OCS-A 0501 MASS USA

VINEYARD WIND

Site Assessment Plan (SAP)
Vineyard Wind Lease OCS-A 0501

Massachusetts Offshore Wind Energy Area

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1.0 PROJECT INFORMATION (585.610(A))

1.1 Project Overview

This section describes basic project information.

1.1.1 Contact Information (585.610(a)(1))

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1.1.2 Concept (585.610(a)(2))

The general concept is to install and maintain up to two Meteorological (MET) and/or oceanographic buoys, hereafter referred to as MET/ocean buoy(s), within the Massachusetts Wind Energy Area (WEA) of the Atlantic Ocean, as designated by the Bureau of Ocean Energy Management (BOEM) and leased to OffshoreMW, LLC (OffshoreMW). Offshore MW is in the process of changing its name to Vineyard Wind, LLC (Vineyard Wind); however, it is the same entity that currently holds the lease and will be referred to as Vineyard Wind throughout this document.

The devices to be deployed have not yet been selected, but will be limited to either a floating Light Detection and Ranging (LiDAR) buoy or wave and current buoy. The buoy and LiDAR are floating and moored to the seafloor. The proposed locations for the MET/ocean buoy(s) (SAP-1 and SAP-2) are shown in Figure 1.2.1 Location Plat; coordinates and water depths are presented below.

SAP-1
Latitude: 41.072588
Longitude: -70.482501
Depth (m): 41

SAP-2
Latitude: 41.006427
Longitude: -70.477654
Depth (m): 44

The information collected from the MET/ocean buoy(s) will be used during the wind turbine pre-installation, installation, and commissioning period to supplement existing met-ocean measurement data available in the vicinity of the Massachusetts WEA. Historical and ongoing collection of meteorological and oceanographic data in the region will inform the project and COP submittal in support of engineering and design of the WTG foundations and above water components. The MET/ocean buoy(s) will likely be removed and decommissioned shortly after final commissioning of the wind farm.

Installation of the MET/ocean buoys(s) is planned for March 2018. The installation process is expected to take two weeks, from arrival of the work platforms in the port of operations to the time the buoy(s) enter the water and mooring weights are placed on the seafloor. The total duration of the MET/ocean buoy(s) deployment for data collection is anticipated to be approximately 5 years.

1.1.3 Designation of Operator (585.610(a)(3))

Vineyard Wind intends to be the sole operator of the MET/ocean buoy(s) in compliance with the stipulations stated in the Lease and described in Section 1.1.4, as they relate to the Site Assessment Plan (SAP) and SAP activities.

1.1.4 Lease Stipulations and Compliance (585.610(a)(4))

The lease issued to OffshoreMW (for the Massachusetts Wind Energy Area is posted on the BOEM website at https://www.boem.gov/Lease-OCS-A-0501/. As indicated above, Offshore MW is in the process of changing its name to Vineyard Wind; however, it is the same entity that currently holds the lease and will continue to comply with the stipulations in this lease as they relate to the development and approval of this SAP and SAP activities.

Vineyard Wind completed SAP survey activities as described in Section 2.0 in accordance with a pre-survey meeting and SAP Survey Plan approved by BOEM on August 26, 2016. Vineyard Wind also conducted a tribal pre-survey meeting, as specified in the lease prior to conducting SAP survey activities, and consulted with United States Fleet Forces (USFF) N46 and the Fleet Forces Atlantic Exercise Coordination Center (FFAECC), which coordinates all regional military/other agency activities (both sea and air) for the Narragansett Bay operating area (OPAREA) and ensures events are de-conflicted.

Vineyard Wind will conduct the activities described in this SAP as approved by BOEM. Vineyard Wind proposes to conduct SAP activities in a manner that will not unreasonably interfere with or endanger other approved activities, will not cause any undue harm or damage to the environment, will not create hazardous or unsafe conditions, and will not adversely affect resources of historic, cultural or archaeological significance in the lease area. Measures that will be implemented to avoid, minimize, and/or mitigate potential impacts associated with SAP activities, as required by the lease, are described in Section 3.0 of the SAP.

Furthermore, Vineyard Wind will comply with the federal regulations and associated SAP guidelines regarding the items listed in Table 1.1.4 below, as stated in the table and outlined in this SAP.

Table 1.1.4 Compliance with Regulations

Regulation	Description	Compliance Statement
585.105 (a)	Design your projects and conduct all activities in a manner that ensures safety,	Vineyard Wind will comply with the requirements of 585.105(a). Project design standards and company HSE policies in place to ensure safe working conditions for people, *in situ* equipment, and all activities occurring on the Lease and for the project,
	and will not cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components to the extent practicable;	with further design protocols and safety measures to prevent any impacts to the environment,
	and take measures to prevent unauthorized discharge of pollutants	and operational rules and safeguards against any discharge from vessels working on the project, in the Lease area

	including marine trash and debris into the offshore environment.	and all surrounding waterways connecting to the port.
585.606 (a)	(1) Conforms to all applicable laws, regulations, and lease provisions of your commercial lease	Vineyard Wind will comply with the requirements of 585.606(a). Applicable laws, regulations, and provisions in Lease OCS-A 0501 will be followed.
	(2) Is safe	Vineyard Wind has planned and is prepared to conduct all site assessment activities in a safe manner following company HSE policies (Vineyard Wind's and subcontractors).
	(3) Does not unreasonably interfere with other uses of the OCS, including those involved with National security or defense	Activities will not interfere with other uses of the OCS and Lease area; Vineyard Wind and its contractors will continue to communicate with the USCG, appropriate entities, and other users of the OCS; and get approval from Navy Fleet Forces Atlantic that the OCS is clear for SAP activities.
	(4) Does not cause undue harm or damage to natural resources; life (including human and wildlife); property; the marine, coastal, or human environment; or sites, structures, or objects of historical or archaeological significance	Vineyard Wind has and will continue to conduct due diligence efforts to protect all facets of the environment during offshore and upland project activities, as well as any cultural resources identified in our work areas. Refer to Section 3 of this document regarding the analysis of site characteristics, potential impacts, and avoidance and mitigation measures.
	(5) Uses best available and safest technology	MET/ocean equipment and mooring designs are standard, accepted systems being utilized for other offshore wind SAP monitoring, and represent the best available and safest technologies for the environment at this time.
	(6) Uses best management practices	Vineyard Wind will continue to use best management practices (BMP) regarding all project tasks. Some of the BMPs specific to the SAP activities include, but are not limited to; • avoidance of impacts to benthic and nektonic habitats, • avoidance of impacts to marine mammals, seals, and turtles, • installation activities only during approved months to avoid impacts to fisheries and marine mammals, • avoid any bottom disturbance during installation except the weight for the mooring itself, • use of approved USCG lighting and marking of mooring buoys to avoid impacts to the commercial fishing industry,

		• design of the buoys to minimize avian perching, • design of the moorings to avoid entanglement by marine mammals, turtles, and seals, • routine inspection of the moorings to ensure structural integrity and minimal seabed disturbance, • combine vessel trips for inspection, maintenance, and data downloads to minimize environmental impact, • prepare and execute an oil spill response plan, • exercise responsible and safe behavior during all site activities.
	(7) Uses properly trained personnel	Vineyard Wind will ensure that suitably experienced personnel will be employed for all facets of SAP activities, meeting company and HSE standards for the work to be performed.

1.2 Proposed Activity

1.2.1 General Structure and Project Design, Fabrication, and Installation (585.610(a)(6))

As outlined in Section 1.1.2, a maximum of two bottom mounted devices are anticipated to be installed within the Massachusetts WEA during the development and installation period of the wind farm. These devices will be installed in SAP Area 1 at 41 m (134.5 ft.) water depth at position Latitude: 41.072588 Longitude: -70.482501, and at SAP Area 2 at 44 m (144.4 ft.) water depth at position Latitude: 41.006427 Longitude: -70.477654 (see location plat, Figure 1.2.1). Vineyard Wind proposes to collect the relevant met-ocean data using either a floating Lidar such as the AXYS WindSentinel™ and/or the AXYS TRIAXYS Wave and Current Buoy. Both instruments are off-the-shelf products and are widely applied in the offshore industry. The measurement devices and their components under consideration are described in Tables 1.2.1 and 1.2.2. Components of these buoys and moorings including the gravity-based anchor and the chain that affixes the buoy to the anchor, are further described below. Detailed technical information about the floating LiDAR buoy and the wave and current buoy are provided in Appendix A.

More specifically, both the AXYS WindSentinel™ and AXYS TRIAXYS buoys will be mounted to the seafloor using a steel chain connected to a gravity based device (mooring weight). Typical mooring weights consist of a cement clump or steel anchor with a steel chain (specifications in the tables below).

The following sections provide detailed descriptions of the proposed devices including their associated mooring designs, instruments, and anticipated seafloor impact.

Buoyancy calculations and mooring calculations for the two deployment systems have been made available for Vineyard Wind by AXYS, based on existing met-ocean data for the Vineyard Wind site. These site specific values for the mooring design are included in Tables 1.2.1 and 1.2.2.

The mooring design and materials are site specific and take the following factors into consideration:

- Water depth
- Current speed
- Tides
- Waves
- Winds
- Type of deployment vessel and equipment available on board
- Desired length of life of the mooring
- Vessel traffic in the vicinity of the mooring

The buoy(s) will be equipped with the proper safety lighting, markings and signal equipment per United States Coast Guard (USCG) Private Aids to Navigation (PATON) requirements. Coordination with the USCG is presently underway.

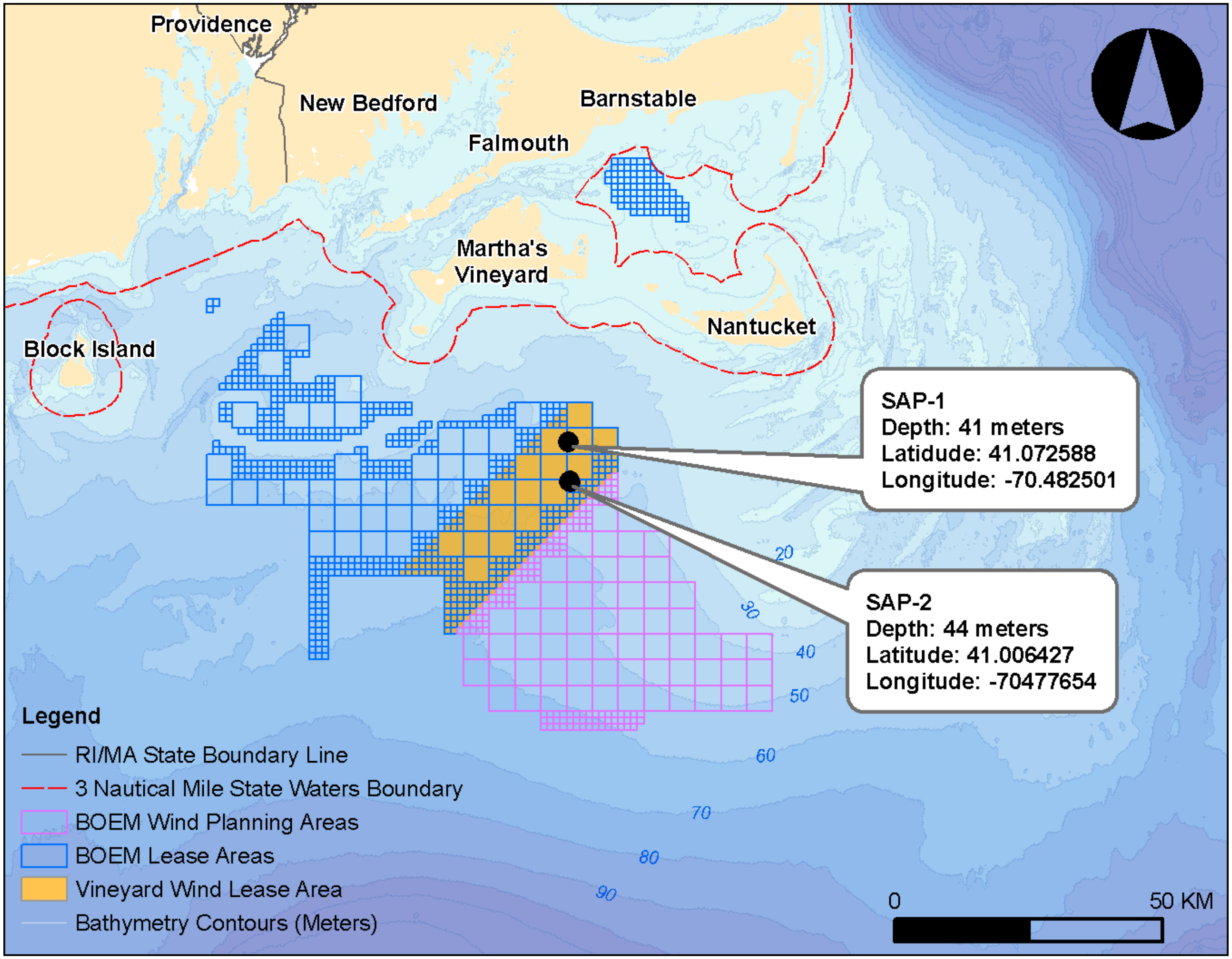
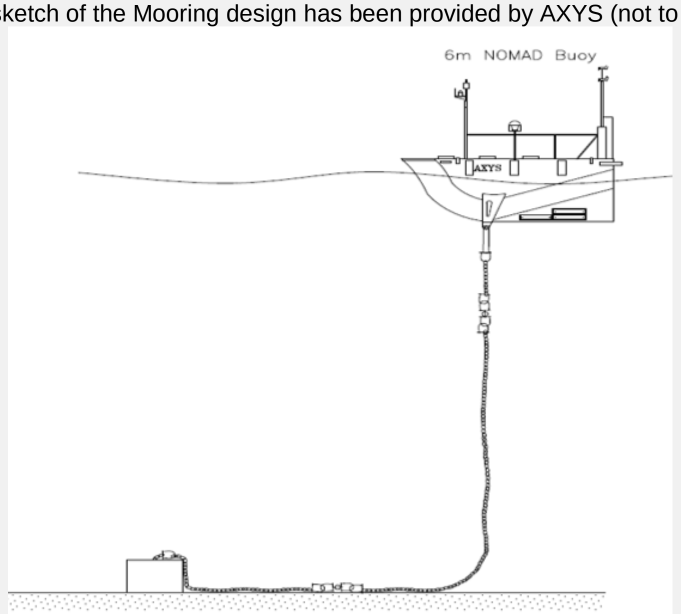


Figure 1.2.1. *Location Plat showing location of SAP Areas. Sources: BOEM, Wind Energy Areas, 2015; NOAA, Raster Navigational Charts, 2013; Mass GIS, State Outline, 1991.*

Table 1.2.1. Summary Description of the AXYS WindSentinel buoy system

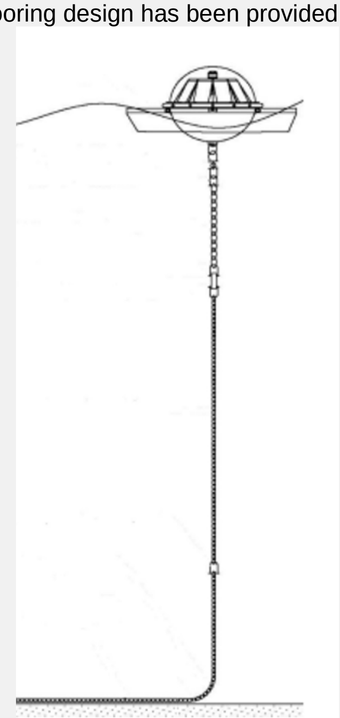
AXYS WindSentinel™ Floating LiDAR (also referred to as "Flidar", a commercial name by AXYS)	
	The AXYS WindSentinel™ is a marine buoy equipped with LiDARs specifically suited for marine conditions. Specific details of the device can be found in Appendix A. This summary table only addresses key technical data.
Overall dimension	Length: 6.30m (248 inches) Width: 3.2m (126 inches) Height to Deck Hatch: 2.85m (112 inches)
Weight	Bare Hull Weight (BHW) with no batteries, fuel or payload: *Approx. 6,800 kg (15,000 lbs) (includes 1,000 #/454kgs ballast)* BHW + 40 batteries + full payload + 240 gallons fuel *Approx. 10,000 kg (21,800 lbs)*

Mooring design	The Device will be secured to the seafloor using a simple mooring design. This design facilitates only very limited seafloor impact. The Device will be attached to the seafloor by means of a single concrete clump anchor. The concrete clump anchor will have a total weight of 5,000-6,000 kg (11,000-13,000 lbs) and the following dimensions. Height of approx. 0.6 m (2.3 ft) and Width/Length of approx. 2.0 m (6.7 ft). The mooring will consist of one cement clump weight interconnected to the device with all steel chains. Initial mooring analysis have been conducted and the mooring chain as standard all steel chain mooring with open links with 32mm-40mm nominal diameters. The steel chains will be mounted to the device using a steel mooring yoke. The steel chains will have a yielding strength of ca 1000 kN and a weight of ca. 40 kg/m. Due to the weight of the steel chain and general design no entanglement of the chain is expected. Below sketch of the Mooring design has been provided by AXYS (not to scale):  The total mooring length will be ca. 160m from bottom of the device to concrete clump anchor attachment. The device will have a total radius range of approx. 155m relative to the main anchor weight centre. The mooring chain will have a maximum length seafloor attachment radius of 115m. The maximum horizontal radius of the anchor sweep chain contacting the seafloor will not be more then 115m and will be within the 300m x 300m surveyed area. Any impact from installation vessels will be very limited, as the installation will be performed without anchoring.
Seafloor impact	Vertical penetration of the anchor clump depends on the weight, outer dimensions and seabed conditions. A total seafloor penetration during the deployment period for the concrete clump anchor weight is anticipated to be conservatively calculated up to approx. 2.5m (8 ft). Only very limited scour development of approx. 0.3m or 1 ft around the concrete clump anchor is expected due to minimal currents and relatively cohesive seabed conditions. These conditions have been considered as part of the planning of the installation, operations and decommissioning.

Tracking and Recovery	Tracking of the buoy will be done by means of the GPS and AIS devices. AXYS maintains a list of known and pre-validated vessel providers. In case of an emergency recovery, the availability of the closest suitable vessels is confirmed. Some drag or walking of the anchor weight may be expected in an extreme storm situation. AXYS has run mooring simulations to capture an approximation of the maximum mooring tension we would experience at the anchor. The size of the anchor is designed to be slightly larger than the design tension. The buoy tracks the GPS location of the system and sends an alert if the buoy moves outside a predefined circle. .
Maintenance activities	Planned on-site maintenance for the WindSentinel™ Buoy is scheduled at 6 and 12 months and will be completed by a vessel comparable to the support vessel used for installation. Planned maintenance activities will occur at 6-month intervals and will include replacement of consumables, service of sensors, data retrieval, and cleaning of solar panels and wind turbines, A detailed service, which will include all 6-month activities, as well as cleaning of biofouling and review and maintenance of the mooring system, will be performed at 12-month intervals.

Table 1.2.2. Summary Description of the AXYS TRIAXYS Wave and Current Buoy

AXYS Technology - TRIAXYS Wave and Current Buoy	
	The AXYS TRIAXYS is a marine buoy measuring sea state conditions and sub surface currents. • Specific details of the device can be found in Appendix A. This summary table only addresses key technical data.
Overall dimension	Buoy Diameter: 1.10m (43 inches) With Floatation Ring 2.20m (86 inches) Height: 1.10m (43 inches)
Weight	Weight (including batteries): 230 kg (510 lbs)

Mooring design	The Device will be secured to the seafloor using a simple mooring design. This design facilitates only very limited seafloor impact. The TRIAXYS buoy will be mounted with a floating ring to ensure sufficient buoyance capacity. The buoy hull dome and floating ring are constructed from stainless steel and impact resistant polycarbonate. The Device will be attached to the seafloor by means of a single heavy steel chain interconnected with open link chain between the buoy and single heavy chain on the bottom. The heavy steel chain will have a total weight of approx. 500kg (1,100 lbs) and a length of approx.15m. Mooring analyses have been conducted and the mooring chain as a standard steel chain mooring with open links 16-20 mm nominal diameter. The steel chain will be attached to the device using a steel mooring yoke. A floatation collar mounted under the device will be utilized to provide the required buoyancy for the chain. The mooring system will have a yielding strength of ca 800 kN and a weight of ca. 6 kg/m. Due to the weight of the chain, the mooring assembly will be kept straight and vertical, and no entanglement of the mooring system is expected. Below sketch of the Mooring design has been provided by AXYS (not to scale):  The total mooring length will be approx. 75m (246 ft) from bottom of the device to the seafloor heavy chain. The device will have a total radius range of approx. 155m relative to the main anchor slap centre. The mooring chain will have a maximum length seafloor attachment radius of 65m. The maximum horizontal radius of the chain contacting the seafloor will not be more then 35m (114 ft) with in the 300m x 300m deployment area. Any impact from installation vessels will be very limited, as the installation will be performed without anchoring.

Seafloor impact	Vertical penetration of the heavy steel depends on the weight, outer dimensions and seabed conditions. A total seafloor penetration during the deployment period for the chain anticipated to be approx. 0.5m (1.6 ft). Little to no scour development around the chain is expected due to minimal currents and relatively cohesive seabed conditions.
Tracking and Recovery	Tracking of the buoy will be done by means of the GPS and AIS devices. AXYS maintains a list of known and pre-validated vessel providers. In case of an emergency recovery, the availability of the closest suitable vessels is confirmed. Drag or walking of the heavy chain may be expected in an extreme storm situation. AXYS has run mooring simulations in an attempt to capture an approximation of the maximum mooring tension we would experience at the anchor. The size of the anchor chain is designed to be slightly larger than the design tension. The buoy tracks the GPS location of the system and sends an alert if the buoy moves outside a predefined circle. .
Maintenance activities	Planned on-site maintenance for the TRIAXYS Buoy is scheduled every 3 months for the first year of operation and will be completed by a vessel comparable to the support vessel used for installation. Planned maintenance activities at the first 3-month interval would include cleaning of the ADCP sensor and cleaning of the buoy dome and hull if necessary. The 6-month maintenance will include all three-month maintenance activities, as well as visual inspection of the mooring system. At 12 months the mooring will be recovered and carefully inspected. If required, it will be changed out during the 12-month maintenance period.

1.2.1.1 MET/Ocean Datasets Supporting Mooring Design

For the specific design of the anchoring systems for both the AXYS WindSentinel and AXYS TRIAXYS buoys Vineyard Wind have provided detailed information about specific met-ocean conditions. A number of met-ocean time series have been used for analyzing the site conditions in the wind farm area and these datasets are summarized here.

Locations of the datasets utilized for these calculations are shown in Figure 1.2.1.1.

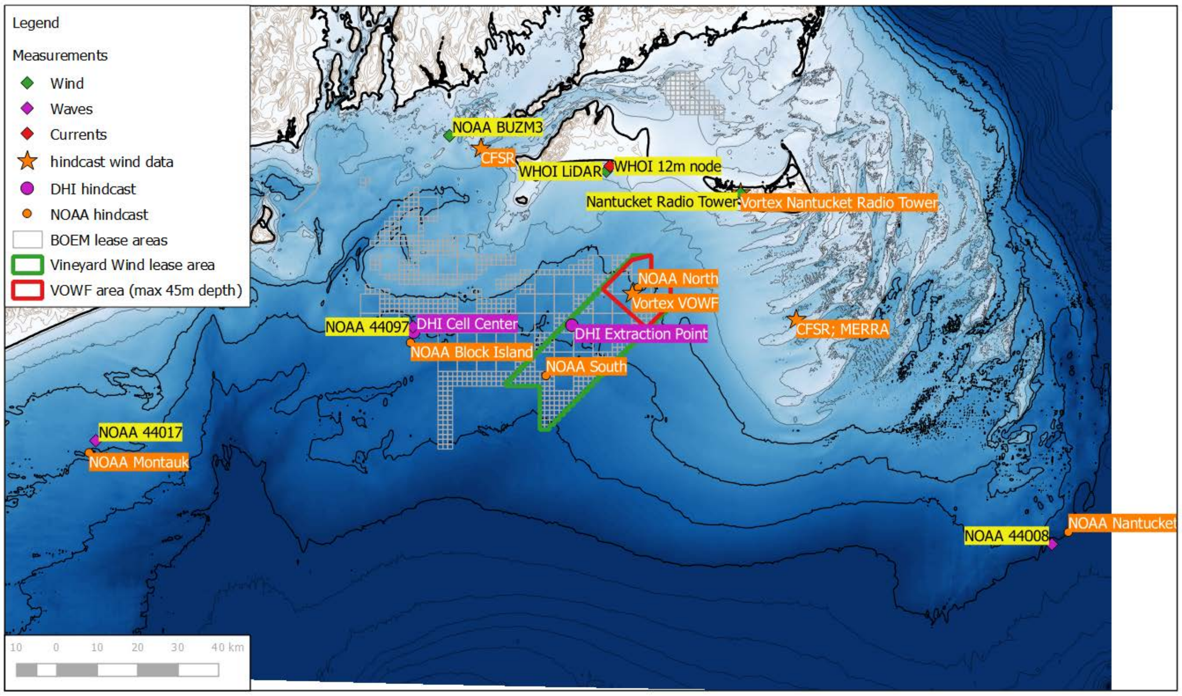


Figure 1.2.1.1: Location of the primary and secondary met-ocean data time series that were used as part of the Met-ocean analysis. Measurement locations are highlighted in yellow. Water depth contour lines are provided every 10mMSL.

- The DHI hindcast met-ocean times series dataset has been extracted within the lease area, and is considered to be representative for the complete lease area.
- Wave measurement datasets: the wave measurements at the NOAA wave buoys 44097 (Block Island Waverider) and 44017 (Montauk 3-meter discus buoy) have been used by DHI for calibrating the hindcast time series, and by the assessment of the specific met-ocean conditions.
- Wind measurement datasets: the short-term Nantucket Radio Tower and WHOI LiDAR time series were used together with the long-term NOAA C-MAN platform BUZM3 data (Buzzards Bay).
- Hindcast wind data: nearby reanalysis (CFSR, MERRA) long-term time series, as well as two short-term mesoscale time series were used in conjunction with the measured wind data to estimate the temporal- (multidecadal)- and spatial variation of the wind resource.

In Figure 1.2.2.2 below the non-extreme sea state conditions are shown.

[redacted]

[redacted]

In addition for the extreme wave conditions an overview of the significant wave height time series from DHI is shown in Figure 1.2.2.3, and the largest 3-hour H_{m0} values occurring during the following storms are:

- Hurricane Gloria 1985 (12.0 m)
- Hurricane Bob 1991 (8.0 m)
- December 1992 Nor'easter 1992 (8.7 m)
- Superstorm (also referred to as Great Blizzard) of March 1993 (12.0 m)
- Hurricane Floyd 1999 (9.3 m)
- Hurricane Irene 1991 (9.9 m)
- Hurricane Sandy 2012 (9.1 m)

Please note that among those are two non-tropical storms, see Figure 1.2.2.4 for an overview of the storm tracks.

[redacted]

[redacted]

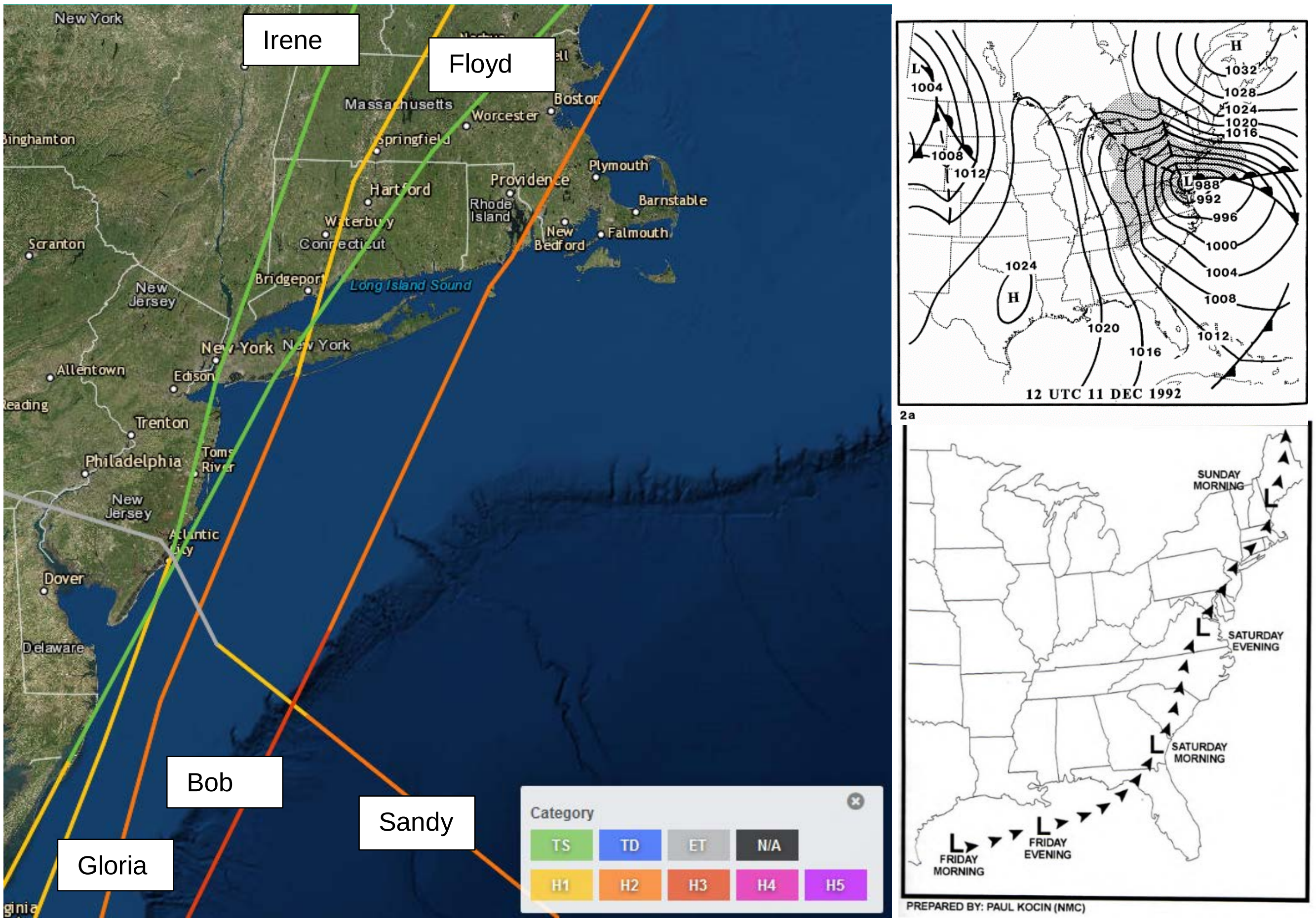


Figure 1.2.2.4: Left: Tracks of the major hurricanes during the hindcast period (September 1979 – December 2016). Top-right: Track of the Great Blizzard of 1993. Bottom-right: Track of the 1992 Nor'easter.

