New England Wind

AVANGRID RENEWABLES

Construction and Operations Plan

Lease Area OCS-A 0534

Volume III Appendices

February 2024

Submitted by
Park City Wind LLC

Submitted to
Bureau of Ocean Energy Management
45600 Woodland Rd
Sterling, VA 20166

Prepared by
Epsilon Associates, Inc.

New England Wind Construction and Operations Plan for Lease Area OCS-A 0534

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Submitted to:
BUREAU OF OCEAN ENERGY MANAGEMENT
45600 Woodland Rd
Sterling, VA 20166

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February 2024

On April 29, 2022, modifications were made to the project design Envelope that involved changing the maximum wind turbine generator (WTG) and electrical service platform (ESP) topside parameters for Phase 1 (Park City Wind) to match those of Phase 2 (Commonwealth Wind) (see Table 1). As a result of this change, the potential minimum footprint of Phase 1 decreased, and correspondingly the potential maximum footprint of Phase 2 increased (see Table 2). Additionally, the maximum capacity in megawatts for both phases was eliminated to accommodate the rapid advancement in commercially available wind turbine generator size and technology.

Table 1 Modifications to the Phase 1 WTG and ESP Parameters[1]

Maximum WTG Parameters	Previous Dimension	New Dimension[2]
Tip Height	319 m (1,047 ft)	357 (1,171 ft)
Top of the Nacelle Height	199 m (653 ft)	221 m (725 ft)
Hub Height	192 m (630 ft)	214 m (702 ft)
Rotor Diameter	255 m (837 ft)	285 m (935 ft)
Minimum Tip Clearance[3]	27 m (89 ft)	27 m (89 ft)
Blade Chord	8 m (26 ft)	9 m (30 ft)
Tower Diameter	9 m (30 ft)	10 m (33 ft)[4]
Maximum ESP Parameters	**Previous Dimension**	**New Dimension[2]**
Width	45 m (148 ft)	60 m (197 ft)
Length	70 m (230 ft)	100 m (328 ft)
Height	38 m (125 ft)	No change
Height of Topside (above MLLW[5])	70 m (230 ft)	No change

1. Maximum WTG dimensions are included in Table 3.2-1 and maximum ESP dimensions are included in Table 3.2-3 of COP Volume I
2. The new Phase 1 WTG and ESP maximum parameters were revised to match those of Phase 2
3. All parameters are maximum values except tip clearance, where the minimum tip clearance represents the maximum potential impact
4. To accommodate the slight increase in tower diameter, the maximum transition piece diameter/width for Phase 1 monopile foundations was also increased from 9 m (30 ft) to 10 m (33 ft) (see Table 3.2-2 of COP Volume I)
5. MLLW: Mean Lower Low Water

To accommodate the larger Phase 1 WTG dimensions and greater capacity range, the minimum footprint of Phase 1 decreased and the maximum footprint of Phase 2 increased, thus also adjusting the potential number of WTG/ESP positions within each Phase (see Table 2).

Table 2 Modifications to the Phase 1 and Phase 2 Layout and Size

		Previous Layout and Size	New Layout and Size
Phase 1	Number of WTGs	50-62	41-62
	Area	182-231 km^2 (44,973-57,081 acres)	150-231 km^2 (37,066-57,081 acres)
Phase 2	Number of WTGs	64-79	64-88
	Area	222-271 km^2 (54,857-66,966 acres)	222–303 km^2 (54,857–74,873 acres)

Additionally, while the Project Design Envelope (PDE) previously included a total of four or five offshore export cables for New England Wind (two offshore export cables for Phase 1 and two or three offshore export cables for Phase 2), the Proponent has confirmed that there will be a total of five offshore export cables (two offshore export cables for Phase 1 and three offshore export cables for Phase 2).

These revisions remain within the maximum design scenario considered for this report (see Section 9.3.2.4) and the maximum potential impacts are still representative considering these modifications. Therefore, this report was not updated to reflect these minor modifications, as the findings are not affected.

The Proponent has also identified two variations of the Phase 2 Offshore Export Cable Corridor (OECC)— the Western Muskeget Variant and the South Coast Variant—in the event that technical, logistical, grid interconnection, or other unforeseen issues arise during the engineering and permitting processes that preclude one or more Phase 2 offshore export cables from being installed within all or a portion of the OECC (see Section 4.1.3 of COP Volume I). This Appendix considers the potential impacts associated with the Western Muskeget Variant[1]; an assessment of the South Coast Variant in federal waters is provided separately in the COP Addendum.

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[1] While the PDE allows for one or two offshore export cables to be installed within the Western Muskeget Variant, it is highly unlikely that more than one cable could be installed within the Western Muskeget Variant due to multiple technical reasons related to challenging site conditions.

New England Wind

Navigation Safety Risk Assessment

December 10, 2021 | 13057.501.R1.Rev2

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New England Wind

Navigation Safety Risk Assessment

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Revision	Date	Status	Comments	Prepared	Reviewed	Approved
0	29Sept2020	Final	Final	DE/DT/RDS	LW/RDS	RDS
1	11May2021	Final	Revised per USCG / BOEM Comments	DE/DT/RDS	LW/RDS	RDS
2	10Dec2021	Final	Final	DE/DT/RDS	LW	LW

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Executive Summary

New England Wind is the proposal to develop offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0534 along with associated offshore and onshore cabling, onshore substations, and onshore operations and maintenance (O&M) facilities. New England Wind will be developed in two phases with a maximum of 130 wind turbine generator (WTG) and electrical service platform (ESP) positions. Four or five offshore export cables will transmit electricity generated by the WTGs to onshore transmission systems in the Town of Barnstable, Massachusetts, as shown in Figure E.1. Park City Wind LLC, a wholly owned subsidiary of Avangrid Renewables, LLC, is the Proponent and will be responsible for the construction, operation, and decommissioning of New England Wind.

New England Wind's offshore renewable wind energy facilities are located immediately southwest of Vineyard Wind 1, which is located in Lease Area OCS-A 0501. New England Wind will occupy all of Lease Area OCS-A 0534 and potentially a portion of Lease Area OCS-A 0501 in the event that Vineyard Wind 1 does not develop "spare" or extra positions included in Lease Area OCS-A 0501 and Vineyard Wind 1 assigns those positions to Lease Area OCS-A 0534. For the purposes of the Construction and Operations Plan (COP), the Southern Wind Development Area (SWDA) is defined as all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501, as shown in Figure E.1.

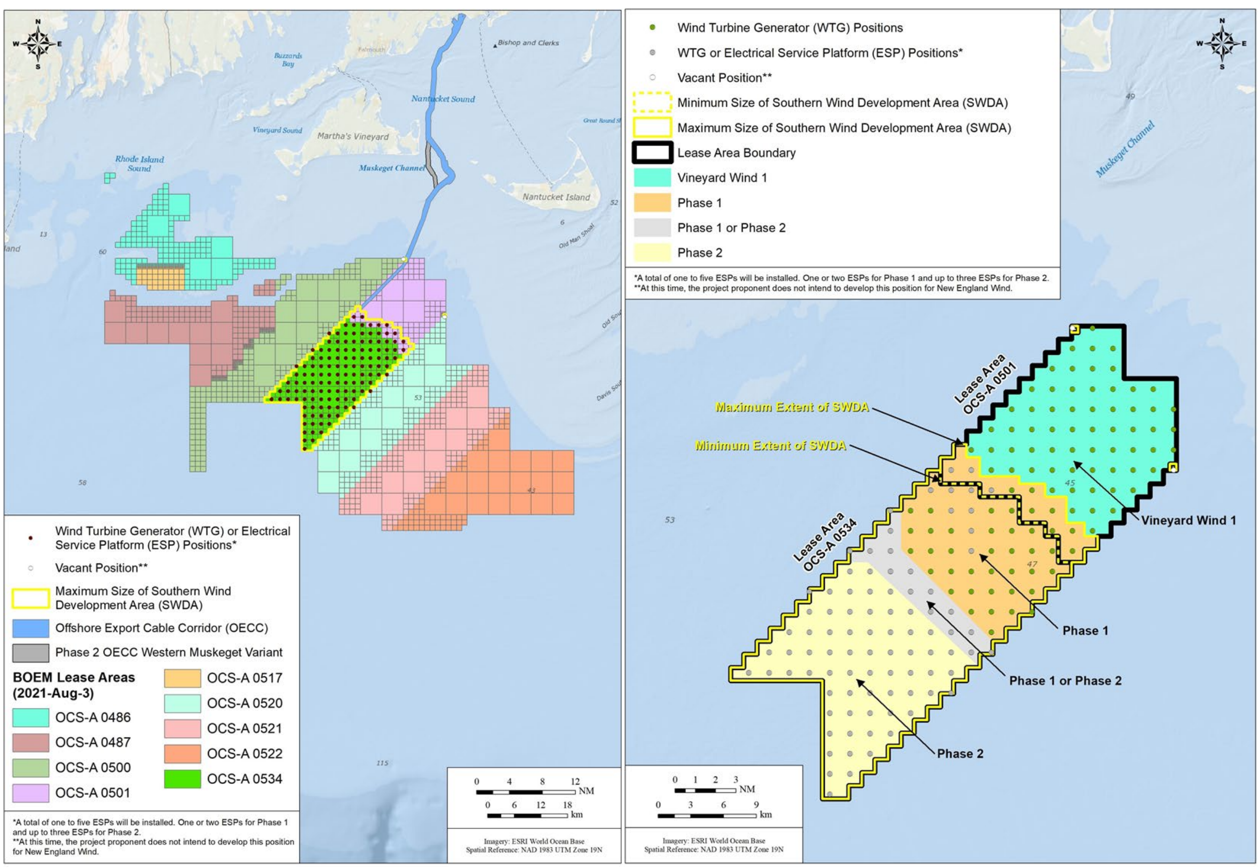

Figure E.1: BOEM Lease Areas (left) and New England Wind Layout (right)

Phase 1 will consist of 50 to 62 WTGs oriented in an east-west and north-south grid pattern with one nautical mile (1 NM [1.85 km]) spacing. This arrangement also creates diagonal corridors in the northwest-southeast and southwest-northeast directions with a spacing of 0.7 NM (1.3 km). Phase 1 will also include one or two ESPs, which are offshore substations that serve as common interconnection points for the WTGs. The ESPs will be positioned along the grid arrangement at one or two of the grey circles in Figure E.1, which shows the potential ESP locations under consideration. Two offshore export cables will transmit electricity from the ESPs to a landfall site at Craigville Public Beach or Covell's Beach in the Town of Barnstable.

Phase 2, when constructed, will be immediately southwest of Phase 1 and will occupy the remainder of the SWDA. It may include one or more projects depending on market conditions. The footprint and total number of WTG and ESP positions in Phase 2 depends upon the final footprint of Phase 1; Phase 2 is expected to contain 64 to 79 WTG/ESP positions (up to three positions will be occupied by ESPs). Consistent with Phase 1, the Phase 2 WTGs and ESPs will be oriented in an east-west and north-south 1 NM by 1 NM (1.85 km by 1.85 km) grid.

While the Proponent intends to install all New England Wind offshore export cables within the Offshore Export Cable Corridor (OECC) that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the fallback option to install one or two Phase 2 cables along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant [1] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel.

The United States Coast Guard (USCG) provides guidance on the information and factors that the USCG will consider when reviewing an application for a permit to build and operate an Offshore Renewable Energy Installation (OREI), such as New England Wind. This information, which is outlined in USCG Navigation and Vessel Inspection Circular No. 01-19 (NVIC 01-19), is provided through conducting a Navigation Safety Risk Assessment (NSRA). The NSRA is intended to identify hazards to navigation and associated consequences that might be created by an OREI during construction, operations and maintenance, and decommissioning. Key considerations include: (1) safety of navigation; (2) the effect on traditional uses of the waterway; and (3) the impact on maritime search and rescue activities by the USCG and others.

This report constitutes the NSRA conducted for New England Wind in accordance with NVIC 01-19. There are a number of studies and navigational guidelines produced by the USCG and international organizations that have also been referenced and employed in the preparation of the NSRA. One of the key studies relied upon was The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study (MARIPARS) completed by the USCG to evaluate whether navigational safety concerns exist with vessel transits across the adjacent leases that comprise the Massachusetts Wind Energy Area (MA WEA) and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA), which includes Lease Areas OCS-A 0534 and OCS-A 0501.

Existing Vessel Traffic

As a starting point in the study, a comprehensive assessment of existing vessel traffic in and adjacent to the SWDA was conducted using Automatic Identification System (AIS) and the National Oceanic and Atmospheric Administration's (NOAA) Vessel Monitoring System (VMS) datasets.

