring seasonally in all oceans worldwide, with distinct populations located in virtually every sea. All populations except one (in the Arabian Sea) undertake migrations between breeding and feeding grounds (Fleming & Jackson, 2011). This is a familiar whale, with a stout, robust body and very long pectoral fins (up to 1/3 of the body

length) that have a series of bumps known as tubercles on them. The head is rounded and flat and also covered in tubercles. The dorsal fin is located 2/3 along the back and is low, often sitting on a raised hump of tissue and is highly variable in shape and size (Jefferson et al., 2008). Flukes are large, with a serrated trailing edge and are often raised high during diving (Shirihai & Jarrett, 2006). The humpback whale is black to blue-black in colour, with pale to white undersides that show black markings that vary according to the individual. They measure between 11-17 m in length, with the females generally larger than the males, and they weigh up to 35 tonnes (Jefferson et al., 2008). The blow is bushy but visible, reaching 2.5 to 3 m (Shirihai & Jarrett, 2006). Humpback whales are 'gulp' feeders; although unlike other species have many varied methods of feeding, including lunge feeding, tail flicking and bubble-netting (Fleming & Jackson, 2011). Humpback whales often congregate in large, loose groups for breeding and feeding (Shirihai & Jarrett, 2006). The mating system is thought to be male-dominance polygyny, where males compete for individual females and exhibit competitive behaviour. The 'song' of male humpback whales is a long, complex vocalisation produced usually on the winter breeding grounds, but also on migration and seasonally on feeding grounds. Studies suggest the song is used to advertise for females and to establish dominance amongst males (Fleming & Jackson, 2011). Available population estimates total more than 60,000 animals with populations continuing to increase; therefore the species is listed as 'Least Concern' on the IUCN Red List (IUCN, 2015). However concern does remain about apparent discrete and small subpopulations for which information remains lacking.

On 2nd July at 04:41h, there was a low frequency acoustic detection identified of a probable humpback whale during the hours of darkness (Figure 4.12). The spectrogram showed a tonal down-sweep vocalisation centred at 300Hz with a harmonic at 700Hz lasting 2-3 seconds in duration. It was not possible to determine distance and bearing to the sound source. Survey operations were active at the time of the acoustic detection but no mitigation action was required.

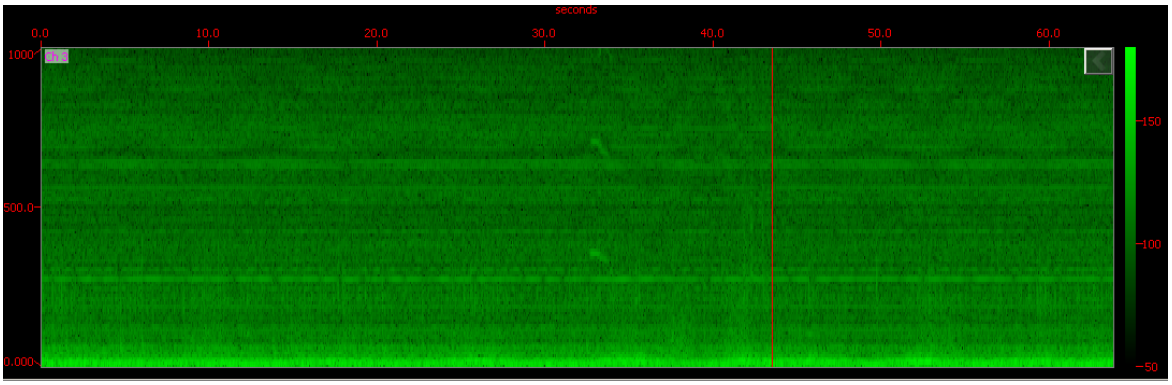

Figure 4.12 Acoustic detection of humpback whale recorded on 2nd July 2015 during the geotechnical survey

4.7.2 Unidentified dolphin species

On 3rd July between 09:37h and 10:20h, acoustic detections of whistles from unidentified dolphins were detected on the spectrogram (Figure 4.13). The spectrogram showed frequency modulated whistles ranging between 6 – 18 kHz. Survey operations were active at the time of the acoustic detections but no mitigation action was required.

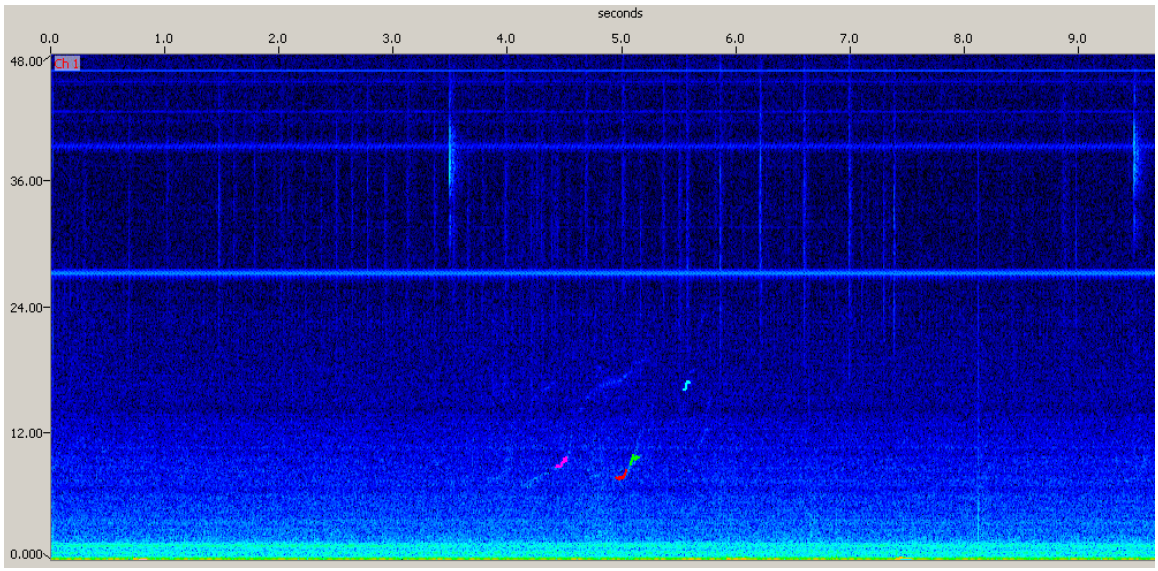

Figure 4.13 Acoustic detection of an unidentified dolphin recorded on 3rd July 2015 during the geotechnical survey

On 7th July between 01:15h and 02:02h, acoustic detections from a group of unidentified dolphins were detected on the spectrogram whilst survey operations were active. The vocalisations consisted of whistles ranging between 8 – 24 kHz (Figure 4.14), echolocation clicks and frequency modulated burst pulses (Figure 4.15).