There are no long-term wave measurements covering the entire hindcast period. Two measurement locations have been selected for validating the extreme values of the hindcast data: the NOAA buoy 44097 (Block Island Waverider), and the NOAA buoy 44008 (Nantucket), see Figure 1.2.2.5. The NOAA Montauk wave buoy was either not yet installed, or not measuring at the times of the major storms.

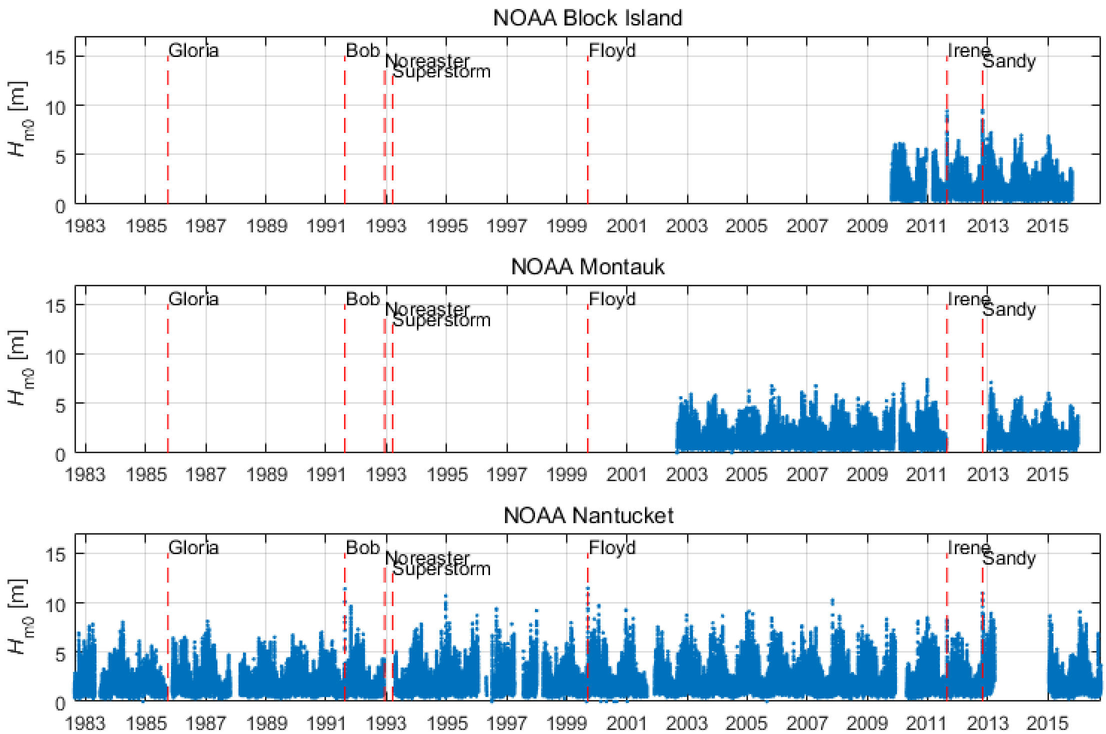


Figure 1.2.2.5: Time series of measured significant wave height at the three NOAA buoys close to the VOWF site. Please note that hurricane Gloria, and the two winter storms have not been captured by the Nantucket buoy, and that there are no data from the Montauk buoy during hurricanes Sandy and Irene.

For each of the storms listed above, the DHI time series and NOAA hindcast time series have been compared to the NOAA Block Island and NOAA Nantucket measurements (when available). The DHI time series consists of hourly 3-hour averages, while the NOAA hindcast consists of 3-hourly 3-hour averages, and hourly 1-hour averages[1]. The measurements are provided as hourly 1-hour averages, this can therefore explain some of the discrepancies between the simulated and measured data. The following observations are consistent with the validation study carried out:

- The DHI hindcast overestimates the maximum significant wave height by ca. 1.0 m (Irene, Sandy).
- The NOAA hindcast underestimates the maximum significant wave height by far more than the effect of averaging from 1-hour to 3-hour (Bob: ca. 1 m underestimation, Floyd: ca. 4 m).

In order to determine the 50-year significant wave height, subsets of extreme values belonging to independent storms (separated in time by more than one day) were extracted from the hindcast time series, using different H_{m0} threshold values. For each of these subsets, a generalized Pareto- and a two-

[1] For the evaluation of extreme values, and in order to better understand the model behavior in storm conditions, the hourly 1-hour NOAA time series were downloaded for the Nantucket buoy location. Those temporally refined data are only available at some selected locations (corresponding with NDBC historical measurement buoys), whereas the 3-hourly 3-hour time series are available at all the locations displayed in Figure 1.2.1.1. See the NOAA hindcast documentation for more details: http://polar.ncep.noaa.gov/mmab/papers/tn302/MMAB_302.pdf.

parameter Weibull-distribution have been fitted to the histograms of extreme significant wave heights. The different analysis leads to a 50-year value of significant wave height of [redacted] and the following extreme wave conditions apply:

[redacted]

The range of associated period is derived:

[redacted]

The peak period is estimated based on experience as:

[redacted]

1.2.2 Deployment Activities (585.610 (a)(7))

Detailed procedures for deployment of the two devices are provided in Appendix A. The instrument is likely to be deployed using an installation vessel and a support vessel. Specifications of potential deployment vessels are also provided in Appendix A. The installation period for both devices is expected to be a maximum two-day effort for each. It is anticipated that the deployment activities will be conducted from New Bedford Harbor, Massachusetts or a similar suitable port in the area. All devices will need scheduled and unscheduled service during the deployment period. Such service activities will be made with service vessels with sufficient crane capacity. Any device that suffers from malfunction or collision will be replaced with a similar device.

1.2.3 Mitigation Measures (585.610 (a)(8))

The Project will implement best practices and comply with all applicable regulations to eliminate or minimize the potential for adverse environmental impacts during buoy installation, operation, and decommissioning. This will include measures to avoid and prevent accidental events such as fuel spills. These measures will ensure that any unavoidable impacts are negligible. Mitigation measures are described in detail in Section 3.3.

1.2.4 Decommissioning and Site Clearance Procedures (585.610 (a)(11))

Device recovery will be undertaken by vessels similar to those used during commissioning. The recovery of the MET/ocean buoy(s) will typically proceed by decoupling the buoy from the mooring and conducting a standard marine mooring recovery process. The buoy will then be moved to shore and decommissioned. As part of the decommissioning process, local authorities (Coast Guard, maritime authorities) will be advised of the removal of the devices from the area.

1.2.5 CVA nomination (585.610 (a)(9)

The installation, operation, and decommissioning of a standard MET/ocean buoy does not qualify as a complex or significant activity; therefore, nomination of a Certified Verification Agent (CVA) is not required and Vineyard Wind requests a waiver of the CVA requirement according to 30 CFR § 585.705(c). The proposed MET/ocean buoys for deployment are standardized devices and commercially available and have been deployed in similar and significantly more harsh conditions than on the Vineyard Wind lease. The mooring design will be internally checked and assessed by Vineyard Wind ensuring third party evaluation and review of design documentation. In addition, all installation and maintenance activities will be performed under surveillance by key experts representing Vineyard Wind.

1.3 Regulatory Framework (585.610(a)(13))

1.3.1 List of Permits/Authorizations

Vineyard Wind will apply for approvals and/or authorizations as shown in Table 1.3.1 to conduct site assessments activities (MET/ocean buoy installation, operation, and decommissioning):

Table 1.3.1. Vineyard Wind SAP Permitting Plan

Agency	Permit / Approval	Expected Filing Date
Bureau of Offshore Energy Management (BOEM)	Site Assessment Plan (SAP) • National Environmental Policy Act (NEPA) • MA Coastal Zone Management (CZM) Consistency • National Historic Preservation Act Review & State Historic Preservation Act Consultation	March 31, 2017
US Army Corps of Engineers (USACE)	Section 10/404 Permit via Nationwide Permit 5 – Scientific Collection Device	Fall 2017
US Coast Guard (USCG)	Private Aid to Navigation Local Notice to Mariners	Fall 2017
DOD Fleet Forces Command / Narragansett Bay Operating Area (OPAREA)	Department of Defense Consultation	Fall 2017

1.3.2 Completed and Anticipated Agency Correspondence (585.610(a)(14))

Vineyard Wind has conducted or will conduct outreach with the following local, state, and federal agencies via meetings and/or correspondence. This outreach will address planned site assessment and development activities for the Vineyard Wind Offshore Wind Project, including the proposed MET/ocean buoy(s). These agencies include:

- BOEM
- National Marine Fisheries Service (NMFS)
- USACE
- USCG, District Commander
- MA CZM
- US Navy – Fleet Forces

Vineyard Wind will continue to provide notifications as required (i.e. to BOEM, USACE, USCG) during deployment and operation of the MET/ocean buoy(s), and prior to decommissioning.

1.3.3 Consistency Certification (585.611(b)(9))

BOEM has performed a consistency review and issued a Regional Consistency Determination (CD) finding that SAP activities anticipated for the Rhode Island and Massachusetts WEAs, including the installation, operation and decommissioning of MET towers and buoys, are consistent with the provisions of the Coastal Management Programs of the State of Rhode Island and Commonwealth of Massachusetts (BOEM 2013). The SAP activities proposed by Vineyard Wind are consistent with the activities anticipated in the BOEM consistency review; therefore, no further consistency review certification should be required.

1.4 Financial Assurance Information (585.610(a)(15))

In compliance with BOEM regulations (30 CFR 585.610(a)(15)), prior to SAP approval, Vineyard Wind will provide Surety Bond, issued by a primary financial institution, or other approved security, as required in (30 CFR 585.515) and (30 CFR 585.516) in order to guarantee the commissioning obligation.

1.5 Other Information (585.610(a)(16)) – *As requested by BOEM*

No other information has been requested by BOEM at this time relative to the proposed site assessment activities.

2.0 SURVEY RESULTS (585.610(B))

The surveys conducted to date are summarized below and included as appendices, as necessary.

2.1 Geotechnical Survey (585.610(b)(1))

Geotechnical survey data were not collected and not considered necessary for the installation of a MET/ocean buoy. This approach was agreed upon with BOEM in our approved survey plan (Appendix B). High Resolution Geophysical (HRG) survey data, as discussed below, were evaluated to verify that the seabed could support the proposed MET/ocean buoy(s).

2.2 Geological Survey and Shallow Hazards (585.610(b)(4)), (585.610(b)(2))

Alpine Ocean Seismic Survey, Inc. (Alpine), a Gardline company, conducted HRG surveys in the SAP Area on behalf of Vineyard Wind. Surveys were conducted between September and October 2016 in accordance with the Vineyard Wind Survey Plan approved by BOEM on September 15, 2016. Data acquired included bathymetry, side scan sonar, magnetometer, and shallow and medium penetration sub-bottom profiler data. The detailed methodologies and results of the survey are included as Appendix C and summarized in Section 3.1.1.

2.3 Archeological Resources (585.610(b)(3))

Gray & Pape, Inc. conducted a Phase I archeological assessment to identify potential archeological resources within the SAP Area. This work was performed to assist Vineyard Wind in compliance with Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended, and its implementing regulations 36 Code of Federal Regulations (CFR) 800, entitled Protection of Historic Properties. All work was performed in accordance with the NHPA of 1966, as amended; the National Environmental Policy Act of 1969, as amended, and its implementing regulations (36 CFR Part 800); and the Archeological Resources Protection Act of 1979.

Gray & Pape's report, titled Marine Archaeological Resource Assessment in Support of the Vineyard Wind Offshore Wind Energy Project off Martha's Vineyard, Massachusetts, is provided in Appendix D. This report follows BOEM's *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR § 585*, dated July 2015. The report's findings are summarized in Section 3.1.8.

2.4 Biological Survey (585.610(b)(5))

The biological surveys utilized to prepare this document are described below in the resource sections with biological relevance.

3.0 SITE CHARACTERIZATION AND IMPACT ASSESSMENT (585.611(B))

3.1 Environmental Baseline

3.1.1 Geologic Setting

The proposed MET/ocean buoy location(s) will be located within the Massachusetts WEA, located on the Atlantic Outer Continental Shelf (OCS). The sediments found along the OCS are recently deposited and re-worked glacial materials (i.e., Pleistocene and Holocene in age) that were formerly exposed during lower sea-level stages. These outwash plains were extensively re-worked by meltwater discharges while a rising sea-level would ultimately drown much of the coastal plain region.

Based on the results of the HRG survey (as described in Appendix C) and site-specific investigations, the geological setting in the SAP Area is characterized as an overall depositional environment dominated by re-worked Late Pleistocene and Holocene sediments with localized areas of erosion. A net deposition or non-erosive environment is interpreted over most of the area based on the finer grained sediments (fine sand and silt) that prevail on the seabed, and exhibit either a flat-lying, featureless topography (SAP-2) or a "pitted" nature (localized small scale depressions) which may be caused by bioturbation (SAP-1). Localized erosion and/or reworking exists in the form of rippled scour areas which have minimal seabed relief (typically less than 0.5 m). Only one of these scour features was observed, in SAP-1, with dimensions of 5-10 m wide and greater than 50 m in length.

Hazard Assessment (585.611(b)(1))

The HRG data were reviewed for potential seafloor, subsurface, and man-made hazards that may adversely impact installation and operation of the proposed MET/ocean buoy(s) within the SAP Areas (Appendix C). Seafloor and subsurface hazards, including, steep slopes, bedforms, rock/ hard-bottom, diapiric structures, faults, gas or fluid expulsion, scour, and channels, were not identified within the SAP Area. Man-made hazards, including shipwrecks, debris, cables, pipelines, and ordnance, were also not detected within the SAP Areas. There was evidence of small sand ripples (centimeter level) in SAP-1; however, these are not anticipated to pose a risk to MET/ocean buoy installation or operation.

3.1.2 Coastal Habitats

The MET/ocean buoy(s) will be located approximately 30 km (19 nmi) offshore of Martha's Vineyard and therefore is not likely to affect coastal habitats. Increased vessel traffic associated with SAP activities could affect coastal habitats and terrestrial mammals due to wake erosion and associated sediment disturbance; however, this is unlikely, as described in Section 3.2.1.

3.1.3 Water Quality (585.611(b)(2))

Water quality in coastal waters is controlled primarily by the anthropogenic inputs of land runoff, land point source discharges, and atmospheric deposition. Regionally, the condition of Northeast coastal waters (Maine to Virginia), as measured by the EPA water quality index (WQI), is good to fair, based on results of the 2010 National Coastal Condition Assessment (US EPA 2010). The coastal waters of Massachusetts (south of Cape Cod) and nearby waters in Rhode Island (Block Island Sound) are generally in good condition, as measured by the WQI. More specifically, nitrogen, chlorophyll *a*, dissolved oxygen, and transparency levels are assessed as good, while phosphorus levels are considered to be fair.

With increasing distance from shore (including marine waters of the OCS), oceanic circulation patterns play an increasingly larger role in dispersing and diluting anthropogenic contaminants and determining water quality. Water quality data available for OCS marine waters in and near the MA WEA include chlorophyll *a*, turbidity, temperature, and salinity.

Chlorophyll *a*

Chlorophyll *a* concentrations, an indicator of primary productivity, vary substantially between locations in southern New England marine waters. Levels are highest at the Nantucket Shoals with chlorophyll *a* concentrations declining near the MA WEA (The Nature Conservancy 2016). Seasonal variation in chlorophyll *a* is significant in the region but more muted in the MA WEA lease area, where median chlorophyll concentrations peak at 0.64 mg/m^3 in winter and reach their lowest levels (0.31 mg/m^3) in summer (Table 3.1.3-1).

Table 3.1.3-1. Seasonal Variation in Chlorophyll a Concentration Within the Vineyard Wind Lease Area from 2003 to 2015

Season	Chlorophyll *a* concentration (mg/m3)		
	Median	Minimum	Maximum
Spring	0.54	0.43	0.68
Summer	0.31	0.22	0.44
Fall	0.37	0.23	0.60
Winter	0.64	0.45	0.91

Source: Derived from The Nature Conservancy (2016)

Turbidity

Limited turbidity data are available for the MA WEA. However, turbidity casts completed in 2009 and 2010 in adjacent waters to the west indicate background turbidities generally below 1.25 nephelometric turbidity units (NTU). Although measured turbidity levels were highest in December and lowest in June, the data reveal only minimal seasonal variation (Ullman and Codiga 2010).

Existing factors affecting turbidity levels in and around the SAP areas include natural phenomenon such as the tides and currents during normal weather (minimal to no impact), and intense storm systems from adverse weather (hurricanes, nor'easters) that are capable of more significant bottom disturbance. Anthropogenic sources of increased turbidity include primarily bottom fishing activity (trawlers, draggers).

Potential increased turbidity due to suspended sediment may be associated with the installation of the mooring weights that maintain the MET/ocean buoy(s) on location. This will be very localized to the near field zone of impact where the weights touch down on the seafloor and is expected to be dissipated quickly by the bottom currents. The disturbance is anticipated to be less than the effect of a fishing trawler operating across the SAP area. Grain size of the sediments in the SAP areas (predominantly fine sand) also indicates the material will settle out of suspension a short distance from the bottom impact, with no long term effects to water quality.

Water Temperature

Based on data collected during Northeast Fisheries Science Center (NEFSC) multispecies bottom trawl surveys from 2000 to 2016 (Table 3.1.3-2), water temperatures in the MA WEA and surrounding area are characterized by the following:

1. Bottom temperatures are substantially colder in winter and spring than fall, on average
2. Surface water temperatures are warmer and more variable in fall than winter or spring
3. Differences in surface and bottom temperatures indicate that thermal stratification within the water column is greatest in the fall with a nearly isothermal profile through winter and spring;

National Data Buoy Station 44097 is located approximately 22 km (12 nmi) southwest of the Vineyard Wind lease area and provides additional data on the seasonal variation in water temperatures. These data reflect a seasonal range in surface temperatures similar to the Northeast Fisheries Science Center (NEFSC) multispecies bottom trawl survey (Table 3.1.3-2).

Table 3.1.3-2. Seasonal Water Temperature Data Summary

Season	Layer	Temperature (°C)	
		NEFSC[a] (mean ± 1 SD)	Buoy 44097 [b] (mean)
Spring	Surface	6.3 ± 2.0	7.7
	Bottom	7.2 ± 2.9	No data
Summer	Surface	No data	19.6
	Bottom	No data	No data
Fall	Surface	17.5 ± 3.2	17.0
	Bottom	12.7 ± 3.1	No data
Winter	Surface	5.4 ± 1.6	8.5
	Bottom	7.5 ± 3.3	No data

[a] Winter survey data available only for the 2000 – 2007 period
[b] Sea surface temperature data were not available between July 13, 2010 and November 5, 2010.
Sources: NEFSC multispecies bottom trawl surveys (2000-2016)
NOAA National Data Buoy Station 44097 (2009-2016)

Salinity

In contrast, NEFSC multispecies bottom trawl survey data indicate only minimal seasonal variability in salinity (Table 3.1.3-3). This is particularly evident at the surface, where the salinity averaged the same in spring, fall, and winter. Additionally, vertical salinity gradients in the water column were consistently small in spring, fall, and winter (<1.0 practical salinity unit [psu] from surface to bottom).

Table 3.1.3-3. Seasonal Salinity Data Summary

Season	Average Depth (m)	Layer	Salinity[a] (psu - mean ± 1 SD)
Spring	94.0	Surface	32.9 ± 0.7
		Bottom	33.5 ± 1.1
Summer	No data	Surface	No data
		Bottom	No data
Fall	87.9	Surface	32.9 ± 1.1
		Bottom	33.4 ± 1.2
Winter	103.7	Surface	32.9 ± 0.5
		Bottom	33.8 ± 1.1

[a] Winter survey data available only for the 2000 – 2007 period
Source: NEFSC multispecies bottom trawl surveys (2000-2016)

3.1.4 Benthic Resources (585.611(b)(3-5))

This section describes the benthic resources present in and adjacent to the SAP Area. A review of regional benthic resources is presented for context, followed by a summary of results from a site-specific benthic field survey.

Regional Characterization

Benthic habitat in the Massachusetts WEA is generally characterized by fine- and medium-grained sand (BOEM 2014). No state-managed artificial reefs have been documented within the MA WEA and other types of potentially sensitive or unique benthic habitat types, such as hard bottom, live bottom, and SAV, are unlikely to be present.

The benthic community in the region of the MA WEA includes amphipods and other crustaceans, polychaetes, bivalves, sand dollars, burrowing anemones, and sea cucumbers (BOEM 2014). Recent video surveys of benthic epifauna indicate that the common sand dollar (*Echinarachnius parma*) is abundant within the MA WEA; this species occurred in up to 75-100% of samples in the northern portion of the Vineyard Wind Lease Area (SMAST 2016). Hermit crabs, moon snails, sea stars, hydrozoans, bryozoans, and sponges were also targeted during this study, but were found to be very uncommon in the Vineyard Wind Lease Area.

Benthic infaunal assemblages within the lease area are likely dominated by polychaete worms, amphipod crustaceans, and bivalve mollusks. Infaunal sampling in areas south of Martha's Vineyard and Nantucket in September 2011 found that oligochaetes, polychaetes, and nemertean ribbon worms were the most widely distributed taxa (AECOM 2012). A total of 128 different families were identified from the samples with an average of 23 (SD ± 7) taxa per location. Organism density ranged from 12 to over 1,000 individuals per sample, with an average density of 599.5 (SD ± 712.1) organisms per 0.04 m^2. Nut clams, small bivalves in the family Nuculidae, were the most abundant taxon, and comprised over 24% of all organisms. Capitellid polychaetes and four-eyed amphipods (Ampeliscidae) were also abundant, comprising 16.0% and 9.0% of organisms, respectively.

Benthic Field Survey

A site-specific field survey of benthic resources, focused on four locations near the location of the proposed MET/ocean buoy(s), was conducted on November 10, 2016 (Figure 3.1.4). The field survey involved the collection of four benthic grab samples. Benthic macrofauna were sorted, identified, and enumerated from each sample. Full results of the benthic sample analysis are presented in Appendix E.

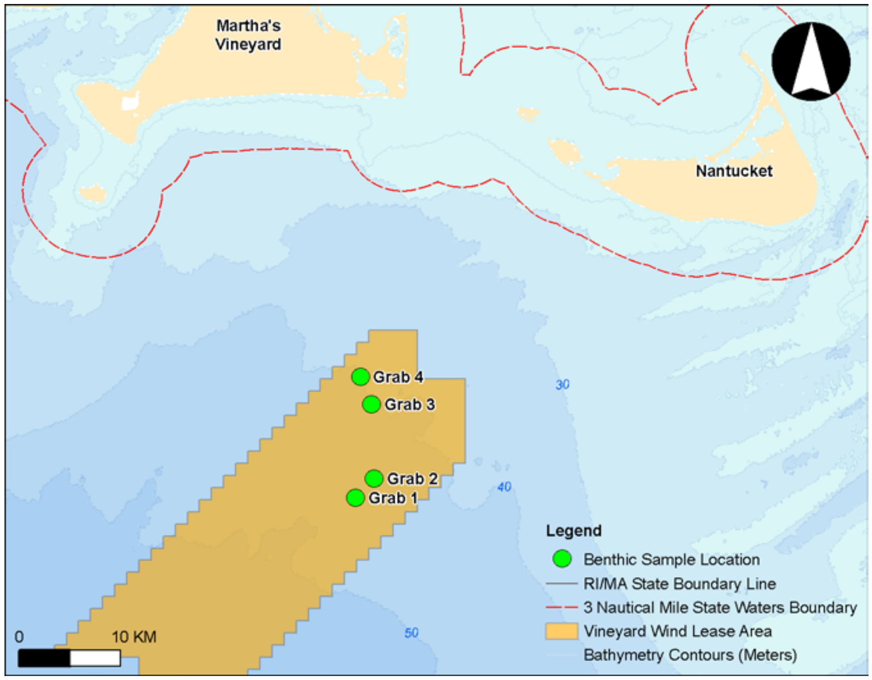


Figure 3.1.4. *Locations of the grab samples collected during the benthic field survey*

Overall, 32 taxa were identified from the four benthic grab samples (Table 3.1.4-1). Taxa richness per sample ranged from 6 (Grab 4) to 19 (Grab 1) taxa per grab, with a mean richness of 15 taxa per grab.

The mean macrofaunal density for the analyzed samples was 118,370 individuals/m^3 (Table 3.1.4-1). The highest macrofaunal density (234,409 individuals/m^3) was found in Grab 4, while macrofaunal density was lowest (48,227 individuals/m^3) in Grab 2. Of the four samples analyzed, three were characterized by densities of 90,000 individuals/m^3 or more.

The benthic macrofaunal assemblage in the analyzed samples consisted of polychaete worms, crustaceans, mollusks, echinoderms, and nemertean ribbon worms (Table 3.1.4-1). The most speciose taxonomic group was polychaete worms, which contributed approximately 44% of the taxa documented in the analyzed samples.

The taxonomic group with the highest density was polychaete worms, followed by nematode roundworms and crustaceans (Table 3.1.4-1). The most abundant macrofaunal taxa observed were the lumbrinerid polychaete *Scoletom*a sp. and a paraonid polychaete (Paraonidae). Some meiofaunal organisms such as nematode roundworms (Nematoda), were also observed at high abundances. Together, these taxa accounted for more than 50% of all individuals identified in this study.

Most of the benthic macrofaunal taxa observed in the site-specific benthic grab samples were small burrowing or tube-building taxa. The most commonly observed polychaete taxa, *Scoletoma sp*. and Paraonidae, are both typical of sandy shelf habitats (Pollock 1998). The most abundant crustaceans (four-eyed [ampeliscid] amphipods) are also shallow burrowers (Bousfield 1973, Weiss 1995). No shellfish of commercial importance were observed in the site-specific benthic grab samples.

Table 3.1.4-1. Summary of Key Statistics from the Site-specific Benthic Field Survey

Statistic	Value
Number of Samples	4
Mean Density per Cubic Meter (±1 SD)	118,370 ± 80,581
Mean Taxa Richness (±1 SD)	15 ± 6
Total Number of Taxa	32
Number of Taxa Observed by Taxonomic Group	
Polychaete worms	14
Crustaceans	9
Mollusks	4
Echinoderms	1
Nemertean ribbon worms	3
Nematode roundworms*	1
Percent of Total Abundance by Taxonomic Group	
Polychaete worms	47.7%
Crustaceans	23.6%
Mollusks	2.5%
Echinoderms	0.6%
Nemertean ribbon worms	1.8%
Nematode roundworms*	23.8%

*****Meiofaunal taxa (i.e., smaller than 500 µm)

Taxonomic Classification of Benthic Habitat in the SAP Area

Benthic habitat within the SAP Areas for the proposed MET/ocean buoy is typical of the WEA, consisting primarily of fine sands with various quantities of silt and shell hash (Appendix E**)**. Water depths range from 36.2 m to 50.4 m (118 ft. and 165 ft.). Sensitive or unique benthic habitats such as hard bottom, live bottom and SAV do not appear to be present. Bottom conditions at the two proposed MET/ocean buoy locations are described as predominantly flat and featureless, with sand ripples and depressions at centimeter level in scale (Appendix E).

Given the information available through prior characterizations and the site-specific benthic, geophysical, and geotechnical investigations conducted, benthic habitat in the SAP Area has been classified to the lowest achievable taxonomic level under the Coastal and Marine Ecological Classification System (CMECS), as presented below in Table 3.1.4-2.

Table 3.1.4-2. Benthic Habitat Classification

Biogeographic Setting
Realm: Temperate North Atlantic
Province: Cold Temperate Northwest Atlantic
Ecoregion: Virginian
Aquatic Setting
System: Marine
Subsystem: Marine Offshore
Tidal Zone: Subtidal Zone
Water Column Component
Water Column Layer: Marine Offshore Lower Water Column
Salinity Regime: Euhaline Water
Temperature Regime: Moderate Water (Seasonal Variation from Cold to Warm)
Geoform Component
Tectonic Setting: Passive Continental Margin
Physiographic Setting: Continental Shelf
Geoform Origin: Geologic
Level 2 Geoform: Sediment Wave Field
Substrate Component
Substrate Origin: Geologic Substrate
Substrate Class: Unconsolidated Mineral Substrate
Substrate Subclass: Fine Unconsolidated Substrate
Substrate Group: Sand
Co-occurring Element: Substrate Subclass: Shell Hash
Biotic Component
Biotic Setting: Benthic Biota
Biotic Class: Faunal Bed
Biotic Subclass: Soft Sediment Fauna
Biotic Group: Small Surface-Burrowing Fauna
Co-occurring Element: Biotic Group: Small Tube-Building Fauna
Co-occurring Element: Biotic Group: Mobile Crustaceans on Soft Sediments
Co-occurring Element: Biotic Group: Sand Dollar Bed

3.1.5 Fisheries and Essential Fish Habitat (585.611(b)(3-5))

The Massachusetts WEA is located in the northern Mid-Atlantic Bight (MAB) of the Northeast U.S. Shelf Ecosystem. This sub-region is also occasionally referred to as the Southern New England, as described by Stevenson et al. (2004). This region has a very diverse and abundant fish assemblage that is generally categorized according to life habits or preferred habitat associations, such as pelagic, demersal, and highly migratory. A list of major fish assemblages is presented in Table 3.1.5-1 and described in more detail below. Species with Essential Fish Habitat (EFH) designations in the WEA, as defined by the Magnuson- Stevens Fishery Conservation and Management Act, are also included in Table 3.1.5-1 and described below.

There are also important shellfish that may be found in the area of the WEA. These species are addressed in Section 3.1.4, Benthic Resources. The economic importance of managed fish and shellfish species in the Massachusetts WEA is further discussed in Section 3.1.9, Commercial and Recreational Fishing.