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[1] The Western Muskeget Variant is the same exact corridor as the western Muskeget option included in the Vineyard Wind 1 COP and has already been thoroughly reviewed and approved by BOEM as part of that COP.

The AIS data covered the period from 2016 through 2019 and were processed to identify continuous vessel tracks. These tracks were then categorized by vessel type and time period (months to years). The analyses of AIS data indicated that historical vessel traffic levels within the SWDA are relatively low. The vessel traffic is seasonal in nature with approximately 0.5 vessels every day on average in the winter months to a peak of 6.4 vessels per day on average in the month of August. An evaluation of vessel proximity revealed that two or more vessels are present within the SWDA simultaneously for only 124 hours per year on average (1.4% of the year). There was one short period (a few hours) in September 2016 in which up to 14 vessels were in the SWDA with most of these vessels sailing at speeds less than 4 knots while trawling.

It was found that fishing vessels (transiting and trawling) represented the majority (59%) of total vessel traffic based on unique transits through the SWDA. Fishing vessels have a wide range of tracks through the SWDA with the most frequent transit directions along east-west, and east northeast-west southwest tracks. Based on AIS data, fishing vessels typically have a length overall (LOA) of 60 to 80 ft; however, there are likely a number of fishing vessels less than 65 ft LOA which transit through the SWDA but that do not transmit AIS data. It is estimated that 40 to 60% of the commercial fishing fleet is represented in the AIS data. Overall, available data indicate relatively low levels of fishing effort in the SWDA.

The frequency and density of trawling activities (assumed as times when fishing vessels were sailing at less than 4 knots) within the SWDA is variable between seasons and years. The highest frequency of trawling occurs during August and September. An analysis was also conducted to assess the relative duration of trawling within the confines of the SWDA. That is, for each trawler track that entered the SWDA, the track duration was analyzed to determine the amount of time spent within and outside the SWDA. The results indicated that approximately 25% of the total trawl time was spent inside the SWDA versus 75% of the time outside.

Recreational vessels transit the SWDA with an average of 174 unique transits per year through the SWDA over the 4-year AIS data period (approximately 20% of the unique vessel tracks). Most recreational vessels have a length of 30 to 60 ft (15 to 20 m) LOA but there are a small number of large motor and sailing recreational vessels greater than 200 ft that transit through the SWDA.

There is existing use of the SWDA waterway by larger commercial vessels including passenger, dry cargo, and tanker vessels. Over a 4-year period, on average, 103 larger commercial vessels transited through the SWDA each year. The typical size of these vessels was 600 ft (182 m) or greater. It is anticipated that these vessels will transit around the SWDA and not through the turbine field.

Traffic along or crossing the Offshore Export Cable Corridor (OECC) which connects the SWDA to the coastline of Massachusetts was also analyzed. Most of the vessel crossing traffic occurs between Martha's Vineyard and the mainland of Cape Cod. Overall, vessel traffic density along the OECC is relatively low, including the Phase 2 OECC Western Muskeget Variant, with the highest concentration of traffic midway through Nantucket Sound.

Navigational Maneuverability

A desktop analysis of navigational channel requirements was completed based on the guidance provided by the MARIPARS and other international guidance (e.g., PIANC, 2018) with a calculation that involves considerations of navigational spacing, a ship collision avoidance zone, a safety margin for vessel turning, and a safety zone around each turbine. With a 164 ft (50 m) safety zone assumed, both the 1 NM (1.85 km) and the 0.7 NM (1.3 km) corridors would accommodate all fishing vessels in the existing fleet. MARIPARS also provided an estimate of the corridor width assuming a safety zone of 820 ft (250 m), resulting in all of the fishing vessel fleet being accommodated within a 1 NM (1.85 km) corridor and approximately 95% of the fishing vessel fleet accommodated within a 0.7 NM (1.3 km) corridor. It is very important to recognize that the corridor widths are notional and not actual channels with physical limits at the channel edges. Vessels can certainly navigate from one corridor to the next without restriction. In the case of the diagonal corridors, the turbines which define the corridor "edges" are offset from one another.

The corridor spacing will also accommodate the majority of the recreational fleet, other than approximately 5 to 10% of the largest vessels. It is noted that while these largest vessels are classified as recreational by AIS category they are in fact crewed by licensed professional mariners.

As noted previously, it is anticipated that larger commercial vessel (e.g., cargo, tanker, passenger, military, and tug tow) traffic may navigate to the south of the SWDA toward existing shipping routes, including the Nantucket to Ambrose Safety Fairway (westbound) and Ambrose to Nantucket Safety Fairway (east bound) which are approximately 20 NM (37 km) to the south of the SWDA, rather than through the turbine field. It has been estimated that this diversion will add an extra 1 NM (1.9 km) in distance and five minutes to the overall journey time based on the average vessel speed. Various paths for re-routing of fishing and recreational vessels were also assessed should some of these vessels choose to divert around the SWDA rather than travel through it. With most re-routing paths for fishing vessels and recreational vessels, the increase in time was a matter of a few minutes. The largest increase in transit time was 56 minutes for recreational vessels that currently travel from northwest to southeast directly through the middle of the SWDA under existing conditions.

There are air draft considerations with the turbine field due to the turbine rotor size. The minimum rotor tip clearance from chart datum (Mean Lower Low Water [MLLW] tidal level) is 89 ft (27 m). The minimum possible tip clearance from (Mean Higher High Water [MHHW]) high tide level is 80 ft (24.4 m) allowing for a 5 ft (1.5 m) safety margin. Most fishing and non-sailing recreational vessels have air drafts which are less than this height; however, some cargo and sailing vessels do reach these air draft levels. Cargo and sailing vessels are at little risk of interacting with the WTG blades under normal conditions as the area of minimum tip clearance is very near the WTG tower/foundation where vessels would not normally navigate, but the risk increases should the vessel lose power and/or steerage and become adrift or if there is a loss of navigational awareness under poor visibility conditions. The vessel must be in very close proximity to the WTG in order for a turbine strike to be possible and such an event would likely be associated with a co-incident allision between the vessel and the turbine foundation.

Navigational Risk

A quantitative navigational risk assessment was conducted for both Lease Area OCS-A 0534 and Lease Area OCS-A 0501 (that is, Vineyard Wind 1 and New England Wind) for both the existing pre-construction and future operations of the wind farms to determine the impact and relative change in navigational safety risk due to the installation of the WTGs and ESPs. For simplicity, it was assumed that the pre-construction condition was open ocean, though this is a conservative assumption for New England Wind since Vineyard Wind 1 will be constructed prior to New England Wind.

The navigational risk assessment was carried out using Baird's proprietary Navigational and Operational Risk Model (NORM). The model utilizes raw AIS, wind, and visibility data as inputs along with the geometric layout and characteristic dimensions of the WTGs and ESPs. To account for non-AIS equipped vessels, which is estimated at 50% of the fishing and recreational fleets (the mid-point of estimated 40 to 60% of vessels not equipped with AIS), the total number of vessels for these fleets included in the AIS dataset was doubled. The model computes the risk of vessel collision and allision with an offshore structure by vessel category. Three different types of possible collision directions are considered including head-on, overtaking and crossing. Two types of allision are taken into account: (1) "drifting" allisions in which the vessel loses propulsion and/or steerage (i.e., mechanical failure); and (2) “powered” allisions in which the vessel strikes the turbine under power. The study area included the Lease Areas OCS-A 0534 and OCS-A 0501 along with a 6.5 NM (12 km) perimeter around the Lease Areas to best capture only the vessel traffic that may be appreciably affected by the installation.

The total annual frequency for a vessel collision under existing conditions (pre-construction) was estimated as 0.061 collisions/allisions per year or an estimated average recurrence interval of 16 years (i.e., one collision every 16 years on average) as detailed in Section 9.3. Much of this risk arose from the fishing and recreational vessels as these provided the bulk of the historical vessel transits through the SWDA.

For the operations phase scenario, an algorithm routes the vessel traffic through the SWDA based on vessel origin and destination. The model results suggest, consistent with existing conditions, that the most common potential accident scenario is collision. The overall risk of allision is small with average recurrence intervals for all classes of vessels in the range approximately of 363 to 1,173 years, depending on WTG foundation type.

Overall, the total frequency of all operations phase accident scenarios within the two Lease Areas for all vessel classes was calculated to be 0.076 to 0.078 accidents per year, depending on the type of WTG foundation considered for the allision calculations. These accident rates correspond to an approximately 13-year average recurrence interval, which is slightly more frequent than the average recurrence interval during the pre-construction scenario. Compared to the estimated pre-construction collision risk, this is a small increase in risk (approximately 0.015 to 0.017 additional accidents per year) and equates to an additional vessel collision once every 59 to 67 years on average, depending on foundation type. Most of the increase in collision risk occurs due to the presence of New England Wind and Vineyard Wind 1 O&M vessel traffic, which represented an approximately 13% increase in traffic volumes in the NORM study area and a 34% increase in the Lease Areas. However, is important to recognize that the CTVs will be modern, highly specialized vessels manned by professional crew. They will be outfitted with recent technology in terms of marine radar, AIS, and chart display. These vessels also will have specified weather thresholds in which transits will not be carried out. These additional safety factors associated with the CTVs have not been taken into account in the modeling.

It is important to recognize that the model has simulated the risk associated with both Lease Areas OCS-A 0501 and OCS-A 0534, not just the SWDA. Of this total risk, the risk associated with the Vineyard Wind 1 project is estimated as approximately 0.0664 accidents per year. Thus, the increase in overall risk associated with the SWDA itself is approximately 0.010 to 0.012 additional accidents per year, or one additional accident every 86 to 104 years. Note that some of this risk increase occurs in the Vineyard Wind 1 Wind Development Area since it was assumed that the New England Wind O&M vessels will transit across the Vineyard Wind 1 Wind Development Area to reach the SWDA.

Emergency Response

The USCG (2020) MARIPARS undertook a detailed assessment of the effect of the 1 NM by 1 NM (1.85 km by 1.85 km) turbine spacing on aerial search and rescue (SAR). It was found that this spacing will “allow sufficient navigational room for aircrews to execute USCG missions in diverse and challenging weather conditions or deal with an aircraft emergency and/or navigational malfunction.”

The WTG spacing and minimum tip clearance of the blades is not expected to impact the operation of USCG marine assets that are in use in the area. It is expected that these marine assets will be able to safely navigate and maneuver adequately within the SWDA. Given the WTG spacing and relative size, it is not expected that New England Wind will significantly affect travel times to and within the SWDA by vessels responding to SAR distress calls.

Marine Radar and Communications

The New England Wind WTGs may affect some shipborne radar systems, potentially creating false targets and clutter on the radar display. Vessels navigating within the SWDA may become "hidden" on the radar systems due to shadowing created by the WTGs. The effectiveness of radar systems and any impacts from WTGs will vary from vessel to vessel based on several factors, including radar equipment type, settings, and installation (including location of placement on the vessel).

Various studies of this issue have been carried out. For example, comprehensive investigations were conducted by the British Wind Energy Association (BWEA) into marine radar effects at the Kentish Flat Offshore Wind Farm (BWEA 2007). It was concluded that trained radar operators were able to discern spurious signals and could track the movement of other vessels near and within the wind farm. It was also identified that adjustment of the gain setting on the radar could improve detection of other vessels. Similar conclusions were also derived in a numerical study of marine radar impacts conducted for the Block Island Wind Farm (QinetiQ, 2015).

Recently, the USCG's (2020) MARIPARS also reviewed several studies on the relationship between offshore renewable energy installations and marine radar interference. After reviewing these studies, the USCG concluded that, "To date, the USCG is not aware of an authoritative scientific study that confirms or refutes the concern that WTGs will degrade marine radar."

Based on a review of various studies conducted for existing offshore wind fields, the New England Wind WTGs are expected to have little impact on very high frequency (VHF), the Rescue 21 system, digital select calling (DSC) communications or AIS reception. BOEM is currently sponsoring a study by the National Academies of Sciences, Engineering, and Medicine to evaluate impacts of WTGS on marine vessel radar and identify potential mitigation measures. The study will consist of a literature review and may also include modeling, in order to better characterize potential effects and identify actions to reduce impacts. The results of this study will also inform understanding of potential impacts for New England Wind.

Construction Impacts

Construction and installation of New England Wind will require the use of a wide range of construction and support vessels in the SWDA. These vessels will transit within the SWDA, along the OECC, and along vessel routes between the SWDA, OECC, and various ports.