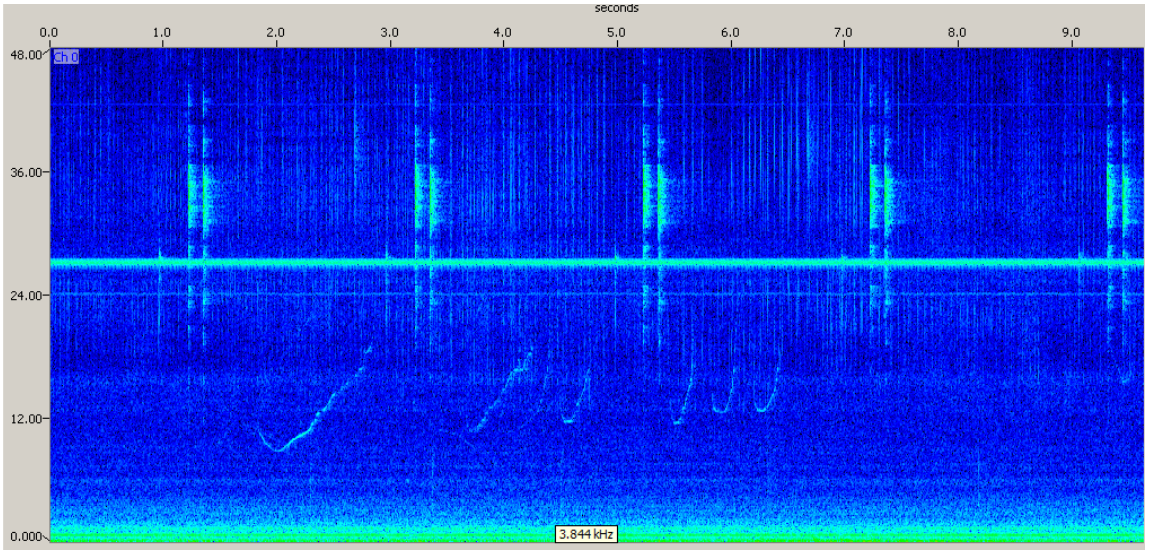

Figure 4.14 Acoustic whistle detection of unidentified dolphins recorded on 7th July 2015 during the geotechnical survey

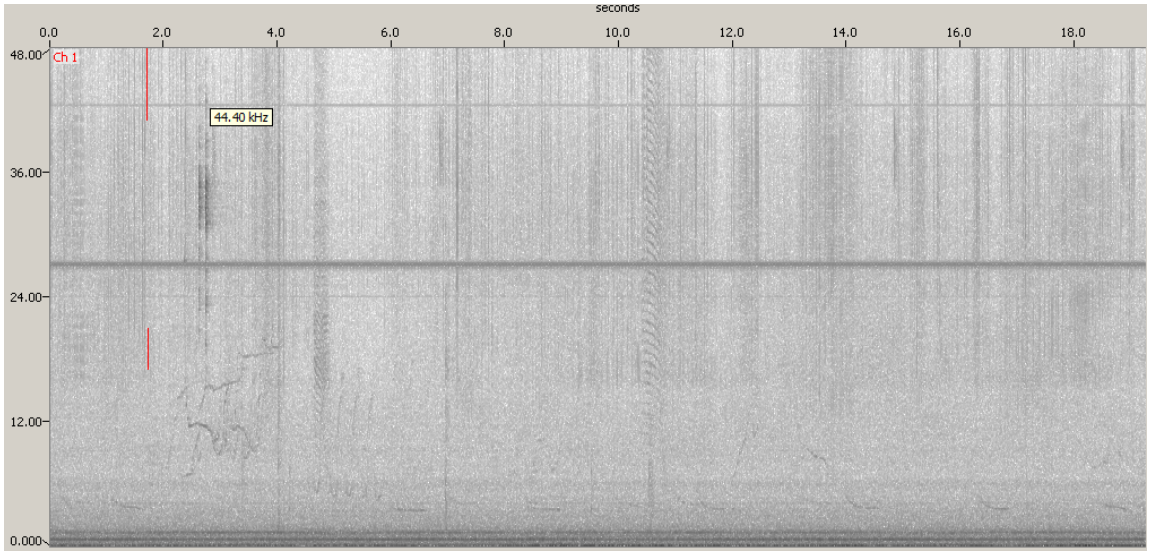

Figure 4.15 Acoustic click and burst pulse detection of unidentified dolphins recorded on 7th July 2015 during the geotechnical survey

4.8 Comparison of Detection Methods

During the geotechnical survey, three different detection methods were used. PAMS was operated 24-hours a day during data acquisition to detect cetaceans acoustically, while reticule binoculars were used during daylight hours and night-vision binoculars with COTI were used at night, to detect marine mammals and sea turtles visually.

There was one sighting of cetacean (unidentified dolphins) recorded whilst PAMS was deployed. There was five sightings of cetaceans (two bottlenose dolphins and three unidentified dolphins including one dead species) recorded while PAMS was not deployed either when waiting on weather or during transit to site (Figure 4.16). There were three further acoustic detections of one during daylight and two during hours of darkness.