Table 3.1.5-1. Major Fish Species Potentially Occurring in the MA WEA

Species	EFH	Listing Status	Commercial / Recreational Importance	Habitat Association
Acadian redfish (*Sebastes fasciatus*)			●	Demersal
Alewife (*Alosa pseudoharengus*)		C/S	●	
American sand lance (*Ammodytes americanus*)			●	Demersal
Atlantic bluefin tuna *(Thunnus thynnus)*	●	S		Pelagic
Atlantic butterfish *(Peprilus triacanthus)*	●		●	Demersal / Pelagic
Atlantic cod *(Gadus morhua)*	●			Demersal
Atlantic mackerel *(Scomber scombrus)*	●			Pelagic
Atlantic sea herring *(Clupea harengus)*	●		●	Pelagic
Atlantic yellowfin tuna *(Thunnus albacares)*	●			Pelagic
Basking shark (*Cetorhinus maximus*)	●	C		Pelagic
Beardfish (*Polymixia lowei*)			●	Demersal
Black sea bass *(Centropristis striata)*	●		●	Demersal
Blue shark (*Prionace glauca)*	●			Pelagic
Bluefin tuna *(Thunnus thynnus)*			●	Pelagic
Bluefish *(Pomatomus saltatrix)*	●			Pelagic
Cobia *(Rachycentron canadum)*	●			Pelagic
Common Thresher shark *(Alopias vulpinus)*	●			Pelagic
Dusky shark *(Carcharhinus obscurus)*	●	S		Pelagic
Fourspot flounder (*Hippoglossina oblonga*)			●	Demersal
Golden Tilefish *(Lopholatilus chamaeleonticeps)*			●	Demersal
Haddock *(Melanogrammus aeglefinus)*	●		●	Demersal
King mackerel *(Scomberomorus cavalla)*	●			Pelagic
Little skate *(Leucoraja erinacea)*			●	Demersal
Monkfish *(Lophius americanus)*	●		●	Demersal
Northern sand lance (*Ammodytes dubius*)			●	Demersal
Northern sea robim *(Prionotus carolinus)*			●	Demersal
Ocean pout *(Macrozoarces americanus)*	●			Demersal
Pollock *(Pollachius pollachius)*			●	Demersal
Red hake *(Urophycis chuss)*	●			Demersal
Round herring (*Etrumeus teres*)			●	Pelagic
Sandbar shark *(Carcharhinus plumbeus)*	●			Pelagic
Scup *(Stenotomus chrysops)*	●		●	Demersal/ Pelagic
Shortfin mako *(Isurus oxyrinchus)*	●			Pelagic
Shortnose greeneye (*Chlorophthalmus agassizi*)			●	Demersal
Silver hake (*Merluccius bilinearis*)			●	Demersal
Spanish mackerel *(Scomberomorus maculatus)*	●			Pelagic
Spiny dogfish *(Squalus acanthias)*	●		●	Demersal

Species	EFH	Listing Status	Commercial / Recreational Importance	Habitat Association
Striped bass *(Morone saxatilis)*			●	Pelagic
Summer flounder *(Paralichthys dentatus)*	●		●	Demersal
Swordfish *(Xiphias gladius)*			●	Pelagic
Tiger shark (*Galeocerdo cuvier)*	●			Pelagic
White hake *(Urophycis tenuis)*			●	Demersal
Whiting *(Merluccius bilinearis)*	●			Demersal
Windowpane flounder *(Scopthalmus aquosus)*	●			Demersal
Winter flounder *(Pseudopleuronectes americanus)*	●		●	Demersal
Winter skate *(Leucoraja ocellata)*			●	Demersal
Witch flounder *(Glyptocephalus cynoglossus)*	●		●	Demersal
Yellowtail flounder *(limanda ferruginea)*	●		●	Demersal

*C= candidate, S= species of concern

Pelagic Fishes

Pelagic species spend most of their lives swimming in the water column, rather than occurring on or near the bottom. Many coastal pelagic species rely on coastal wetlands, seagrass habitats, and estuaries to provide habitat for specific life stages and many of these species migrate north and south along the Atlantic Coast during some periods of the year. In general, these fish use the highly productive coastal waters within the Atlantic region during the summer months and migrate to deeper and/or more distant waters during the rest of the year. Important pelagic finfish in the area of the WEA, include forage species, such as Atlantic herring (*Clupea harengus*), and predatory fish, such as Atlantic bluefin tuna (*Thunnus thynnus*), yellowfin tuna (*Thunnus albacares*), king mackerel (*Scomberomorus maculates*), and whiting (*Merluccius bilinearis*).

Demersal Fishes

Demersal fish (groundfish) are those fish that spend at least a portion of their life cycle in association with the ocean bottom. Demersal fish are often found in mixed species aggregations that differ depending upon the specific area and time of year. Many demersal fish species have pelagic eggs or larvae that are sometimes carried long distances by oceanic surface currents. The WEA supports both the intermediate and shallow demersal finfish assemblages defined by Overholtz and Tyler (1985). Many of the fish species in these assemblages are important because of their value in the commercial and/or recreational fisheries. Important demersal fish in the area include winter flounder (*Pseudopleuronectes americanus*), yellowtail flounder (*Limanda ferruginea*), and monkfish (*Lophius americanus*).

The NMFS NEFSC has been conducting fishery- independent Autumn Bottom Trawl Surveys annually since 1963. Two metrics derived from this survey, total biomass and species richness, have been used to show the relative distribution of fish in the area of the WEA relative to surrounding locations. Total biomass of fish is low across the WEA; however, species richness appears relatively high in the vicinity of the WEA (BOEM 2014).

Highly Migratory Fishes

Highly migratory fish often migrate from southern portions of the South Atlantic to as far north as the Gulf of Maine. Examples of these species include Atlantic bluefin tuna (*Thunnus thynnus*) and yellowfin tuna (*Thunnus albacares*). Other than some tuna species which exhibit schooling behavior, many of the highly migratory species occur either singly or in pairs.

Threatened and Endangered Fish

There are three fish species that are federally listed as endangered or endangered that may occur off the mid-Atlantic coast, including the shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), and Atlantic salmon (*Salmo salar*) (Table 3.1.5-2).

Additional species that have been proposed for endangered status and not deemed candidates—or are currently candidates for listing and the status determination has not been made yet; are known as Federal "species of concern" and are included in Table 3.1.5-2.

Table 3.1.5-2. List of Threatened and Endangered Species and Species of Special Concern

Species (Scientific Name)	ESA Status
Atlantic salmon (*Salmo salar)*	Endangered
Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered
Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)	Endangered/ Threatened
Atlantic Bluefin tuna (*Thunnus thynnus*)	Species of concern
Atlantic Halibut (*Hippoglossus hippoglossus*)	Species of concern
Atlantic wolfish (*Anarhichas lupus*)	Species of concern
Dusky shark (*Carcharhinus obscurus*)	Species of concern
Porbeagle shark (*Lamna nasus*)	Species of concern
Rainbow smelt (*Osmerus mordax*)	Species of concern
Sand tiger shark (*Carcharias taurus*)	Species of concern
Thorny skate (*Amblyraja radiata*)	Species of concern
Alewife (*Alosa pseudoharengu*s)	Candidate species/ species of concern
Blueback herring (*Alosa aestivalis*)	Candidate species/ species of concern
Cusk (*Brosme brosme*)	Candidate species/ species of concern
American eel (*Anguilla rostrata*)	Candidate species
Basking shark (*Cetorhinus maximus*)	Candidate species
Great hammerhead shark (*Sphyrna mokarran*)	Candidate species
Scalloped hammerhead shark (*Sphyrna lewini*)	Candidate species

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

The Atlantic sturgeon is an anadromous species that resides for much of its life in estuarine and marine waters throughout the Atlantic Coast, but ascends coastal rivers in spring to spawn in flowing freshwater. Sturgeon eggs are adhesive and attach to gravel or other hard substrata. Larvae develop as they move downstream to the estuarine portion of the spawning river, where they reside as juveniles for years. Subadults will move into coastal ocean waters where they may undergo extensive movements usually confined to shelly or gravelly bottoms in 10 to 50 m (33 to 164 ft.) water depths (Dunton et al., 2010).

Atlantic sturgeon distribution varies by season; they are primarily found in shallow coastal waters (bottom depth <20 m [<66 ft.]) during the summer months (May to September) and move to deeper waters (20-50 m [66-165 ft.]) in winter and early spring (December to March) (Dunton et al., 2010).

Primary threats to Atlantic sturgeon include bycatch in trawl and gillnet fisheries, habitat degradation and loss, ship strikes, and general depletion from historical fishing. A status review for Atlantic sturgeon indicated that all five distinct population segments (DPSs) occur in the vicinity of the Massachusetts WEA (NOAA 2016a; BOEM 2014). In Massachusetts waters, Atlantic sturgeon have been captured in offshore trawl and gillnet fisheries, but this species rarely seen in State or Federal fishery-independent surveys (BOEM 2014).

Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is an anadromous species found in larger rivers and estuaries of the North America eastern seaboard from the St. Johns River in Florida to the St. Johns River in Canada. In the northern portion of its range, shortnose sturgeon are found in the Chesapeake Bay system; Delaware River; the Hudson River; the Connecticut River; the lower Merrimack River; and the Kennebec River to the St. John River in New Brunswick, Canada. Shortnose sturgeon occur primarily in fresh and estuarine waters and occasionally enter the coastal ocean. Adults ascend rivers to spawn from February to April; eggs are deposited over hard bottom, in shallow, fast-moving water (Dadswell et al., 1984). Because of their preference for fresh and estuarine waters, shortnose sturgeon are unlikely to be found in the vicinity of the MA WEA.

The shortnose sturgeon was listed as endangered in 1967 because the U.S. Fish and Wildlife Service (USFWS) concluded that the fish had been eliminated from the rivers in its historic range (except the Hudson River) and was in danger of extinction because of pollution, loss of access to spawning habitats, and direct and incidental overfishing in the commercial fishery for Atlantic sturgeon (NMFS 2010a; NOAA 2015). Distinct Population Segments (DPS) are currently identified in North Carolina, South Carolina, Georgia, and northern Florida river systems (NOAA 2015).

Atlantic Salmon (*Salmo salar*)

Atlantic salmon is an anadromous species that historically ranged from northern Quebec southeast to Newfoundland and southwest to Long Island Sound. The Gulf of Maine Distinct Population Segment (DPS) of the Atlantic salmon that spawns within eight coastal watersheds within Maine is federally listed as endangered. In 2009 the DPS was expanded to include all areas of the Gulf of Maine between the Androscoggin River and the Dennys River (NOAA 2016b).

The life history of Atlantic salmon consists of spawning and juvenile rearing in freshwater rivers to extensive feeding migrations in the open ocean. Adult Atlantic salmon ascend the rivers of New England in the spring through fall to spawn. Suitable spawning habitat consists of gravel or rubble in areas of moving water Juvenile salmon remain in the rivers for 1-3 years before migrating to the ocean. The adults will undertake long marine migrations between the mouths of U.S. rivers and the northwest Atlantic Ocean, where they are widely distributed seasonally over much of the region. Typically, most Atlantic salmon spend two winters in the ocean before returning to freshwater to spawn (NOAA 2016b).

It is possible that adult Atlantic salmon may occur off the Massachusetts coast while migrating to rivers to spawn. However, only certain Gulf of Main populations are listed as endangered, and Gulf of Maine salmon are unlikely to be encountered south of Cape Cod (BOEM 2014).

Commercially and Recreationally-Important Fish

Many of the fish species found off the Massachusetts coast are important due to their value as commercial and/or recreational fisheries. U.S. fisheries landings data from 2015 indicate that the following species were the top valued commercial finfish in Massachusetts: haddock, goosefish, Atlantic herring, winter flounder, silver hake, Atlantic cod, Pollock, redfish, bluefin tuna, and white hake. Massachusetts recreational fishery landings from 2015 were dominated by Atlantic cod, striped bass, Atlantic mackerel, Pollock, and bluefish (NMFS 2017).

Fishing effort within the Massachusetts WEA varies seasonally and is concentrated in the central and western regions (BOEM 2014). Peak vessel trips typically occur from May to September (AIS 2017); however, vessels likely cross the WEA in transit between scallop fishing grounds on George's Bank and the major scallop port of New Bedford MA (BOEM 2014)

A detailed description of fishing activities and the economic value of fisheries is provided in Section 3.1.9, Commercial and Recreational Fisheries.

Essential Fish Habitat

The Magnuson-Stevens Act requires Federal agencies to consult on activities that may adversely affect EFH designated in fishery management plans. Additionally, fishery management councils identify habitat areas of particular concern (HAPCs) within fishery management plans. HAPCs are discrete subsets of EFH that provide extremely important ecological functions or are especially vulnerable to degradation. There is no HAPC identified for any listed finfish species within the Massachusetts WEA.

EFH has been designated for the following species for one or more life stages near the MA WEA (Table 3.1.5-3.

Table 3.1.5-3. EFH Designated Species in MA WEA

Species	Eggs	Larvae	Juveniles	Adults
Atlantic butterfish *(Peprilus triacanthus)*		●	●	●
Atlantic cod *(Gadus morhua)*	●	●	●	●
Atlantic mackerel *(Scomber scombrus)*	●	●		
Atlantic sea herring *(Clupea harengus)*		●	●	●
Basking shark (*Cetorhinus maximus*)			●	●
Black sea bass *(Centropristis striata)*			●	●
Blue shark (*Prionace glauca)*			●	●
Bluefin tuna *(Thunnus thynnus)*			●	●
Bluefish *(Pomatomus saltatrix)*			●	●
Cobia *(Rachycentron canadum)*	●	●	●	●
Common thresher shark *(Alopias vulpinus)*		●	●	●
Dusky shark *(Carcharhinus obscurus)*			●	

Species	Eggs	Larvae	Juveniles	Adults
Haddock *(Melanogrammus aeglefinus)*	●	●		●
King mackerel *(Scomberomorus cavalla)*	●	●	●	●
Long finned squid *(Loligo pealeii)*			●	●
Monkfish *(Lophius americanus)*	●	●	●	●
Ocean pout *(Macrozoarces americanus)*	●	●	●	●
Ocean quahog *(Artica islandica)*			●	●
Red hake *(Urophycis chuss)*	●	●	●	●
Redfish *(Sebastes fasciatus)*				
Sandbar shark *(Carcharhinus plumbeus)*			●	●
Scup *(Stenotomus chrysops)*			●	●
Short finned squid *(Illex illecebrosus)*				
Shortfin mako shark *(Isurus oxyrinchus)*		●	●	●
Spanish mackerel *(Scomberomorus maculatus)*	●	●	●	●
Spiny dogfish *(Squalus acanthias)*			●	●
Summer flounder *(Paralichthys dentatus)*	●	●		●
Surf clam *(Spisula solidissima)*				●
Tiger shark (*Galeocerdo cuvieri*)			●	
Whiting *(Merluccius bilinearis)*	●	●	●	●
Windowpane flounder *(Scophthalmus aquosus)*	●	●	●	●
Winter flounder *(Pseudopleuronectes americanus)*	●	●	●	●
Witch flounder *(Glyptocephalus cynoglossus)*	●	●		
Yellowfin tuna (*Thunnus albacares*)			●	●
Yellowtail flounder *(Limanda ferruginea)*	●	●	●	●

3.1.6 Marine Mammals and Sea Turtles (585.611(b)(3-5))

A total of 38 marine mammal species are known to occur in the Northwestern Atlantic (OCS) (BOEM 2014). All of these species are protected under the Marine Mammal Protection Act (MMPA), and 5 are listed as endangered under the Endangered Species Act (ESA). A total of 5 sea turtles could occur in Northwestern Atlantic OCS waters, all of which are protected under the ESA. The following subsections describe these species.

Marine Mammals

Many of the marine mammal species that inhabit the Northwestern Atlantic are not likely to be found in the Lease Area, as they either do not commonly occur in this region of the Atlantic (blue whale, Atlantic spotted dolphin, white-beaked dolphin, beaked whales, hooded seal), or commonly occur only further offshore in shelf edge/slope habitats (Risso's dolphin) (BOEM 2014). Harp seals are considered annual vagrants in southern Massachusetts waters, and this region is the extralimital extent of their range (BOEM 2014, NOAA 2016c).

The marine mammal species that are considered common in OCS and/or coastal waters offshore of Massachusetts (BOEM 2014) include:

- North Atlantic right whale
- fin whale
- minke whale
- humpback whale
- sperm whale
- long-finned pilot whale
- Atlantic white-sided dolphin
- short-beaked common dolphin
- bottlenose dolphin
- harbor porpoise
- harbor seal
- gray sea

Of the 12 species described above, 4 are baleen whales, 6 are toothed whales, and 2 are seals. All ESA-listed species known to be present in the northwestern Atlantic OCS are included, except the blue whale and sei whale. These species are not classified as commonly occurring in the region, and are unlikely to be found within the relatively shallow waters of the Lease Area, and so were excluded from further analysis (BOEM 2014). Though sperm whales also generally prefer deeper waters than are found within the Lease Area, this species has been included as it is common within the Western North Atlantic, and has been sighted with increasing frequency in recent years. The following table summarizes the status and distribution of the 12 species listed above.

Table 3.1.6-1. Marine Mammals Likely to Occur

Species	Status[1]	General Occurrence in North Atlantic	Typical Habitat			Average Density in SAP Area and Adjacent Waters (#/10 km grid square)[2]	Best Abundance Estimate[3]
			Coastal	Shelf	Slope/ Deep		
Order Cetacea							
Family Balaenidae							
North Atlantic right whale (*Eubalaena glacialis*)	E/D	Common	●	●	●	0.323	476
Family Balaenopteridae							
Humpback whale (*Megaptera novaeangliae*)		Common	●	●	●	0.188	823
Fin whale (*Balaenoptera physalus*)	E/D	Common	●	●	●	0.356	1,618
Minke whale (*Balaenoptera acutorostrata*)		Common	●	●	●	0.109	20,741
Family Delphinidae							
Long-finned Pilot Whale (*Globicephala melas*)[4]		Common		●	●	1.355	27,151
Short-beaked common dolphin (*Delphinus delphis*)		Common		●	●	6.429	173,486

Species	Status[1]	General Occurrence in North Atlantic	Typical Habitat			Average Density in SAP Area and Adjacent Waters (#/10 km grid square)[2]	Best Abundance Estimate[3]
			Coastal	Shelf	Slope/ Deep		
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)		Common		●	●	6.076	48,819
Bottlenose dolphin (*Tursiops truncatus*)		Common	●	●	●	1.991	77,532
Sperm whale (*Physeter macrocephalus*)	E/D	Common		●	●	0.015	2,288
Harbor porpoise (*Phocoena phocoena*)		Common	●	●		8.784	79,833
Order Carnivora							
Family Phocidae							
Harbor seal (*Phoca vitulina*)		Common	●	●		9.743	75,834
Gray seal (*Halichoerus grypus*)		Common	●	●		14.116	331,000

Source of Status, General Occurrence in North Atlantic, and Typical Habitat: BOEM EA 2014.
[1]Status: E/D – Endangered (ESA)/Depleted (MMPA)
[2]Average Density: Average of the monthly data provided in MDAT 2016 and Roberts et al. 2016 (Order Cetacea), except for species which only have annual data (long-finned pilot whale); average of the seasonal data provided in Navy 2007 (Order Carnivora).
[3]Best Abundance Estimate: Waring et al. 2016.
[4] Density and abundance estimates for long-finned pilot whales are combined estimates including both long-finned pilot whales and short-finned pilot whales.

For the purposes of this document, the marine mammals addressed in detail are the species in Table 3.1.6-1 that commonly occur in and around the Lease Area, typically utilize coastal and shelf habitats, and are protected under the MMPA, including the three large whale species (North Atlantic right whale, fin whale, and sperm whale). The sea turtles addressed are those commonly occurring in the Western Atlantic, which are also protected under the ESA (as shown in Table 3.1.6-2). For detailed information on other species not addressed herein, refer to the EA (2014) and the Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf (MMS 2007).

Section 3.1.6.2 contains detailed information about the abundance, distribution, and habitat use patterns for the North Atlantic right whale, fin whale, and sperm whale.

Sea Turtles

Of the 5 species of sea turtles likely to occur in the Northwest Atlantic OCS, only 4 species are likely to be encountered in the Massachusetts WEA (Table 3.1.6-2). These species include the loggerhead sea turtle, green sea turtle, Kemp’s ridley sea turtle, and leatherback sea turtle. The hawksbill sea turtle is not likely to occur in the viscinity of the project area and therefore is not addressed further in this document.

Table 3.1.6-2. Sea Turtles Likely to Occur

Order Testudines (turtles)	Relative Occurrence in WEAs[1]	ESA Status	Max Density in WEA and Adjacent Waters (SPUE)[3]	Best Abundance Estimate
Family Cheloniidae (hardshell sea turtles)				
Loggerhead sea turtle (*Caretta caretta*)	Common	Threatened[4]	6.19	
Green sea turtle (*Chelonia mydas*)	Unknown	Threatened[2]	0	
Kemp's Ridley sea turtle (*Lepidochelys kempii*)	Rare	Endangered	-	
Family Dermochelyidae (leatherback sea turtle)				
Leatherback sea turtle (*Dermochelys coriacea*)	Common	Endangered	29.14	

[1]The occurrence category is based upon research conducted in support of the Rhode Island Ocean Special Area Management Plan and summarized in the BOEM EA (2014).
[2]North Atlantic Distinct Population Segment (DPS)
[3]SPUE (sightings per unit effort) values represent the number of animals sighted per 1,000 km of survey track (BOEM EA, 2014). For a detailed description of SPUE values refer to the BOEM EA, page 130.
[4]Northwest Atlantic Ocean DPS

Section 3.1.6.3 contains detailed information about the abundance, distribution, and habitat use patterns for the loggerhead sea turtle, leatherback sea turtle, Kemp's Ridley sea turtle, and green sea turtle.

3.1.6.1 Data Sources

Abundance, distribution, and habitat use patterns for the species of concern was derived primarily from the following sources, and data specific to the Lease Area were used, where available.

Northeast Large Pelagic Survey

The Northeast Large Pelagic Survey collaborative aerial and acoustic surveys for large whales and sea turtles were conducted for the Massachusetts Clean Energy Center (MassCEC) and Bureau of Ocean Energy Management (BOEM) by the Large Pelagic Survey Collaborative (comprised of the New England Aquarium, Cornell University's Bioacoustics Research Program, the University of Rhode Island and the Center for Coastal Studies) (Kraus et al. 2016). This study was designed to provide a comprehensive baseline characterization of the abundance, distribution, and temporal occurrence of marine mammals, with a focus on large endangered whales and sea turtles, in the Rhode Island/Massachusetts (RIMA) and MA WEAs and surrounding waters. Information was collected using line-transect aerial surveys and passive acoustic monitoring from October 2011 to June 2015 in the MA WEA, and from December 2012 to June 2015 in the RIMA WEA. A total of 76 aerial surveys were conducted, and Marine Autonomous Recording Units were deployed for a total of 1,010 calendar days, during the study period. For survey methodologies and details please refer to: https://www.boem.gov/RI-MA-Whales-Turtles/.

Vineyard Wind 2016 G&G Surveys

Vineyard Wind conducted preliminary geotechnical and geophysical (G&G) surveys within the boundaries of the Lease Area in the fall of 2016. Activities occurred onboard the Research Vessel (RV) Shearwater and the RV Ocean Researcher over a total of 11 survey days (excluding weather). Protected species observers (PSOs) monitored the areas surrounding the survey boats for marine mammals and sea turtles using visual observation and passive acoustic monitoring.

Marine Mammal Stock Assessment Reports

Under the 1994 amendments of the Marine Mammal Protection Act (MMPA), the USFWS and the NMFS are required to generate stock assessment reports for all marine mammal stocks in waters within the U.S. Exclusive Economic Zone (Waring et al. 2016, Waring et al. 2015). These Marine Mammal Stock Assessment reports are updated annually for all strategic stocks, and revisited every three years for all other stocks. These publications provide general information about species habitat use patterns, population size, and estimates of annual human-caused serious injury and mortality.

Northeast Ocean Data Portal

The Marine-Life Data and Analysis Team, in collaboration with the Northeast Regional Planning Body and expert work groups composed of over 80 regional scientists and managers, produced a series of data products presented on the Northeast Ocean Data Portal (Roberts et al. 2016, MDAT 2016). This resource provides modeled estimates of the predicted distribution and abundance of 151 different marine mammal, bird, and fish species in the Western North Atlantic.

Rhode Island Ocean SAMP Surveys

The estimated occurrence of various turtles in and near the SAP areas (Table 3.1.6-2) was obtained from an analysis of existing data collected for the Rhode Island Ocean Special Area Management Plan (Kenney and Vigness-Raposa, 2010).

3.1.6.2 Marine Mammal Species Profiles

North Atlantic Right Whale (*Eubalaena glacialis*)

North Atlantic right whales (NARW) are among the rarest of all marine mammal species in the Atlantic Ocean. They average approximately 15.25 meters (50 feet) in length (NOAA 2016d). They have stocky, black bodies with no dorsal fin, and bumpy, coarse patches of skin on their heads called callosities. NARW feed mostly on zooplankton and copepods belonging to the *Calanus* and *Pseudocalanus* genera (Waring et al. 2016). Right whales are slow moving grazers that feed on dense concentrations of prey at or below the water’s surface, as well as at depth (NOAA 2016d). Research suggests that NARW must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall NARW habitats (Kenney et al. 1986, Kenney et al. 1995). Historically, the population suffered severely from commercial overharvesting and has more recently been threatened by incidental fishery entanglement and ship strikes. The NARW is a strategic stock and is listed as endangered under the ESA.

These baleen whales have two separate stocks: the eastern and western Atlantic stocks. The NARW occurring in U.S. waters belong to the western Atlantic stock. The western NARW population ranges primarily from calving grounds in coastal waters of the southeastern United States to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian

Shelf, and Gulf of St. Lawrence (Waring et al. 2016). The size of this stock is considered to be extremely low relative to its Optimum Sustainable Population (OSP) in the U.S. Atlantic Exclusive Economic Zone (EEZ). In the Western North Atlantic, right whales are subject to relatively high levels of injury and mortality from collisions with vessels and entanglement in fishing gear (Knowlton and Kraus 2001, Kraus et al. 2005). The minimum rate of annual human-caused mortality and serious injury to right whales averaged 4.3 per year for the period of 2009 through 2013 (Waring et al. 2016). The best estimate of the NARW population size is a minimum of 476 individuals based on photo-ID recapture data from 2011; however, recent population estimates of 526 individuals were published in the NARW annual report card (Waring et al. 2016; Pettis and Hamilton 2015).

The NARW is a strongly migratory species which travels from high-latitude feeding waters to low-latitude calving and breeding grounds. These whales undertake a well-defined, strongly seasonal migration from their northeast feeding grounds (generally spring, summer and fall habitats) south along the U.S. east coast to their sole known calving and wintering grounds in the waters of the southeastern U.S. (Kenney and Vigness-Raposa 2010). NARWs are usually observed in groups of less than 12 individuals, and most often as single individuals or pairs. Larger groups may be observed in feeding or breeding areas (Jefferson et al. 2008). Surveys have demonstrated the existence of seven areas where Western North Atlantic right whales congregate seasonally: the coastal waters of the southeastern United States; the Great South Channel; Jordan Basin; Georges Basin along the northeastern edge of Georges Bank; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Roseway Basin on the Scotian Shelf (Waring et al. 2016). NMFS has designated two critical habitat areas for the NARW: the Gulf of Maine/Georges Bank region, and the Southeast calving grounds from North Carolina to Florida. Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the North Atlantic right whale (Brown et al. 2009).

Kraus et al. (2016) sighted right whales during winter and spring aerial surveys in the MA WEA. Though right whales were visually observed within the Lease Area only in spring, NARW were detected acoustically within this area during all months of the year. NARW exhibited notable seasonal variability in acoustic presence, with maximum occurrence in the Lease Area in winter and spring (January-March), and minimum occurrence in summer (July, August, and September). A total of 77 unique

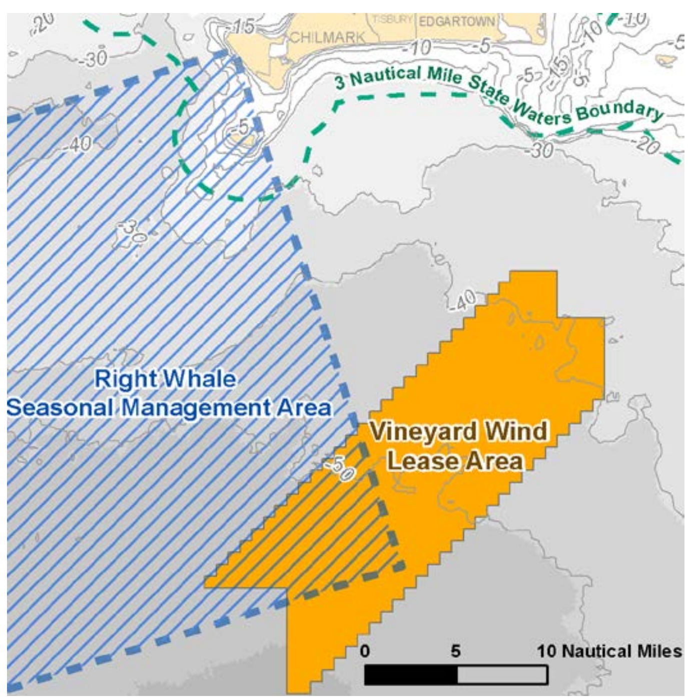


Figure 3.1.6.2 Right Whale Seasonal Management Area

individual NARW were observed in the study area over the duration of the Northeast Large Pelagic Survey (October 2011-June 2015). This species was not detected visually or acoustically in the Lease Area during the 2016 G&G surveys for the Project (unpublished data). Roberts et al. (2016) and MDAT (2016) indicate that the highest density of NARW in the SAP Area and adjacent waters occurs in April at 21.478 individuals per 10 km (5.4 nmi) grid square.

In order to protect this species, Seasonal Management Areas (SMAs) for reducing ship strikes of NARWs have been designated in the U.S. and Canada. All vessels greater than 19.8 meters (65 feet) in overall length must operate at speeds of 10 knots or less within these areas during seasonal time periods. The closest SMA overlaps with the southern portion of the Lease Area (Figure 3.1.6.2) and becomes active between November 1 and April 30 each year.

Fin Whale (*Balaenoptera physalus*)

Fin whales are the second-largest species of baleen whale, with a maximum length of about 75 feet in the Northern Hemisphere (NOAA 2016e). These whales have a sleek, streamlined body with a V-shaped head making them fast swimmers. This species has a distinctive coloration pattern: the dorsal and lateral sides of the body are black or dark brownish gray and the ventral surface is white. Fin whales feed on krill, small schooling fish (e.g. herring, capelin and sand lance) and squid by lunging into schools of prey with their mouths open (Kenney and Vigness-Raposa 2010). They occur year-round in a wide range of latitudes and longitudes, but the density of individuals in any one area changes seasonally NOAA 2016e). Fin whales are the most commonly sighted large whales in continental shelf waters from the mid-Atlantic coast of the United States to Nova Scotia (Sergeant 1977, Sutcliffe and Brodie 1977, CeTAP 1982, Hain et al. 1992). The fin whale is listed as an endangered species under the ESA.