It is estimated that an average of 30 vessels will be present in the SWDA during construction of each Phase; however, many of the vessels will be in the immediate vicinity of the working area for days or weeks at a time. It is anticipated that temporary safety buffer zones will be established around the working areas to reduce hazards during construction activities (see Section 11.1 for additional details). Overall, it is not anticipated that there will be any significant disruption to navigational patterns within the SWDA other than the presence of temporary safety buffer zones, which will cover a small portion of the SWDA, and some limited movement of vessels to and from the various ports (12 one-way transits per day on average).

An average of approximately seven vessels may be used for cable laying activities in the OECC with up to approximately 15 vessels during the peak months of activity. Although temporary safety buffer zones may be established around these vessels, these vessels should not result in any significant obstruction to local traffic. The Proponent will work with local ferry operators and harbor pilots to mitigate risks and minimize schedule delays.

Various ports along the eastern seaboard will be used to support the construction logistics. The largest number of trips is expected between New Bedford Harbor and the SWDA with an average of 7 round trips per day (equivalent to 14 daily transits) and up to 15 round trips per day (30 transits) during the peak of construction activity. This may be compared to an existing average of 45 transits per day for AIS-equipped vessels at New Bedford. Peak traffic typically occurs in July and August, with an existing average of 86 daily transits. The actual total number of existing transits may be significantly higher, possibly by a factor of two or three, due to the numerous smaller vessels that do not utilize AIS.

Proposed Mitigations for Navigation Risk

A series of measures to mitigate risk during both the construction and operation of New England Wind have been developed based on the study's findings, as summarized below.

Construction & Installation

To mitigate navigation risk, the Proponent proposes to:

- Utilize a Marine Coordinator to manage all construction vessel logistics and implement marine communication protocols.
- Provide Offshore Wind Mariner Update Bulletins and coordinate with the USCG regarding the issuance of Notices to Mariners (NTMs) advising other vessel operators of New England Wind's construction and installation activities.
- Regularly provide updates as to the locations of installed WTGs and ESPs to the USCG and NOAA for use in navigational charts.
- Identify the WTGs and ESPs as Private Aids to Navigation (PATONs).
- Provide temporary lighting and marking on foundation structures as they are built, depending on the sequence and timing of construction.
- Require all New England Wind construction vessels and equipment to display required navigation lighting and day shapes.
- Coordinate with the USCG to mitigate safety concerns.
- Implement temporary safety buffer zones around areas of active work. This will allow fishing vessels and other stakeholders to use other areas of the SWDA and OECC. Additional details are provided in Section 11.1.
- When feasible, deploy one or more safety vessels to monitor vessel traffic approaching the construction areas.

Operations & Maintenance (O&M)

Proposed measures to mitigate navigation risk during O&M of New England Wind are provided below.

Overall Marine and SAR Coordination

- Utilize a Marine Operations Liaison Officer who will act as the strategic maritime liaison between New England Wind's internal parties and all external maritime partners and stakeholders.
- Provide Offshore Wind Mariner Update Bulletins and coordinate with the USCG regarding the issuance of NTMs advising other vessel operators of New England Wind's O&M activities.
- Work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested New England Wind WTGs to be engaged within a specified time upon request from the USCG during SAR operations and other emergency response situations. This emergency braking system will be satisfactorily tested at least twice per year.

- Operations center(s) will be maintained and continuously operated 24 hours per day throughout the life of New England Wind. The center(s) can assist the USCG in the response to distress calls through active control over the WTG braking system.

Vessel Navigation

- Use of a 1 NM by 1 NM WTG/ESP layout oriented north-south and east-west will allow fixed fishing gear to be placed along the east-west turbine alignment so that it is visually apparent where this gear is located. This is consistent with the current practice of placing such gear along east-west LORAN lines.
- The locations and air draft heights of the WTGs and ESPs will be provided to the USCG and NOAA for identification on relevant navigational charts. USCG can advise NOAA of any other relevant notes or precautionary statements to be published on relevant navigational charts.
- The USCG can also advise on other restrictions and recommendations by means of NTMs.

WTG and ESP Marking and Lighting

- The WTGs and ESPs will be marked and lit in accordance with USCG and BOEM requirements. Each structure will be marked with a unique alphanumeric identifier to aid in visual confirmation of vessel location. Each WTG and ESP will be maintained as a PATON per the requirements of the USCG.
- Mariner Radio Activated Sound Signals (MRASS) and AIS transponders are included in the design of the offshore facilities to enhance safety; the number, location, and type of these items will be determined in coordination with the USCG for the final WTG layout.
- AIS transponders with the capability to transmit to each WTG and ESP would be implemented as directed by the USCG.
- The WTGs and ESPs will include an aviation obstruction lighting system in compliance with Federal Aviation Administration (FAA) and BOEM requirements.
- Alphanumeric marking of structures is expected to be consistent across the MA WEA and RI/MA WEA lease areas and such marking has been coordinated with USCG and BOEM as part of the “Rhode Island and Massachusetts Structure Labeling Plot”.

Marine Radar and AIS

BOEM is currently sponsoring a study by the National Academies of Sciences, Engineering, and Medicine to evaluate impacts of WTGS on marine vessel radar and identify potential mitigation measures. The study will consist of a literature review and may also include modeling, in order to better characterize potential effects and identify actions to reduce impacts. Mitigation for radar impacts (if needed) as well as communications consistency measures are expected to be based on regional efforts which would be implemented in conjunction with other MA WEA and RI/MA WEA developers. Possible mitigation measures that may be considered are presented below; however, it is noted that these are preliminary concepts, and it is expected that such regional mitigation measures will be refined and updated pending ongoing consultations with BOEM, USCG, and other MA WEA and RI/MA WEA developers:

- Communications and training could be provided to local marine radar users regarding spurious signals and clutter that can occur in the vicinity of offshore structures as well as the recommend approaches for reducing these effects.
- Investigation of the use of more advanced radar systems that may provide improved filtering of spurious signals and the tracking of small vessels.
- Investigation of the use of AIS in smaller vessels as a more reliant means of navigating in a turbine field.

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Tables

Figures

Acronyms

ACPARS	Atlantic Coast Port Access Route Study
ADLS	Aircraft Detection Lighting System
AIS	Automatic Identification System
ARI	Average Recurrence Interval
ASCC	Air Station Cape Cod
ATON	Aids to Navigation
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
CFSR	Climate Forecast System Reanalysis
COLREGS	International Regulations for Preventing Collisions at Sea
COP	Construction and Operations Plan
DSC	Digital Selective Calling
DWT	Deadweight Tonnage
ECDIS	Electronic Chart Display and Information System
EMF	Electromagnetic Field
EPA	Environmental Protection Agency
ESP	Electrical Service Platform
FAA	Federal Aviation Administration
FLiDAR	Floating Light Detection and Ranging
ft	feet
GIS	Geographic Information System
GPS	Global Positioning System
GSPR	General Provisions on Ships' Routing
Hz	Hertz
IALA	International Association of Lighthouse Authorities
IMO	International Maritime Organization
IPS	Intermediate Peripheral Structures
IPS	Intermediate Peripheral Structures
JBCC	Joint Base Cape Cod
knts	Knots - vessel speed in nautical miles per hour
LOA	length overall
m	meter
RI/MA WEA	Rhode Island and Massachusetts Wind Energy Area

MARIPARS	Massachusetts and Rhode Island Port Access Route Study
MER	Marine Environmental Response
MGN	Marine Guidance Note
MHHW	Mean Higher High Water
MISLE	Marine Information for Safety and Law Enforcement
MKD	Minimum Keyboard Distance
MLLW	Mean Lower Low Water
MMSI	Maritime Mobile Service Identity
MRASS	Mariner Radio Activated Sound Signal
MSL	Mean Sea Level
MTS	Marine Transportation System
MW	megawatt
NCEI	National Centers for Environmental Information
NCEP	National Centers for Environmental Prediction
NDBC	National Data Buoy Centre
NM	nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NORM	Navigational and Operational Risk Model
NSRA	Navigation Safety Risk Assessment
NTM	Notice to Mariners
NVIC	Navigation and Vessel Inspection Circular
O&M	Operations and Maintenance
OECC	Offshore Export Cable Corridor
OREI	Offshore Renewable Energy Installation
PATON	Private Aids to Navigation
PIANC	World Association for Waterborne Transport Infrastructure
RACON	Radar Transponder
Ro-Ro	Roll-on roll-off vessel
SAR	Search and Rescue
SOV	Service Operational Vessel
SPS	Significant Peripheral Structure
SWDA	Southern Wind Development Area
TSS	Traffic separation scheme
UNCLOS	United Nations Convention on the Law of the Sea

USACE	US Army Corps of Engineers
USCG	US Coast Guard
VHF	Very High Frequency Radio
VMS	Vessel Monitoring Service
WDA	Wind Development Area
WIS	Wave Information Study
WTG	Wind Turbine Generator

1. Introduction

1.1. Description of New England Wind

New England Wind is the proposal to develop offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0534 along with associated offshore and onshore cabling, onshore substations, and onshore operations and maintenance (O&M) facilities. New England Wind will be developed in two phases with a maximum of 130 wind turbine generator (WTG) and electrical service platform (ESP) positions. Four or five offshore export cables will transmit electricity generated by the WTGs to onshore transmission systems in the Town of Barnstable, Massachusetts, as shown in Figure 1.1 and Figure 1.2. Park City Wind LLC, a wholly owned subsidiary of Avangrid Renewables, LLC, is the Proponent and will be responsible for the construction, operation, and decommissioning of New England Wind.

New England Wind's offshore renewable wind energy facilities are located immediately southwest of Vineyard Wind 1, which is located in Lease Area OCS-A 0501. New England Wind will occupy all of Lease Area OCS-A 0534 and potentially a portion of Lease Area OCS-A 0501 in the event that Vineyard Wind 1 does not develop "spare" or extra positions included in Lease Area OCS-A 0501 and Vineyard Wind 1 assigns those positions to Lease Area OCS-A 0534. For the purposes of the Construction and Operations Plan (COP), the Southern Wind Development Area (SWDA) is defined as all of Lease Area OCS-A 0534 and the southwest portion of Lease Area OCS-A 0501, as shown in Figure 1.2. The SWDA may be 101,590 to 111,939 acres (411 to 453 square kilometers [km^2]) in size depending upon the final footprint of Vineyard Wind 1. At this time, the Proponent does not intend to develop the two positions in the separate aliquots located along the northeastern boundary of Lease Area OCS-A 0501 as part of New England Wind. The SWDA (excluding the two separate aliquots that are closer to shore) is just over 20 miles (mi) (32 km) from the southwest corner of Martha's Vineyard and approximately 24 mi (38 km) from Nantucket.[2] The WTGs and ESPs in the SWDA will be oriented in an east-west, north-south grid pattern with one nautical mile (NM) (1.85 km) spacing between positions. This uniform grid layout provides 1 NM wide corridors in the east-west and north-south directions as well as 0.7 NM (1.3 km) wide corridors in the northwest-southeast and northeast-southwest directions.

Four or five offshore export cables—two cables for Phase 1 and two or three cables for Phase 2—will transmit electricity from the SWDA to shore. Unless technical, logistical, grid interconnection, or other unforeseen issues arise, all New England Wind offshore export cables will be installed within a shared Offshore Export Cable Corridor (OECC) that will travel from the northwestern corner of the SWDA along the northwestern edge of Lease Area OCS-A 0501 (through Vineyard Wind 1) and then head northward along the eastern side of Muskeget Channel toward landfall sites in the Town of Barnstable (see Figure 1.1). The OECC for New England Wind is largely the same OECC proposed in the approved Vineyard Wind 1 COP, but it has been widened to the west along the entire corridor and to the east in portions of Muskeget Channel.

Each Phase of New England Wind will be developed and permitted using a Project Design Envelope (the "Envelope") that defines and brackets the characteristics of the facilities and activities for purposes of environmental review while maintaining a reasonable degree of flexibility with respect to the selection of key components, such as the WTGs, foundations, offshore cables, and ESPs.

Phase 1 of New England Wind

[2] Within the SWDA, the closest WTG is approximately 34 km (21 mi) from Martha's Vineyard and 40 km (25 mi) from Nantucket.