All sightings of cetaceans occurred during daylight hours. None were visually detected at night (Figure 4.16).

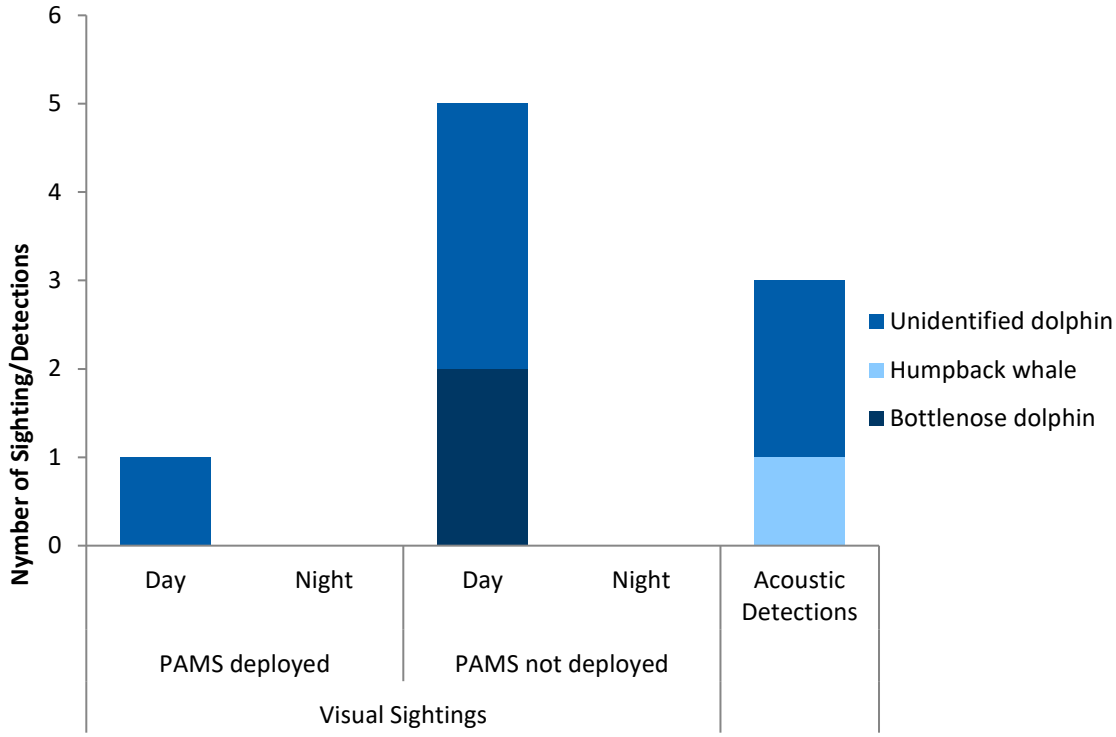

Figure 4.16 Number of visual sightings and acoustic detections of cetaceans during the geotechnical survey including transit when PAMS was not deployed

In addition to cetacean sightings, there were five sightings of loggerhead turtle, one sighting of a leatherback turtle and four sightings of unidentified turtles. Of these, two were sighted during hours of darkness and eight were sighted during daylight hours (Figure 4.17).

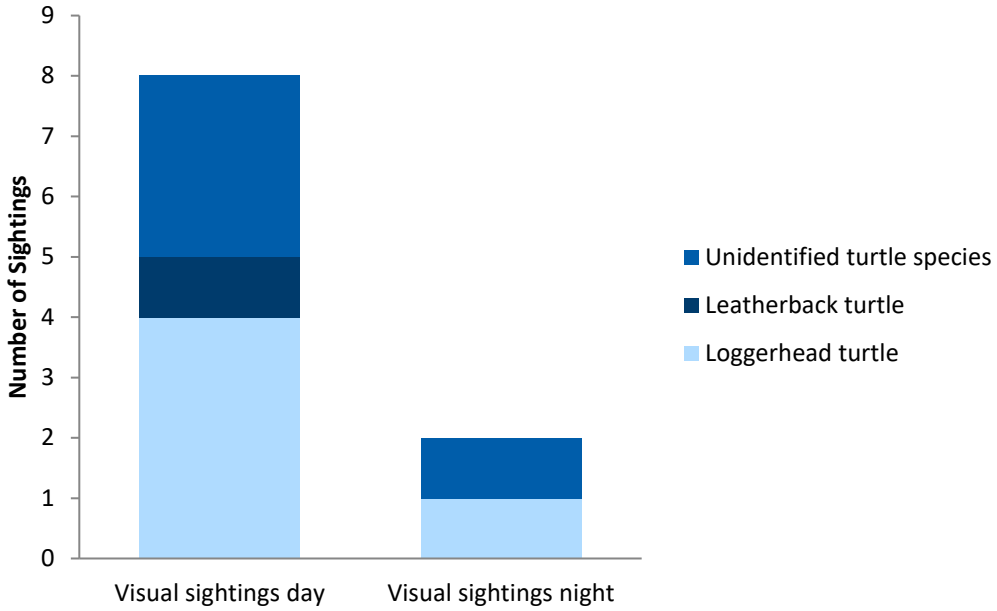

Figure 4.17 Number of visual sightings of sea turtles during the geotechnical survey

4.9 Accuracy of Distance Estimation Instruments

During the geotechnical survey, the PSOs used two methods to estimate distance of marine mammals or sea turtles from the vessel during daylight hours: reticule binoculars and range finder sticks. Both instruments were calibrated regularly against the vessel's radar with objects such as other vessels and the results were recorded in a standardised form. The minimum distance that was used for calibration was 470 m – any objects that were observed closer than this to the *M.V. Discovery* were too small to be detected by radar and therefore could not be used for calibration of the visual equipment. A table detailing the recorded distances can be found in Appendix E.