Fin whales off the eastern United States, Nova Scotia and the southeastern coast of Newfoundland are believed to constitute a single stock under the present International Whaling Commission (IWC) scheme (Donovan 1991), which has been called the Western North Atlantic stock. The best abundance estimate available for the Western North Atlantic fin whale stock is 1,618 individuals (Waring et al. 2016). The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown, but the North Atlantic population is listed as a strategic stock under the MMPA. Like most other whale species along the U.S. east coast, ship strikes and fisheries entanglements are perennial causes of serious injury and mortality. For the period 2009 through 2013, the minimum annual rate of human-caused mortality and serious injury to fin whales was 3.55 per year (Waring et al. 2016).

The fin whales' range in the Western North Atlantic extends from the Gulf of Mexico and Caribbean Sea, to the southeastern coast of Newfoundland in the north (Waring et al. 2016). Fin whales are common in waters of the U. S. Atlantic EEZ, principally from Cape Hatteras northward. While fin whales typically feed in the Gulf of Maine and the waters surrounding New England, mating and calving (and general wintering) areas are largely unknown (Hain et al. 1992, Waring et al. 2016). It is likely that fin whales occurring in the U.S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions. However, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support (Waring et al. 2016). Based on an analysis of neonate stranding data, Hain et al. (1992) suggested that calving takes place during October to January in latitudes of the U.S. mid-Atlantic region. Fin whales are the dominant large cetacean species during all seasons from Cape Hatteras to Nova Scotia, having the largest standing stock, the largest food requirements, and therefore the largest influence on ecosystem processes of any cetacean species (Hain et al. 1992, Kenney et al. 1997). There are currently no critical habitat areas established for the fin whale.

Kraus et al. (2016) suggests that, compared to other baleen whale species, fin whales have a high multi-seasonal relative abundance in the MA and RIMA WEAs and surrounding areas. Fin whales were sighted in the Lease Area in spring and summer. This species was observed primarily in the offshore (southern) regions of the study area during spring, and found closer to shore (northern areas) during the summer months. Although fin whales were largely absent from visual surveys in the winter months, acoustic data indicate that this species is present in the study area during all months of the year. Acoustic detection data indicate a lack of seasonal trends in fin whale abundance; acoustic presence was lowest in the months of April-July, but overall monthly variation was minimal. As the detection range for fin whale vocalizations is in excess of 200 km (108 nmi), some detected signals may have originated from areas outside of the MA and RI WEAs (though the arrival patterns of many fin whale vocalizations indicate that received signals originated from within the study area). This species was not detected visually or acoustically in the Lease Area during the 2016 G&G surveys for the Project (unpublished data). Roberts et al. (2016) and MDAT (2016) indicate that the highest density of fin whales in the SAP Area and adjacent waters occurs in July and is estimated to be 0.465 individuals per 10 km (5.4 nmi) grid square.

Sperm Whale (*Physeter macrocephalus*)

The sperm whale is the largest of all toothed whales; males can reach 16 m (52 ft) in length and weigh over 45 tons (40,823 kg), and females can attain lengths of up to 11 m (36 ft) and weigh over 15 tons (13,607 kg) (Perrin et al. 2002). Sperm whales have extremely large heads, which account for 25-35% of the total length of the animal. This species tends to be uniformly dark gray in color, though lighter spots may be present on the ventral surface. Sperm whales frequently dive to depths of 400 m (1,300 ft) in search of their prey, which includes large squid, fishes, octopus, sharks, and skates (Perrin et al. 2002). This species can remain submerged for over an hour and reach depths as great as 1,000 m (3,280 ft). Sperm whales have a worldwide distribution in deep water and range from the equator to the edges of the polar ice packs (Whitehead 2002). Sperm whales form stable social groups and exhibit a geographic social structure; females and juveniles form mixed groups and primarily reside in tropical and subtropical waters, whereas males are more solitary and wide-ranging and are found at higher latitudes (Whitehead 2002; Whitehead 2003). This species is listed as endangered under the ESA.

The International Whaling Commission recognizes only one stock of sperm whales for the North Atlantic, and Reeves and Whitehead (1997) and Dufault et al. (1999) suggest that sperm whale populations lack clear geographic structure. Current threats to the sperm whale population include ship strikes, exposure to anthropogenic noise and toxic pollutants, and entanglement in fishing gear (though entanglement risk for sperm whales is relatively low compared to other, more coastal whale species) (NOAA 2016f, Waring et al. 2015). Though there is currently no reliable estimate of total sperm whale abundance in the entire Western

North Atlantic, the most recent population estimate for this region is 2,288 individuals (Waring et al. 2015). This estimate was generated from the sum of surveys conducted in 2011, and is likely an underestimate of total abundance, as these surveys were not corrected for sperm whale dive-time. Total annual estimated average human caused mortality to this stock during the period from 2008 to 2012 was 0.8 sperm whales (Waring et al. 2015). The status of the North Atlantic sperm whale stock relative to OSP is unknown, but this stock is classified as depleted and strategic under the MMPA.

Sperm whales mainly reside in deep-water habitats on the outer continental shelf, along the shelf edge, and in mid-ocean regions (NMFS 2010b). However, this species has been observed in relatively high numbers in the shallow continental shelf areas of southern New England (Scott and Sadove 1997). Sperm whale migratory patterns are not well defined, and no obvious migration patterns have been observed in certain tropical and temperate areas. However, general tends suggest that most populations move poleward during summer months (Waring et al. 2015). In U.S. Atlantic EEZ waters, sperm whales appear to exhibit seasonal movement patterns (CeTAP 1982**,** Scott and Sadove 1997). During the winter, sperm whales are concentrated to the east and north of Cape Hatteras. This distribution shifts northward in spring, when sperm whales are most abundant in the central portion of the mid-Atlantic bight to the southern region of Georges Bank. In summer, this distribution continues to move northward, including the area east and north of Georges Bank and the continental shelf to the south of New England. In fall months, sperm whales are most abundant on the continental shelf to the south of New England and remain abundant along the continental shelf edge in the mid-Atlantic bight. There are no critical habitat areas designated for the sperm whale.

Kraus et al. (2016) suggests that sperm whales occur infrequently in the MA and RIMA WEAs and surrounding areas. Sperm whales were sighted during aerial surveys in the study area only during the summer and autumn, and were not detected acoustically. Sperm whales, traveling singly or in groups of 3 or 4, were observed three times in August and September of 2012, and once in June of 2015. Effort-weighted average sighting rates could not be calculated, as sperm whales were only observed on 4 occasions throughout the duration of the study (Autumn 2011 to Summer 2015). This species was not detected visually or acoustically in the Lease Area during the 2016 G&G surveys for the Project (unpublished data). Roberts et al. (2016) and MDAT (2016) indicate that the highest density of sperm whales in the SAP Area and adjacent waters occurs in July and is estimated to be 0.022 individuals per 10 km (5.4 nmi) grid square.

3.1.6.3 Sea Turtle Species Profiles

Loggerhead Sea Turtle (*Caretta caretta*)

Loggerhead sea turtles can reach 1 meter (3 feet) in length, have a reddish-brown, slightly heart shaped carapace, and feed primarily upon hard-shelled prey including whelks and conch (NOAA 2016g). This species has a circumpolar distribution, and inhabits continental shelves, bays, estuaries, and lagoons throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd 1988). Loggerheads occur in continental shelf waters of the Northwest Atlantic from Florida to Nova Scotia (NMFS and USFWS 2008), although their presence varies seasonally due to changes in water temperature (Shoop & Kenney 1992, Epperly et al. 1995a, Epperly et al. 1995b, Braun-McNeill et al. 2008). Loggerhead sea turtles in the Northwest Atlantic Ocean DPS are listed as threatened under the ESA.

The most recent regional abundance data for the loggerhead turtle was collected in 2010. The preliminary regional abundance was approximately 588,000 individuals based on only positive identifications of loggerhead sightings, and approximately 801,000 individuals based on positive identifications and a portion of unidentified turtles from the survey (NMFS NEFSC, 2011).

During spring and summer months, loggerhead turtles are abundant in coastal waters off New York and the Mid-Atlantic states, and a small number of individuals may reach as far north as New England. These turtles first appear in significant numbers in the waters around New England in early June, and can be found in this region throughout the summer (Morreale and Standora 1989). In late September through mid-October, Loggerhead turtles begin to migrate southward to coastal areas off the south Atlantic states, particularly from Cape Hatteras, North Carolina, to Florida (Morreale and Standora 1989; Musick et al. 1994). Nearly all loggerheads remaining in northern waters after the beginning of November are cold-stunned and were likely caught by rapidly declining water temperatures during their southward migration (Morreale and Standora 1989). During the winter, loggerhead turtles tend to aggregate in warmer waters along the western boundary of the Gulf Stream off Florida (Thompson 1988) or hibernate in bottom waters and soft sediments in channels and inlets along the Florida coast (Ogren and McVea 1981; Butler et al. 1987). In the winter and spring, loggerheads congregate off southern Florida before migrating northward to their summer feeding ranges (CeTAP 1982). There are 38 critical habitat areas designated for the Northwest Atlantic Ocean DPS of loggerhead sea turtles, including nearshore reproductive habitat, sargassum habitat, migratory corridors, breeding areas and wintering habitat. All critical habitat areas are located well to the south of the Vineyard Wind Lease Area.

Loggerheads were the second most commonly observed species of sea turtle in the MA and RIMA WEAs and surrounding waters during recent multi-year surveys and were sighted a total of 78 times over three years (Kraus et al. 2016). This species was detected within the Vineyard Wind Lease Area during the spring, summer, and autumn. Nearly all loggerhead observations occurred during the months of August and September. This species was not sighted in the Vineyard Wind Lease Area during the 2016 G&G surveys for the Project (unpublished data). Roberts et al. (2016) and MDAT (2016) indicate that the maximum sightings of loggerhead sea turtles per unit effort in the SAP Area and adjacent waters occurs in summer and is estimated to be 6.19 species per unit of effort (SPUE).

Green Sea Turtle (*Chelonia mydas*)

The green turtle is the largest hard-shelled sea turtle, and can reach over 1 meter (3 feet) in length (NOAA 2016h). This species has an oval carapace that is variable in color and can be green, brown, yellow, gray, or black (NOAA 2016h). Unique among sea turtles, the adult green turtle is exclusively herbivorous and eats seagrass and algae (NOAA 2016h). Green turtles are found worldwide, and are known to occur in temperate waters, though they are generally found in tropical and subtropical regions (NOAA 2016h, NMFS and USFWS 1991). Green turtles in waters along the eastern U.S. Atlantic coast belong to the North Atlantic DPS, which is listed as threatened under the ESA.

Due to the global distribution and widespread nesting areas of the green turtle, estimates of the total population of this species are unavailable. Green turtles in the North Atlantic DPS nest in small numbers in the U.S. Virgin Islands, Puerto Rico, Georgia, South Carolina, and North

Carolina, and in larger numbers in Florida (USFWS 2016). The Florida green turtle nesting aggregation is a regionally significant colony, and data indicate that over 5,000 females nested in 2010 (USFWS 2016).

In the Western North Atlantic, green turtles are found in inshore and nearshore waters from Texas to Massachusetts (NOAA 2016h). This species generally feeds in shallow lagoons, inlets, reefs, shoals, and bays that have abundant algae or sea grass (NMFS and USFWS 2007b). Females nest between June and September on mainland or island sandy beaches along the southeastern U.S. coast, and are not know to nest as far north as Massachusetts (BOEM 2014). Green sea turtles are rare in southern New England, and are generally only observed during summer months due to the low water temperatures in this region (CETAP 1982). No adult green turtles have been recorded in New England (BOEM 2014). The only designated critical habitat area for green sea turtles surrounds an island off the coast of Costa Rica, and is far to the south of the project area (NOAA 2016h).

There were no confirmed sightings of green turtles in the MA and RIMA WEAs and surrounding waters during recent multi-year surveys (Kraus et al. 2016). This species was not sighted in the Vineyard Wind Lease Area during the 2016 G&G surveys for the Project (unpublished data).

Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)

The Kemps ridley turtle has a nearly circular grayish-green carapace and is the smallest sea turtle in the world, reaching only 60-70 cm in length (24-28 inches). This species feeds primarily on swimming crabs, but will also consume fish, jellyfish, and mollusks (NOAA 2016i). Kemp's ridley turtles primarily reside in the nearshore neritic zone, and rarely venture into waters deeper than 50 meters (160 feet) (NOAA 2016i, Byles and Plotkin, 1994). The Kemp's Ridley turtle is listed as endangered under the ESA.

Kemp's ridley sea turtles exhibit unique nesting behavior observed in only one other sea turtle species; during events called "arribada" female turtles arrive onshore in very large, synchronous aggregations to nest (NOAA 2016i). This species nests almost exclusively in the Western Gulf of Mexico, primarily in the states of Tamaulipas and Veracruz, Mexico (BOEM 2014). Though extremely large arribadas occurred in the 1940s (as many as 42,000 Kemps ridley turtles were observed in one day in 1947), populations plummeted between the 1940s and the 1980s, reaching a low of fewer than 250 nesting females in 1985 (NOAA 2016i). Conservation efforts led to annual increases of approximately 15% in Kemps ridley breeding populations through 2009. However, recent data indicate a decrease in the number of Kemp's ridley nests since 2010 (NOAA 2016i). The most recent estimate of the Kemp's Ridley turtle population is 7,000 to 8,000 nesting females (NMFS and USFWS, 2007a). Though this species is female biased, there are likely several thousand additional males (NMFS and USFWS, 2007a).

The Kemp's ridley sea turtle is found most commonly along the eastern coast of North America, from the Gulf of Mexico to Nova Scotia (NOAA 2016i, BOEM 2014). After nesting and breeding, this species travels to foraging grounds in shallow coastal waters along the Atlantic seaboard, where they remain for the duration of the spring and summer (BOEM 2014). Kemp's ridley turtles begin leaving northern areas in mid-September, and most have departed for warmer southern waters by the beginning of November (Burke et al. 1989, Morreale and Standora 1989). Only juvenile Kemp's ridley turtles (2-5 years of age) have been reported in New England waters (BOEM 2014). There are no critical habitat areas designated for the Kemp's ridley sea turtle, though petitions to designate areas on the Texas coast and marine habitat in the Gulf of Mexico are currently being reviewed.

Kemp's Ridley turtles were observed rarely in the MA and RIMA WEAs and surrounding waters during recent multi-year surveys (Kraus et al. 2016). The only confirmed observations of this species were in vertical camera photographs, all six of which took place in August and September of 2012. This species was not sighted in the Vineyard Wind Lease Area during the 2016 G&G surveys for the Project (unpublished data).

Leatherback Sea Turtle (*Demochelys coriacea*)

Leatherbacks are the largest living turtles, reaching up to 2 meters (6.5 feet) in length, and are the only sea turtle that lacks a hard, bony shell (NOAA 2016j). The leatherback gets its name from its distinctive longitudinally-ridged carapace, which is composed of layers of oily connective tissue overlain on loosely interlocking dermal bones (NOAA 2016j). This species is the most wide-ranging of all sea turtles, and is found in tropical, subtropical, and cold-temperate waters (NMFS and USFWS 1992). Leatherbacks have evolved physiological and anatomical adaptations that allow them to survive in cold waters (Frair et al. 1972, Greer et al. 1973, NMFS and USFWS 1992), enabling them to range along the entire east coast of the U.S. (NMFS and USFWS 1992). Unlike most other sea turtles, which feed upon hard-shelled organisms, leatherbacks consume soft bodied prey including salps and jellyfish (NOAA 2016j). In the North Atlantic Ocean, leatherback turtles regularly occur in deep waters (100 m [>328 ft.]), but are also sighted in coastal areas of the U.S. continental shelf (NMFS and USFWS 1992). Leatherback turtles are listed as endangered under the ESA.

Leatherback turtles found along the eastern U.S. Atlantic coast belong to the Northwest Atlantic subpopulation. Nearly all leatherback nesting on continental United States shores occurs on the eastern coast of Florida (FFWCC 2017). Though the breeding population of Leatherback turtles in Florida remains small, and is likely less than 1000 individuals, the number of nests across the state of Florida has increased at a rate of approximately 10% per year since 1979 (Stewart et al. 2011). Though accurate information regarding the entire Atlantic Leatherback population is lacking (NOAA 2016j), estimates based on data from the seven nesting sites in this region range from 34,000 to 94,000 (NMFS and USFWS, 2007c; TEWG, 2007).

Leatherback sea turtles are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Morreale *et al.* 1994, Eckert 1999). Adult leatherbacks migrate extensively throughout the Atlantic basin in search of food, and may swim 6,000-12,000 km (up to ~7,400 mi) in a year (James et al. 2005). Following breeding and nesting in Florida and the tropical Caribbean, and aided by the northward flow of the Gulf Stream, leatherback turtles move northward beyond the shelf break in the spring. During summer months, leatherbacks move into fairly shallow coastal waters, apparently following their preferred jellyfish prey. In the fall, they move offshore and begin their southern migration to the winter breeding grounds (Payne et al. 1986). In southern New England, leatherback sea turtles are most commonly observed during summer and fall (Kenney

& Vigness-Raposa 2010). There are no critical habitat areas designated for the leatherback sea turtle along the U.S. Atlantic coast.

Leatherbacks were the most commonly observed species of sea turtle in the MA and RIMA WEAs and surrounding waters during recent multi-year surveys, and were observed on 151 occasions over three years (Kraus et al. 2016). This species was commonly sighted in summer and fall, infrequently observed in spring, and absent from the study area in winter. Leatherbacks were detected within the Vineyard Wind Lease Area only in summer and fall, and maximum occurrence of this species occurred in late summer. Loggerhead sightings were most highly concentrated south of Nantucket, to the west of the Vineyard Wind Lease Area. Two dead loggerhead turtles were observed during the 2016 G&G survey; however, it was determined by the on-site PSOs that the survey activities were not the cause of death. Roberts et al. (2016) and MDAT (2016) indicate that the maximum sightings of leatherback sea turtles per unit effort in the SAP Area and adjacent waters occurs in summer and is estimated to be 29.14 (SPUE).

3.1.7 Coastal and Marine Birds and Bats (585.611(b)(3-5))

Numerous species of birds are known to occur in the Massachusetts WEA, many of which are protected under the Migratory Bird Treaty Act of 1918 (MBTA) (16 U.S.C. 703–712). Three of these species are also protected under the ESA. Additionally, one species of bat has the potential to occur in waters of the Massachusetts WEA, which is also protected under the ESA. The following subsections describe these species.

In addition, the list below (Table 3.7.1-1) summarizes the species that may be found in the project area according to the IPaC (Information, Planning, and Conservation system; USFWS) report.

Table 3.1.7-1. Species Identified by the IPaC Database in the General Project Area.

Genus	Species	Common Name	Season(s)	
Sterna	*paradisaea*	Arctic Tern	At Sea:	Summer (June-Aug)
Fratercula	*arctica*	Atlantic Puffin	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Winter (Dec-Feb)
Melanitta	*nigra*	Black Scoter	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Winter (Dec-Feb)
Rissa	*tridactyla*	Black-legged Kittiwake	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Winter (Dec-Feb)
Chroicocephalus	*philadelphia*	Bonaparte's Gull	At Sea:	Winter (Dec-Feb)
Somateria	*mollissima*	Common Eider	At Sea:	Winter (Dec-Feb)
Gavia	*immer*	Common Loon	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Summer (June-Aug), Winter (Dec-Feb)
Uria	*aalge*	Common Murre	At Sea:	Spring (Mar-May), Winter (Dec-Feb)
Sterna	*hirundo*	Common Tern	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Summer (June-Aug)
Calonectris	*diomedea*	Cory's Shearwater	At Sea:	Spring (Mar-May), Fall (Sep-Nov), Summer (June-Aug)
Phalacrocorax	*auritus*	Double-crested Cormorant	At Sea:	Summer (June-Aug)

Genus	Species	Common Name	Season(s)	
Alle	*alle*	Dovekie	At Sea:	Fall (Sep-Nov), Winter (Dec-Feb)
Larus	*marinus*	Great Black-backed Gull	At Sea:	Spring (Mar-May), Fall (Sep-Nov), Winter (Dec-Feb), Summer (June-Aug)
Punus	*gravis*	Great Shearwater	At Sea:	Fall (Sep-Nov), Summer (June- Aug)
Larus	*argentatus*	Herring Gull	At Sea:	Spring (Mar-May), Fall (Sep-Nov), Winter (Dec-Feb), Summer (June-Aug)
Podiceps	*auritus*	Horned Grebe	At Sea:	Winter (Dec-Feb)
Limosa	*haemastica*	Hudsonian Godwit	At Sea:	Migrating
Larus	*atricilla*	Laughing Gull	At Sea:	Winter (Dec-Feb)
Oceanodroma	*leucorhoa*	Leach's Storm-petrel	At Sea:	Fall (Sep-Nov)
Sterna	*antillarum*	Least Tern	At Sea:	Summer (June-Aug)
Clangula	*hyemalis*	Long-tailed Duck	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Winter (Dec-Feb)
Punus	*punus*	Manx Shearwater	At Sea:	Spring (Mar-May), Fall (Sep-Nov), Summer (June-Aug)
Fulmarus	*glacialis*	Northern Fulmar	At Sea:	Fall (Sep-Nov), Winter (Dec-Feb)
Morus	*bassanus*	Northern Gannet	At Sea:	Spring (Mar-May), Fall (Sep-Nov), Summer (June-Aug), Winter (Dec-Feb)
Stercorarius	*pomarinus*	Pomarine Jaeger	At Sea:	Spring (Mar-May), Fall (Sep-Nov), Summer (June-Aug)
Alca	*torda*	Razorbill	At Sea:	Spring (Mar-May), Fall (Sep-Nov), Winter (Dec-Feb)
Phalaropus	*lobatus*	Red-necked Phalarope	At Sea:	Summer (June-Aug), Fall (Sep- Nov)
Gavia	*stellata*	Red-throated Loon	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Winter (Dec-Feb)
Punus	*griseus*	Sooty Shearwater	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Summer (June-Aug)
Melanitta	*perspicillata*	Surf Scoter	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Winter (Dec-Feb)
Melanitta	*fusca*	White-winged Scoter	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Summer (June-Aug)
Oceanites	*oceanicus*	Wilson's Storm-petrel	At Sea:	Fall (Sep-Nov), Spring (Mar-May), Winter (Dec-Feb)

Source: USFWS IPaC database (https://ecos.fws.gov/ipac/), July 17, 2017

Avian

Within the SAP Area, there are numerous marine and coastal bird species that may be present, including both resident and migratory species. Resident species are present throughout the year, whereas migratory species may be present only during breeding and wintering seasons, or they may only migrate through. These migrant and resident birds include various species of birds that rely on marine and coastal waters, which may occur in or around the SAP Area and adjacent waters (Table 3.1.7-2). Figure 3.1.7 depicts abundance estimates for "all avian species" as presented in the Northeast Ocean Data Portal, based on the results of a culmination of data sources modeled by the Marine-life Data and Analysis Team (MDAT).

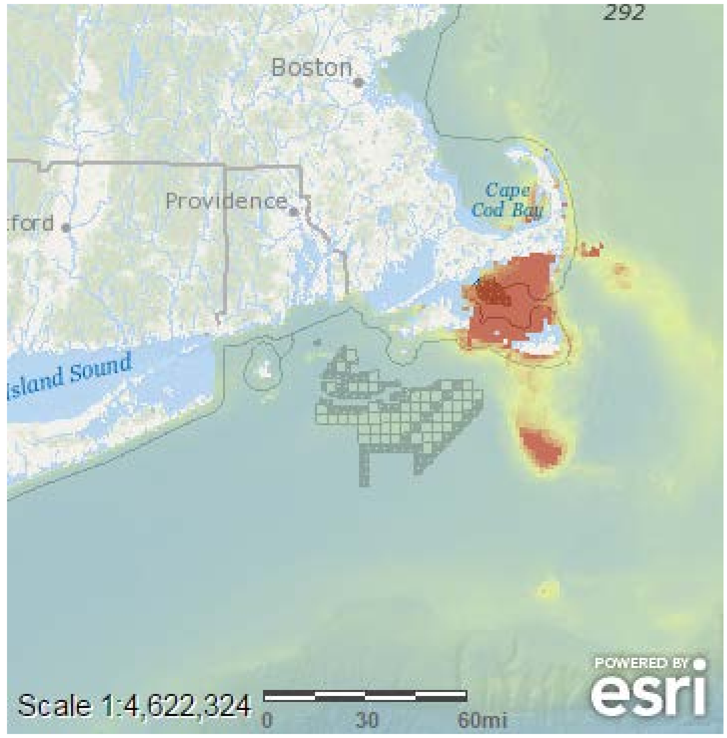


Figure 3.1.7. *All Avian Species Abundance; warmer colors represent higher abundance; source: Northeast Ocean Data Portal, 2017*

Table 3.1.7-2. Species Known to Occur Offshore Massachusetts

Genus	Species	Common Name	Winter	Spring	Summer	Fall
			(P: present; A: absent)			
Waterfowl (mostly during migration)						
Chen	*caerulescens*	Snow Goose	P	P	A	P
Branta	*bernicla*	Brant	P	P	A	P
Branta	*canadensis*	Canada Goose	P	P	P	P
Aythya	*valisineria*	Canvasback	P	P	A	P
Aythya	*americana*	Redhead	P	P	A	P
Aythya	*marila*	Greater Scaup	P	P	A	P
Aythya	*affinis*	Lesser Scaup	P	P	A	P
Somateria	*spectabilis*	King Eider	P	A	A	A
Somateria	*mollissima*	Common Eider	P	P	P	P
Histrionicus	*histrionicus*	Harlequin Duck	P	P	A	P
Melanitta	*perspicillata*	Surf Scoter	P	P	P	P
Melanitta	*fusca*	White-winged Scoter	P	P	P	P
Melanitta	*nigra*	Black Scoter	P	P	P	P
Clangula	*hyemalis*	Long-tailed Duck	P	P	A	P
Bucephala	*albeola*	Bufflehead	P	P	A	P
Bucephala	*clangula*	Common Goldeneye	P	P	A	P
Bucephala	*islandica*	Barrow's Goldeneye	P	P	A	P

Genus	Species	Common Name	Winter	Spring	Summer	Fall
			(P: present; A: absent)			
Mergus	*serrator*	Red-breasted Merganser	P	P	P	P
Loons and Grebes						
Gavia	*immer*	Common Loon	P	P	P	P
Gavia	*stellata*	Red-throated Loon	P	P	P	P
Podiceps	*auritus*	Horned Grebe	P	P	A	P
Podiceps	*grisegena*	Red-necked Grebe	P	P	A	P
Shearwaters and Petrels						
Fulmarus	*glacialis*	Northern Fulmar	P	P	P	P
Calonectris	*diomedea*	Cory's Shearwater	A	A	P	P
Puffinus	*gravis*	Great Shearwater	A	A	P	P
Puffinus	*griseus*	Sooty Shearwater	A	P	P	P
Puffinus	*puffinus*	Manx Shearwater	A	P	P	P
Puffinus	*lherminier*	Audubon's Shearwater	A	A	P	P
Oceanites	*oceanicus*	Wilson's Storm-Petrel	A	A	P	P
Pelagodrama	*marina*	White-faced Storm-Petrel	A	A	P	A
Oceanodroma	*leucorhoa*	Leach's Storm-Petrel	A	A	P	P
Oceanodroma	*castro*	Band-rumped Storm-Petrel	A	A	P	A
Sulids						
Morus	*bassanus*	Northern Gannet	P	P	P	P
Phalacrocorax	*auritus*	Double-crested Cormorant	P	P	P	P
Phalacrocorax	*carbo*	Great Cormorant	P	P	P	P
Shorebirds						
Phalaropus	*lobatus*	Red-necked Phalarop	A	A	A	P
Phalaropus	*fulicarius*	Red Phalarope	P	P	P	P
Jaegers						
Stercorarius	*pomarinus*	Pomarine Jaeger	A	P	P	P
Stercorarius	*parasiticus*	Parasitic Jaeger	A	P	P	P
Stercorarius	*longicaudus*	Long-tailed Jaeger	A	A	P	P
Alcids						
Alle	*alle*	Dovekie	P	P	P	P
Uria	*aalge*	Common Murre	P	P	A	P
Uria	*lornvia*	Thick-billed Murre	P	A	A	P
Alca	*torda*	Razorbill	P	P	A	P
Cepphus	*grylle*	Black Guillemont	P	A	A	A
Fratercula	*artica*	Atlantic Puffin	P	P	P	P
Gulls and Terns						
Rissa	*tridactyla*	Black-legged Kittiwake	P	P	P	P
Larus	*philadelphia*	Bonaparte's Gull	P	P	P	P
Chroicocephalus	*ridibundus*	Black-headed Gull	P	P	A	P
Hydrocoloeus	*minutus*	Little Gull	P	A	P	A
Larus	*atricilla*	Laughing Gull	A	P	P	P
Larus	*delawarensis*	Ring-billed Gull	P	P	P	P
Larus	*argentatus*	Herring Gull	P	P	P	P
Larus	*glaucoides*	Iceland Gull	P	P	A	P
Larus	*fuscus*	Lesser Black-backed Gull	P	P	P	P
Larus	*hyperboreaus*	Glaucous Gull	P	P	A	A

Genus	Species	Common Name	Winter	Spring	Summer	Fall
			(P: present; A: absent)			
Larus	*marinus*	Great Black-backed Gull	P	P	P	P
Onychoprion	*anaethetus*	Bridled Tern	A	A	P	A
Sternula	*antillarum*	Least Tern	A	P	P	A
Sterna	*caspia*	Caspian Tern	A	P	P	P
Chlidonias	*niger*	Black Tern	A	P	P	P
Sterna	*dougalli*	Roseate Tern	A	P	P	P
Sterna	*hirundo*	Common Tern	A	P	P	P
Sterna	*paradisae*	Arctic Tern	A	P	P	A
Sterna	*forsteri*	Forster's Tern	P	P	P	P
Sterna	*maxima*	Royal Tern	A	A	P	A

Source: BOEM EA (2014)

For the purposes of this document only ESA listed species will be discussed in further detail. For information on other species not addressed herein, refer to BOEM (2014) and the Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf (MMS 2007).

There are three species of marine and coastal birds that may be present within the SAP Area: piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and roseate tern (*Sterna dougallii*). Table 3.1.7-3 provides a list of coastal and marine birds that are federally listed that may be found in or adjacent to the SAP Area.