Phase 1, also known as the 804 MW Park City Wind project, will be developed immediately southwest of the Vineyard Wind 1 project. The Phase 1 Envelope allows for 50 to 62 WTGs with generating capacities ranging from approximately 13-16 MW and one or two ESPs. Depending upon the capacity of the WTGs, Phase 1 will occupy 44,973 to 57,081 acres (182 to 231 km^2) of the SWDA. The Phase 1 Envelope includes two WTG foundation types: monopiles and piled jackets. Strings of WTGs will connect with the ESP(s) via a submarine inter-array cable transmission system. The ESP(s) will include step-up transformers and other electrical equipment and will also be supported by a monopile or jacket foundation. Two high-voltage alternating current (HVAC) offshore export cables up to approximately 101 km (54 NM) in length (per cable) installed within the SWDA and an Offshore Export Cable Corridor (OECC) will transmit electricity from the ESP(s) to a landfall site at the Craigville Public Beach or Covell's Beach in the Town of Barnstable. Underground onshore export cables, located principally in roadway layouts, will connect the landfall site to a new Phase 1 onshore substation in Barnstable. Grid interconnection cables will then connect the Phase 1 onshore substation to the ISO New England (ISO-NE) electric grid at Eversource's existing 345 kilovolt substation in West Barnstable.

Phase 2 of New England Wind

Phase 2, also known as Commonwealth Wind, will deliver 1,200 to 1,500 MW of power. When constructed, Phase 2 will be immediately southwest of Phase 1 and will occupy the remainder of the SWDA. Phase 2 may include one or more projects, depending on market conditions. The footprint and total number of WTG and ESP positions in Phase 2 depends upon the final footprint of Phase 1; Phase 2 is expected to contain 64 to 79 WTG/ESP positions (up to three positions will be occupied by ESPs) within an area ranging from 54,857–66,965 acres (222–271 km^2). The Phase 2 Envelope allows for WTGs with generating capacities ranging from approximately 13-19 MW and includes three general WTG foundation types: monopiles, jackets (with piles or suction buckets), or bottom-frame foundations (with piles or suction buckets). Inter-array cables will transmit electricity from the WTGs to the ESP(s). The ESP(s) will also be supported by a monopile or jacket foundation (with piles or suction buckets).

Two or three HVAC offshore export cables will transmit power from the ESP(s) to shore. Unless technical, logistical, grid interconnection, or other unforeseen issues arise, all Phase 2 offshore export cable(s) will be installed within the same OECC as the Phase 1 cables from the northwestern corner of the SWDA to within approximately 1-2 mi (2-3 km) of shore, at which point the OECC for each Phase will diverge to reach separate landfall sites in Barnstable. Underground onshore export cables, located primarily within in roadway layouts, will connect the landfall site(s) to one or two new onshore substations in the Town of Barnstable. Grid interconnection cables will then connect the onshore substation site(s) to the West Barnstable Substation.[3]

While the Proponent intends to install all New England Wind offshore export cables within the OECC that travels from the SWDA northward through the eastern side of Muskeget Channel towards landfall sites in the Town of Barnstable, the Proponent is reserving the fallback option to install one or two Phase 2 cables along the western side of Muskeget Channel, referred to as the Phase 2 OECC Western Muskeget Variant[1] (see Section 4.1.3.2 of COP Volume I). Throughout this section, unless the Western Muskeget Variant is specified, "the OECC" refers to the OECC that travels along the eastern side of Muskeget Channel. For both Phases, to support New England Wind construction and operation activities, the Proponent will use a combination of North Atlantic ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and/or Canada.

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3 One or more Phase 2 offshore export cables may deliver power to a second grid interconnection point if technical, logistical, grid interconnection, or other unforeseen issues arise. Under this scenario, Phase 2 could include one onshore transmission system in Barnstable and/or an onshore transmission system(s) in proximity to the second grid interconnection point (see Section 4.1.4 of COP Volume I).

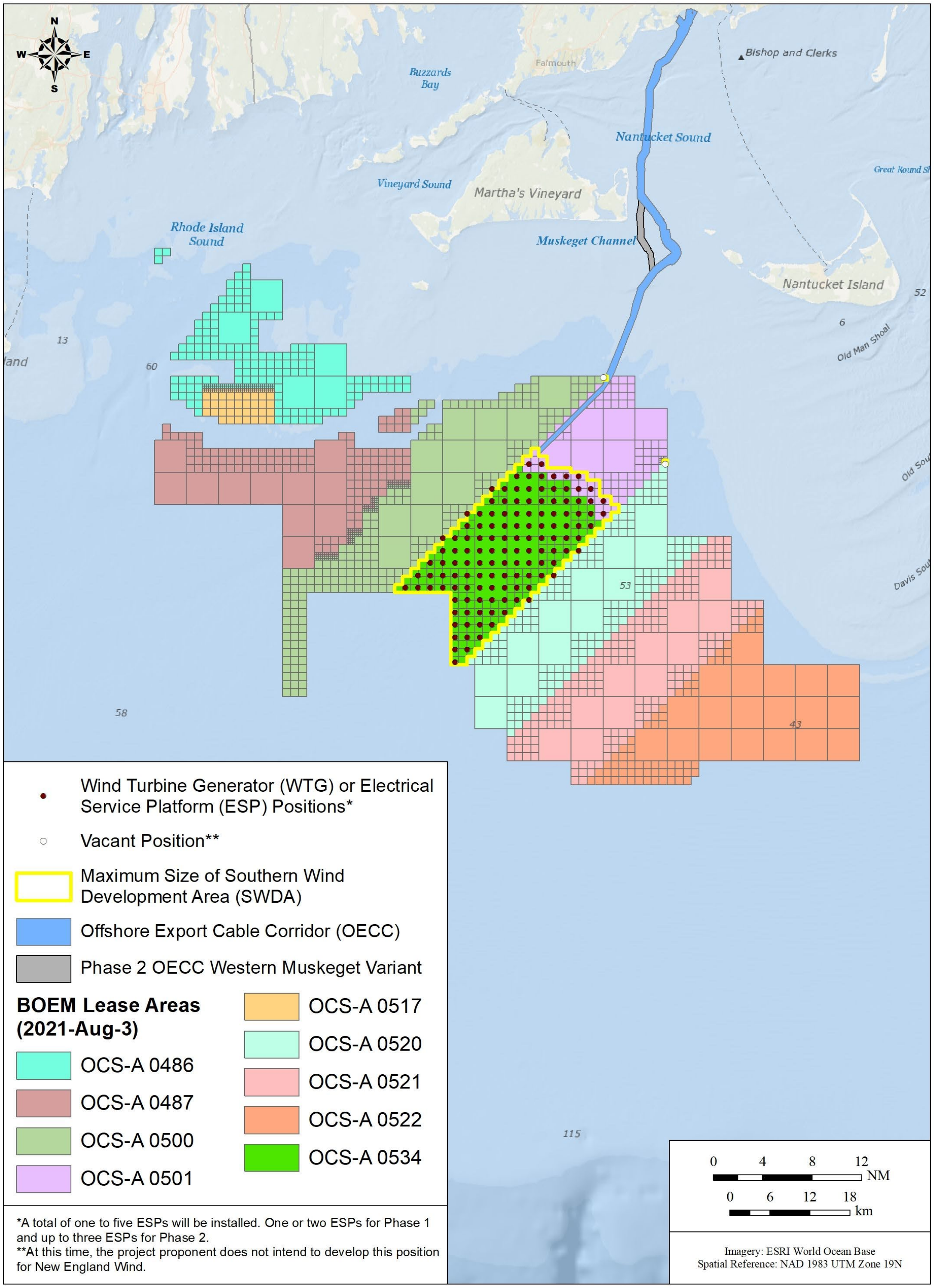
N
W
E
S
Buzzards Bay
Falmouth
Bishop and Clerks
Nantucket Sound
Great Round Sh
Vineyard Sound
Martha's Vineyard
Rhode Island Sound
Muskeget Channel
Nantucket Island
52
6
Old Man Shoal
13
60
53
58
43
115
Wind Turbine Generator (WTG) or Electrical Service Platform (ESP) Positions*
Vacant Position**
Maximum Size of Southern Wind Development Area (SWDA)
Offshore Export Cable Corridor (OECC)
Phase 2 OECC Western Muskeget Variant
BOEM Lease Areas (2021-Aug-3)
OCS-A 0486
OCS-A 0487
OCS-A 0500
OCS-A 0501
OCS-A 0517
OCS-A 0520
OCS-A 0521
OCS-A 0522
OCS-A 0534
*A total of one to five ESPs will be installed. One or two ESPs for Phase 1 and up to three ESPs for Phase 2.
**At this time, the project proponent does not intend to develop this position for New England Wind.
0 4 8 12 NM
0 6 12 18 km
Imagery: ESRI World Ocean Base
Spatial Reference: NAD 1983 UTM Zone 19N

Figure 1.1: Regional Map Showing the Massachusetts Wind Energy Area and Rhode Island/Massachusetts Wind Energy Area

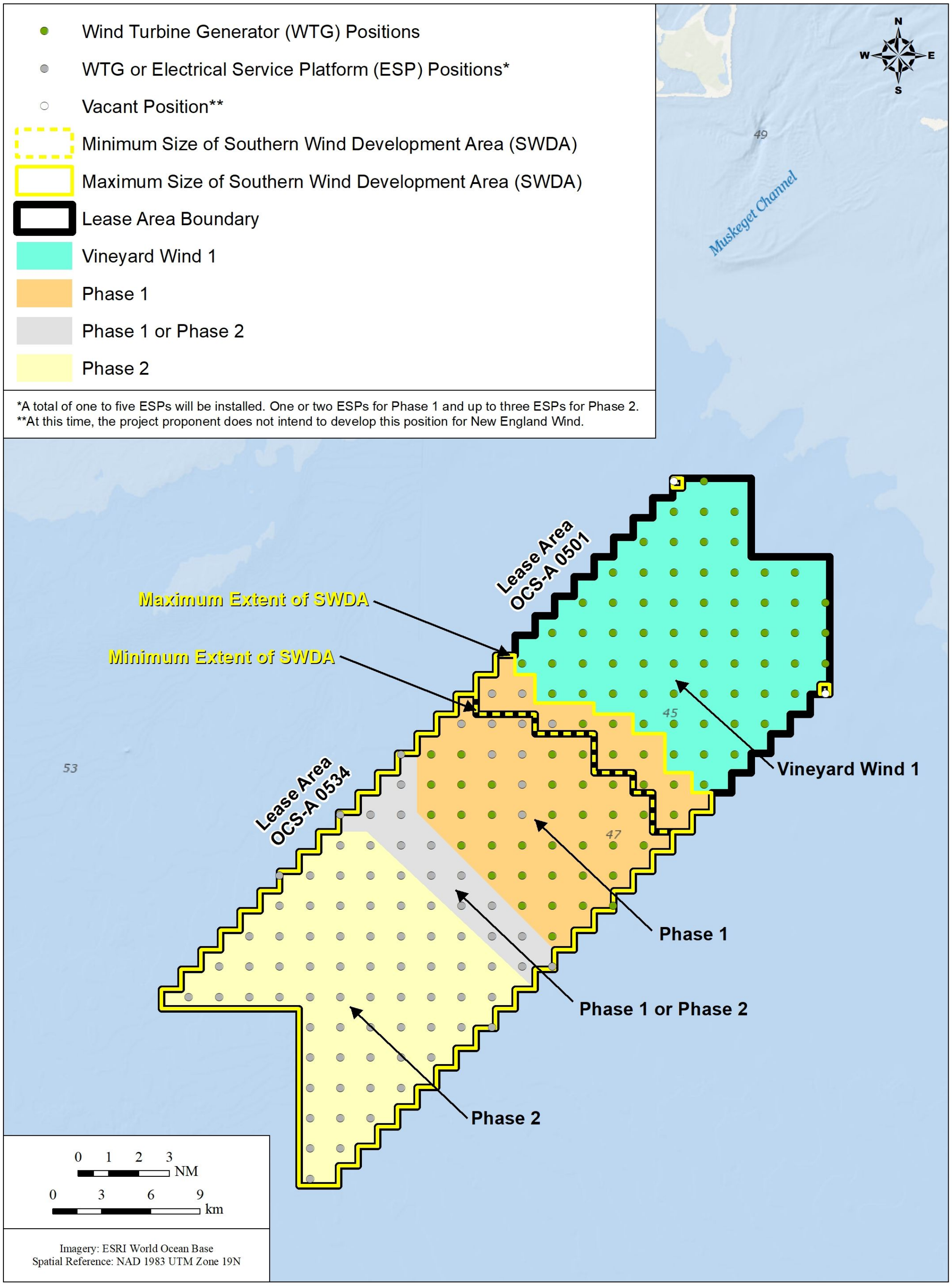

Figure 1.2: New England Wind with Phases

1.2. Purpose of the Navigation Safety Risk Assessment

The United States Coast Guard (USCG) provides guidance on the information and factors that will be considered when reviewing an application for a permit to build and operate an Offshore Renewable Energy Installation (OREI), such as New England Wind. This information, which is outlined in USCG Navigation and Vessel Inspection Circular No. 01-19 (NVIC 01-19), is to be summarized through conducting a Navigation Safety Risk Assessment (NSRA). The NSRA is intended to identify hazards to navigation and associated consequences that might be created by the OREI during construction and installation, operations and maintenance, and decommissioning. Key considerations include: (1) safety of navigation; (2) the effect on traditional uses of the waterway; and (3) maritime search and rescue activities by the USCG and others.