A comparison of the average differences in the accuracy of distance estimation showed that the range finder stick and reticule binoculars had a similar percentage error of 6.7% and 6.9% respectively. Both pieces of equipment tended to underestimate distance more than overestimate, for the reticular binoculars nine out of 15 measurements were underestimated, whilst 11 out of 15 measurements were underestimated using the range finder stick.

At distances less than 1000m, the errors of the range finder and reticule binoculars were reduced to 3.5% and 0.6%, respectively. It is therefore clear that both measuring devices are more accurate at distances less than 1000 m from the observer. Within the mitigation zones themselves (50 – 500 m), few calibrations were possible, however it is likely that these errors will be low.

Figure 4.18 shows the errors of the range finders and reticule binoculars out to a distance of 3000 m compared against the true values taken from the vessel's radar.

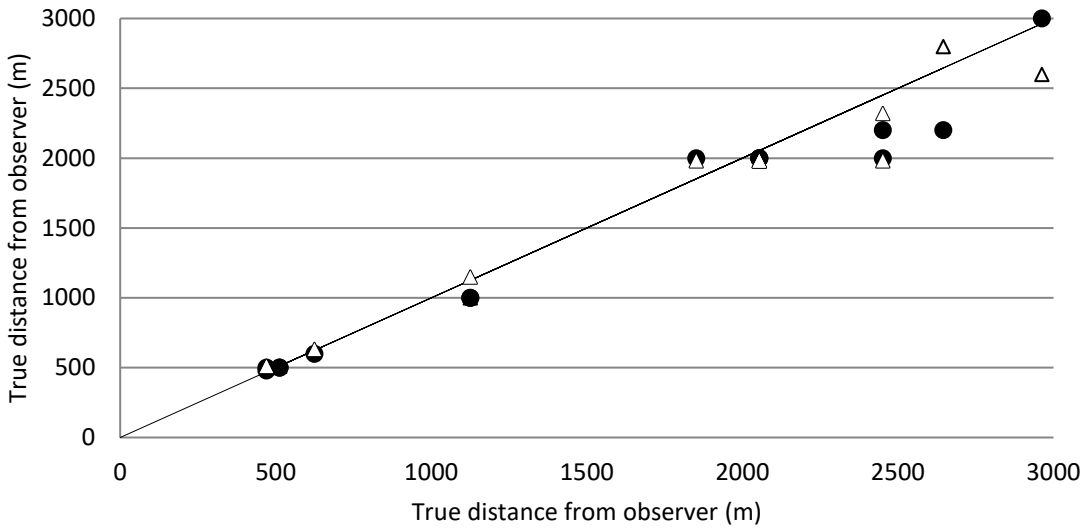

Figure 4.18 Comparison of distances measured using ship's radar (solid line), range finder stick (filled circles) and reticule binoculars (open triangles) out to 3000 m

5. DISCUSSION

5.1 Marine Mammal and Sea Turtle Detection

Marine mammal and sea turtle research carried out previously within the waters of the eastern Atlantic off Maryland have recorded 24 cetacean species, two species of pinniped and four species of sea turtle occurring throughout the year (Kenney *et al.,* 1997; Marine Mammal and Sea Turtle Stranding, 2014; NOAA 2014; IUCN 2015). While these species occur in spatially distinct areas (Kenney *et al.,* 1997; NOAA 2014; IUCN 2015), and not necessarily in the current survey area, it must be remembered that marine mammals and sea turtles are highly mobile. It was therefore anticipated that marine mammal and sea turtle encounters were possible, and as such visual and acoustic monitoring was conducted during all operations including transit to and from site.

The spatio-temporal distribution and high mobility of marine mammals and sea turtles may also have had an effect on detection. Many species of marine animal migrate at certain times of the year, primarily in relation to prey abundance and distribution, breeding opportunities and availability of space (Stern, 2002; Plotkin, 2003). In the survey area the distribution of marine mammals and turtles is seasonally variable (Kenney *et al.,* 1997; Marine Mammal and Sea Turtle Stranding, 2014; NOAA 2014; IUCN 2015). Therefore certain species may not have been present, or present in abundance, in the area during the survey period.

5.2 Comparison of Detection Methods

During the geotechnical survey between 16th June and 9th July there were 16 visual sightings of marine mammals and turtles and three acoustic detections of marine mammals. Of the visual sightings, 14 occurred during daylight and two during night time operations. Of the acoustic detections one occurred during daylight and two during night time operations.

Weather can affect the ability to detect marine animals in a number of ways, with increasing sea state, wind force and decreasing visibility reducing the detection probability of marine animals (Forney, 2000) particularly those with inconspicuous surfacing behaviour such as the harbour porpoise (Palka, 1996). Weather conditions recorded during marine mammal and sea turtle monitoring were predominantly good. Sea states were generally slight with a low swell and good visibility during daylight hours so conditions are were not likely to have significantly affected the visual detection of marine mammal or turtle species. As with daylight visual detection, poor weather conditions and high sea states have a negative effect on detection ability; this may have more effect during hours of darkness.

Night vision binoculars with COTI are most effective at close distances. Their effectiveness is greatest within 300 m of the vessel and decreases thereafter however the 500 m range can still be patrolled effectively and the likelihood of detecting a large animal such as the north Atlantic right whale at this distance is still high.

All but one sighting of cetacean was observed outside 500 m and none were observed within the 200 m mitigation zone therefore it is not unexpected that there were only two visual sightings at night. Marine turtles often remain below the surface which can make night time visual detection difficult however the two night time visual detections during the survey were turtles.

During the hours of darkness the observer is not able to scan the horizon with the naked eye, this has the potential to narrow the field of view for the observer however this can be averted if this is

taken into account by the observer and they alter their visual scanning accordingly to increase the chances of detecting animals.