Table 3.1.7-3. ESA Listed Coastal and Marine Bird Species with Potential to Occur

Common Name	Scientific Name	Federal Status[1]
Piping Plover	*Charadrius melodus*	T
Red Knot	*Calidris canutus rufa*	T
Roseate Tern	*Sterna dougallii*	E

Source: BOEM EA (2014)
[1]Federal status: Federally Endangered (E); Federally Threatened (T)

Piping plover and red knot are shorebirds that are unlikely to come into contact with SAP activities. Roseate terns may occur in the SAP Area, as they forage offshore. Section 3.1.7.1 contains detailed information about the abundance, distribution, and habitat use patterns for the piping plover, red knot, and roseate tern.

Bats

There are 9 species of bats which are known to occur in terrestrial Massachusetts and could occur offshore (Table 3.1.7-4). Little is known about how these species use the waters offshore of Massachusetts; however, recent studies have been conducted along the Atlantic coast showing that migratory tree bats utilize offshore waters during their seasonal migrations, over several degrees of latitude (Cryan 2003; Stantec 2016; NJDEP 2010; Hatch 2013). Although the migration patterns of bats are not well-documented, many bats species make extensive use of linear features in the landscape, such as ridges or rivers while commuting and migrating suggesting a preference for overland migration routes. No migratory tree bats are federally listed. The majority of bat occurring in Massachusetts are known as cave bats, which utilize caves and mines for part or all of the year. Cave bats include the federally threatened northern long-eared bat and the federally endangered Indiana bat; these species appear to occur very infrequently offshore, as they do not migrate and have relatively small home ranges (BOEM 2007).

In an effort to understand where and when bats occur offshore (beyond 5.5 km [3 nmi] from land), an acoustic survey of bat activity on islands, offshore structures, and coastal site in the New England Gulf of Maine, mid-Atlantic coast, and Great Lakes regions occurred between 2012 to 2014 (Stantec 2016). While research vessels detected bats up to 130 km (70 nmi) from land (east of New Jersey), the study documented a statistically significant and ecologically relevant negative effect of distance from the mainland on the overall consistency, frequency and magnitude of bat activity in the three study regions. Furthermore, the results showed pronounced seasonal patterns and strong influence of weather variability on bat activity depending on region. The study suggests that because of the absence of suitable habitat, bats can only occur offshore during periods of migration and foraging; and as a result, conditions of higher risk due to offshore wind development are presumably less frequent offshore than at terrestrial sites. Therefore, it is unlikely that federally listed bats will occur in the SAP Area.

Table 3.1.7-4. Species of Bat Known to Occur in Massachusetts

Common Name	Scientific Name	Federal Status[2]	Cave-Hibernating Bats	Migratory Tree Bats
Eastern small-footed bat	*Myotis lebeii*		X	
Little brown bat	*Myotis lucifugus*		X	
Northern long-eared bat	*Myotis septentrionalis*	T	X	
Indiana bat[1]	*Myotis sodalis*	E	X	
Tri-colored bat	*Perimyotis subflavus*		X	
Big brown bat	*Eptesicus fuscus*		X	
Eastern red bat	*Lasiurus borealis*			X
Hoary bat	*Lasiurus cinereus*			X
Silver-haired bat	*Lasionycteris noctivagans*			X

Source: BOEM EA (2014); since published the Northern long-eared bat status was updated
[1]The Indiana bat is not known to occur in eastern Massachusetts
[2]Federal status: Federally Endangered (E); Federally Threatened (T)

According to BOEM (2014), Indiana bats are not known to occur in eastern Massachusetts; therefore, due to their limited home range, they will not be discussed further in this document. Section 3.1.7.2 contains detailed information about the abundance, distribution, and habitat use patterns for the northern long-eared bat.

3.1.7.1 Avian Species Profiles

Piping Plover

The piping plover (*Charadrius melodus*) is a small, migratory shorebird that breeds on beaches from Newfoundland to North Carolina (and occasionally in South Carolina) and winters along the Atlantic Coast from North Carolina south, along the Gulf Coast, and in the Caribbean (USDOI and USFWS 1996, Elliot-Smith and Haig 2004). According to the U.S. Department of the Interior (USDOI) and USFWS (2009), piping plovers that breed on the Atlantic Coast belong to the subspecies *C. melodus melodus*. The Atlantic Coast population is classified as threatened under the ESA, whereas other piping plover populations inhabiting the Northern Great Plains and Great Lakes watershed are endangered (USDOI and USFWS 2015a). This species is also listed as threatened by the Massachusetts Natural Heritage & Endangered Species Program (MA NHESP). Since its federal listing in 1985, the Atlantic Coast population estimate has increased from 790 pairs to an estimated 1,849 pairs in 2008, and the U.S. portion of the population has almost tripled, from approximately 550 pairs to an estimated 1,596 pairs (USFWS 2009b). The most recent abundance estimates by USFWS estimate approximately 1,762 nesting pairs in 2011 (USDOI and USFWS 2012).

The Atlantic Coast Population of piping plovers nest along beaches in New Brunswick, Prince Edward Island, Nova Scotia, Quebec, southern Maine, Rhode Island, Massachusetts, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina. These birds winter primarily on the Atlantic Coast from North Carolina to Florida, although some migrate to the Bahamas and West Indies from mid-September to March (USDOI and USFWS 1996). Piping plovers inhabit coastal sandy beaches and mudflats. They use open, sandy beaches close to the primary dune of the barrier islands for breeding, preferring sparsely vegetated open sand, gravel, or cobble for a nest site. In winter the species remains confined to coastal areas, but uses a wider variety of habitats, including mudflats and dredge spoil areas, and, most commonly, sandflats (O'Brien et al. 2006). They feed on marine worms, fly larvae, beetles, insects, crustaceans, mollusks, and other small invertebrates. They forage along the wrack zone, or line, where dead or dying seaweed, marsh grass, and other debris is left on the upper beach by the high tide (USDOI and USFWS 2015a).

A key threat to the Atlantic Coast population is habitat loss resulting from shoreline development (USDOI and USFWS 1996). Piping plovers are very sensitive to human activities. Disturbances from anthropogenic activities can cause the parent birds to abandon their nests. Since the listing of this species under the ESA in 1986, the Atlantic Coast piping plover population has increased 234 percent (USDOI and USFWS 2009). Although increased abundance has reduced near-term vulnerability to extinction, piping plovers remain sparsely distributed across their Atlantic Coast breeding range, and populations are highly vulnerable to even small declines in survival rates of adults and fledged juveniles (USDOI and USFWS 2009).

Only the Atlantic Coast population has the potential to occur in the SAP Area. Piping plovers may occur in Massachusetts from late March through mid-October, which encompasses both their breeding season and their spring and fall migratory seasons (BOEM 2014). Within this period, piping plovers are unlikely to occur in the SAP Area during their breeding season, particularly from May to mid-August, as they are restricted to sandy coastal beaches (Burger et al. 2011). Plovers are more likely to traverse the SAP Area during their migratory periods, primarily April and May in springtime and August and September in the fall, as their migratory pathways do not appear to be concentrated along the coast. Although there are no definitive observations of piping plovers more than 4.8 km (3 mi) from the Atlantic Coast, this species is known to use islands more than 4.8 km (3 mi) from the coast as both breeding and wintering grounds, and have been observed in significant pre-migratory concentrations in southeastern Cape Cod and Monomoy Island in late summer (Normandeau Associates Inc., 2011).

The FWS first designated critical habitat for the wintering population of piping plovers in 142 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas on July 10, 2001 (Federal Register 2001). Critical habitat areas were subsequently revised in North Carolina in 2008 (Federal Register 2008) and in Texas in 2009 (Federal Register 2009). No critical habitat has been designated in waters offshore of Massachusetts. Although the precise route of migration is not firmly established, it is possible that these birds could fly over the SAP Area during migration.

***Rufa* Red Knot**

The *rufa* red knot (*Calidris canutus rufa*) is a medium-sized shorebird from the sandpiper family that was added to the list of threatened species under the ESA effective in January 2015. It is also a Species of Greatest Conservation Need (SGCN) in the Massachusetts Wildlife Action Plan and is proposed for listing under MESA. The red knot is one of the longest-distance migrants in the world, traveling annually in large flocks between breeding grounds in the mid- and high-arctic areas and wintering grounds in southern South America (Harrington, 2001; Morrison et al., 2001; USDOI, FWS, 2010b; Normandeau Associates, Inc., 2011). Each spring, red knots congregate in Delaware Bay during their northward migration to feed on horseshoe crab eggs (*Limulus polyphemus*) and refuel for breeding in the Artic. Protection of this species has become necessary after noted population declines in the 2000s, largely due to an increase in the harvest of horseshoe crabs for bait in the conch and eel fishing industries (Niles et al. 2009), as well as, coastal development and beach erosion/nourishment (Niles at al. 2008).

The red knot's northward migration through the contiguous U.S. occurs in April-June and the southward migration occurs in July-October. Delaware Bay is the most important spring migration stopover in the eastern U.S. because it is the final stop at which the birds can refuel in preparation for their nonstop leg to the Arctic (Harrington 2001, NatureServ 2015a, USDOI and USFWS 2010a). Approximately 90 percent of the entire population of the red knot can be present in Delaware Bay in a single day (Cornell Lab of Ornithology 2015). Red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks (USDOI and USFWS 2010b) for a variety of small animal prey while on the ground, or while wading in shallow water within coastal environments (Harrington, 2001). Due to challenges with the species' migratory habits and differing survey methods across the red knots' range, there is not a range wide population estimate.

There are no nesting records of this species in Massachusetts. In North America, this species breeds in the high Arctic and winters well to the south of Massachusetts (Harrington, 2001) and therefore, its potential occurrence in coastal Massachusetts is restricted to migration. Red knots use coastal areas of Massachusetts as migratory stopover locations for foraging during spring and fall migrations. Historical records show that thousands of red knots utilized the Massachusetts shoreline during both spring and fall migrations (MA NHESP 2016a). Historical migratory stop-over locations in Massachusetts included beaches on outer Cape Cod and mainland beaches along West Cape Cod Bay (MA NHESP 2016a).

The red knot's migratory routes are not well characterized, however recent studies using geolocation and geospatial datasets of coastal observations have begun to reveal some migratory patterns with respect to the Atlantic OCS region (Burger et al. 2012a, 2012b; Niles et al. 2010; Normandeau Associates Inc. 2011). These studies generally suggest that red knot migratory pathways along the Atlantic Coast are fairly widespread and diverse, but there appear to be more of a mid-Atlantic and southerly concentration of Red Knot coastal occurrences in spring; in contrast with a more northerly concentration, particularly in Massachusetts, during the fall. Hence, more Red Knot migratory passage likely takes place through the SAP Area during fall migration than during spring migration (BOEM 2014).

Roseate Tern

The roseate tern (*Sterna dougallii*) is a worldwide species that is divided into five subspecies. The Atlantic subspecies (*S. dougallii dougallii*) breeds in two discrete areas in the western hemisphere (USDOI and USFWS 1998). The northwestern Atlantic population of roseate tern, which is listed as endangered under the ESA and by MA NHESP, breeds from New York to Maine and into adjacent areas of Canada. Historically this population bred as far south as Virginia; however, the southern extent is now New York (USDOI and USFWS 2015b). Northwestern roseate terns are thought to migrate through the eastern Caribbean and along the north coast of South America, wintering mainly on the east coast of Brazil (USDOI and USFWS 2010a). Reasons for the initial listing of the roseate tern included the concentration of the population into a small number of breeding sites and, to a lesser extent, declines in population (USDOI and USFWS 1998). The most important factor in breeding colony loss was predation by herring gulls and/or great black-backed gulls.

The roseate tern is a medium-sized tern that is primarily pelagic along seacoasts, bays, and estuaries, going to land only to nest and roost (Sibley 2000). They forage offshore and roost in flocks typically near tidal inlets in late July to mid-September. Along the Atlantic Coast, they nest on sandy beaches of islands, open bare ground, and grassy areas, typically near areas with cover or shelter (NatureServ 2015b). Roseate terns forage mainly by plunge-diving and contact-dipping (in which the bird’s bill briefly contacts the water). They also forage by surface-dipping over shallow sandbars, reefs, and schools of predatory fish. The roseate tern’s diet consists almost exclusively of small schooling fish, including sand lances, for which it forages by flying slowly, typically 10 to 39 feet above the water, then plunge-diving to catch fish at depths no greater than a few inches (Gochfeld et al., 1998).

The most current abundance estimate for the northwestern Atlantic population is approximately 3,200 nesting pairs (Nisbet, Gochfeld, and Burger 2014). The northwestern Atlantic breeding population currently breeds on only a handful of primarily island colonies from the maritime provinces of Canada to Long Island, NY (Gochfeld et al., 1998; USFWS, 2010). The population has become extremely concentrated and restricted in recent years, with as many as 87 percent of individuals breeding in colonies on islands off of Massachusetts and New York (Bird and Ram Islands in Buzzards Bay, MA and Great Gull Island, NY) (USFWS, 2010). The coastal region of southeastern Cape Cod, near Chatham and Monomoy Island, is the most important post-breeding staging area for roseate terns, hosting up to 7,000 individuals annually representing nearly the entire northwestern Atlantic population (Burger et al. 2011; Normandeau Associates Inc., 2011).

Only the northwestern Atlantic population of roseate tern is likely to occur in the WEA, however according to BOEM's 2014 EA, very little roseate tern activity is expected to occur in the Massachusetts WEA during both nesting and post-breeding staging periods. Modeling conducted by Kinlan et al. (2014) suggests that roseates annually concentrate north of the Massachusetts WEA near Martha's Vineyard and Nantucket, using the waters of Nantucket Sound and the Muskeget Channel. In addition, recent surveys for roseate terns in the region support these modeled predictions, including an aerial survey conducted by Veit and Perkins (2014) that shows activity almost exclusively near the Muskeget Channel from August to September. During the nesting period from mid-May to the end of July, adults typically remain

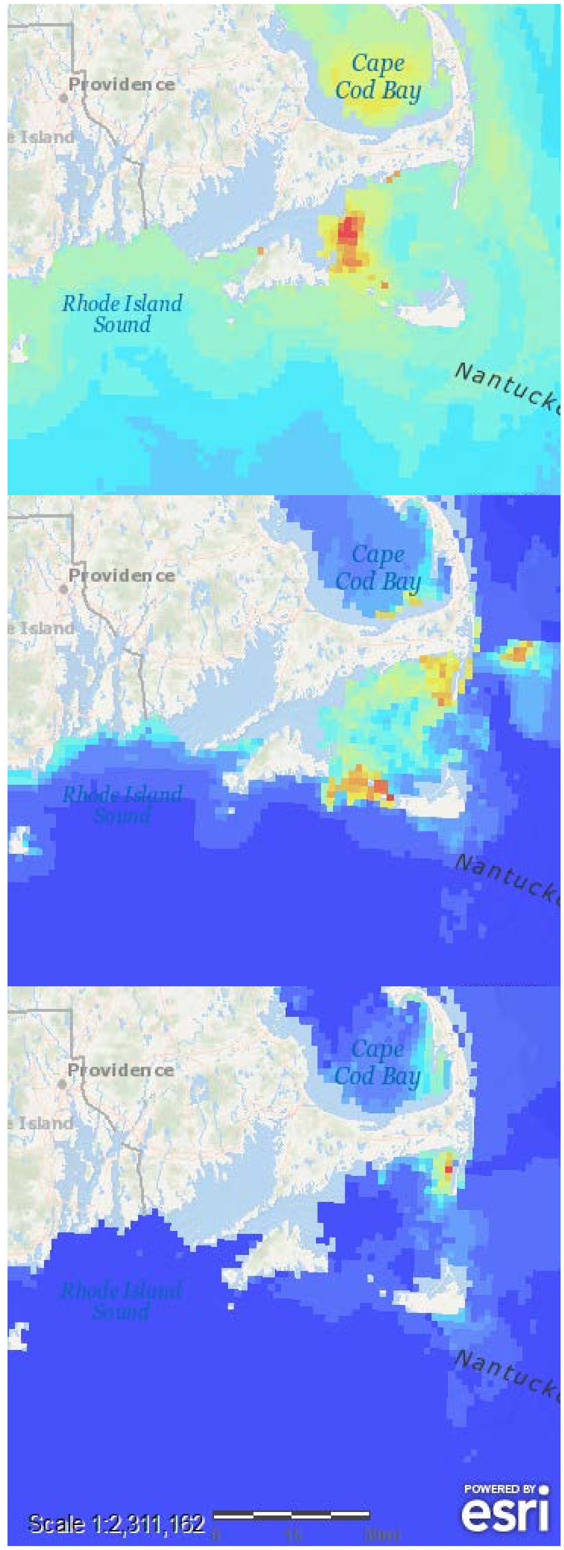


***Figure 3.1.7.1**. Roseate tern abundance; spring, summer, fall (top to bottom); source: Northeast Ocean Data Portal.*

within 6.9 km (4.3 mi) of their nesting colonies. While occupying post-breeding areas most foraging activity is concentrated in shallow, nearshore waters, although some individuals may occur up to 16 km (10 mi) from the coast (Burger et al. 2011; Normandeau Associates Inc., 2011). The migration routes of roseate terns during spring and fall are not well known, but are believed to be largely pelagic (Gochfeld et al., 1998; Nisbet, 1984; USFWS, 2010); hence, roseates may traverse the SAP Area during these periods.

No critical habitat areas have been published for the roseate tern.

3.1.7.2 Bat Species Profiles

Northern Long-eared Bat

The northern long-eared (NLEB) bat is a medium-sized, cave-dwelling bat about 3 to 3.7 inches in length, with a wingspan of 9 to 10 inches, and long ears compared to other bats in its genus (USFWS 2017). Northern long-eared bats are widely distributed in the eastern United States and Canada, with the exception of the very southeastern United States and Texas. This species was listed as threatened throughout its range under the ESA in 2015 due to the rapid spread of white-nose syndrome, which was discovered in 2006 in a hibernaculum in New York State. Infected *Myotis* hibernacula in the New York and surrounding states have experienced mortality rates of over 90 percent (USFWS 2017). Northern long-eared bats are also listed as endangered by the MA NHESP.

NLEB are widespread in Massachusetts, and have been found in 11 of 14 counties. Winter hibernacula have been reported in Berkshire, Franklin, Hampden, Middlesex, and Worcester counties (MA NHESP 2015). According to data collected by the MA NHESP (2016b), NLEB maternity roosts (but no hibernacula) have been identified on Martha's Vineyard (Dukes County), Massachusetts, approximately 22.5 (14 mi) north of the WEA. Females bear and rear young from mid-May through July and forage between August and October. NLEB use approximately 0.6 km^2 (150 acres) for their home range during this period (Owen et al. 2003) and therefore would be highly unlikely to occur within the WEA, even transiently.

3.1.8 Archaeological Resources (585.611(b)(6))

Findings of the BOEM approved SAP survey (described in Appendix D) show that the seabed in the SAP Area consist of Holocene marine deposits of sand that were deposited or reformed by marine transgression and other geologic processes. Other than the occasional sand waves there was little relief in the SAP Area. The ocean bottom in the SAP Area consisted of sands.

Geologic data indicate that the SAP Area was once subaerial during the period of last glaciation and potentially could host people of the Paleoindian tradition. During the end of that period the area was inundated by the glacial melt water during marine transgression circa 10,000 years Before Present. Therefore, the archaeological sensitivity for prehistoric cultural resources within the SAP Area is temporally limited. The seabed and near subsea bed materials do not indicate any paleochannels, accumulated soils, or sediments prior to inundation.

Historically, the area was transited from the earliest periods of European exploration and settlement. Numerous ships have been lost in Martha's Vineyard and Nantucket area. None have been reported in the SAP Area. The geophysical data confirm the historic documentation. No magnetic anomalies or side scan sonar images created from survey data had the obvious characteristics of a potential shipwreck or prehistoric site. The maximum magnetometer reading from background varied only slightly (less than ±1.3 nT) over the area. Side scan sonar data indicated that the sea bed was virtually void of any features other than one large sand wave and numerous dragger scars, remnants of fishing activities. There was one noticeable feature which is considered debris. Subbottom profiler data indicate relatively flat, laminated near subsurface materials. There were no obvious water courses or other sub seabed features that may indicate high probability areas of potential Paleoindian habitation.

No significant cultural resources were identified during this marine geophysical investigation for cultural resources and no further investigations are recommended for the SAP Area.

3.1.9 Social and Economic Resources (585.611(b)(7))

Much of the available social and economic data are summarized by county. For the purposes of this project, data from Dukes County, Barnstable County, and Nantucket County are summarized below.

Dukes County consists of 11 islands off the southeast coast of Massachusetts, including Martha's Vineyard. Barnstable County consists of the 15 municipalities on the Cape Cod Peninsula extending from the southeast coast of Massachusetts. Nantucket County comprises the Island of Nantucket. Dukes County year-round population is approximately 16,535, Barnstable County's is 214,000 and Nantucket's is 11,000. The populations in each location swells summer months with the influx of vacation-home residents and other tourists. Each County is highly dependent on summer tourism (Cape Cod Commission 2012, Martha's Vineyard Commission 2008, Nantucket Master Plan 2009).

Land uses along the coast of each County consists primarily of low density residential with a few high density developed town centers. Each County considers vehicle traffic congestion generated by the tourism season to be significant concerns. (Martha's Vineyard Commission 2010; Cape Cod Commission 2012, Nantucket Master Plan 2009.)

Coastal Industries & Employment

In 2013, ocean related businesses provided 16% of total jobs in Barnstable and Dukes County, 20% in Nantucket County and 96% of jobs were tourism and recreation related (NOAA 2017a). Dukes and Nantucket Counties are a seasonal, visitor-based economy. With the exception of some remaining commercial fishing industry employing only a very small number of people, there are no significant exports of goods or services. The driving force of the County's economic base is visitors and especially second homeowners who purchase goods and services during their stay (Martha's Vineyard Commission 2008, NOAA 2012). Barnstable County's economy is also a seasonal, visitor-based economy; however, there are more health, social service, and professional, management, administrative and waste management employment opportunities (NOAA 2012).

Commercial & Recreational Fisheries

Vessel activity (recreational angling and charter/party trips) within the MA WEA is confined primarily to the north and western portion of the area. State commercial fishing effort is considered "low" to "medium" in State waters south of Martha's Vineyard, adjacent to the location of the WEA. Species considered most important from this area are striped bass, fluke (summer flounder), black sea bass, and scup. The same areas are considered of "medium" and "high" importance to Massachusetts fisheries resources based on State survey data. Commercial otter trawl trips reported from federally mandated vessel trip reports show the fishing effort inside the WEA is concentrated in the central and western regions. This effort is small compared to that in the regional fishing grounds located outside the WEA. Commercial scallop dredge vessel trip reports also show very little effort in the WEA. However, vessels likely cross the WEA in transit between scallop fishing grounds on George's Bank and the major scallop port of New Bedford MA (BOEM 2014)

Commercial landings data (weight and monetary value) for Massachusetts are presented below for 2011 to 2015 for all species with average annual landings valued at greater than $1,000,000 (Table 3.1.9-1). The most commercially important species are sea scallop and American lobster. Recreational landings data for Massachusetts are presented below for 2012 to 2016 for all species with annual landings greater than 45,360 kg (100,000 lbs) (Table 3.1.9-2). Striped bass is a very important sport fish in nearshore and offshore regions in both states, as are scup, bluefish, tautog, Atlantic cod, summer flounder, and tunas/mackerels (NMFS 2017).

Table 3.1.9-1. Annual Landings of Commercially Important* Fish Species for Massachusetts from 2011 to 2015. Landings Weights (lbs) and Values ($) are Presented

Species	2011		2012		2013		2014		2015		Average annual landings	
	(lbs)	$	(lbs)	$	(lbs)	$	(lbs)	$	(lbs)	$	(lbs)	$
SCALLOP, SEA	33,091,859	$330,943,531	36,725,267	$364,863,812	29,287,337	$334,205,322	21,392,034	$271,373,414	21,514,646	$264,933,400	28,402,229	$313,263,896
LOBSTER, AMERICAN	13,372,540	$53,302,490	14,485,339	$53,357,118	15,259,697	$61,661,564	15,322,892	$68,375,940	16,450,530	$78,290,126	14,978,200	$62,997,448
CLAM, ATLANTIC SURF	11,663,022	$10,014,049	18,240,911	$16,071,856	20,802,922	$17,488,715	19,416,223	$16,762,548	18,828,455	$17,094,750	17,790,307	$15,486,384
OYSTER, EASTERN	230,981	$9,066,317	309,836	$12,070,626	328,656	$13,896,080	443,705	$19,575,343	593,469	$22,741,520	381,329	$15,469,977
COD, ATLANTIC	15,012,175	$27,582,793	8,983,606	$18,558,036	4,145,441	$8,376,619	4,294,491	$7,493,636	2,913,481	$5,528,295	7,069,839	$13,507,876
GOOSEFISH	10,142,780	$13,430,685	11,582,871	$13,595,655	9,498,440	$8,869,503	10,533,109	$10,028,473	11,084,376	$10,251,355	10,568,315	$11,235,134
HADDOCK	12,151,584	$15,814,175	4,180,085	$7,565,174	3,977,813	$5,706,381	9,682,269	$10,946,352	11,479,861	$12,049,084	8,294,322	$10,416,233
HERRING, ATLANTIC	66,970,193	$8,802,476	81,781,049	$11,529,446	74,992,417	$10,749,786	77,872,559	$9,431,945	70,888,448	$8,787,347	74,500,933	$9,860,200
CLAM, OCEAN QUAHOG	12,478,860	$7,995,143			14,476,040	$10,228,720	13,421,677	$9,813,936	13,340,110	$9,063,394	13,429,172	$9,275,298
FLOUNDER, WINTER	4,477,544	$7,773,424	5,149,283	$10,137,523	5,376,720	$8,830,550	3,818,405	$7,484,783	3,198,835	$6,742,066	4,404,157	$8,193,669
POLLOCK	11,792,014	$9,000,698	11,147,701	$9,432,450	7,938,660	$7,695,602	7,070,046	$7,035,654	5,062,091	$5,206,286	8,602,102	$7,674,138
CRAB, JONAH	5,379,794	$3,648,514	7,540,394	$5,573,270	10,095,402	$9,111,026	11,858,704	$9,278,006	9,096,378	$6,894,538	8,794,134	$6,901,071
WHELK, CHANNELED	954,379	$5,943,552	1,147,719	$6,160,825	720,698	$5,589,829	612,856	$4,863,226	632,145	$4,810,947	813,559	$5,473,676
HAKE, SILVER	8,261,597	$5,012,900	7,389,004	$4,515,538	6,583,346	$3,891,955	8,422,473	$5,835,675	9,197,229	$6,522,591	7,970,730	$5,155,732
CLAM, SOFTSHELL	825,371	$4,723,456	975,344	$6,438,800	675,154	$4,625,474	414,976	$4,004,946	416,180	$4,472,995	661,405	$4,853,134
TUNA, BLUEFIN	796,085	$6,668,154	623,079	$5,523,790	363,331	$2,520,369	636,561	$3,876,602	1,098,148	$5,499,685	703,441	$4,817,720
HAKE, WHITE	5,283,622	$4,808,661	4,793,328	$5,292,573	3,720,438	$4,834,617	3,298,979	$4,481,361	2,961,075	$4,019,708	4,011,488	$4,687,384
REDFISH, ACADIAN	4,293,767	$2,636,857	7,824,895	$5,189,380	7,535,796	$4,076,794	9,504,452	$5,192,314	10,310,054	$5,890,405	7,893,793	$4,597,150
FLOUNDER,ATLANTIC,PLAICE	2,844,375	$3,983,283	2,952,340	$4,539,119	2,367,755	$3,825,412	2,233,167	$3,771,763	2,105,087	$3,939,103	2,500,545	$4,011,736
CLAM, NORTHERN QUAHOG	783,380	$3,959,558	609,893	$3,682,733	707,204	$3,838,358	687,407	$3,825,507	644,775	$4,375,877	686,532	$3,936,407
BASS, STRIPED	1,162,429	$3,183,749	1,218,485	$3,504,686	1,004,468	$3,130,000	1,138,518	$4,832,063	865,760	$3,570,775	1,077,932	$3,644,255
SKATES	13,284,301	$3,570,273	13,618,020	$3,315,643	9,518,192	$3,065,925	12,787,191	$4,521,163	11,122,162	$2,573,562	12,065,973	$3,409,313
CLAMS OR BIVALVES	293	$520	14,957,800	$10,140,896	2,018	$2,384					4,986,704	$3,381,267
CRAB, DEEPSEA RED									3,254,277	$3,231,116	3,254,277	$3,231,116
FLOUNDER, WITCH	1,721,397	$3,581,709	1,953,530	$3,671,910	1,238,139	$3,090,458	1,083,087	$2,682,576	934,365	$2,392,934	1,386,104	$3,083,917
FLOUNDER, YELLOWTAIL	3,516,492	$4,126,781	3,300,577	$4,363,975	1,674,614	$2,443,704	1,187,424	$1,505,630	1,306,170	$1,501,238	2,197,055	$2,788,266
FLOUNDER, SUMMER	1,132,192	$2,559,852	891,498	$2,341,558	859,384	$2,422,062	696,033	$2,503,920	748,433	$2,763,662	865,508	$2,518,211
SQUID, LONGFIN	1,408,248	$1,809,694	2,944,258	$3,579,450	866,984	$1,080,370	2,431,616	$2,308,681	1,884,656	$2,342,565	1,907,152	$2,224,152
SCALLOP, BAY	157,593	$1,957,430	170,979	$2,128,221	187,438	$2,477,817	154,729	$2,523,309	83,128	$1,443,888	150,773	$2,106,133
CRABS	3,596,476	$3,486,698	2,570,479	$2,570,425	1,806,603	$1,806,603	1,933,498	$1,933,498	4,259	$2,864	1,982,263	$1,960,018
SWORDFISH	740,635	$2,249,718	851,281	$2,698,922	628,111	$2,013,390	389,026	$1,326,363	627,364	$1,391,403	647,283	$1,935,959
SHARK, SPINY DOGFISH	9,071,662	$1,932,190	13,116,375	$2,887,523	6,216,751	$977,955	9,439,008	$2,027,687	7,851,049	$1,458,760	9,138,969	$1,856,823
CLAM, ATLANTIC JACKKNIFE	67,431	$447,695	126,801	$932,863	277,460	$2,347,970	173,100	$1,820,939	119,576	$1,417,831	152,874	$1,393,460
HAGFISHES					1,314,897	$1,426,918			1,260,167	$1,286,518	1,287,532	$1,356,718
MACKEREL, ATLANTIC	515,461	$136,613	4,131,405	$654,329	7,279,352	$1,222,966	10,754,742	$2,421,055	6,934,684	$1,926,478	5,923,129	$1,272,288
MUSSEL, BLUE	132,898	$546,076	408,739	$602,756	1,145,623	$1,511,654	1,126,270	$1,505,641	3,292,088	$2,042,166	1,221,124	$1,241,659

* includes species with average annual landings
greater than $1,000,000

Table 3.1.9-2. Annual landings (lbs) of Recreationally Important* Marine Species for Massachusetts from 2012 to 2016

Region	Species	2012	2013	2014	2015	2016[a]	Average Annual Landings
Nearshore[b]	Striped bass	5,227,095	3,617,514	3,926,303	2,683,645	2,151,765	3,521,264
	Scup	1,799,447	1,951,067	1,754,207	1,271,100	1,435,030	1,642,170
	Bluefish	1,265,926	2,372,904	1,901,432	1,782,684	507,179	1,566,025
	Atlantic Mackerel	560,982	1,107,684	916,819	1,732,837	1,751,115	1,213,887
	Black sea bass	1,052,049	626,782	959,769	716,679	879,739	847,004
	Other tunas/ mackerels	56,993	0	60,946	33,198	792,283	188,684
	Tautog	94,699	191,786	397,047	181,119	53,121	183,554
	Pollock	144,497	164,278	44,889	77,980	339,380	154,205
	Summer flounder	171,534	63,268	193,836	141,667	111,483	136,358
	Atlantic Cod	317,669	106,345	152,361	2,327	22,634	120,267
	Herrings	43,869	24,759	122,081	20,890	362,113	114,742
	Little tunny/Atlantic bonito	6,248	5,970	50,785	279,630	221,990	112,925
Offshore[c]	Atlantic Cod	606,784	802,629	1,118,137	6,480	121,750	531,156
	Striped bass	214,798	575,901	470,880	18,079	86,314	273,194
	Atlantic Mackerel	62,785	179,017	155,792	371,880	343,885	222,672
	Pollock	526,097	328,000	42,233	72,119	82,978	210,285
	Other tunas/ mackerels	433,582	0	147,351	0	213,941	158,975
	Bluefish	32,182	189,404	66,684	54,624	275,836	123,746

* includes species with average annual landings greater than 100,000 lbs

[a]2016 data are preliminary

[b]landings from inshore areas and ocean waters ≤ 3 mi from shore

[c]landings from ocean waters > 3 mi from shore

Source: NMFS 2017

Recreation Use

All of the Counties are predominantly visited for their beaches and are considered some of the premiere summer beach destinations in the country. The sandy beaches attract beachgoers looking for relaxation, swimming, beachcombing, and sunbathing. Surfing, diving, and boat- and shore fishing are also very popular activities (ICF Incorporated 2012.)