The NSRA process is to be conducted in cooperation and consultation with a wide range of stakeholders, including federal, state, tribal entities and local agencies, local maritime representatives, and the general public.

This report provides the NSRA conducted for New England Wind.

1.3. Overview of the Methodology

The NSRA has involved a number of activities including a detailed assessment of existing vessel traffic in the SWDA by means of vessel Automatic Identification System (AIS) data and the National Oceanic and Atmospheric Administration (NOAA) Vessel Monitoring Service (VMS) dataset; a review of the characteristics of the existing waterway; an analysis of meteorological and oceanographic ("metocean") conditions affecting navigation (e.g., winds, waves, ice, etc.); and an evaluation of historical search and rescue activity in the region. A summary of feedback from stakeholder engagement is provided.

Using this baseline information, an evaluation of navigational hazards during construction and operation of New England Wind was carried out. This subsequently led to the identification of various risks as well as mitigation measures and associated monitoring.

1.4. Report Organization

This report follows a general outline of describing New England Wind, the relevant characteristics of the surrounding environment, the vessel traffic in the area, the effects of New England Wind on navigational risks, and mitigation measures for the navigational risks from New England Wind. Appendix E contains a cross reference between the specific guidance given in Enclosure (2) of NVIC 01-19 requirements and the contents of this report.

2. New England Wind Description

2.1 Wind Farm Layout

Phase 1 will consist of 50 to 62 WTGs oriented in an east-west and north-south grid pattern with one nautical mile (1 NM [1.85 km]) spacing, as shown in Figure 2.1. This arrangement also creates diagonal corridors in the northwest-southeast and southwest-northeast directions with a spacing of 0.7 NM (1.3 km). Phase 1 will also include one or two ESPs, which are offshore substations that serve as common interconnection points for the WTGs. The ESPs will be positioned along the grid arrangement; the green circles in Figure 2.1 show potential locations under consideration.

The footprint and total number of WTG and ESP positions in Phase 2 depends upon the final footprint of Phase 1; Phase 2 is expected to contain 64 to 79 WTG/ESP positions (up to three positions will be occupied by ESPs). Consistent with Phase 1, the Phase 2 WTGs and ESPs will be oriented in an east-west and north-south 1 NM by 1 NM (1.85 km by 1.85 km) grid.

It is worth noting that the 1 NM by 1 NM grid layout of both Phases limits the total energy production potential of New England Wind and the associated benefits of clean, renewable energy. Typically, offshore renewable wind energy facilities are designed to maximize the amount of energy that can be generated within a given area. In general, the most optimal WTG layout for wind energy production is a non-grid WTG layout with closer turbine spacing and a higher density of WTGs around the edges of the wind farm; such a design maximizes the number of WTGs per area while minimizing wake effects that impact the efficiency of downwind turbines.

However, as permitting of the first offshore wind farms within the Massachusetts Wind Energy Area (MA WEA) and Rhode Island/Massachusetts Wind Energy Area (RI/MA WEA) progressed, other users of the Outer Continental Shelf (OCS) expressed the need for alternative, more uniform turbine layouts to accommodate vessel transits, fishing, and other uses of the MA WEA and RI/MA WEA. Various wind turbine layouts and transit plans were proposed in 2018 through numerous forums in New England, including proposals from the Massachusetts Coastal Zone Management Fisheries Working Group and the Responsible Offshore Development Alliance (RODA).

Recognizing that a consensus among all stakeholders could not be reached, the USCG initiated the Massachusetts and Rhode Island Port Access Route Study (MARIPARS) on March 26, 2019 to evaluate the need for vessel routing measures, including regional transit lanes, within the MA WEA and RI/MA WEA (see Section 3.2.2). The study solicited several rounds of public input from maritime community representatives, fishing industry representatives, developers, environmental groups, and other interested stakeholders.

In response, on November 1, 2019, the New England offshore wind leaseholders submitted a joint letter to USCG that proposed a collaborative regional layout for wind turbines across the entire RI/MA WEA and MA WEA. As stated in the letter:

> Under this proposal each turbine would be spaced 1 nautical mile (nm) apart in fixed east-to-west rows and north-to-south columns to create the 1 nm by 1 nm grid arrangement preferred by many stakeholders, including fishermen operating in the region. This 1x1 nm layout has also been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This proposed layout will provide a uniform, wide spacing among structures to facilitate search and rescue operations.

On May 27, 2020, USCG published the final MARIPARS, which found that, “After considering all options and the vessel traffic patterns within the MA/RI WEA, a standard and uniform grid pattern with at least three lines of orientation throughout the MA/RI WEA would allow for safe navigation and continuity of USCG missions through seven adjacent wind farm lease areas over more than 1,400 square miles of ocean.”

Thus, New England Wind will adopt the 1 NM by 1 NM WTG/ESP layout proposed by the five New England offshore wind leaseholders, which in accordance with the USCG’s recommendations contained in the MARIPARS and aligns with the layout preferred by many stakeholders, including fishermen. The 1 x 1 NM WTG/ESP layout was also approved by BOEM through its Record of Decision on the Vineyard Wind 1 project. The Proponent expects this 1 NM by 1 NM layout to be similarly adopted by other developers throughout the lease areas in the MA WEA and RI/MA WEA.

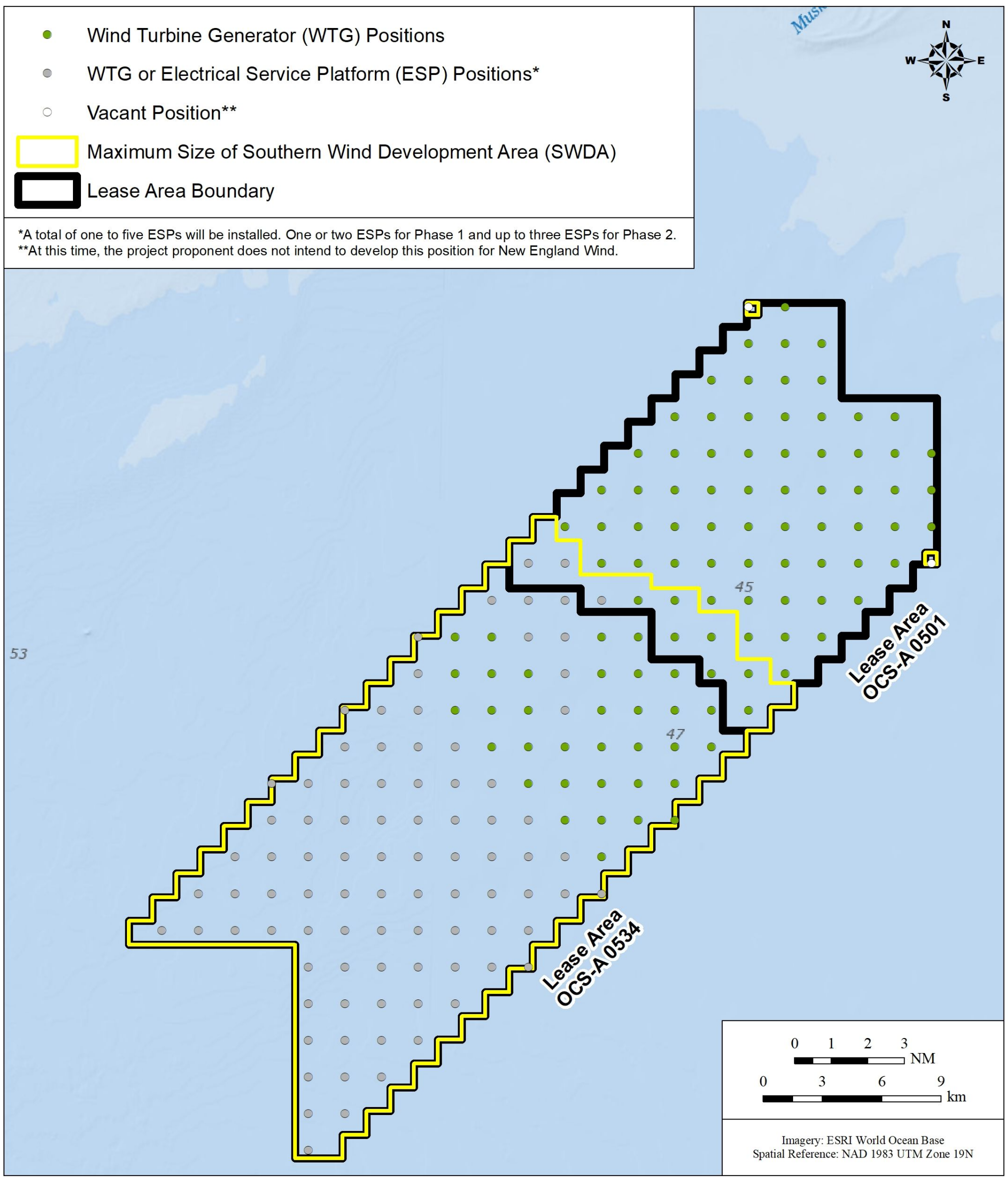

Figure 2.1: New England Wind Layout

2.2 Wind Turbine Generators and Foundations

As noted previously, Phase 1 will consist of 50 to 62 WTGs and their foundations, along with one or two ESPs and their foundations, inter-array cables, and offshore export cables. Phase 2 will have a maximum of 79 WTGs if all available positions are used for WTGs. Table 2.1 summarizes the dimensions for the WTGs. With respect to vessel navigation, an important consideration is the minimum tip clearance, which is identified as being a minimum of 89 ft (27 m) for both Phases.

Table 2.1: WTG Dimensions

Parameter	Phase 1	Phase 2
WTG Capacity	13–16 MW	13–19 MW
Maximum Tip Height	1,047 ft (319 m) MLLW[1]	1,171 ft (357 m) MLLW
Maximum Top of The Nacelle Height[2]	653 ft (199 m) MLLW	725 ft (221 m) MLLW
Maximum Hub Height	630 ft (192 m) MLLW	702 ft (214 m) MLLW
Maximum Rotor Diameter	837 ft (255 m)	935 ft (285 m)
Minimum Tip Clearance	89 ft (27 m) MLLW	89 ft (27 m) MLLW
Maximum Blade Chord	26 ft (8 m)	30 ft (9 m)
Maximum Tower Diameter	30 ft (9 m)	33 ft (10 m)

1. MLLW refers to Mean Lower Low Water, which is the average height of the lowest daily tide. Navigational charts in the US normally refer to this as the elevation datum.
2. Includes lights and appurtenances.

The WTGs will be supported on foundations that rest or are driven into the seabed. Three different foundation concepts are being considered:

- Monopiles – A monopile is a single, hollow steel cylinder that is secured to the seabed.
- Jackets – A jacket foundation is a steel structure that includes three or four legs that are inter-connected by steel tubular cross-bracing. The structure is secured to the seabed by piles or suction buckets (for Phase 2, only).
- Bottom-Frame Foundations (for Phase 2, only) – This is a triangular space-frame structure that has a single vertical column with three horizontal elements that connect to the foundation's "feet." The feet are secured to the seabed by piles or suction buckets.

The dimensions for the WTG foundations are provided in Table 2.2 and Table 2.3. This navigation safety risk assessment has considered the maximum dimensions from either Phase 1 or 2.

Rock scour protection may be placed around the bases of the foundations on the seabed. The horizontal extent of the scour protection depends on the foundation type.