PAMS is a highly reliable technique for detecting marine mammals at night however animals must be vocalising in order to be detected therefore it is ineffective at monitoring turtle and pinniped species which are not known to vocalise underwater. Over half of the visual sightings were of turtles therefore it is expected that during this survey PAMS will have a lower detection rate than visual observations.

For some species, particularly baleen whales, vocal activity may vary with season, location, behaviour and gender (Mellinger *et al*., 2007; Boisseau *et al*., 2008). Some species of cetacean are notoriously difficult to monitor acoustically, for example the beaked whales (Barlow & Gisner, 2006). Despite this many species of cetacean are audible for a greater proportion of time than they are visible at the surface (Gordon *et al*., 2003). In general PAMS has the advantage of being able to detect elusive or small mammals, like the harbour porpoise, that can often be missed by observers during unfavourable weather conditions and the hours of darkness (O'Brien, 2009).

Of the six cetacean sightings, four occurred when drilling was not taking placed therefore PAMS was not deployed and one of these sightings was of a dead delphinid. The final sighting occurred ten minutes after a PAMS detection which may have been the same pod of dolphins. The two other detections occurred during hours of darkness. The detection of a probable humpback whale was estimated by the operator to be at least one kilometre away, meaning a visual sighting would have been less likely.

During this project the PAMS was vertically deployed as the vessel was stationary during operational periods. This meant that it was hard to estimate distances of detections.

5.3 Accuracy of Distance Estimation Instruments

Comparison of the accuracy of distance estimation between reticule binoculars and range finder sticks with objects (e.g. other boats) on the vessel's radar revealed that both pieces of equipment has a similar accuracy overall with both range finders and reticule binoculars being highly accurate within 1000 m of the observer, which more than adequately covers the mitigation zones in place during the current survey.

5.4 Marine Mammal and Sea Turtle Encounters

During the survey two species of cetacean were positively identified and at least one other species of cetacean was encountered during the unidentified species detections (visual and acoustic). No species of pinniped and two species of sea turtle were identified. All protected species identified are commonly encountered within the region (Kenney *et al.,* 1997; Marine Mammal and Sea Turtle Stranding, 2014; NOAA 2014; IUCN 2015). Bottlenose dolphins are resident along the eastern United States coastline. Loggerhead turtles are annual visitors to the area during the summer months (Shoop, 1987). Although less common, Leatherback turtles are also a common inhabitant to the region (Shoop, 1987).

There four occasions when cetaceans' species were encountered while the drilling equipment was active, equalling the number of encounters when drilling was inactive. No conclusions could be drawn from the observed behaviours to indicate whether the cetaceans were avoiding the drilling vessel.

There were four sightings of turtles while drilling operations were ongoing, and the animals did not exhibit any adverse behavioural reactions during any of these encounters. There was two delays to operations on the 7th July due to the presence of turtles. Operations were delayed for 60 minutes after each encounter.

The sighting of a dead dolphin occurred during the transit to the survey area, and thus the animals death could not have been caused by the geotechnical survey activity. The full details of the incident were immediately relayed to the appropriate authorities, and is included in the appendix (Appendix B)

5.5 Recommendations

In order to minimise the impacts on marine mammals and sea turtles the geotechnical survey was run in accordance with a dedicated MMMP. The MMMP implemented during the survey successfully achieved a high standard of mitigation suitable for the project. This success relied on the use of experienced and dedicated observers.

The passive acoustics system was limited in its ability to estimate distance in this instance due to the vertical deployment method which prevented time of arrival calculations on acoustic signals. A three dimensional array would be beneficial in future situations when the passive acoustics deployment platform is stationary.

Using of a number of detection methods in conjunction with each other increases the effectiveness of detection of all animals in the area. All methods available have some form of limitation however using various detection methods will allow the effect of this to be minimised. It is therefore recommended that there is continued use of 24 hour operations is for further projects, utilising more than one detection method.

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APPENDICES

APPENDIX A MARINE MAMMAL MITIGATION PLAN

Marine Mammal Monitoring and Mitigation Plan

US Wind Inc. (US Wind) proposes to conduct marine Geophysical and Geotechnical (G&G) surveys as required by BOEM to file a Site Assessment Plan (SAP) for offshore wind facility development on leases OCS-A 0489 and OCS-A 0490. The Project team intends to begin these site characterization studies in early-May, 2015.

US Wind submitted a formal survey plan, dated January 30, 2015, in accordance with the Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 585 for these G&G activities to BOEM. In response to BOEM comments, US Wind submitted a revised survey plan on March 4, 2015. A pre-survey meeting was held at BOEM headquarters on March 11, 2015 in accordance with US Wind's lease. In response to comments received at that meeting, US Wind submitted a further revised SAP Survey Plan. This Marine Mammal Monitoring and Mitigation Plan is part of that revised plan.

DESCRIPTION OF PROPOSED G & G ACTIVITY

The G&G survey activity that will be conducted to support preparation of the SAP is described below. Additional detail can be found in the SAP Survey Plan.

High Resolution Geophysical Survey

US Wind proposes to conduct an HRG survey utilizing the following acoustic survey equipment: multi beam and single beam depth sounders, side scan sonar, and shallow penetration subbottom profiler. Medium penetration equipment will not be used, as the project will rely on existing data previously collected for the Lease Areas.[1] The equipment systems (or equivalent) proposed for use during the HRG surveys are included in Table 1 below. The HRG Survey is estimated to last approximately 47 days under 24-hour operations, not including weather or protected species down time.

Table 1. Equipment to be utilized (or equivalent) during HRG Survey

Survey Task	Sample Equipment Model Type	Frequency (kilohertz)
Multi Beam Depth Sounder	R2Sonic 2024	
Single Beam Depth Sounder	ODOM Echotrac CVM	
Side Scan Sonar	Klein Dual 3900	450 and 900 kHz
Shallow-penetration Subbottom Profiler (chirp)	Teledyne Benthos CHIRP III	2-7 kHz

Sound emitted by the HRG survey equipment proposed for use by US Wind is as indicated in Table 1. This proposed equipment meets industry standards and is consistent with equipment previously evaluated for acoustic impacts by BOEM and National Marine Fisheries Service (NMFS) in the PEIS[2] and for other offshore renewable energy projects.