Dukes County's 240 km (150 mi) coastline is almost entirely remote sand beach. The County has approximately 15 large public beaches, but much of Martha's Vineyard coast is private access only. There are approximately five harbors, two marinas and three yacht clubs in the County. Dukes County's only nationally protected land is on Noman's Land Island National Wildlife Refuge. (ICF Incorporated 2012.)

Much of the 885 km (550 mi) coastline in Barnstable County is sand beach that is ideal for sunbathers, walkers, snorkelers, windsurfers, and surfers (although surfing and windsurfing only occur on the south- and west-facing beaches). The County has more than 150 public beaches and several more private beaches. There are three national parks that account for 234 km^2 (58,000 acres) of protected land. (ICF Incorporated, 2012.)

The island of Nantucket is surrounded in all directions by 180 km (110 mi) of shoreline, and 130 km (80 mi) of beach, all of which are open to the public. The Nantucket Wildlife Refuge accounts for 0.1 km^2 (24 acres) of nationally-protected land and is the only national park/refuge on the island. There are two harbors, two yacht clubs, and multiple marinas. (ICF Incorporated, 2012.)

Environmental Justice

Each County has a lower percentage of minority population than Massachusetts state average. (USEPA 2017) The Wampanoag Tribe of Gay Head (Aquinnah) land trust is located in the southwest portion of Martha's Vineyard Island in the town of Gay Head (BOEM 2009). The Wampanoag Tribe of Gay Head (Aquinnah) uses Vineyard Sound and surrounding water for subsistence harvesting. (BOEM 2009).

Visual Resources

The MET/ocean buoy(s) will at most be approximately 3 m (9.8 ft.) tall; and therefore, will only be seen from approximately 6.7 km (3.6 nmi) (Appendix D). As the closest MET/ocean buoy will be over 30 km (16 nmi) from Martha's Vineyard and Nantucket it will not be seen from shore. Although there are several historic and culturally significant resources on Martha's Vineyard and Nantucket, the presence of a buoy over 30 km away will not create any visual impact. Boaters and tourist traveling offshore may be able to see the buoy; however, due to the existing conditions (presence of other buoys, boaters, ships, etc.), it is unlikely that the presence of a relatively small buoy(s) will significantly alter or diminish the visual aesthetic. Furthermore, because boats/ships are generally moving, the close-up views, and any associated impacts, would be brief (BOEM 2014).

3.1.10 Coastal and Marine Uses (585.611(b)(8))

The Atlantic OCS in the vicinity of the MA WEA supports a variety of coastal and marine uses. Aside from commercial and recreational fishing, which is described in Section 3.1.9, Social and Economic Resources, uses include shipping and marine transportation, air traffic and airports, and military activities.

The Northeast Ocean Data Portal summarizes vessel traffic data for the Northeast Atlantic waters, including the MA WEA (which includes the Vineyard Wind Project Area). Vessel traffic within the region of the MA WEA is relatively low compared to regional marine traffic hotspots. Tow-tug and passenger vessel density within the region is very low, and though tanker and cargo vessels occur at greater densities than other identified vessel types, these primarily occur along the southern and western regions of the WEA. Much of the marine traffic within the WEA is not attributed to the above vessel types, and is likely due to fishing, recreation, or other marine activities (Northeast Ocean Data Portal 2015)

In 2009, a total of 1207 transits occurred through the MA WEA. Though the number of unique vessels traveling within the MA WEA could not be determined with certainty, a total of 373 unique Maritime Mobile Service Identities (a proxy for individual vessels) transited the WEA during this time. Vessel traffic density was greatest in the southern and western portions of the WEA, and cargo ships were the most frequently observed vessel type (USCG 2016).

Approaches to Nantucket Memorial airport, and two airports on Martha's Vineyard, are located over the WEA. There are no military training routes in the airspace over the WEA and closest restricted airspace occurs around a small island that is approximately 5.2 km (2.8 nmi) south of the western end of Martha's Vineyard and approximately 12 km (6.5 nmi) north of the WEA. Similarly, there are no danger zones or restricted areas within the WEA; the closest danger zone/restricted area is the restricted air space over Nomans Land Island that is approximately 18.5 km (10 nmi) north of the WEA. Nomans Land Island is also designated as a danger zone for naval operations (33 CFR 334.70) because unexploded ordnance is suspected to be present (NOAA Office of Coast Survey, 2017) and public access is not permitted. The WEA is within the Narragansett Bay OPAREA, and a U.S. Navy aviation warning area occurs over the majority of the area. Though vessel traffic is generally dispersed throughout the WEA, it remains low (BOEM 2014).

3.1.11 Air Quality (585.610(a)(12) and 585.659)

Air quality is characterized by comparing the ambient air concentrations of criteria pollutants to the National Ambient Air Quality Standards (NAAQS), which have been established by the EPA to be protective of human health and welfare. The Clean Air Act (CAA) establishes two types of national air quality standards: (1) primary standards, which set limits to protect public health, including the health of "sensitive" populations (e.g., asthmatics, children, and the elderly); and (2) secondary standards, which set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The NAAQS have been established in 40 CFR Part 50 for each of the seven criteria pollutants: sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$, particulate matter with a diameter less than or equal to 10 and 2.5 µm, respectively), and lead (Pb).

Ambient air quality concentrations of criteria pollutants are determined using data collected by monitoring stations that are mainly operated by the states. These monitoring sites provide long-term assessment of pollutant levels by measuring the quantity and types of certain pollutants in the surrounding, outdoor air. When the monitored pollutant levels in an area exceed the NAAQS for any pollutant, the area is classified as “nonattainment” for that pollutant. All counties in Massachusetts and Rhode Island are presently “in attainment” (or compliant with) with the NAAQS, except for Dukes County, Massachusetts, which is presently in nonattainment with the ozone NAAQS. Nonattainment areas are classified as Extreme, Severe, Serious, Moderate, and Marginal. Dukes County is classified as Marginal.

The NAAQS for ozone are 0.12 ppm (1-hour average) and 0.075 ppm (8-hour average). Ozone is a regional air pollutant issue and the northeast part of the country has been designated as an Ozone Transport Region. Prevailing southwest to west winds carry air pollution in the form of nitrogen oxides (NO_X) and Volatile Organic Compounds (VOC) from emission sources located outside of northeastern state boundaries into the northeast, contributing to high ozone concentrations in these areas.

Air Emissions from SAP Activity

Specific to the vessel activities anticipated in the SAP areas which include the installation, maintenance, and decommissioning of the MET/buoy(s), the following data have been assembled to provide a conservative estimate (more than expected) of emissions from the vessel engines and generators that will likely be in use offshore.

Specific expected activities with air emissions include marine vessel trips and maneuvering for one MET/ocean buoy. This work is expected to entail:

- Five daily trips during installation (including allowance for standard weather issues).
- The project expects to use New Bedford or a similar port in the area for deployment and maintenance activities.
- Two types of vessels are foreseen to be used during the deployment and maintenance.

- o Vessel type A: Work boat app. 95 feet with up to 1000 HP to be used for deployment
- o Vessel type B: Smaller type support vessel with up to 450 HP to be used for deployment + inspection and maintenance
- Onsite maintenance will be planned for approximately 3 times a year and expected to be performed by vessel type B.
- Two days for decommissioning.

The table below provides an estimation of expected emissions.

Activity	Emissions (tons/year)							
	NOx	VOC	CO	PM10	PM2.5	CO2	SO2	HAPs
Deployment	0.389	0.010	0.060	0.012	0.011	26.6	0.000	0.001
Maintenance	0.077	0.002	0.012	0.003	0.002	5.2	0.000	0.000
Decommissioning	0.155	0.004	0.024	0.005	0.005	10.6	0.000	0.000
Total	**0.621**	**0.017**	**0.095**	**0.019**	**0.018**	**42.4**	**0.0004**	**0.0015**

An OCS air permit is not required because the project is not considered an OCS source, the project emissions are associated with mobile sources, and total emissions are well below the thresholds of 50 tons per year of NOx and VOCs, 100 tons per year of the other criteria air pollutants, and 25 tons per year of HAPs (hazardous air pollutants) or 10 tons per year of any individual HAP.

3.2 Potential Impacts

To assess the SAP activities described in Section 1.0, impacts have been classified into one of four levels – negligible, minor, moderate, or major, according the MMS Programmatic Environmental Impact State for Alternative Energy as described below (MMS 2007).

The impact levels are defined as follows:

- Negligible: No measurable impacts.
- Minor: Most impacts to the affected resource could be avoided with proper mitigation. If impacts occur, the affected resource will recover completely without any mitigation once the impacting agent is eliminated.
- Moderate: Impacts to the affected resource are unavoidable. The viability of the affected resource is not threatened although some impacts may be irreversible, OR The affected resource would recover completely if proper mitigation is applied during the life of the project or proper remedial action is taken once the impacting agent is eliminated.
- Major: Impacts to the affected resource are unavoidable. The viability of the affected resource may be threatened, AND The affected resource would not fully recover even if proper mitigation is applied during the life of the project or remedial action is taken once the impacting agent is eliminated.

The following table summarizes the potential impacts that could be incurred due to the SAP activities; this impact assessment factors in the implementation of mitigation measures proposed in Section 3.3. For the purposes of this document, only resources with negligible impacts or greater will be described in the subsections below.

Table 3.2. Summary of Impacts

Project Activity	Geologic Resources	Coastal Habitats & Terrestrial Mammals	Water Quality	Benthic Resources	Fisheries & Essential Fish Habitat	Marine Mammals & Sea Turtles	Coastal & Marine Birds & Bats	Air Quality	Archaeological Resources	Visual Resources	Navigation, Transportation & Military Activities	Commercial & Recreational Fishing	Socioeconomics
Installation													
Vessels	NA	N	NA	NA	NA	N	NA	N	NA	NA	N	NA	NA
Anchor Deployment	N	NA	NA	N	N	NA	NA	NA	NA	NA	N	NA	NA
Operation													
Service Vessels	NA	N	NA	NA	NA	N	NA	N	NA	NA	N	NA	NA
Buoy (incl. anchor & chain sweep)	N	NA	NA	N	N	N	NA	NA	NA	NA	N	NA	NA
Lighting	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	N	NA	NA
Decommissioning													
Vessels	NA	N	NA	NA	NA	N	NA	N	NA	NA	N	NA	NA
Anchor Removal	N	NA	NA	N	N	NA	NA	NA	NA	NA	N	NA	NA

N = Negligible
NA = Not applicable or less than negligible

3.2.1 Vessel Related Potential Impacts

The vessel activities necessary to install, operate, and remove a MET/ocean buoy have the potential to affect coastal habitats and terrestrial mammals, marine mammals and sea turtles, air quality, and navigation, transportation, and military operations. Potential impacts to these resources are described below.

Although other resources could experience minor side effects from vessel related activities, due to the very limited number of vessels and vessel trips associated with the SAP activities, those effects are expected to be less than negligible; and therefore, will not be described further.

Certain non-routine events associated with vessel activities, although unlikely, include collisions and spills. Vessels associated with installation, operation, and decommissioning could collide with other vessels and experience accidental capsizing or result in a diesel spill. Collisions are considered unlikely since vessel traffic is controlled by multiple routing measures, such as safety fairways, TSSs, and anchorages. These higher traffic areas were excluded from the WEAs, as described in BOEM (2014).

A diesel spill could also occur as a result of accidents or natural events. Vessels are expected to comply with USCG requirements relating to prevention and control of oil spills.

Coastal Habitats and Terrestrial Mammals

Increased minimal vessel traffic associated with SAP activities could impact coastal habitats and terrestrial mammals due to wake erosion and associated sediment disturbance. However; given the existing volume and commercial/industrial nature of existing vessel traffic in the SAP Area, only a negligible increase, if any, to wake induced erosion may occur around smaller, non-armored, waterways used by project vessels. Therefore, potential impacts are expected to be negligible, if any.

Marine Mammals and Sea Turtles

Increased minimal vessel traffic associated with SAP activities could impact marine mammals and sea turtles due to the potential disturbance from work vessels and from vessel collisions.

The potential disturbance to this resource is from the presence of the vessels traveling to and from the SAP Area. The dominant source of noise from vessels is from the propeller cavitation, and the intensity of this noise is largely related to ship size and speed. Exposure of marine mammals and sea turtles to individual construction operations vessels would be transient, and the noise intensity would vary depending upon the source and specific location. Reactions of marine mammals may include apparent indifference, cessation of vocalizations or feeding activity, and evasive behavior (e.g., turns, diving) to avoid approaching vessels (Richardson et al., 1995; Nowacek and Wells, 2001). Behavior would likely return to normal following passage of the vessel, and it is unlikely that such short-term effects would result in long-term population-level impacts for marine mammals. Furthermore, the SAP Area and adjacent waters are well-traveled waters and are host to an active fishing industry (recreational and commercial) and commercial shipping industry, and marine mammals and sea turtles are habituated to the existing conditions. While vessel traffic associated with the SAP activities may add to the existing conditions, because there will so few vessel trips associated with the SAP activities, the change is expected to be insignificant. Thus, impacts from vessel presence and noise to marine mammals and sea turtles would be negligible, if any.

Vessels associated with the SAP activities could collide with marine mammals or sea turtles during transit. However; the implementation of the vessel strike avoidance measures (Section 3.3.1) will limit the likelihood or prevent such collisions. These measures contain vessel approach protocols derived from the MMPA and identify safe navigational practices based on speed and distance limitations when encountering marine mammals. Considering the implementation of mitigation measures; the limited intermittent activities, which are spread out temporally, no significant impacts due to vessel strikes are anticipated. Thus, impacts from vessel collisions to marine mammals and sea turtles would be negligible, if any.

Air Quality

Due to the low level of additional vessel traffic that will be traversing the SAP Area at any one time over the course of the installation, operation and removal of the MET/ocean buoy(s), and due to the existing air quality in these areas, the amount of human activity that emits air pollutants in these areas, and the short duration of the emissions associated with these activities, and the mitigation measures described in Section 3.3, the potential impacts to ambient air quality are expected to be negligible, if any.

Navigation, Transportation, and Military Operations

There will be a very limited increase in vessel traffic associated with SAP activities, and only limited potential for impacts to navigation, transportation and military activities. SAP activities, in accordance with the Lease, are subject to restrictions imposed by military and NASA needs, rules, and regulations. To address the requirements of its Lease and avoid such interference, coordination between the Department of Defense (DoD) and vessel operators and contractors will be required, as needed throughout SAP activities, to ensure there are not conflicts with and/or adverse impacts to military activities in the SAP Area. Thus, potential impacts to navigation, transportation, and military operations are expected to be negligible, if any.

3.2.2 Buoy-Related Potential Impacts

The presence of a MET/ocean buoy, and its components, have the potential to affect geologic resources, benthic resources, fisheries and essential fish habitat, marine mammals and sea turtles, navigation, and transportation and military operations. Potential impacts to these resources are described below.

Although other resources could experience minor effects from the buoy(s) presence, due to the very small size of the buoy(s) and temporary existence, those effects are expected to be less than negligible; and therefore, will not be described further.

Geologic Resources

It is anticipated that deployment of the MET/ocean buoy would impact a small area of seafloor, approximately 4 m^2 (43 ft^2), due to placement of the anchor or mooring weight to secure the buoy. Thus, potential impacts to geologic resources are expected to be negligible, if any.

Benthic Resources

The primary direct impact from installation of the buoy(s) would include injury or mortality of benthic epifauna and infauna within the immediate area where the anchor is placed on the seafloor. Indirect construction impacts from suspended sediments and sediment deposition are not anticipated during installation of the buoy(s).

Operational impacts to benthic resources would consist primarily of anchor chain sweep and habitat alteration, both of which would be temporary and highly localized. With regard to anchor chain sweep, organisms with limited mobility and consequent inability to avoid the impacted area may experience injury or mortality. However, these impacts are anticipated to be temporary and highly localized; chain sweep is expected to disturb an area with a radius of 100-150m around the anchor.

Habitat alteration will be associated with the introduction of hard substrate (concrete slab anchors and chains) in an area currently consisting of unconsolidated sands. Benthic epifauna adapted to hard bottom habitats (fouling community) would be anticipated to colonize the new areas of hard substrate created by the buoy(s) anchoring system.

Indirect impacts from suspended sediments and sediment deposition are possible but expected to be extremely limited, due to the small size and temporary nature of the MET/ocean buoy and anchoring system.

The primary direct impact from removal of the buoy(s) would include injury or mortality of benthic epifauna that colonized the anchor during operation. However, following removal of the anchor, the benthic community is expected to rapidly recolonize the underlying seafloor. Indirect impacts from suspended sediments and sediment deposition are not anticipated during removal of the buoy(s).

Overall, small area of impact, compared to the large source area of similar undisturbed habitat adjacent to it, is expected to result in rapid recovery of benthic resources following removal of the MET/ocean buoy(s), as has been observed following temporary physical disturbance in similar habitats (e.g., Guerra-García et al. 2003, Schaffner 2010). Thus, potential impacts to benthic resources from SAP activities are anticipated to be negligible, if any.

Fisheries and Essential Fish Habitat

The presence of MET/ocean buoy(s) would result in some loss of habitat and cause some sediment to become suspended around the anchor chain sweep. This sediment would be dispersed and settle on the surrounding seafloor. However, due to the small footprint of disturbance relative to the overall resource, the temporary nature of the action, and availability of similar benthic habitat adjacent to the SAP Area, it is expected that the SAP activities would have negligible effects that could impact fish resources, if any.

Marine Mammals and Sea Turtles

The presence of MET/ocean buoy(s) would result in small areas of the seafloor being temporarily disturbed and occupied. This activity could conceivably impact marine mammals and sea turtles by removing a small amount of forage area that would otherwise be available to these species. However, due to the small footprint of disturbance, the temporary nature of the action, and likely availability of similar habitat adjacent to the SAP Area, it is expected that the presence of buoy(s) would have negligible effects that could impact marine mammals and sea turtles.

Navigation, Transportation and Military Operations

The presence of a MET/ocean buoy(s) has the potential to interfere with existing vessel traffic and military operations. The mitigation measures described in Section 3.3 will significantly reduce any potential impacts to navigation, transportation and military operations. Thus, potential impacts to navigation, transportation and military operations are expected to be negligible, if any.

3.3 Mitigation Measures

In accordance with the Lease and BOEM's 2014 EA, the following subsections describe the Standard Operating Conditions (SOCs) pertinent to the installation, operation, and removal of a temporary MET/ocean buoy.

For cultural resources and biologically sensitive habitats, the primary mitigation strategy is avoidance. The exact location of meteorological towers and buoys would be adjusted to avoid adverse effects to offshore cultural resources or biologically sensitive habitats, if present.

BOEM has developed several measures called Standard Operating Conditions (SOCs) to minimize or eliminate impacts on protected species. These SOCs were developed through consultation with other Federal and State agencies. The following mitigation measures are derived from BOEM's SOCs and supplemented with additional measures to ensure protection to the affected resources.

3.3.1 Vessel Strike Avoidance Measures

The measures in this section are quoted directly from the Lease and are applicable to the preparation of a SAP and a COP. These measures are not applicable to approved SAP activities, although the measures used in the activities described herein are expected to be similar.

3.3.1.1. The Lessee must ensure that all vessels conducting activity in support of plan (i.e., Site Assessment Plan [SAP] and/or COP) submittal comply with the vessel-strike avoidance measures specified in the following stipulations, except under extraordinary circumstances when complying with these requirements would put the safety of the vessel or crew at risk

3.3.1.2. The Lessee must ensure that vessel operators and crews maintain a vigilant watch for cetaceans, pinnipeds, and sea turtles and slow down or stop their vessel to avoid striking these protected species.

3.3.1.3. The Lessee must ensure that all vessel operators comply with 10 knot (<18.5 km/hr) speed restrictions in any Dynamic Management Area (DMA). In addition, the Lessee must ensure that all vessels operating from November 1 through July 31 operate at speeds of 10 knots (<18.5 km/hr) or less.

3.3.1.4. North Atlantic Right Whales:

3.3.1.4.1. The Lessee must ensure all vessels maintain a separation distance of 500 m (1,640 ft) or greater from any sighted North Atlantic right whale.

3.3.1.4.2. The Lessee must ensure that the following avoidance measures are taken if a vessel comes within 500 m (1,640 ft) of any North Atlantic right whale:

3.3.1.4.2.1. If underway, vessels must steer a course away from any sighted North Atlantic right whale at 10 knots (<18.5 km/h) or less until the 500 m (1,640 ft) minimum separation distance has been established (except as provided in Stipulation 3.3.1.4.2.2).

3.3.1.4.2.2. If a North Atlantic right whale is sighted in a vessel's path, or within 100 m (328 ft) to an underway vessel, the underway vessel must reduce speed and shift the engine to neutral. The Lessee must not engage the engines until the North Atlantic right whale has moved outside the vessel's path and beyond 100 m (328 ft).

3.3.1.4.3. If a vessel is stationary, the vessel must not engage engines until the North Atlantic right whale has moved beyond 100 m (328 ft), at which point the Lessee must comply with Stipulation 3.3.4.2.1.

3.3.1.5. Non-delphinoid Cetaceans Other than the North Atlantic Right Whale:

3.3.1.5.1. The Lessee must ensure all vessels maintain a separation distance of 100 m (328 ft) or greater from any sighted non-delphinoid cetacean.

3.3.1.5.2. The Lessee must ensure that the following avoidance measures are taken if a vessel comes within 100 m (328 ft) of any non-delphinoid cetacean:

3.3.1.5.2.1. If any non-delphinoid cetacean is sighted, the vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the non-delphinoid cetacean has moved outside of the vessel's path and beyond 100 m (328 ft).

3.3.1.5.2.2. If a vessel is stationary, the vessel must not engage engines until the non-delphinoid cetacean has moved out of the vessel's path and beyond 100 m (328 ft).

3.3.1.6. Delphinoid Cetaceans:

3.3.1.6.1. The Lessee must ensure that all vessels maintain a separation distance of 50 m (164 ft) or greater from any sighted delphinoid cetacean.

3.3.1.6.2. The Lessee must ensure the following avoidance measures are taken if the vessel comes within 50 m (164 ft) of a sighted delphinoid cetacean:

3.3.1.6.2.1. The Lessee must ensure that any vessel underway remain parallel to a sighted delphinoid cetacean's course whenever possible, and avoid excessive speed or abrupt changes in direction. The Lessee may not adjust course and speed until the delphinoid cetacean has moved beyond 50 m (164 ft) and/or the delphinoid cetacean has moved abeam of the underway vessel.

3.3.1.6.2.2. The Lessee must ensure that any vessel underway reduce vessel speed to 10 knots (18.5 km/h) or less when pods (including mother/calf pairs) or large assemblages of delphinoid cetaceans are observed. The Lessee may not adjust course and speed until the delphinoid cetaceans have moved beyond 50 m (164 ft) and/or abeam of the underway vessel.

3.3.1.7. Sea Turtles and Pinnipeds:

3.3.1.7.1. The Lessee must ensure all vessels maintain a separation distance of 50 m (164 ft) or greater from any sighted sea turtle or pinniped.

3.3.1.8. Vessel Operator Briefing. The Lessee must ensure that all vessel operators are briefed to ensure they are familiar with the above listed stipulations.

3.3.2 Marine Trash and Debris Prevention

The measures in this section are quoted directly from the Lease.

The Lessee must ensure that vessel operators, employees, and contractors engaged in activity in support of plan (i.e., SAP and/or COP) submittal are briefed on marine trash and debris awareness and elimination, as described in the Bureau of Safety and Environmental Enforcement (BSEE) Notice to Lessee (NTL) No. 2015-G03 ("Marine Trash and Debris Awareness and Elimination") or any NTL that supersedes this NTL, except that the Lessor will not require the Lessee, vessel operators, employees, and contractors to undergo formal training or post placards. The Lessee must ensure that these vessel operator employees and contractors are made aware of the environmental and socioeconomic impacts associated with marine trash and debris and their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into the marine environment. The above-referenced NTL provides information the Lessee may use for this awareness training.

3.3.3 Buoy Markings and Lighting

Navigation lights for buoy(s) will be in compliance with USCG requirements. In addition, support vessels will be used only when necessary and vessel lighting will be hooded and directed downward, when possible, to reduce upward illumination and illumination of adjacent waters.

3.3.4 Buoy Notifications

Vineyard Wind will communicate the exact GPS location of the buoy(s) with the USCG, DoD, BOEM, and all other pertinent agencies. Additionally, the exact timing of the installation and removal of the buoy(s) will also be directly coordinated with USCG, DoD, BOEM, and all other pertinent agencies.

3.3.5 Air Quality Control Measures

Given the minimal air emissions associated with the SAP activities the appropriate mitigation measures are consistent with industry standard, area-wide measures for marine vessels. This includes existing fleet wide requirements for engine certifications (for 40 C.F.R Part 89, Tier 3 engines typical), emissions control equipment, and regular maintenance along with the use of ultra-low sulfur diesel fuel.

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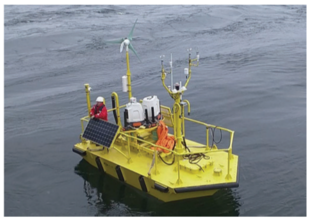
Appendix A

MET/Ocean Buoy Specifications

Proposed AXYS Buoy Systems

AXYS WindSentinel Floating LiDAR (also referred to as "Flidar", a commercial name by AXYS)	
	The AXYS WindSentinel is a marine buoy equipped with LiDARs specifically suited for marine conditions. Specific details of the device can be found in Appendix A. This summary table only addresses key technical data.
Overall dimension	Length: 6.30m (248 inches) Width: 3.2m (126 inches) Height to Deck Hatch: 2.85m (112 inches)
Weight	Bare Hull Weight (BHW) with no batteries, fuel or payload: *Approx. 6,800 kg (15,000 lbs) (includes 1,000 #/454kgs ballast)* BHW + 40 batteries + full payload + 240 gallons fuel *Approx. 10,000 kg (21,800 lbs)*

AXYS Technology - TRIAXYS Wave and Current Buoy	
	The AXYS TRIAXYS is a marine buoy measuring sea state conditions and sub surface currents. • Specific details of the device can be found in Appendix A. This summary table only addresses key technical data.
Overall dimension	Diameter: 1.10m (43 inches) Height: 1.10m (43 inches)
Weight	Weight (including batteries): 230 kg (510 lbs)

DEPLOYMENT DEPTH: 28.8m – 54.5m
MOORING LENGTH: 162m
MOORING SCOPE: 5.63:1 to 2.97:1
EXCURSION RADIUS: 159m – 153m

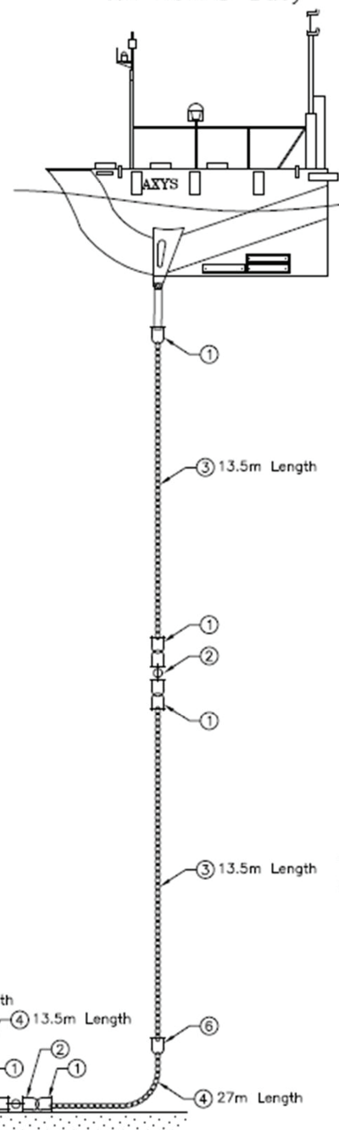
REVISIONS			
REV.	DESCRIPTION	DATE D/M/Y	BY
00	Original design	11/08/16	AJM
01	Added extra swivel, welded SCS, and U mooring separation diagram as per TE, increased font	07/10/16	JRC

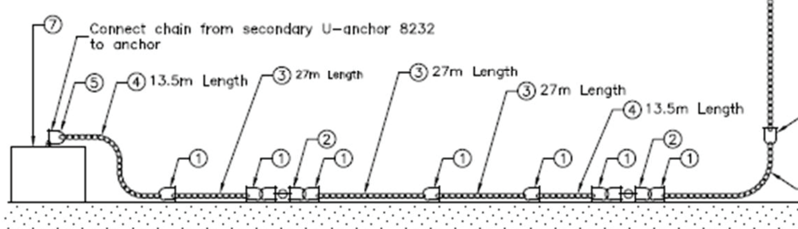
Bill of Materials

ItemNo	Description	Qty
1	38mm [1–1/2"] 3rd Class USCG SKS (28,223 kg [62,000 lb] PL)	10
2	38mm [1–1/2"] Eye&Eye Swivel, Welded Nut (20,502.4 kg [45,200 lb] WLL; 102,512 kg [226,000 lb] ULL)	3
3	32mm [1–1/4"] OLC, Grd 2, Blk (41,276.9 kg [91,000 lb] BL; 20,638.5 kg [45,500 lb] PL)	108m
4	38mm [1–1/2"] OLC, Grd 2, Blk (59,421 kg [131,000 lb] BL; 29,710 kg [65,500 lb] PL)	54m
5	42mm [1–5/8"] D Forelock Shackle with Oval Pin (75,000 kg [165,350 lb] BL)	1
6	38mm [1–1/2"] Crosby G–2150 SCS, Welded Nut (17,000 kg [37,400 lb] WLL)	1
7	5,000 kg Load Certified Oval Pattern Cast Iron Sinker; 70mm Eye	1

Definitions

ItemNo	Description
SKS	Split Key Shackle, a.k.a. Forelock Shackle
USCG	United States Coast Guard
BL	Breaking Load, a.k.a. Breaking Strength
PL	Proof Load, a.k.a. Proof Strength
WLL	Working Load Limit
ULL	Ultimate Load Limit
Grd	Grade, per ABS or Lloyd's Register
Blk	Black. Acceptable alternative is Galvanized
ABS	American Bureau of Shipping
SAS	Safety Anchor Shackle
SCS	Safety Chain Shackle





NOTES:
1. Reference http://goo.gl/ENikX4 for North American chain dimensions.
2. Reference http://goo.gl/jnnlS5 for European chain dimensions.
3. Reference http://goo.gl/NTia0w for 1–1/2" US Coast Guard 3rd Class Split Key Shackle Specifications.