Table 2.2: Phase 1 WTG Foundation Maximum Dimensions

Concept	Monopile	Jackets
	With or Without TP	Piles (3-4 Piles)
Maximum Total Length (from interface with WTG to deepest point beneath the seafloor)	466 ft (142 m)	564 ft (172 m)
Maximum Pile Diameter at Base	39 ft (12 m)	13 ft (4 m)
Maximum TP Length for Monopiles/ Height above Mudline for Jackets	148 ft (45 m)	285 ft (87 m)
Maximum TP Diameter/Width	30 ft (9 m)	82 ft (25 m)
Maximum Distance Between Adjacent Legs	N/A	131 ft (40 m)
Maximum Area of Scour Protection per Foundation	1.0 acres (4,072 m^2)	1.1 acres (4,624 m^2)

Table 2.3: Phase 2 WTG Foundation Maximum Dimensions

Concept	Monopile	Jackets		Bottom-Frame	
	With or Without TP	Piles (3-4 Piles)	Suction Bucket (3 Buckets)	Piled (3 Piles)	Suction Bucket (3 Buckets)
Maximum Total Length (from interface with WTG to deepest point beneath the seafloor)	482 ft (147 m)	581 ft (177 m)	351 ft (107 m)	581 ft (177 m)	351 ft (107 m)
Maximum Pile/Bucket Diameter at Base	43 ft (13 m)	13 ft (4 m)	49 ft (15 m)	13 ft (4 m)	49 ft (15 m)
Maximum TP Length for Monopiles/ Height above Mudline for Jackets and Bottom-Frames	164 ft (50 m)	302 ft (92 m)	302 ft (92 m)	302 ft (92 m)	302 ft (92 m)
Maximum TP Diameter/Width	33 ft (10 m)	82 ft (25 m)	82 ft (25 m)	36 ft (11 m)	36 ft (11 m)
Maximum Distance Between Adjacent Legs	N/A	131 ft (40 m)	131 ft (40 m)	285 ft (87 m)	285 ft (87 m)
Maximum Area of Scour Protection per Foundation	1.2 acres (4,778 m^2)	1.1 acres (4,624 m^2)	1.6 acres (6,369 m^2)	1.7 acres (6,862 m^2)	2.4 acres (9,754 m^2)

2.3. Electrical Service Platforms

The electrical service platforms (ESPs) are offshore electrical substations that serve as common interconnection points for the WTGs and include step-up transformers and other electrical gear to increase the voltage of power generated by the WTGs.

The maximum width and length of the Phase 1 ESP topsides is 148 x 230 ft (45 x 70 m). The maximum width and length of the Phase 2 ESP topsides is 197 x 328 ft (60 x 100 m). The ESP topsides will be supported by monopiles, piled jackets, or suction bucket jackets (for Phase 2 only). Table 2.4 and Table 2.5 provide the maximum dimensions for the foundations.

Phase 1 will include one or two ESPs and Phase 2 will have up to three ESPs. Potential ESP locations are shown in Figure 2.1. The ESPs will be located within the same 1 NM by 1 NM grid as the WTGs. For each Phase, if more than one ESP is used, two ESPs may be co-located at one of the potential ESP positions shown on Figure 2.1 (co-located ESPs would be smaller structures installed on monopile foundations). If the ESPs are co-located, each ESP's monopile foundation would be located within 250 ft (76 m) of one of the potential ESP locations (i.e., the monopiles would be separated by up to 500 ft (152 m).

Table 2.4: Phase 1 ESP Maximum Foundation Dimensions

Concept	Monopile	Piled Jackets
No. of legs per foundation	1	3 - 6
No. of piles per foundation	1	3 - 12
Maximum Total Length (from interface with ESP to deepest point beneath the seafloor)	466 ft (142 m)	564 ft (172 m)
Maximum Pile Diameter at Base	39 ft (12 m)	13 ft (4 m)
Maximum TP Length for Monopiles/ Height above Mudline for Jackets	131 ft (40 m)	285 ft (87 m)
Maximum Distance Between Adjacent Legs	N/A	230 ft (70 m)
Maximum Area of Scour Protection per Foundation	1.0 acres (4,072 m^2)	1.5 acres (6,023 m^2)

Table 2.5: Phase 2 ESP Maximum Foundation Dimensions

Concept	Monopile	Piled Jackets	Suction Bucket Jackets
No. of legs per foundation	1	3 - 6	3 - 6
No. of piles per foundation	1	3 - 12	0
Maximum Total Length (from interface with ESP to deepest point beneath the seafloor)	482 ft (147 m)	581 ft (177 m)	351 ft (107 m)
Maximum Pile/Bucket Diameter at Base	43 ft (13 m)	13 ft (4 m)	49 ft (15 m)
Maximum TP Length for Monopiles/ Height above Mudline for Jackets	131 ft (40 m)	302 ft (92 m)	302 ft (92 m)
Maximum Distance Between Adjacent Legs	N/A	328 ft (100 m)	328 ft (100 m)
Maximum Area of Scour Protection per Foundation	1.2 acres (5,027 m^2)	2.5 acres (9,953 m^2)	5.3 acres (21,316 m^2)

2.4. Offshore Export Cable Corridor (OECC)

Two 220-275 kV HVAC offshore export cables will transmit electricity from the Phase 1 ESP(s) to the selected landfall site. Two or three 220-345 kV HVAC Phase 2 offshore export cables will transmit power from the Phase 2 ESP(s) to the selected landfall site(s). These Phase 1 and Phase 2 offshore export cables will be installed within the Offshore Export Cable Corridor (OECC) shown in Figure 1.1 and will be buried beneath the seafloor at a target depth of 5 to 8 ft (1.5 to 2.5 m). If detailed engineering or other technical issues arise demonstrating that installation of all Phase 2 cables within a portion of the OECC in the Muskeget Channel area is not feasible, the Proponent would exercise the option to install one or two Phase 2 offshore export cables within the Western Muskeget Variant.

2.5. New England Wind Activities

2.5.1 Construction and Installation

Construction and installation of New England Wind will require the use of a wide range of construction and support vessels. These vessels will transit within the SWDA, along the OECC, and along vessel routes between the SWDA, OECC, and various ports. Estimates of the numbers and types of vessels are provided in Sections 3 and 4 of COP Volume I. Table 2.6 summarizes the type and dimensions of some of the larger vessels that might be utilized. As this stage of the development process, vessel data is highly speculative and is anticipated to be furthered refined in the future Fabrication and Installation Report.

Table 2.6: Larger Representative Construction Vessels

Vessel Type	Approximate Length ft (m)
Anchor handling tug supply (AHTS) vessels	53-213 (16-65)
Barges	328 (100)
Bunkering vessels	~262 (80)
Cable laying vessels	262-492 (80-150)
Crew transfer vessels (CTVs)	65-98 (20-30)
Dredging vessels	~755 (230)
Heavy lift vessels (HLVs)	505-722 (154-220)
Heavy transport vessels (HTVs)	394-732 (120-223)
Jack-up vessels	180-722 (55-220)
Scour/cable protection installation vessels	426-558 (130-170)
Service operation vessels (SOVs)	~262 (80)
Support vessels	98-394 (30-120)
Survey vessels	42-367 (13-112)
Tugboats	49-124 (15-38)

The offshore construction and installation activities for Phase 1 may occur over a period of approximately one and a half and two years. Several US port facilities in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey have been identified for the major Phase 1 construction staging activities; ports in Europe and Canada may also be used. The Proponent also expects to use one or more of these ports for frequent crew transfer, and to offload shipments of components, store components, prepare them for installation, and then load components onto vessels for delivery to the SWDA.

The timing of Phase 2 is uncertain and depends on market conditions. It may either immediately follow Phase 1 or there may be a gap of a number of years in construction activity. As with Phase 1, a wide range of ports are being considered for construction staging.

The draft COP provides a summary of the anticipated fleet requirements during construction and installation; however, it is difficult to quantify the numbers of vessels and vessel trips from each port at this time. It has been estimated that an average of ~30 vessels would operate at the SWDA or along the OECC at any given time during construction. Typically, the busiest period of construction activity is associated with the installation and commissioning of the foundations, inter-array cables, and WTGs. During the most active period, it is estimated that a maximum of approximately 60 vessels could operate in the Offshore Development Area simultaneously. Specifically for offshore cable laying activities, an average of approximately seven vessels is estimated to be in the OECC during any given month with a maximum of approximately 15 vessels during the month with greatest activity.

Many of the vessels will remain at the SWDA or OECC for days or weeks at a time, making infrequent trips to port for bunkering and provisioning. Estimates of vessel traffic associated with New England Wind construction are summarized in Table 2.7. It is not expected that all of these ports would be used simultaneously; however, several might be used during construction depending on logistics planning.

Table 2.7: Estimated Vessel Traffic During Construction

Ports	Peak Construction Period		Over Construction Period	
	Expected Average Round Trips per Day	Average Round Trips per Month	Expected Average Round Trips per Day	Average Round Trips per Month
All Ports	15	443	8	215
New Bedford Harbor	15	443	7	209
Bridgeport Vineyard Haven Port of Davisville South Quay Terminal	13	376	6	177
ProvPort Brayton Point Commerce Center Fall River New London State Pier Staten Island Ports South Brooklyn Marine Terminal GMD Shipyard Shoreham	6	162	3	68
Salem Harbor Canadian Ports European Ports	2	46	1	20
Capitol Region Ports Paulsboro	1	6	1	3

2.5.2 Operations and Maintenance (O&M)

Once construction is complete and Phase 1 is commissioned, Phase 1 will enter an up to 30-year operating period. For Phase 1, the Proponent expects to use a service operational vessel (SOV) for daily O&M activities, likely based in Bridgeport, Connecticut. The SOV would provide accommodation and workspace allowing workers to remain offshore for days or weeks at a time. Crew transfer vessels and/or daughter craft will likely ferry workers to and from shore. Larger support vessels may be needed from time-to-time to perform certain maintenance activities. Helicopters may also be utilized. In addition to the SOV O&M base, the Proponent may base some Phase 1 O&M activities on Martha's Vineyard; current plans anticipate that crew transfer vessels and/or the SOV's daughter craft would operate out of Vineyard Haven and/or New Bedford during O&M.

For Phase 2 O&M, the Proponent will likely use O&M facilities in Bridgeport, Vineyard Haven, and/or New Bedford Harbor. For either Phase, as described in Section 3.2.2.6 and 4.2.2.6 of Volume I, the Proponent may use other ports to support O&M activities, as necessary.

During the O&M period of each Phase, the number of New England Wind -related vessels operating in the Offshore Development Area depends on the timing and frequency of activities, the number of WTGs and ESPs installed, the final design of the offshore facilities, and the logistics solution used during O&M. For these reasons, the estimates of vessel counts and vessel trips provided below are likely conservative and subject to change.

For each Phase individually, during the busiest year of O&M, an average of approximately five vessels are anticipated to operate in the Offshore Development Area at any given time; additional vessels may be required during certain maintenance or repair scenarios. Approximately 290 vessel round trips are estimated to take place annually during the O&M of each Phase, assuming each Phase's maximum design scenario.

However, due to the range of buildout scenarios for Phases 1 and 2, the Proponent expects the total number of vessel trips during simultaneous operation of both Phases to be less than the sum of vessel trips estimated for each Phase independently. During O&M of both Phases, it is anticipated that an average of approximately seven vessels will operate in the Offshore Development Area on any given day. In certain maintenance or repair scenarios, additional vessels may be required, which are estimated to result in a maximum of ~15 vessels operating within the SWDA or along the OECC at one time (although due to the unpredictable nature of corrective maintenance, the maximum number of vessels is difficult to accurately predict). Approximately 530 vessel round trips are estimated to take place annually during the simultaneous operation of both Phases, which equates to an average of less than two vessel round trips per day.

2.5.3 Decommissioning

Once the Phase 1 and Phase 2 operational terms end, the Phase 1 or 2 facilities will be decommissioned. As per BOEM's decommissioning requirements (30 CFR Part 585), all "facilities, projects, cables, pipelines and obstructions" must be removed or decommissioned within two years following lease termination. Offshore, this will consist of retirement in place or removal of cable systems, dismantling and removal of WTGs, cutting and removal of foundations, removal of scour protection, and removal of ESPs. This process is essentially the reverse of construction and will require similar numbers and sizes of vessels.

3. Relevant Navigational Guidelines and Studies

3.1 Introduction

There are a number of studies and navigational guidelines produced by the US Coast Guard and international organizations that have been employed in this Navigation Safety Risk Assessment (NSRA). This section of the report briefly describes a few of these documents. Where these documents have been used in this analysis is noted within this report by referencing the specific document used. If documents are not specifically cited as part of the analyses, then they are provided in this section for purposes of background information only.

3.2 US Coast Guard

3.2.1 NVIC 01-19

The US Coast Guard Navigation and Vessel Inspection Circular (NVIC) 01-19 is titled *Guidance on the Coast Guard's Roles and Responsibilities for Offshore Renewable Energy Installations (OREI)*. This circular provides guidance on the information and factors that the Coast Guard will consider when reviewing an application for a permit to build and operate an OREI such as a wind farm. As a cooperating agency to BOEM, the USCG can recommend that a developer prepare a Navigation Safety Risk Assessment (NSRA), which must make reference to existing studies, standard industry practices, and guidelines from recognized sources such as government agencies or classification societies.