The proposed side scan sonar equipment operates at frequencies above the hearing threshold of marine mammals (7 Hz to 180 kHz) and sea turtles (<1,600 Hz) and therefore should have no adverse impact on these protected species. Similarly, the multibeam, which will only be used at the MET tower location, will

[1] The Maryland Energy Administration commissioned a similar geophysical survey that acquired medium penetration subbottom data throughout the Project Area and therefore this equipment will not be utilized during the upcoming field program.

[2] Bureau of Ocean Energy Management. 2014. Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas, Final Programmatic Environmental Impact Statement.

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be operated at its highest frequencies (400 kHz) to achieve the highest resolution possible; therefore, the sounds from the multibeam will also be above the hearing threshold of the species of concern.

The single beam depth sounder and shallow-penetration subbottom profiler (chirp) emit sound within the hearing threshold of marine mammals. However, during pre-construction surveys conducted for the Cape Wind Energy Project[3], field testing performed by JASCO Applied Sciences to determine sound pressure levels (SPL) showed that neither the single beam nor the subbottom profiler exceeded 180 dB harassment threshold for protected species, and that the distance to the 160 dB isopleth was 2m and 10m, respectively. Again, no higher impact medium penetration survey equipment is proposed for the US Wind HRG survey.

Geotechnical Survey

Following the completion of the HRG survey, a geotechnical program will be conducted. Approximately twelve sampling locations are proposed across the Project Area. These will be sampled using a combination a cone penetrometer and soil boring equipment. The Geotechnical sampling activities are estimated to take approximately 20 days to complete under 24-hour operations, not including weather or protected species down time.

EXCLUSION ZONES AND ALTERNATIVE MONITORING PLAN

As requested by BOEM, US Wind will staff and equip the SAP survey team to provide both 24-hour Passive Acoustic Monitoring System (PAMS) observations and 24-hour visual observations. The exclusion zones for G&G survey activities will be monitored by qualified Protected Species Observers (PSOs) and PAMS operators and all applicable conditions and procedures contained in the lease (e.g. clearance before start up, ramp up, shut down, etc.) will be implemented.

In order to continue operations at night or during periods of impaired visibility, US Wind will implement additional mitigation measures agreed upon by BOEM and US Wind. These will include supplemental monitoring technologies, as described below, to detect the presence of protected species.

Passive Acoustic Monitoring System

US Wind is teaming with Alpine Ocean Seismic Survey and its parent company Gardline to operate the PAMS system during the G&G program. Gardline has been providing underwater acoustic monitoring and mitigation services to the offshore energy industry since 2002. For US Wind, the HRG survey team will use a towed system specifically designed around the survey vessel specifications provided in Appendix B of the SAP Survey Plan.

The PAMS system will be operated 24 hours per day during the survey to provide a range and bearing to any marine mammals in the vicinity of the survey vessel. Visual observations will be conducted to confirm protected species sightings. US Wind will engage multiple PAMS operators onboard allowing relief to prevent fatigue (see below).

Visual Observers

For night time operations, visual observers will use high performance night vision goggles, i.e., PVS-7-3AG. Observers will also test clip-on thermal imaging (COTI) technology, the specifications for which were provided by BOEM. Due to the potential for reflectivity from bridge windows that could interfere with the use of the night vision optics, PSOs will be required to make night time observations from a platform with no visual barriers.

[3] http://www.nmfs.noaa.gov/pr/pdfs/permits/capewind_iha_application_renewal.pdf

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Gardline will employ standard techniques to calibrate the visual observation equipment. This will include observations of known objects at set distances and under various lighting conditions. This calibration will be performed during mobilization and periodically throughout the survey operation.

Observers will document their sighting results throughout survey operations in accordance with Addendum C, Appendix B of the Lease. Where applicable, a notation will be included regarding the type(s) of equipment in use during the observations.

Protected Species Monitoring Logistics

To provide MMO/PAMS coverage 24-hours a day for the SAP survey, 4 professionals, each of whom is both a certified PSO and an experienced PAMS operator will be required. Two certified PSO professionals who are also trained PAMS operators will work simultaneously on each watch - one on PAMS, the other on visual - on an alternating basis during both day time and night time operations. All of these professionals will have effective training and experience with using night vision optics. These personnel would do no more than 4 hours at each monitoring station (visual or acoustic) and after 4 hours of one discipline would change to another, i.e. change from visually monitoring the sea with binoculars to monitoring the PAMS laptops. Each operator will have a 12 hour break during each 24 hour period. Vessel crews will be available to cover short breaks in PSO coverage to allow the mitigation team to have sufficient meals and rest room breaks. Gardline will ensure that all vessel crew have a short training session prior to or during mobilization to enable them to cover the PSO duties for these short periods. This 4-person staffing program is consistent with berthing available on the survey vessels.

Protected Species Monitoring/Night Time Operations Mitigation Summary

- US Wind will ensure that no night time operations take place without both night vision and PAM systems being fully operational. Redundancy planning will be implemented to achieve this coverage for 24 hour operations.
- PSOs will be required to make night time observations from a platform with no visual barriers.
- The separation distance of 500 m for North Atlantic right whales, 100 m separation distance for all non-delphinoid species and the 50 m separation distance for delphinoid and sea turtle species, as well as the 200 m exclusion zone during G&G surveys operating below 200 kHz, will be ensured and monitored by vessel operators, vessel crew and PSOs, in accordance with the standard operating conditions of the leases.
- Two certified PSO professionals who are also trained PAMS operators will work simultaneously on each watch - one on PAMS, the other on visual - on an alternating basis during both day time and night time operations. All of these professionals will have effective training and experience with using night vision optics.
- Shut down or delaying operations will occur to maintain required exclusion zones when low frequency vocalizations are detected but are not possible to be localized on with the PAMS.
- A spectrum of frequencies will be analyzed in the empirical acoustic data collected by US Wind in order to cover vessel noise, biological noise and HRG equipment noise (i.e., 50, 100, 200, 500 Hz and 1, 2, 5, 7, 10, 20, 50, 100 and 150 kHz). A sub sample of acoustic, and corresponding visual observation, data will be provided to BOEM within 3 weeks after the commencement of HRG surveys.
- All vessel operators will be required to monitor the NMFS North Atlantic right whale reporting systems (e.g., the Early Warning System, Sighting Advisory System, and Mandatory Ship Reporting System for the presence of North Atlantic right whales during HRG survey operations.