When printed, make sure you are using the most current revision of this document.

DESIGNER: AXYS
QA: This drawing is controlled through Q–PULSE
TEMPLATE #: QT730–03–00.dwg

DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED.
LINEAR TOLERANCES ARE: X ±0.1 X.X ±0.03 X.XX ±0.01 X.XXX ±0.003
ANGULAR TOLERANCES ARE: X.X ±0.1 X.XX ±0.05

AXYS TECHNOLOGIES INC.
P.O.BOX 2219, 2045 MILLS RD.
SIDNEY, B.C., CANADA V8L 3S8
(250)655–5850 Fax:(250)655–5856

MATERIAL: As Specified
FINISH: –

FLiDAR WindSentinel
28–55m Depth, All Chain, w/ Anchor

SCALE: NTS | DRAWN BY: AJM | DATE: 11/08/16

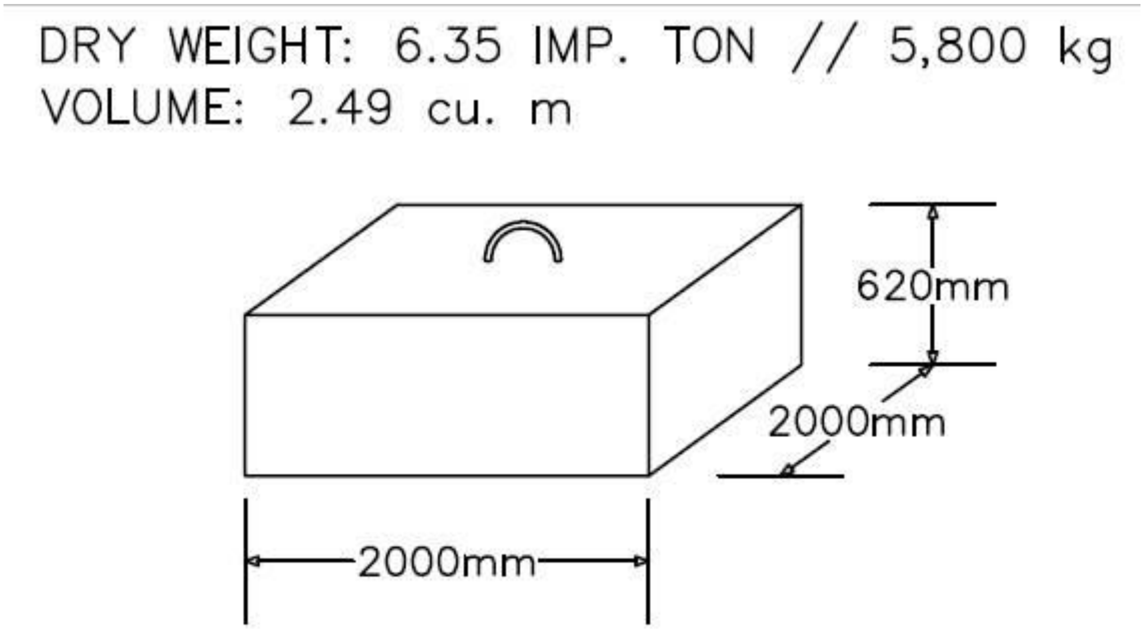
ACAD FILE: ..\CONTROLLED DOCUMENTS\08195\08195005.dwg

SHEET: 1 of 2 | SIZE: A | DRAWING NUMBER: 08195 | REV: 01

http://www.oceanor.no/

Mooring specifications

Example of a concrete anchor.



Using a rated steel anchor is preferred and it has a smaller footprint.

FLiDAR WindSentinel Buoy

Prepared by

AXYS Technologies

Head Office
2045 Mills Road
Sidney, British Columbia
Canada

European Office
Esplanadestraat 1
8400 Oostende
Belgium

www.axystechnologies.com

Housing

Hull	5086 Aluminum (4x compartments)
Superstructure	6061 Aluminum
Mooring Bridle	316 Stainless Steel (Isolated)
Anodes	10kg Zinc (4x mooring yoke; 2x Hull)

Dimensions

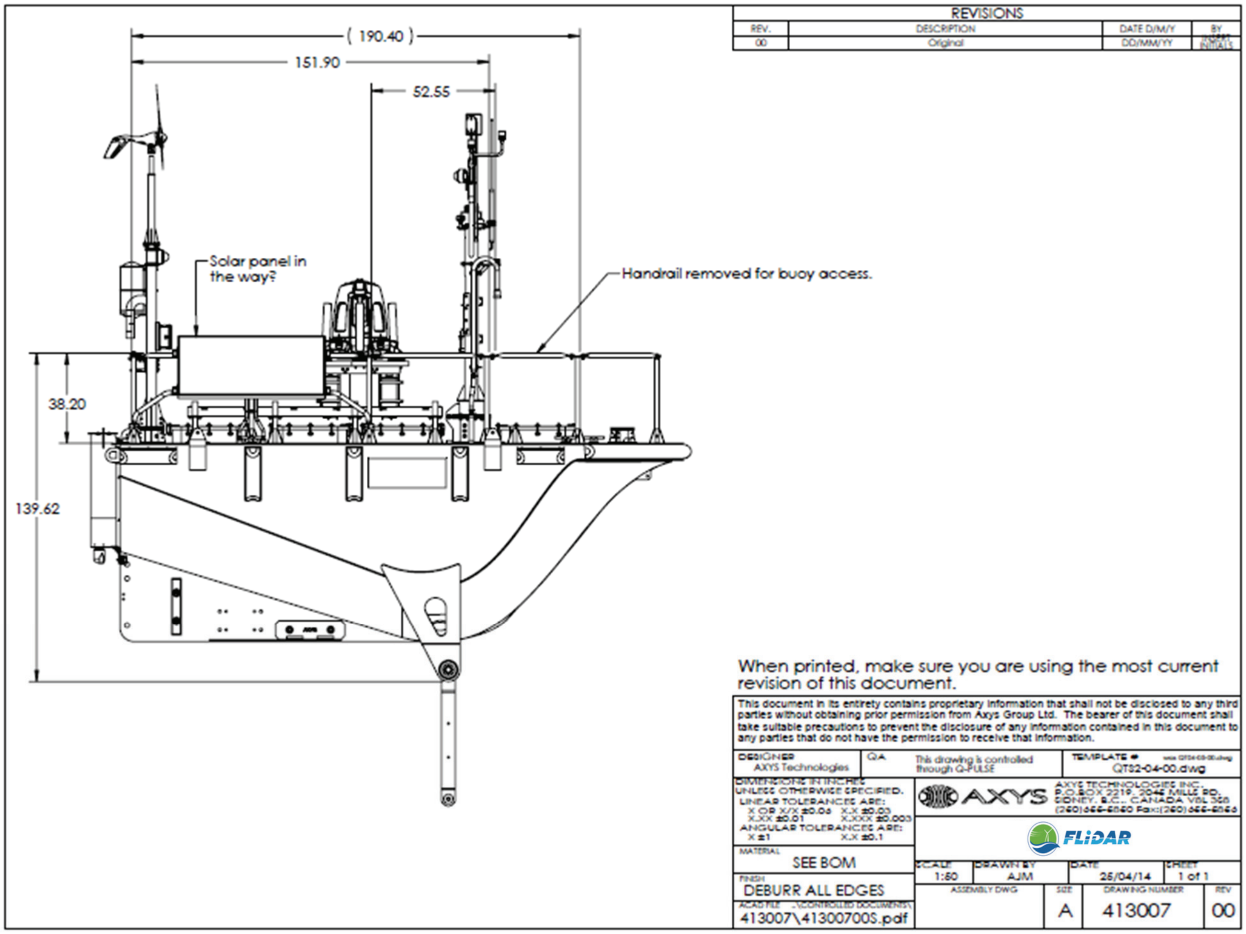


Figure 1: FLiDAR WindSentinel Dimensions – Dual ZephIR Deployment View

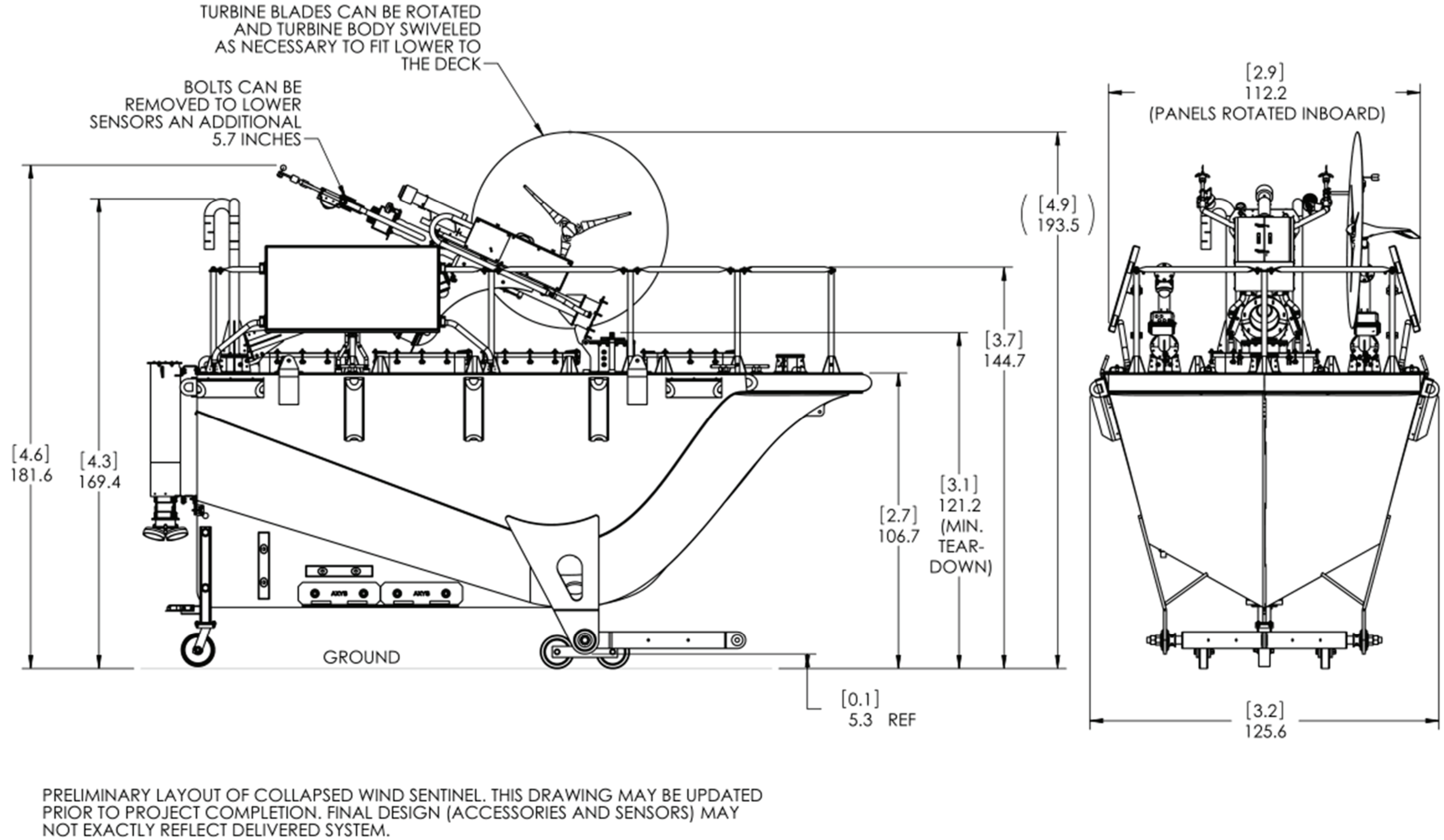


Figure 2: FLiDAR WindSentinel Dimensions – Transportation View

Table 1: Dimensions

Item	Specification
Length	6.30m (248 inches)
Width	3.2m (126 inches)
Height to Deck Hatch (from Yoke Pivot)	2.85m (112 inches)

Weight

Table 2: Weights

Item	Specification
Bare Hull Weight- BHW (with no batteries, fuel or payload)	Approximately 6818 kg (15,000 lb) (includes 1,000 #/454kgs ballast)
BHW + 40 batteries	Approximately 8090 kg (17,800 lb)
BHW + 40 batteries + full payload	Approximately 8773 kg (19,300 lb)
BHW + 40 batteries + full payload + 240 gallons fuel	Approximately 9,910 kg (21,800 lb)

Lighting

Carmanah Light Model M850 Solar LED Marine Lantern.

- Over 7 NM range (3-6 NM in all colours)
- integrated batteries and solar panels
- independent of other buoy components
- Programmable signal pattern can be set to following specifications:
  - FAA L-810 (AC 150/5345-43, EB67)
  - ICAO Type A (Annex 14, Vol. 1, 5th Ed./2009)
  - ICAO Type A (Annex 14, Vol. 1, 6th Ed./2013)
  - ICAO Type B (Annex 14, Vol. 1 5th Ed./2009)
  - ICAO Type B (Annex 14, Vol. 1, 6th Ed./2013)
  - CASA 10 cd (Part 133, Vol. 2)*
  - Transport Canada CD-810 (Std. 621)

Mooring Type, Scope and Materials

The mooring design will take the following factors into consideration:

- Water depth
- Desired length of life of the mooring
- Vessel traffic in the vicinity of the mooring
- Current speed
- Tides
- Waves
- Winds

PROCEDURE FOR A TWO DAY DEPLOYMENT AXYS 6 m FLiDAR buoy

N.B. All works will be preceded by a tool box talk involving all personnel.

A: Pre-mobilization

1. The RAMS document will be approved and agreed between all parties prior to mobilization (AXYS, TSM, and Client).
2. A pre-survey brief will be conducted in the office between the Project Manager and the survey personnel. Survey requirements will be outlined, responsibilities will be defined, next-of-kin details checked and HS&E issues discussed.
3. Weather, tide and sea state will be monitored prior to the works. Mobilization will be subject to safe, workable limits and forecasts. Client will be informed of planned mobilization as soon as the decision to mobilize has been made.

Trip One on Day One: Mooring Deployment

B: Vessel mobilization

1. The anchor weight, lower sections of riser chain (67.5m), rope (28mm dia 3 Strand PolySteel Rope – Break load 13900kg) and temporary marker float will be mobilized to the TSM Albatre in port using an onshore crane.
2. The anchor weight will be placed to the stern of the TSM Albatre.
3. The vessel crane will be used to flake the chain according to its deployment order (see Fig. 2). All riser chain components will be checked. Sacrificial tag lines will be placed at the forward end of each flake between the chain and towing bollard.

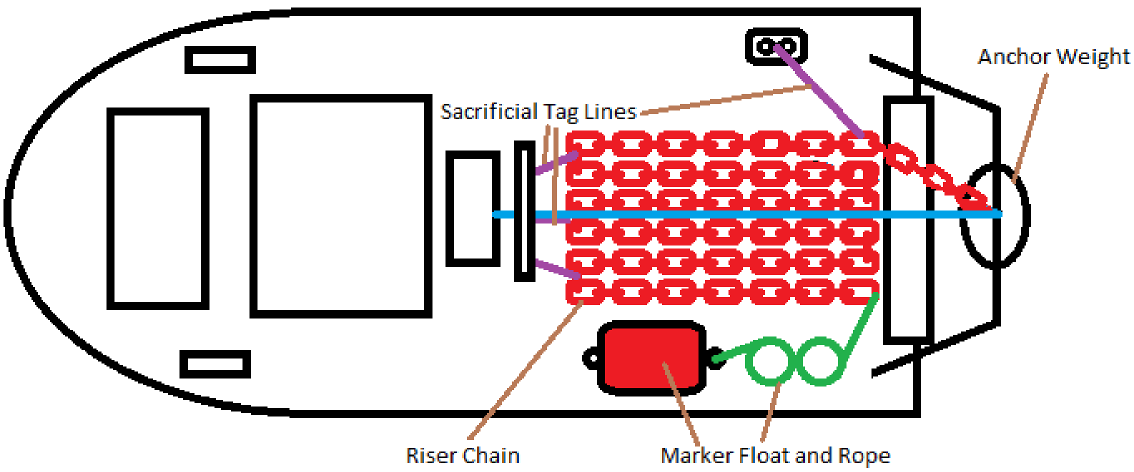


Figure 2: Deck layout of TSM Albatre after mooring has been setup. N.B. Not to scale.

4. The winch wire will be passed through the A-frame and the release hook connected.
5. The release hook will be connected to the anchor weight.
6. A tag line will be attached between a cleat on the TSM Albatre and the main winch capstan, passing through the anchor weight eye and kept taught to secure the anchor weight.

7. The shore-side crane will move the anchor weight to below the A-frame with the top of the anchor weight level with the deck. The winch wire will take the load of the anchor weight and the shore-side crane will be disconnected.
8. Another sacrificial tag line will be connected to the riser chain and a cleat at the stern of the TSM Albatre.
9. The anchor weight will be secured to prevent uncontrolled release of the release hook.

C: AXYS 6 m FLiDAR buoy mooring deployment operation (see Figure 3)

1. A pre-sail briefing will be conducted to define personnel roles and responsibilities.
2. The TSM Albatre will transit to the deployment site.
3. The rope will be attached between the free end of the riser chain and the marker float.
4. The TSM Albatre will take position away from the deployment location and deploy the rope and marker float over the stern of the vessel. Sacrificial tag lines will then be removed from the mooring prior to the chain deployment operations.
5. The TSM Albatre will begin slowly moving towards the deployment location while the chain is released over the stern. The mooring will be allowed to stream off deck over the stern of the vessel (see Fig. 3).
6. The TSM Albatre will maneuver on to position.
7. The release line for the release hook will be controlled by a member of the crew to ensure the line is slack during the deployment operations. This crew member will be positioned to the starboard side of the TSM Albatre.
8. The tag lines and securing lines will be removed from the anchor weight.
9. The safety latch of the release hook will be removed and the anchor weight will be lowered to the seabed.
10. Once on the seabed, the weight will be raised slightly for final positioning. Once on position, the release hook will be engaged and anchor weight deployed.

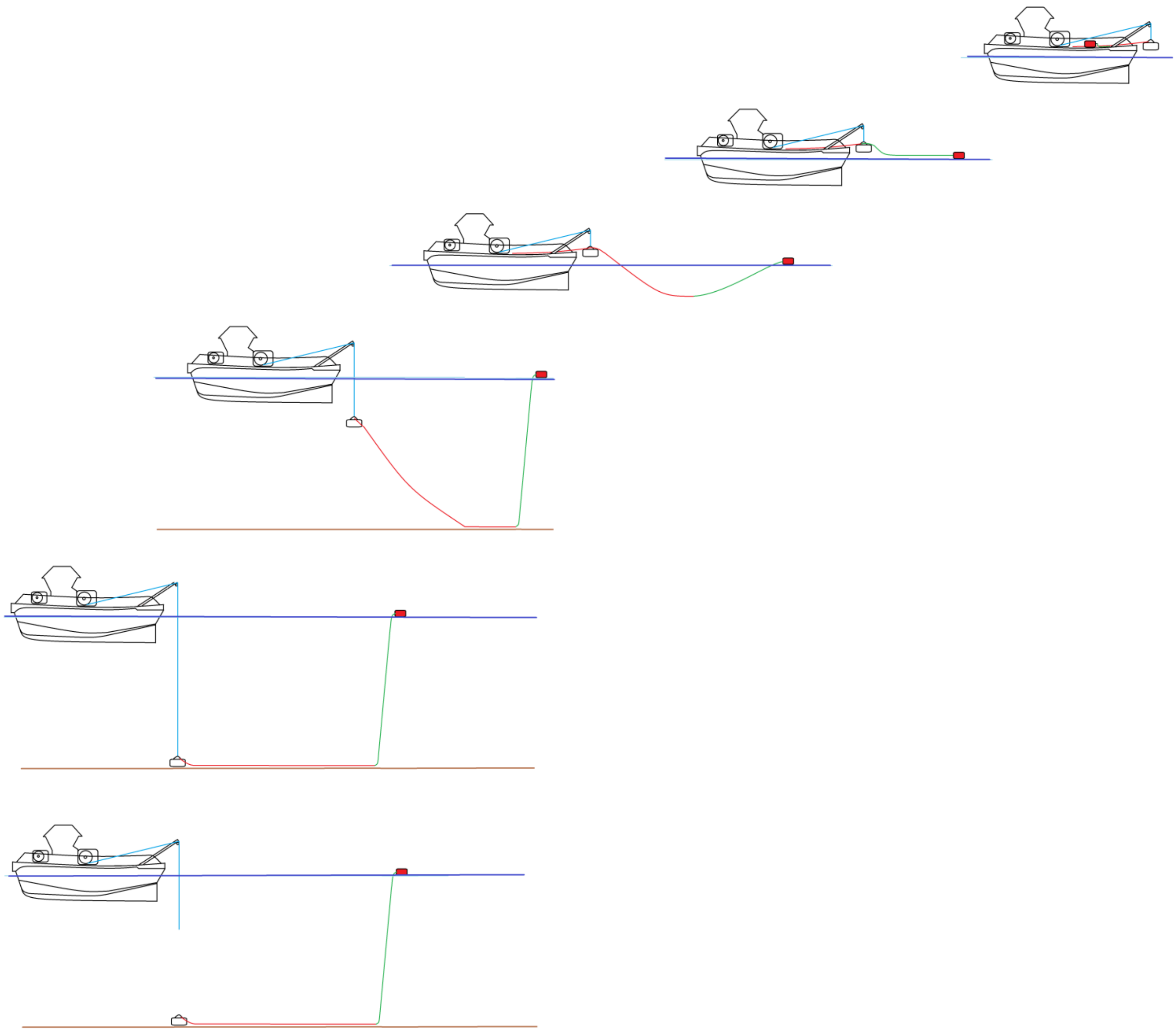


Figure 3: Diagram of riser chain deployment operation. N.B. Image is not to scale; diagram to be used as a guide to operation only. Red lines refer to chain, green lines refer to ropes, light blue lines to winch wires.

<u>Trip Two on Day 2: AXYS 6 m FLiDAR buoy Deployment</u>

<u>D: Vessel mobilization</u>

1. The upper mooring section (13.5m) will be attached to the AXYS 6 m FLiDAR buoy shackled and secured. The free end of the mooring section will be transferred to the TSM Albatre and attached to the winch wire.
2. The AXYS 6 m FLiDAR buoy will be lifted in the water behind the vessel, using an onshore crane and lifting strops attached to the lifting eyes of the AXYS 6 m FLiDAR buoy.

3. The AXYS 6 m FLiDAR buoy will be secured to the quayside in addition to the tow line if departure of the TSM Albatre is delayed for lock gates or similar.

E: AXYS 6 m FLiDAR buoy towing operations

1. The upper mooring (13.5m) section of riser chain from the AXYS 6 m FLiDAR buoy will be used as the primary tow point.
2. The tow will proceed at a maximum of 5 knots from the mobilization port to the deployment site.
3. The TSM Albatre will transit the Dieppe port locks towing the buoy close astern for ease of control.
4. Once in open water, the tow line will be extended to a suitable distance for the tow.
5. Once upon site, the winch wire will be pulled in and a sacrificial line attached to the riser chain. The winch wire will then be removed.
6. A 20m line will be attached between the lower end of the riser chain and a float.
7. The Celtic Wind/Warrior will approach the AXYS 6 m FLiDAR buoy and attach lines to maneuver the AXYS 6 m FLiDAR buoy.
8. The riser will be disconnected from the vessel and the AXYS 6 m FLiDAR buoy moved away using the Celtic Wind/Warrior for the duration of the riser chain recovery.

F: AXYS 6 m FLiDAR buoy deployment operations (see Figure 4)

1. The marker float will be recovered by the TSM Albatre and the rope attached to the main capstan winch. The rope will be wound on, and the mooring chain pulled to the surface.
2. The mooring chain will be brought on deck and secured. The rope will be removed from the riser chain.
3. The mooring buoy for the chain attached to the AXYS 6 m FLiDAR buoy will be recovered and the chain brought on deck and secured.
4. The final connection between the AXYS 6 m FLiDAR buoy and the riser chain will be made.
5. The completed mooring will then be released overboard.
6. The Celtic Wind/Warrior will remove its tow line from the buoy.
7. Post deployment checks will be made, including visual checks of the mooring behavior and buoy movement.

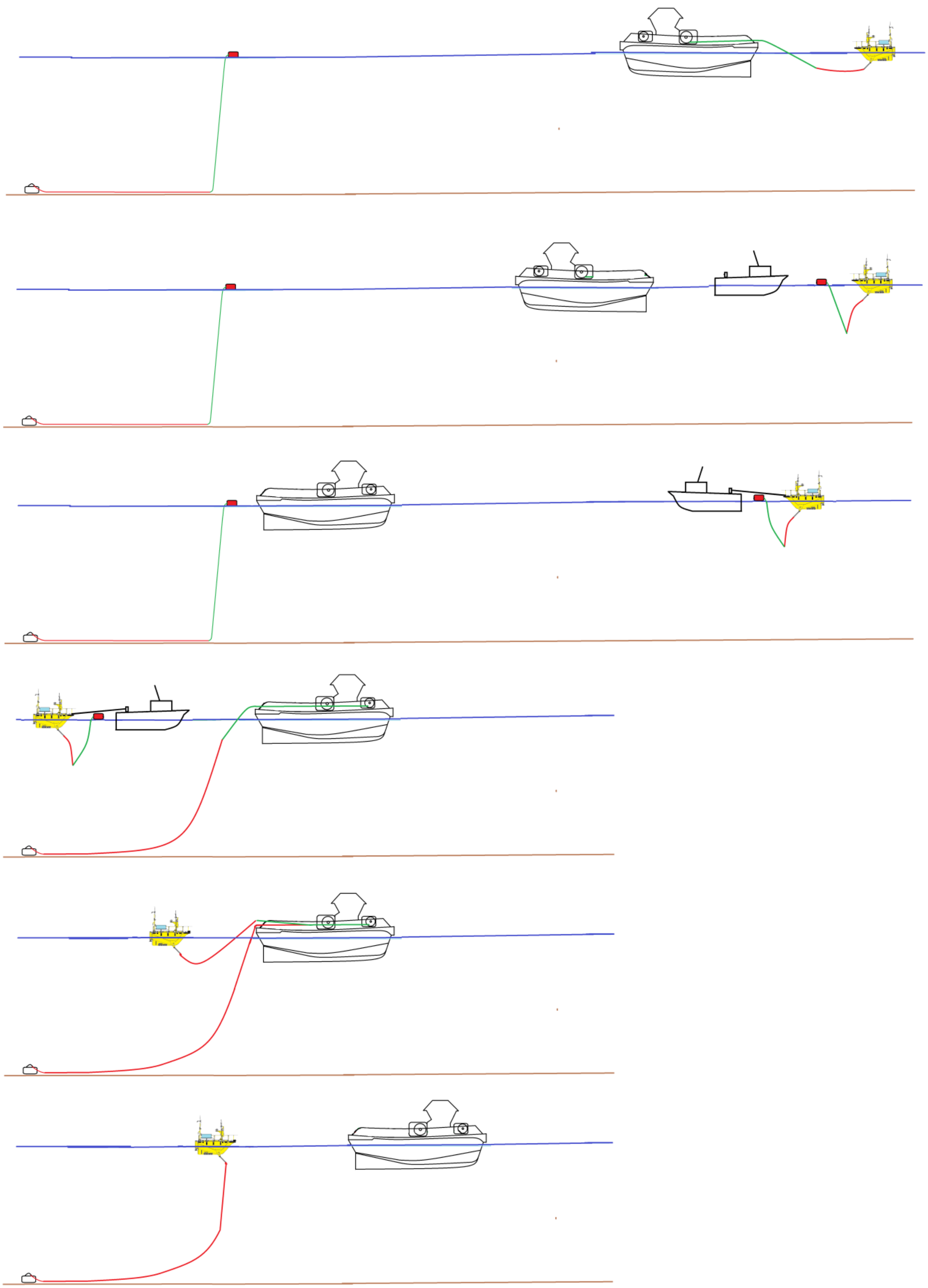


Figure 4: AXYS 6 m FLiDAR buoy deployment operations. N.B. Diagram to be used as a guide to operation only. Red lines refer to chain, green lines refer to ropes.

G: Demobilization

1. A survey de-brief will take place on return to the office between survey personnel and Project Manager. Any actions arising from the post-survey debrief will be assigned to a member of the team and deadlines given.