Enclosure (2) of NVIC 01-19 identifies the information that should be included in the NSRA:

- The site and installation coordinates;
- Details of the installation characteristics such as marking and lighting;
- Completion of a recent marine vessel traffic survey;
- Details of the offshore above and under water structures, and whether these structures can impinge on vessels and emergency response;
- An assessment of navigation within and nearby the structures;
- The effects of meteorological and oceanographic conditions (tides, currents, winds, etc.);
- Potential hinderance to visual navigation such as structural blockage of the view of other vessels or navigational aids;
- Impacts on communications, radar and positioning systems;
- An evaluation of the risk of collision, allision or grounding;
- An assessment of the potential impact on emergency response such as Search and Rescue (SAR), and marine environmental protection;
- A description of facility characteristics and design requirements; and,
- Operational requirements and procedures.

Enclosure (3) provides a summary of marine planning guidelines with reference to international guidance such as the United Kingdom's MGN-371 (now superseded by MGN-543). Enclosure (4) summarizes several potential navigational risk mitigation strategies for consideration by developers.

This NSRA has been prepared in accordance with the requirements of NVIC 01-19 and the NVIC 01-19 checklist is provided in Appendix E.

3.2.2 MARIPARS

The USCG recently completed The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study (MARIPARS) (USCG 2020) to evaluate whether navigational safety concerns exist with vessel transits across the seven adjacent leases that comprise the Rhode Island and Massachusetts Wind Energy Area (RI/MA WEA). The study also assessed the need to recommend changes to enhance navigational safety, and for establishing vessel routing measures. The study was conducted in accordance with the USCG methodology and included a 60-day public comment period and three public meetings. All comments were published in Docket Number USCG-2019-0131. The final report was released on May 14, 2020.

The study tasks included comprehensive analyses of historical vessel traffic using AIS data, review of site weather conditions, examination of historical search and rescue activities, and a detailed assessment of vessel navigational requirements.

The USCG recommended that the RI/MA WEA WTG layout be developed with a standard and uniform grid pattern with at least three lines of orientation with the following dimensions:

- East-west and north—south lanes with a width of 1 NM. This width would ensure two lines of orientation for USCG SAR operations.
- Lanes for commercial fishing activity should be orientated east—west and have a 1 NM width.
- Lanes for vessel transit from northwest to southeast should have a minimum width of 0.6 to 0.8 NM.

Use of a uniform grid pattern was considered sufficient to eliminate the need for the USCG to pursue formal or informal routing measures within the RI/MA WEA[4].

It was also recommended that mariners transiting the RI/MA WEA “use extra caution, ensure proper watch and assess all risk factors.”

The USCG reviewed several studies related to wind turbine interference with marine radar. It was noted that “To date, the USCG is not aware of an authoritative scientific study that confirms or refutes the concern that WTGs will degrade marine radar.”

3.2.3 ACPARS

The USCG undertook the Atlantic Coast Port Access Route Study (ACPARS) (USCG 2015) to assess the potential navigational safety risks associated with the development of OREIs, and to support future marine spatial planning. The final report was published in July 2015; there were three key objectives:

- To determine whether actions should be initiated to modify or create safety fairways, TSSs, and other vessel routing measures;
- To provide data, tools, and methodologies to support future waterways suitability determinations for proposed projects; and
- To develop AIS data products and other support to assist Coast Guard districts with future OREI projects.

The study area comprised the entire eastern seaboard from Maine to Florida.

Part of ACPARS included the identification of alongshore towing vessels and major deep draft vessel routes within the ACPARS study area. Although potential conflicts were identified for towed vessels and certain wind

[4] The “RI/MA WEA” as used in the USCG’s (2020) MARIPARS includes all seven adjacent lease areas on the Outer Continental Shelf (OCS) south of Martha's Vineyard, Massachusetts, and east of Rhode Island.

energy areas, there were no conflicts identified for the MA WEA and RI/MA WEA. For the Offshore Development Area, the ACPARS has been superseded by more recent studies and guidance but is referenced here for background documentation purposes. No marine traffic data from ACPARS has been used in this analysis.

3.2.4 Offshore Structure PATON Marking Guidance (USCG District 1 LNM 44/20)

Offshore wind lessees are required by the USCG to obtain a permit for Private Aids to Navigation (PATON) marking, which USCG defines to cover all structures located in or near US navigable waters. In November 2020, the USCG District 1 released, as part of a Local Notice to Mariners (LNM) 44/20, revised guidance on PATON marking for offshore wind energy structures in USCG First District-area waters (essentially the waters from Maine to New Jersey). Key aspects of this guidance included:

- Tower Identification. WTG towers should contain unique lettering and numbering in an organized pattern as near to rows and columns as possible. The letters/numbers should be as close to 3 meters high as possible and visible above any servicing platform and, if feasible, below. The letters/numbers are to be visible throughout a 360 degree arc from the water's surface and at night through use of retro-reflective paint/materials.
- Lighting. Lighting is to be located on all structures, preferably on the servicing platform, and visible throughout a 360 degree arc from the water's surface. The lighting is differentiated between significant peripheral structures (SPSs), outer boundary towers, and interior towers in terms of range and flash sequence. Temporary components (during construction) must be marked with Quick Yellow (QY) obstruction lights visible at a distance of 5 NM.
- Sound Signals. Mariner Radio Activated Sound Signal (MRASS) are required on corner structures/SPSs that sound every 30 seconds to a range of 2 NM.
- AIS Transponder Signals. AIS transponder signals must be transmitted at all corner structures/SPSs and must be capable of transmitting signals to mark all locations of all structures throughout the turbine field.

3.3 BOEM Guidance on Lighting and Marking of Structures

The Bureau of Ocean Energy Management (BOEM) also issued guidance on the lighting and marking of structures supporting renewable energy development in April 2021 (BOEM, 2021b). BOEM notes that it will review lighting and marking in conjunction with other federal agencies as part of its plan review and approval process. Guidance was provided for both navigation and aviation lighting. Key aspects of this guidance included:

- Paint and Marking. Color recommendations for the turbine and tower are provided, including the need to paint the foundation base yellow. Each WTG is to have a unique alphanumeric identification.
- Lighting. The lighting guidance includes aviation lighting with specification of light wavelength, intensity, and flash cycle. This lighting is placed at the highest point on the turbine nacelle and mid-mast for turbines above 699 ft (213 m). There can be no unlit gaps of more than 0.5 statute miles (804 m) around the perimeter of the facility and no unlit gaps of more than 1 statue mile (1.6 km) within the facility. BOEM (2021b) also includes marine lighting guidance, consistent with USCG's PATON marking guidance. This details specifications on the color, visibility, operation, and synchronization of lights on WTGs and other structures within a wind energy development.

Additional guidance is provided with respect to environmental considerations related to potential impacts to birds, bats, marine mammals, turtles, and fish.

3.4 International Guidelines

The following sections summarize of some, but not all, of the international guidelines that were consulted for the preparation of the NSRA:

3.4.1 PIANC (2018) – Interaction Between Offshore Wind Farms and Maritime Navigation

The World Association for Waterborne Transport Infrastructure (PIANC) issued a report in 2018 giving an approach, guidelines, and recommendations to assess the required maneuvering space for ships in the vicinity of offshore wind farms. This report recommended minimum distances between shipping lanes and sea areas for offshore wind farms in order to ensure minimal risk to navigation. The report touches on international regulations, general navigational guidelines, the effect of WTGs on radar and radio communications, mitigating measures, and emergency situations.

3.4.2 PIANC (2014) – Harbor Approach Channels Design Guidelines

PIANC also published guidelines for the design of vertical and horizontal dimensions of harbor approach channels, the maneuvering and anchorage areas within harbors, and defines restrictions to operations within channels. Although not strictly applicable to offshore wind farms, the basic principles of estimating required channel widths and maneuvering areas outlined in the report are relevant.

3.4.3 International Maritime Organization (IMO)

The International Maritime Organization (IMO) is the United Nations specialized agency responsible for the safety and security of shipping, and the prevention of marine and atmospheric pollution by ships. Its main role is to create a regulatory framework for the shipping industry that is fair and effective, universally adopted, and universally implemented. There are various aspects of the IMO regulations that can apply to offshore wind farms, including:

- The Convention on the International Regulations for Preventing Collisions at Sea, or commonly referred to as COLREGs. These regulations set out the navigational rules to be followed by vessels to avoid collisions.
- The General Provisions on Ships' Routing (GSPR). These provisions apply in areas where vessel traffic is expected to be heavier or where there is restricted room to navigate or presence of obstacles.
- The Standards for Ship Maneuverability (MSC 137[76]) are used to evaluate the maneuvering performance of vessels in support of the design, construction, repair, and operation of vessels. The concepts outlined in these standards, particularly related to vessel turning, are used to define safe distances for maneuvering.

3.4.4 UK Maritime & Coastguard Agency

The UK Maritime & Coastguard Agency has released a number of guidance documents related to navigation in the vicinity of OREIs, including:

- Marine Guidance Note (MGN) 543 on Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response;
- MGN 372 – OREIs: Guidance to Mariners Operating in the Vicinity of UK OREIs; and
- OREIs: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response.

3.4.5 The Netherlands White Paper on Offshore Wind Energy (2013)

Appendix 6 of this document provides an assessment framework for defining safe distances between shipping lanes and offshore wind farms. Some of the outlined criteria underlie a portion of the navigational corridor distances estimated in MARIPARS.

4. Site Environmental Conditions

4.1 Data Sources

This section summarizes the metocean conditions local to the SWDA. The data used for this analysis was sourced from ongoing field measurements from deployed instruments and was supplemented with additional data from the USACE Wave Information Study (WIS) hindcast (WIS, 2010), Climate Forecast System Reanalysis atmospheric model (NCEP, 2010), and NOAA's National Centers for Environmental Information (NCEI, 2020).

The metocean conditions local to the SWDA are a critical input for design and engineering of the WTGs, and for navigational risk of vessels. A single Floating Light Detection and Ranging (FLiDAR) metocean buoy was deployed in late May 2018, which has since been acquiring measurements of environmental and oceanographic data at 10-minute intervals with some small intermittent gaps. The buoy was deployed at 41.0732˚ N, 70.4829˚ W. Details regarding the measurement capabilities and equipment aboard the buoy are listed in Table 4.1 and its location relative to the SWDA is shown in Figure 4.1.

Table 4.1: FLiDAR Buoy Instrumentation and Measurement Capabilities

Environmental Condition	Instrument
Vertical wind profile	ZephIR 300M
Wave height, period, and direction	OCEANOR Wavesense3
Single point wind sensor (speed and direction, wind gusts)	Gill Ultrasonic
Air temperature and humidity	Vaisala HMP155
Air pressure	Vaisala PTB330
Vertical profile of current velocity and direction, and water temperature	Nortek Aquadopp Profiler 600 kilohertz (kHz)
AIS ATON	Protec L3
Dual GPS	Septentrio

4.2 Conventions

The following conventions were used in the measurement and processing of the FLiDAR buoy data:

- **Wind:** direction refers to the compass direction from which the wind is blowing (ºN)
- **Currents:** direction refers to the compass direction that the current is flowing towards (ºN)
- **Waves:** direction refers to the compass direction from which the wave is coming (ºN)
- **Directions:** measured clockwise relative to true or grid North (0º)

The following sections summarize the conditions measured by the FLiDAR buoy and historical conditions obtained from other sources.