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- Boring operations will be initiated during daytime and night vision optics will be used at night by PSOs throughout the operation to monitor the 200 m exclusion zone for protected species.
- US Wind will conduct a comparative assessment of protected species detection using PAM and visual monitoring during day and night time operations, including calibration exercises. The assessment and subsequent final report will be submitted to BOEM 30 days after the surveys are completed.

Protected Species Detection Comparison Report

US Wind will provide BOEM with a post-survey report that will include presentation, analysis, and discussion of the marine mammal detections and methods during the survey. This report will also include an assessment of the methods of detection, equipment, and recommendations.

Noise Assessment

To assess the operational sound signature produced by the survey vessel *Shearwater*, a sound assessment will be conducted. This assessment involves a two-step process:

1. A background noise measurement will be taken while the vessel is dead in the water (or as practicably as possible due to safety) with the towed PAMS cable deployed to collect .wav file data recordings for 30 minutes. Recordings do not need to be for 30 minutes continuously.

2. A vessel noise assessment will be taken with the towed PAMS cable deployed while the vessel is operating at normal survey speed(s) to collect .wav file data recordings for 30 minutes. Recordings do not need to be continuous.

Both sets of vessel noise assessments will be taken at multiple locations to cover variations in site conditions e.g. water depth, bottom conditions, etc. The acoustic signature will also be measured at various vessel RPMs over these site conditions. US Wind will also collect representative baseline and vessel signature data for the geotechnical vessel.

Once data is collected, an underwater noise analysis will be performed using Matlab. In this process, the noise level recorded from the vessel operation will be extracted from the acoustic data in terms of sound pressure level and then compared to the background noise level. This will provide an approximation of the vessel noise level without the contribution of any ambient noise. An acoustic spectrogram will be computed to visualize the vessel's acoustic signature. This will provide the relative received noise levels from the vessel at the hydrophone under various site conditions. US Wind expects to be able to provide preliminary acoustic data from the *Shearwater* to BOEM within two weeks after the start of the survey program. This timeframe should be sufficient to allow for the transfer of data from the offshore survey area to shore plus 7-10 days for processing once the data is received.

POTENTIAL IMPACT TO PROTECTED SPECIES

The US Wind Lease includes specific terms, conditions, and stipulations (Addendum C) that apply to the site characterization studies proposed by US Wind and its team of subcontractors. US Wind understands that these lease conditions, which include exclusion zones for G&G activities and limit nighttime and low visibility activities, were developed as a result of extensive environmental analysis by BOEM and the National Marine Fisheries Service[4]. However, with the monitoring and mitigation proposed by US Wind in

[4] Bureau of Ocean Energy Management. 2014. Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas, Final Programmatic Environmental Impact Statement.

National Marine Fisheries Service. 2013. Biological Opinion.

Bureau of Ocean Energy Management. 2012. Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas, Biological Assessment.

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this plane, 24-hour G&G survey operations can proceed in a manner that will maintain compliance with exclusion zones as specified in the Lease.

In addition, while protected species may be present in the project vicinity during the G&G activities, the Lease Area is not considered critical habitat to any Endangered Species Act (ESA)-listed whale species and the closest Right Whale Seasonal Management Area is located several nautical miles to the north of the Lease Area. Similarly, none of the ESA-listed sea turtles, have critical habitats within the Lease Area and Maryland does not have any primary turtle nesting sites or any reported turtle nesting sites (PEIS). All vessel operators will be required to monitor the NMFS North Atlantic right whale reporting systems (e.g., the Early Warning System, Sighting Advisory System, and Mandatory Ship Reporting System for the presence of North Atlantic right whales during HRG survey operations.

For those animals that are in the vicinity of the Lease Area during survey activities, the use of PAMS and night vision goggles should provide sufficient supplemental information for trained observers to detect the presence of protected species so that exclusion zones can be maintained and applicable operating procedures regarding avoidance, reduction in survey activity, shutdown and ramp up can be implemented as required.

In addition, for the HRG survey activities, the 200m exclusion zone specified to mitigate sound impacts is highly conservative relative to the low-impact types of equipment proposed for the US Wind Survey. Based on operational data collected by JASCO as cited above, the US Wind team estimates that the approximate distance to the 160 dB Level B harassment threshold during the HRG survey will be only 10 meters from the chirp and 2 meters from the single beam. The use of the proposed equipment, combined with the use of PAMS and night vision goggles should ensure that protected species are not exposed to level A or level B harassment sound levels from this activity. US Wind is confident that following BOEM's required monitoring and mitigation measures will ensure that no marine mammals or sea turtles will be harassed during the survey program, and therefore, US Wind does not intend to request Incidental Harassment Authorization from NMFS.

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APPENDIX B INJURED OR DEAD PROTECTED SPECIES INCIDENT REPORTS

INCIDENT REPORT: PROTECTED SPECIES INJURY OR MORTALITY

Photographs and/or video footage should be taken of all injured or dead animals, if possible

Observer's full name and/or Reporter's full name:Gareth Duguid
Date and Time animal observed: 22nd June 2015 @ 10:49 UTC
Date and Time animal/samples collected: N/A
Location of Incident (Latitude/Longitude): 38° 35.55N 74°52.45W
Species Identification (closest taxonomic level possible): Delphinid, probable bottlenose dolphin
Photograph/Video footage collected: YES
If Yes, was the data provided to NMFS? YES
Name of vessel, vessel speed at the times of incident, and activity ongoing at the time of observation (e.g. transit, survey, pile driving): M.V. Ocean Discovery, 5.9 knots, transit to survey site.