An operational and functionality report will be produced by survey personnel to a template agreed upon before operations begin.

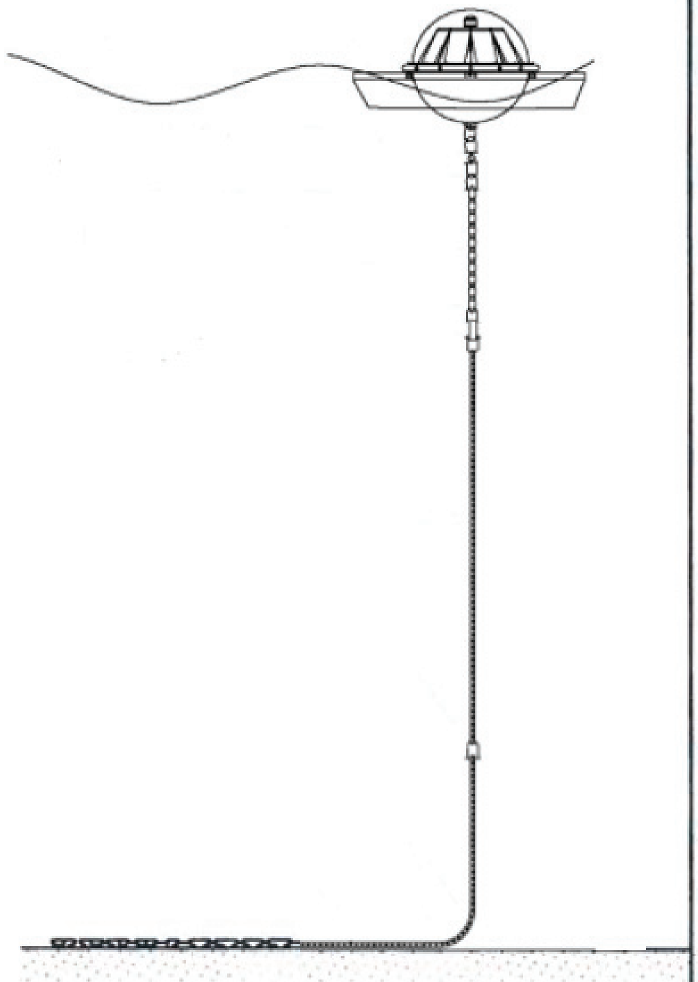
NORTHSTAR COMMANDER

The Northstar Commander is a multi-purpose offshore utility vessel (work-boat), capable of performing a wide variety of duties such as towing, salvage, marine construction, oil-spill response work, in-shore supply work and supporting a wide array of scientific and research projects.

SPECIFICATIONS

Vessel Type	R/V / Commercial Utility Vessel
Length, overall	92ft
Beam	26ft
Draft	8.5ft
Engine	Twin screw Volvo D125-E 450hp each (new 2011)
Accommodations	12 births in 3 cabins
Navigation	2x Furuno Radars, Furuno Nav Net Chart Plotter, AIS & DGPS, Raytheon Thermal Imaging Camera
Fuel Capacity	10,000 gallons
Water Capacity	2,900 gallons with additional options available for extended cruises
Other Equipment	75 ton Tow Winch
	Generators: 1x 65KW John Deere (new 2015) 1X 65KW Caterpillar (reconditioned 2010)
	3.75 ton Palfinger PK 18080MD-S25 Marine Knuckleboom Crane
	Push Knee, Towing Winch, Capstan & Windlass
	Heavy A-frame ready, 16ft A-frame available
	Deck Office Container available
	Auxiliary Hydraulics and additional Pull Master Winches available
	Full USGS safety requirements met

Design Scope: 2:1
Max. Current 1.5m/sec
Max. depth 75m



AXYS

AXYS ENVIRONMENTAL SYSTEMS LTD.
P.O.BOX 2219, 2045 MILLS RD.
SIDNEY, B.C., CANADA V8L 3S1
(604)656-0881 Fax:(604)656-4311

Standard TRIAXYS Mooring Configuration 30–75m

SCALE	DATE	DRAWN BY	APPROVED BY
NTS	Dec 98	AGB	

A

AXYS TECHNOLOGIES INC.

TRIAXYS™

The TRIAXYS™ Wave & Current Buoy is a precision instrument incorporating advanced technologies that make it an easy to use, reliable and rugged buoy for accurate measurement of directional waves and three dimensional currents.

FEATURES & BENEFITS

- Integrated current profiling
- Reliable operation in extreme weather or geographical locations
- Solar powered
- 5 year rechargeable battery life
- Supports AIS Aid to Navigation
- Supports any telemetry
- >2 years of data storage capacity
- Continuous wave sampling
- Spin and impact resistant

TRIAXYS™

Wave & Current Buoy

The TRIAXYS™ Wave & Current Buoy measures directional waves and 3D currents accurately and precisely. The buoy can withstand the rigors associated with deployment and recovery operations including, impact shock, spinning and temporary submergence.

The heart of the TRIAXYS™ Wave & Current Buoy is developed from the AXYS WatchMan500™, which integrates sensor systems and provides onboard data processing, data logging, telemetry, and diagnostic/set-up routines.

The current profiler works equally well in typical ocean surface water and in the high sediment suspensions found near the coast or in rivers. A variety of head designs ensures optimal measurement conditions, regardless of deployment surroundings. The current profiler is insensitive to biofouling and has no moving parts. It provides current speed and direction in up to 128 different layers of the water column. The system electronics integrates Doppler velocity with temperature, pressure, tilt, and compass sensors – all standard with each instrument.

The data transmitted from the buoy include wave statistics, HNE (Heave, North and East Displacements), MeanDir (Wave Direction and energy as a function of frequency), directional and non-directional wave spectra, buoy configuration, status data, position, and WatchCircle™ alarm messages.

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Specifications

- PHYSICAL DESCRIPTION

  Diameter: 1.10m outside bumper

  Weight (including batteries): 235 kg
  Obstruction Light: Amber LED. Programmable IALA ODAS flash sequence with three miles visibility.

- MATERIALS

  Hull: Stainless steel

  Dome: Impact resistant polycarbonate

  Solar Panel Assembly: Fibreglass over foam
  Clamping ring: Stainless steel

- CURRENT PROFILER

  Nortek: Aquadopp 400KHz, 600KHz, 1MHz or 2MHz
  Teledyne RD Instruments: Workhorse Monitor 600KHz

- POWER SYSTEM

  Batteries: 4 @ 12 Volt,100 Amp hr/battery

  Solar Panels: 10 @ 6 Watt
  Maximum Power Point Tracking (MPPT)

  Regulator

- TELEMETRY OPTIONS

  - VHF/UHF
  - IsatData Pro
  - INMARSAT M2M
  - IRIDIUM
  - HSPA Cellular (compatible with GPRS)
  - AIS Aid to Navigation

Resolution/Accuracy

	RANGE	RESOLUTION	ACCURACY
HEAVE	±20 m	0.01 m	Better than 1%
PERIOD	1.5 to 33 sec	0.1 sec	Better than 1%
DIRECTION	0 to 360°	1°	3°
CURRENTS	0-10 m/s	1 cm/s	±10 cm/s
WATER TEMP.	-5 to +50°C	0.1°C	±0.5°C

SYSTEM CERTIFICATION ISO 9001 SGS

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AXYS Technologies Inc.

NORTHSTAR
ENVIRONMENTAL & MARINE SERVICES
Est. 1990

Northstar 4

EQUIPMENT DATA SHEET

Item	Description	Details	Remarks
1	**Vessel Type**	Richard Squires Commercial Workboat	
2	**Official No.**	560915	
3	**Construction**	Aluminum	
4	**Length, Overall**	49' 6"	
5	**Beam**	14' 8"	
6	**Draft**	3' 10"	
7	**Observation platform Clear deck space**	14' x 20'	
8	**Tonnage**	24 GRT	

9	**Color**	Black/White	
10	**Engine**	TMAD 102 Volvo 425 HP Diesel	
11	**Generator**	12 kW Northern Lights	
12	**Cruising Speed**	15 Knots	
13	**Fuel Capacity**	1000 gallons	
14	**Range**	600 miles	
15	**Nav Instruments**	Radar Differential GPS & Chart Plotter Receiver Depth Sounder Auto Pilot	48-mile, Furuno FCV-585 Furuno GP-1850WD Furuno LC-90 Robertson AP 35
16	**Lifting Equipment**	Aft A-frame Altn. Hoisting Boom Avail. Hydraulic Winch Hydraulic Capstan	3000-lb capacity w/ 16' head room 1,750-lb capacity 3,000-lb 2,000-lb
17	**Safety**	6 Man Life Raft USCG Safety Equipment EPIRB, 406 MHz VHF Radio (x2) Satellite Phone Flir IR Camera	
18	**Accommodations**	Sleeps 3, w/ head, shower and galley. Heated and Air Conditioned	
19	**Other Features**	Push Knee Misc. pumps, block and hardware	

Appendix B

BOEM Approval of Vineyard Wind Survey Plan

From:	Rachel Pachter
To:	Matt Robertson; Stephanie Wilson; Erik Peckar
Subject:	FW: BOEM Review of OffshoreMW SAP Survey Plan (OCS-A 0501)
Date:	Tuesday, February 21, 2017 3:56:46 PM

Rachel Pachter

From: "MacDuffee, David" <david.macduffee@boem.gov>
Date: Thursday, September 15, 2016 at 3:35 PM
To: Erich Stephens <estephens@offshoremwllc.com>, Rachel Pachter <Rpachter@offshoremwllc.com>
Cc: James Bennett <James.Bennett@boem.gov>, Annette Moore <annette.moore@boem.gov>, Michelle Morin <michelle.morin@boem.gov>, Lucas Feinberg <lucas.feinberg@boem.gov>, Jessica Stromberg <jessica.stromberg@boem.gov>, Brian Krevor <brian.krevor@boem.gov>
Subject: BOEM Review of OffshoreMW SAP Survey Plan (OCS-A 0501)

Erich and Rachel,

This message is being sent to your attention in response to Offshore MW LLC's (the Lessee's) Site Assessment Plan (SAP) Survey Plan, which was submitted to the Bureau of Ocean Energy Management (BOEM) pursuant to commercial lease OCS-A 0501 offshore Massachusetts.

Commercial lease OCS-A 0501 went into effect on April 1, 2015. The Lessee submitted the SAP Survey Plan pursuant to stipulation 2.1.1.1 of Addendum "C" of commercial lease OCS-A 0501 on May 31, 2016, with subsequent revisions submitted on June 27, July 17, July 25, August 1, and August, 26, 2016. BOEM has completed its review of the final version of the SAP Survey Plan dated August 25, 2016, and determined that the Lessee has satisfactorily modified the Plan to address Lessor's comments in accordance with stipulation 2.1.1.1 of Addendum C of the lease.

In addition to the SAP survey plan, the Lessee submitted an HRG survey equipment field verification plan required by stipulation 4.3.6.3 of Addendum C of the lease, and an Alternative Monitoring Plan to support the Lessee's request to conduct G&G surveys at night or when visual observation is otherwise impaired, as required by stipulation 4.3.3 of Addendum C of the lease. BOEM has determined that the Lessee has satisfactorily modified the HRG survey equipment field verification plan to address Lessor's comments in accordance with stipulation 4.3.6.3 of Addendum C of the lease. Additionally, BOEM has completed its review of the Alternative Monitoring Plan and authorizes the Lessee to conduct G&G surveys at night or when visual observation is otherwise impaired in accordance with stipulation 4.3.3 of Addendum C of the lease.

In accordance with the Biological Opinion issued by the National Marine Fisheries Service, our project-specific assessment of your survey plan has determined that large whales listed under the Endangered Species Act may be present in the survey area, but are not likely to be adversely affected with implementation of the SOCs detailed in the survey plan. Sea turtles may also be present during the survey period and the SOCs proposed must be followed to reduce the potential for adverse impacts to occur. BOEM received concurrence from NMFS on September 15, 2016, in this regard.

Please note that although BOEM has provided feedback on the reconnaissance level survey activities described in the SAP survey plan to ensure compliance with the applicable stipulations in your lease, BOEM anticipates that you will need to conduct future survey activities necessary to support the submission of a Construction and Operations Plan (COP), and those survey activities must be submitted by the lessee in COP survey plan(s) pursuant to stipulation 2.1.1.2 of Addendum C of the lease.

Finally, we look forward to receiving the HRG survey equipment field verification results and the fisheries industry liaison and fisheries representative contact information, which are required to be submitted prior to the commencement of survey activities. Please contact Luke Feinberg (luke.feinberg@boem.gov) should you have any questions.

Thanks,
Dave

David MacDuffee
Chief, Projects and Coordination Branch
U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs
45600 Woodland Road
Sterling, Virginia 20166
Office (703) 787-1576
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Appendix C

Geophysical Survey Report for Site Assessment Plan

OCS-A 0501 MASS USA

VINEYARD WIND

Geophysical Survey Report for Site Assessment Plan

REDACTED

Appendix D

Archaeological Report for Site Assessment Plan

OCS-A 0501 MASS USA

VINEYARD WIND

Geophysical Survey Report for Site Assessment Plan

REDACTED

Appendix E

Benthic Report for Site Assessment Plan

OCS-A 0501 MASS USA

VINEYARD WIND

Geophysical Survey Report for Site Assessment Plan

REDACTED

OCS-A 0501 MASS USA
VINEYARD WIND

ADDENDUM A – UPDATE TO LIDAR SYSTEM

PURPOSE

This Addendum to the Site Assessment Plan (SAP), dated November 22, 2017 and submitted November 27, 2018, provides additional information on the LiDAR system that was ultimately selected by Vineyard Wind for deployment. This system is consistent with the proposed LiDAR system discussed and assessed in the SAP. Furthermore, this system was also separately assessed by BOEM and approved as of May 1, 2017.

SELECTED SYSTEM

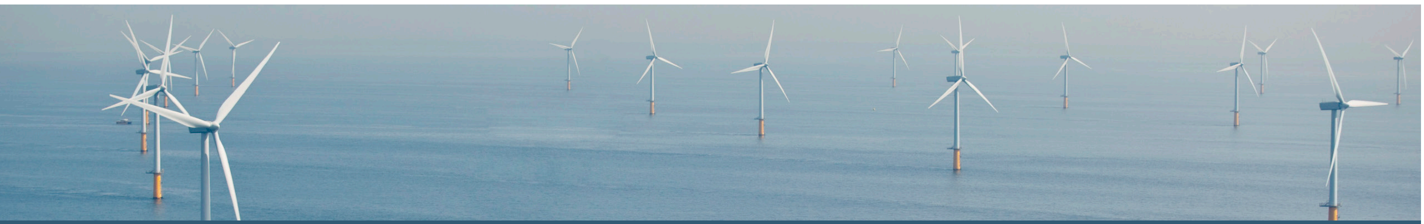
Vineyard Wind has selected the FUGRO Seawatch Wind LiDAR Buoy (FUGRO LiDAR), an off-the-shelf system similar, yet smaller in size than the system originally proposed. In addition, this system does not contain any liquid fuel. All buoy specifications and measurements are provided in Attachment A.

The FUGRO LiDAR will utilize the same gravity based mooring as proposed in the SAP, except for a smaller anchor weight, given the selected LiDAR is smaller. The FUGRO LiDAR will be equipped with the proper safety lighting, markings and signal equipment per United States Coast Guard (USCG) Private Aids to Navigation (PATON) requirements. Coordination with the USCG is completed and a PATON was approved on May 11, 2018.

Attachment A

FUGRO Seawatch Wind LiDAR Buoy Specifications

SEAWATCH Wind LiDAR Buoy



The Wind LiDAR buoy is a cost-effective and reliable solution for measuring wind profiles, waves and current profiles.

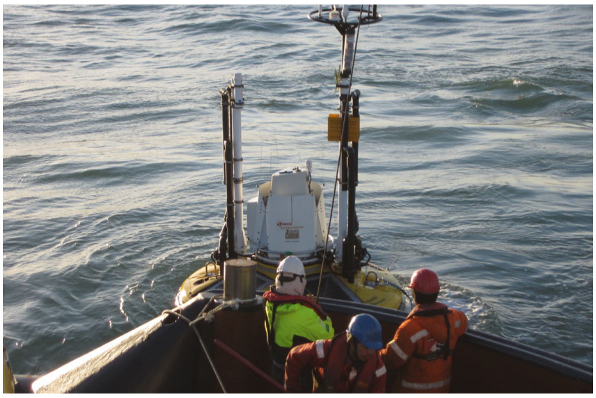
Wind Profile, Wave and Current Measurements

The SEAWATCH Wind LiDAR Buoy represents the next generation of multi-purpose buoys tailored for the renewable energy industry. The buoy accurately measures the speed and direction of wind across the diameter of wind turbine rotors, whilst sensors provide oceanographic parameters such as ocean waves and current profiles.

Accurate measurement of wind profile using SEAWATCH Wind LiDAR Buoy

Features

- Collects data for wind resource assessments and/or for engineering design criteria
- Buoy mast wind profile measurements at 2.5 m, 4 m and 5 m
- Configurable LiDAR wind profile measurements at 10 levels from 12.5 m up to 300 m
- Configurable ocean wave measurements and sea current profiles
- Full on-board processing of all measured data
- Two-way communication link for data transfer and control
- Real-time data transfer and presentation
- Flexible configuration of sensors and data collection
- Modular hull for easy transport and local assembly
- Safe and easy handling and deployment
- Robust and reliable in all weather and temperature extremes
- Position tracker for increased safety
- The Wavescan buoy platform has a successful track record worldwide since 1985



Deployment of the SEAWATCH Wind LiDAR buoy

SEAWATCH Wind LiDAR Buoy

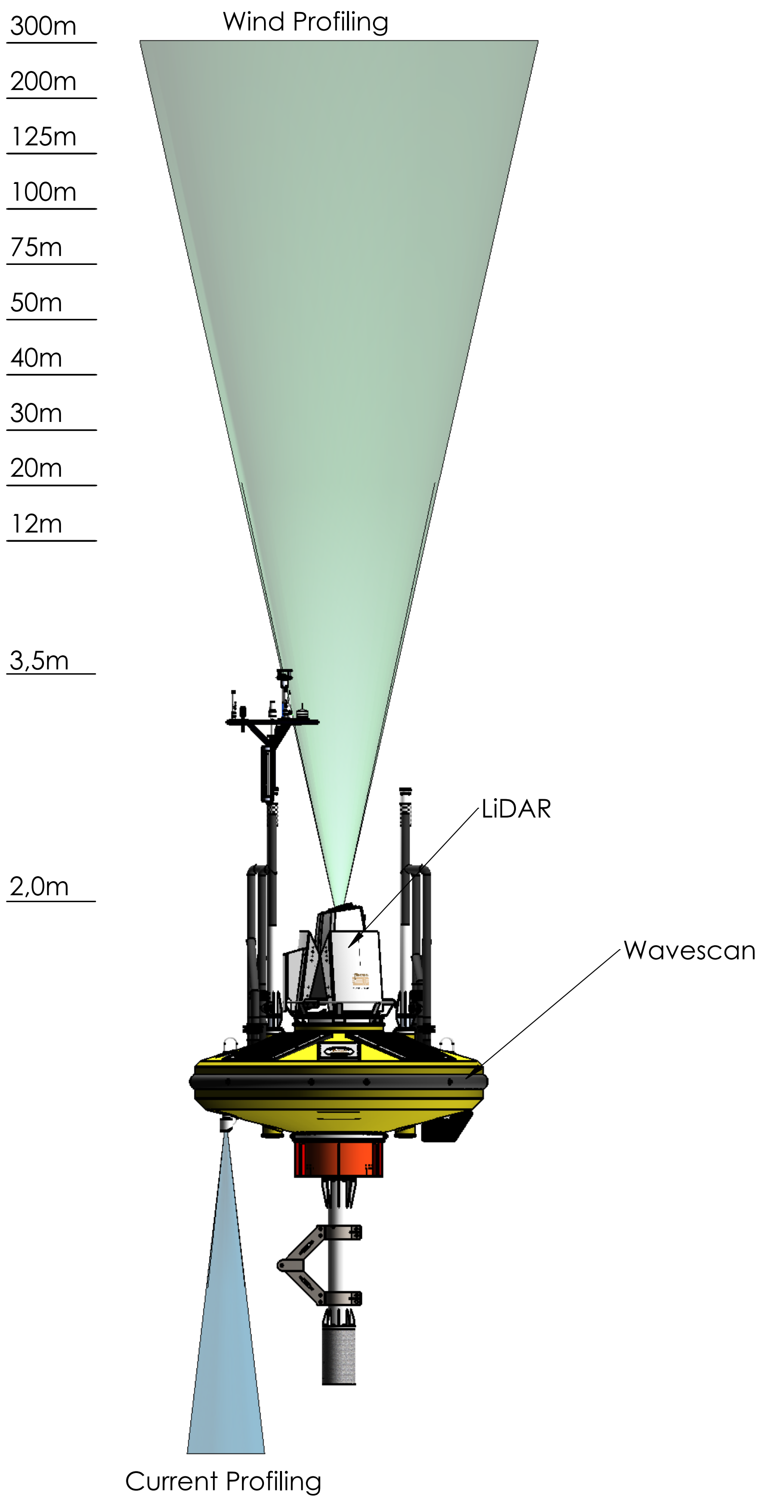
A Unique Cost-Efficient Solution

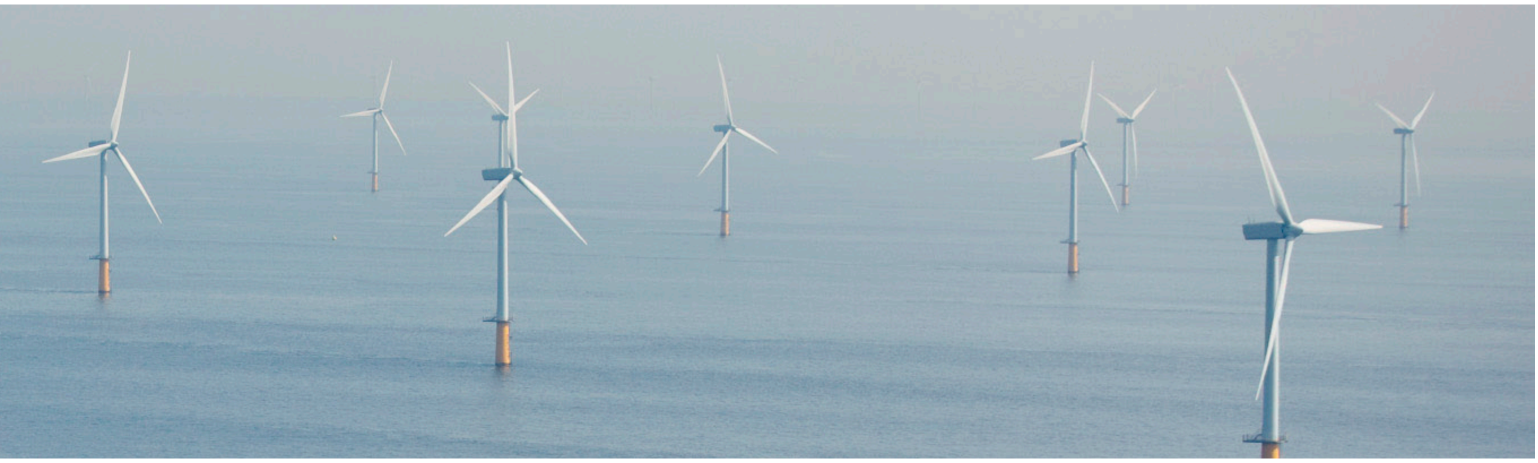
The SEAWATCH Wind LiDAR Buoy is a cost-efficient way to measure wind data at heights of conventional offshore wind turbines for wind resource assessments and engineering design criteria.

It is the first single compact buoy capable of measuring:

- Wind profiles across the blade span of the largest offshore wind turbines
- Ocean wave height and direction
- Ocean current profiles from the surface to the seabed
- Meteorological parameters
- Other oceanographic parameters as required

The smaller SEAWATCH Wind LiDAR Buoy is a proven ocean monitoring solution and is easily deployed and relocated (by towing or lifting onboard vessels) enabling data gathering across multiple locations. This is a more cost-effective alternative to existing wind profiling solutions such as fixed met masts or larger floating buoys.





Proven Platform and Technology

The SEAWATCH Wind LiDAR Buoy is built on the SEAWATCH Wavescan platform which has been deployed for a large number of satisfied clients in the most hostile oceanographic environments since 1985.

Its well proven SEAWATCH technology, includes the GENI™ controller, an intelligent power management unit and the ZephIR LiDAR.

ZephIR LiDAR

The ZephIR LiDAR was selected after years of testing and comparison of various concepts. The ZephIR 300 provides highly accurate measurements across the entire rotor diameter and beyond and can be configured to measure up to 10 different heights from 12.5 to 300 metres above the sea surface.

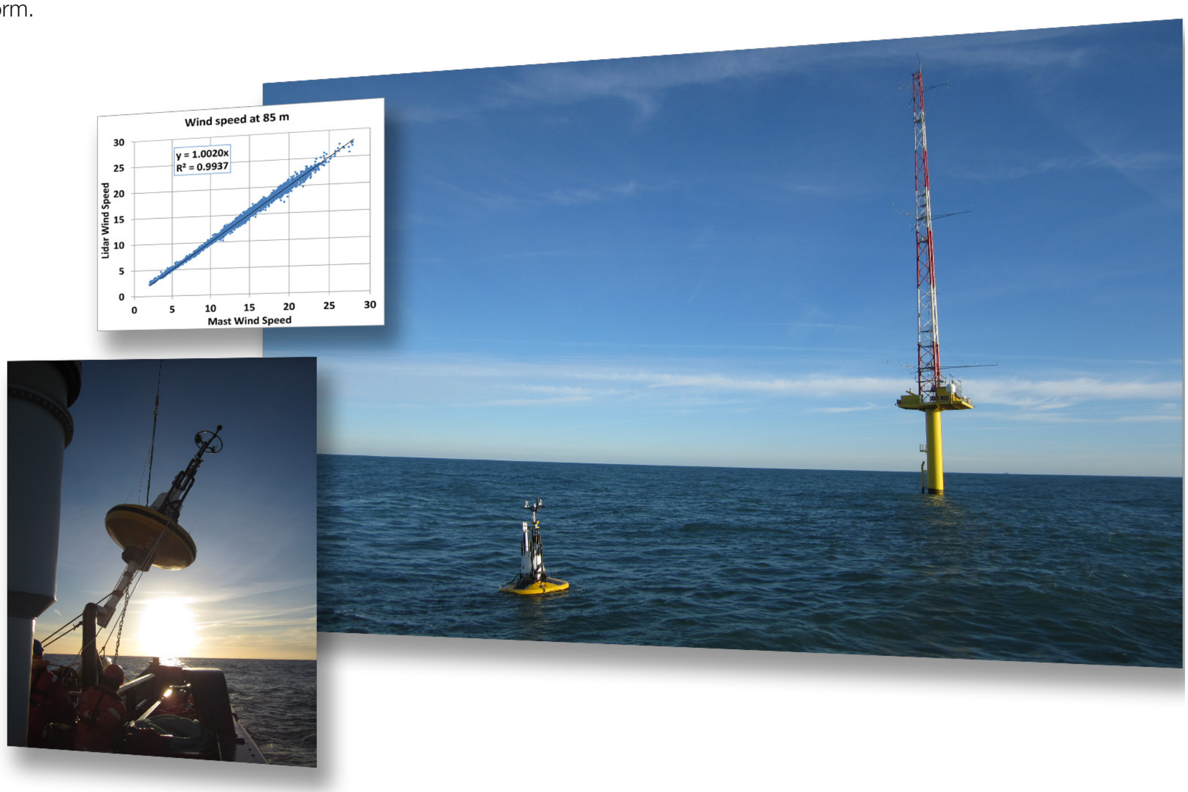
Low power consumption of the ZephIR 300 and intelligent power management are key to efficient operation when using a small low-cost platform.

Successful Collaboration

The SEAWATCH Wind LiDAR Buoy is the result of a successful joint industry R&D project, utilising offshore and wind technology expertise from Norwegian universities, research institutes and the energy company Statoil.

Offshore Testing / Validation

The SEAWATACH Wind LiDAR Buoy has been tested and validated at the Ijmuiden met mast in Dutch waters. The wind profile data measured by the SEAWATCH Wind LiDAR Buoy were compared with data from anemometers at 3 heights mounted on the met mast and a ZephIR LiDAR, measuring the wind profile above 90 m. An inter-comparison showed almost no bias and a squared correlation of more than 0.99. The validation test was performed in close cooperation with DNVGL



SEAWATCH Wind LiDAR Buoy

Technical Specifications

General

Material	Polyethylene, Aluminium, Stainless Steel
Flash light	LED based, 3-4 nautical miles range
	IALA recommended characteristic
Positioning	GPS (Inmarsat-C, Iridium, Standalone Receiver)

Buoy Dimensions

Weight (approx)[1]	1700 kg
Overall height	6.1 m
Diameter	2.8 m
Net buoyancy	2500 kg
Mast height (above water)	3.5 m

Power Supply [2, 3]

Solar panels (optional)	180 W
Lead-acid battery bank (optional)	Up to 248 Ah
Lithium battery bank	Up to 9792 Ah
Fuel cells	Up to 25926 Ah

Processing

4 GB data storage

Real-time operating system (Linux)

Large number of serial and analogue inputs

Flexible data acquisition software

Data Communication

Short range	GSM / GPRS
	UHF / VHF radio (two-way)
Long range	Inmarsat-C and Iridium (two-way)
	ARGOS (one-way)

1 - With fuel cells and methanol cartridges
2 - All values are nominal ratings
3 - The buoy consumes roughly 150 Ah per day. Exact power consumptions will be made for each case

Wind Profiler - ZephIR 300 CW LiDAR

Measurement height (configurable)	10 m – 300 m
Probe length at 10 m	0.07 m
Probe length at 100 m	7.7 m
Number of simultaneous heights measured	Up to 10
Sampling rate	50Hz
Average period (configurable)	1 second upwards
Scanning cone angle	30°
Wind speed accuracy	< 0.5%
Wind speed range	< 1 m/s to 70 m/s
Wind direction accuracy	< 0.5°

Various additional sensors are available on request, including but not limited to:

Oceanographic Sensors

Wave height and direction

Surface current velocity and direction

Water temperature

Conductivity / Salinity

Current profile

CTD profile

Meteorological Sensors

Wind speed/direction

Air pressure

Air temperature

Humidity

Precipitation

Solar radiation

Water Quality Sensors

Dissolved oxygen

Light attenuation

Chlorophyll-a

Hydrocarbon

Turbidity

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