Environmental conditions at time of observation (i.e. Beaufort sea state, cloud cover, wind speed, glare): Slight seas, low swell, NW force 2, 2 Oktas, strong glare, good visibility.

Water temperature (°C) and depth at site of observation: Unknown temperature, 28.7m depth
Describe location of animal and events leading up to, including, and after, the incident: Carcass was observed on the starboard side approximately 400m away from the vessel as we proceeded south-east on transit to survey site from Baltimore.

Status of all sound-source use in the 24 hours preceding the incident: None, in port for previous 24hrs.

Describe all marine mammal, sea turtle, and sturgeon observations in the 24 hours preceding the incident:
Observation was made 30 minutes after a sighting of approximately 40 bottlenose dolphins off the port quarter, heading in the opposite direction. Probable basking shark sighting made at 09:20 UTC.

Marine Mammal Information:
Injuries observed: No obvious injury
Condition/description of animal: Animal was moderately decomposed, bloated and appeared to have an area of skin and blubber missing on it's belly where it had most likely been pecked by seabirds.

Other remarks:

Date and time of incident reported to NMFS Stranding Hotline:
22nd June 2015 @ 12:20 UTC

APPENDIX C COMPLETED JNCC RECORDING FORMS

The completed JNCC forms can be found in the Excel document entitled (10505_USWind_Discovery).

APPENDIX D BEAUFORT WIND, SEA CONDITIONS AND VISIBILITY

WIND SPEED			
Beaufort Scale	**Name**	**Knots**	**Metres/second**
0	Calm	0 - 1	0 - 0.2
1	Light air	1 - 3	0.3 - 1.5
2	Light breeze	4 - 6	1.6 - 3.3
3	Gentle breeze	7 - 10	3.4 - 5.4
4	Moderate breeze	11 - 16	5.5 - 7.9
5	Fresh breeze	17 - 21	8.0 - 10.7
6	Strong breeze	22 - 27	10.8 - 13.8
7	Near gale	28 - 33	13.9 - 17.1
8	Gale	34 - 40	17.2 - 20.7
9	Strong gale	41 - 47	20.8 - 24.4
10	Storm	48 - 55	24.5 - 28.4
11	Violent storm	56 - 63	28.5 - 32.6
12	Hurricane	64+	32.7+

SEA STATE		
Symbol	**Name**	**Height in metres**
0	Calm (glassy)	0
1	Calm (rippled)	0 – 0.10
2	Smooth (wavelets)	0.10 – 0.50
3	Slight	0.50 – 1.25
4	Moderate	1.25 – 2.50
5	Rough	2.50 – 4.00
6	Very rough	4.00 – 6.00
7	High	6.00 – 9.00
8	Very high	9.00 – 14.00
9	Phenomenal	14.00+

VISIBILITY	
Name	**Visibility (nautical miles)**
Fog or dense snow fall	Less than 0.5
Poor visibility	0.5 – 2.0
Moderate visibility	2.0 – 5.0
Good visibility	5.0 – 25.0
Very good visibility	More than 25.0

APPENDIX E MONITORING EQUIPMENT CALIBRATION FORMS

Calibration For Distance Estimation								
Week #	**Date**	**Name of Observer**	**Reticule Binoculars Distance (m)**	**Range Finder Distance (m)**	**Distance provided by the system onboard (m)**	**Sea state (Beaufort Scale)**	**Wind force (Beaufort Scale)**	**Swell**
1	22/06/2015	G. Duguid	1980	2000	2055	2	2	low
1	22/06/2016	R. Price	1980	2000	1852	2	2	low
1	22/06/2017	G. James	1980	2000	2055	2	2	low
1	22/06/2018	L. Buckland	2600	3000	2963	2	2	low
1	22/06/2019	C. Gilchrist	1980	2000	2055	2	2	low
2	29/06/2015	G. Duguid	510	500	513	4	4	low
2	29/06/2015	R. Price	630	600	625	4	4	low
2	29/06/2015	G. James	510	500	513	4	4	low
2	29/06/2015	L. Buckland	510	480	470	4	4	low
2	29/06/2015	C. Gilchrist	510	500	470	4	4	low
3	06/07/2015	G. Duguid	1150	1000	1126	4	4	low
3	06/07/2015	R. Price	1980	2000	2452	5	5	low
3	06/07/2015	G. James	1000	1000	1126	4	4	low
3	06/07/2015	L. Buckland	2320	2200	2452	5	5	low
3	06/07/2015	C. Gilchrist	2800	2200	2646	4	4	low

APPENDIX F PASSIVE ACOUSTIC MONITORING SYSTEM SPECIFICATIONS

General	
Manufacturer	Gardline Environmental Ltd
Model	MK3
Towed streamer section	
Length	N/A integrated into tow cable
Section diameter	14/16mm over cable, 24/29mm over mouldings
Number of Hydrophones	4
Hydrophone type	Custom Built by Gardline Environmental Ltd 1 low frequency 3 broadband frequency
Receive sensitivity (dB re 1 V/µPa)	-204
Hydrophone separation	Hydrophone 1 and 2 0.25 m Hydrophone 2 and 3 1.2 m Hydrophone 3 and 4 1.2 m
Preamplifiers	4 broadband
Preamplifier type	Sensor Technology SA-02
Depth sensor manufacturer	SensorTechnics
Tow cable	
Length	250 m
Diameter	14 mm
Termination	37 pin CEEP Connectors
Deck cable	
Length	100 m
Diameter	14 mm
Termination	37 pin CEEP Connectors