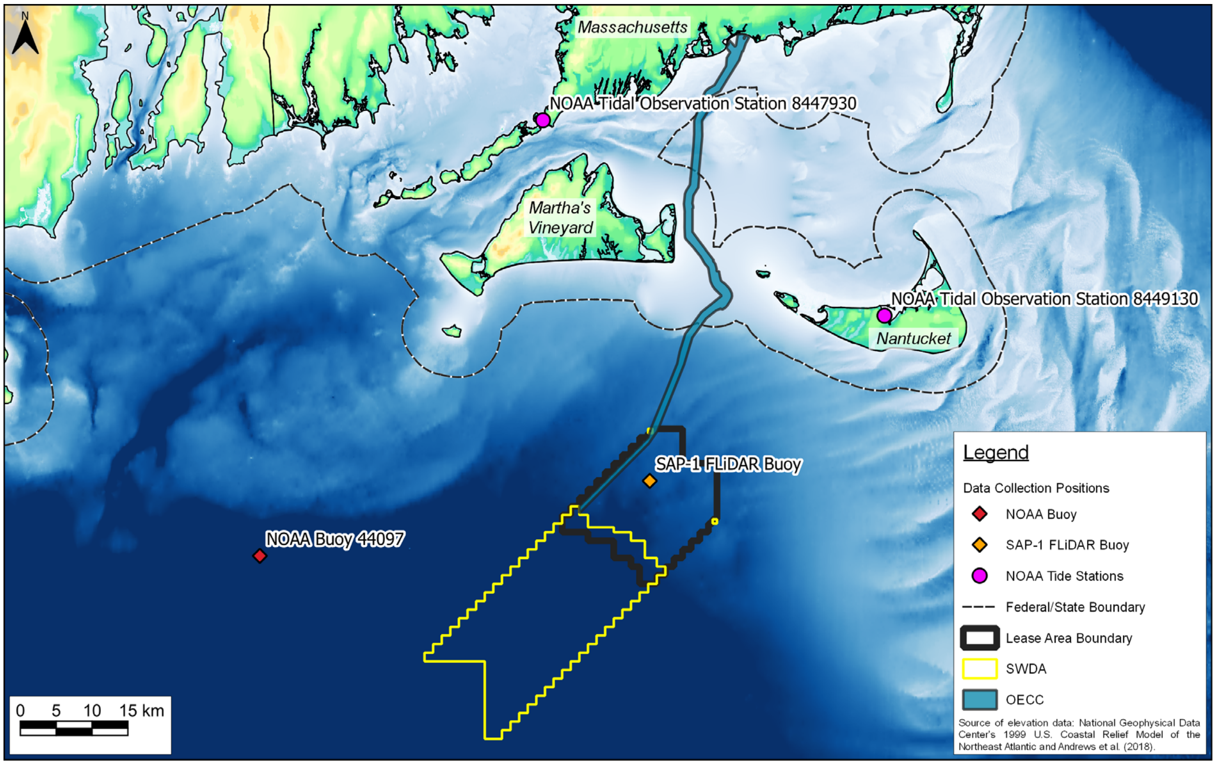

Figure 4.1: Metocean Data Sources

4.3 Wind

Wind data from the FLiDAR buoy (the sensor was approximately 6.3 ft [2.0 m] above sea level) is presented in Figure 4.2. At the buoy location, the measurements show that winds are predominantly from the west, with near equal frequencies of occurrence over a range of approximately 210 to 310 degrees. For the purposes of Figure 4.2, wind direction was binned in 10-degree increments.

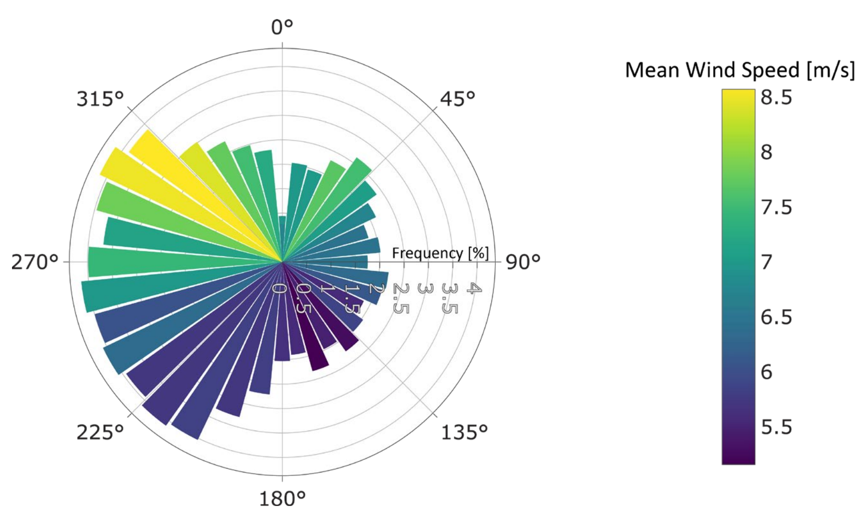

Figure 4.2: FLiDAR Wind Rose (image from COP)

Wind speeds frequently reach beyond 35 knots (18 m/s), with winds of the greatest mean magnitude coming from the northwest quadrant, at approximately 17 knots (9 m/s) on average. Episodic wind gusts range up to more than 58 knots (30 m/s).

Wind data from an anemometer deployed at Martha's Vineyard Airport (41.393º N, 70.615º W) was obtained from NCEI's Integrated Surface Hourly Database for the period of 1973 to 2017 (NCEI, 2020). A wind rose summarizing the wind conditions at this location over this entire period is shown in Figure 4.3. Note that a large percentage of this hourly timeseries is only considered missing because for approximately half of the time series, the measurement frequency was greater than 1 hour.

The data collected at this location is in general agreement with the wind conditions recorded by the buoy in Lease Area OCS-A 0501. The majority of the wind appears to be somewhat uniformly distributed within the directional range of approximately 200 to 360 degrees. For a significant amount of this period, the wind speeds ranged from 0 to 16 knots (0 to 8 m/s) with periodic gusts reaching speeds up to 80 knots (41 m/s), which was recorded on August 1st, 1974.

An analysis by month reveals that from approximately November to March, winds predominantly blow from the Northwest quadrant and then from the Southwest quadrant from approximately May to September. The majority of the wind speeds above 16 knots (8 m/s) occurred within the approximate October to April window.

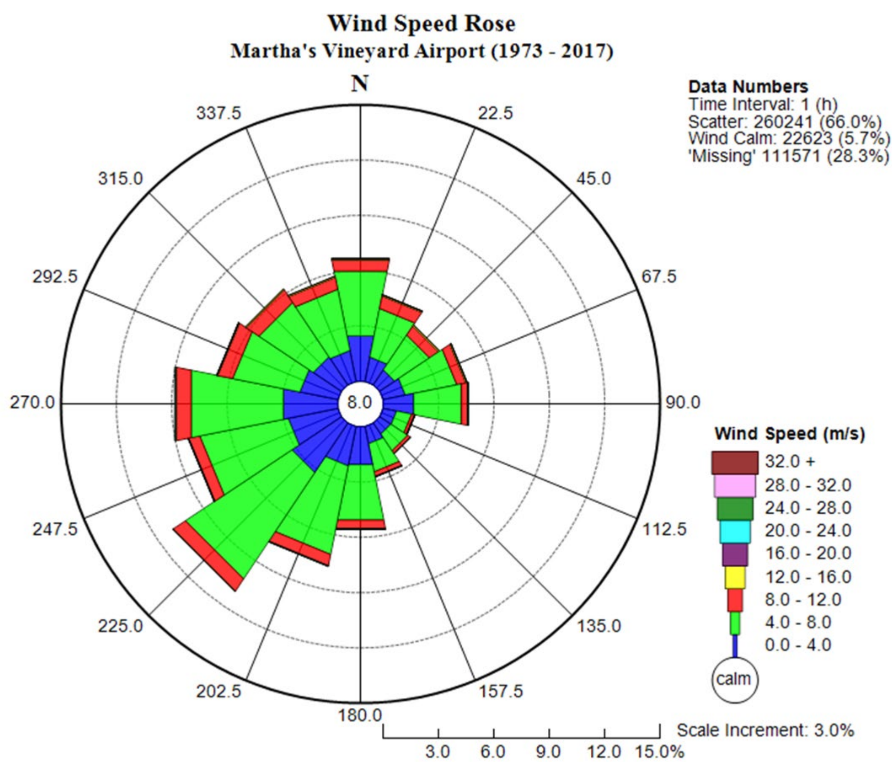

Figure 4.3: Martha's Vineyard Airport Wind Rose

4.4 Waves

Sea state data was extracted for a representative location in southern Nantucket Sound from NOAA's CFSR metocean hindcast. Table 4.2 below summarizes the wave data for this extraction point.

Table 4.2: Southern Nantucket Sound NOAA CFSR Hindcast Wave Characteristics by Month

Month	Average Significant Wave Height	Average Peak Wave Period
January	2.59 ft (0.79 m)	5.64 s
February	2.49 ft (0.76 m)	5.67 s
March	2.39 ft (0.73 m)	6.01 s
April	2.23 ft (0.68 m)	6.04 s
May	1.90 ft (0.58 m)	5.68 s
June	1.77 ft (0.54 m)	5.59 s
July	1.60 ft (0.49 m)	5.72 s
August	1.57 ft (0.48 m)	5.93 s
September	1.80 ft (0.55 m)	6.49 s
October	2.10 ft (0.64 m)	5.56 s
November	2.39 ft (0.73 m)	5.57 s

A low average significant wave height of less than 2.6 ft (0.8 m) was determined from the data at this location. The wave height and direction information for this extraction point is summarized in the wave rose in Figure 4.4. The figure shows that the waves are dominated by seas up to 3.3 ft (1 m) in height from the south to southwest direction.

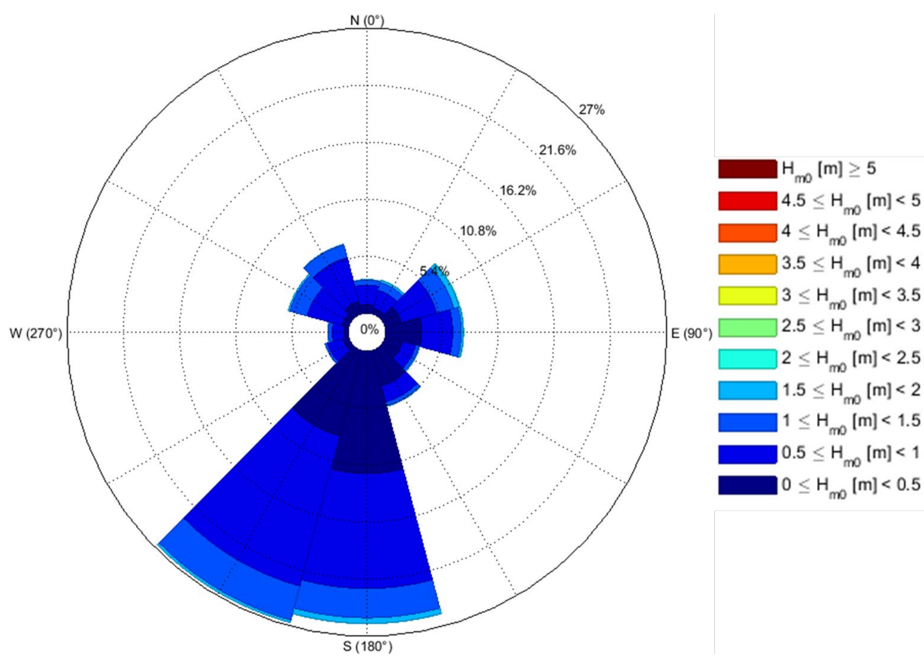

Figure 4.4: Southern Nantucket Sound NOAA CFSR Hindcast Wave Rose (image adopted from COP)

Extreme wave conditions in the area are associated with major storms that affect the region. Table 4.3 shows a list of extreme wave conditions recorded at the NOAA-44097 buoy (shown in Figure 4.1) over the past 10-years, along with the storm they were associated with.

Table 4.3: Extreme Significant Wave Heights recorded at NOAA-44097 Buoy

Storm	Date	Wave Height
Hurricane Earl	4 September 2010	5.6 m (18.4 ft)
Hurricane Irene	28 August 2011	9.4 m (30.8 ft)
Hurricane Sandy	29–30 October 2012	9.5 m (31.2 ft)
Hurricane Joaquin	2–5 October 2015	3.6 m (11.8 ft)
Hurricane Florence	18 September 2018	<2 m (<6.6 ft)
Hurricane Michael	12 October 2018	3.0 m (9.8 ft)
Hurricane Dorian	7 September 2019	3.8 m (12.5 ft)
Tropical Storm Melissa	11–13 October 2019	5.4 m (17.8 ft)

While wave can reach heights up to nearly 33 ft (10 m) during extreme storm conditions, all datasets indicate that waves greater than 6.6 ft (2 m) are rarely seen during normal conditions.

4.5 Currents

Within the vicinity of the SWDA, the currents are predominantly driven by tidal forces but can be wind influenced near the surface. In general, flood currents flow east through Nantucket Sound except between Martha's Vineyard and Nantucket Island where a northerly flow exists through Muskeget Channel. During ebb tide the flow moves west through Nantucket Sound and water moves south through Muskeget Channel.

Figure 4.5 shows the average peak flood and ebb surface currents generated from a tidal cycle, at 36 different monitoring stations generated by NOAA (2018). There are particularly high current speeds in areas where land masses cause constriction of the flow or where bathymetric features such as shoals influence the flow behavior. Given the location of the SWDA offshore of Martha's Vineyard and the relative depth in this area (approximately 164 ft [50 m]), these types of phenomena are not present and, with respect to navigational risk, the main concern is the direction and speed of the currents generated solely from tidal forcing and wind effects.

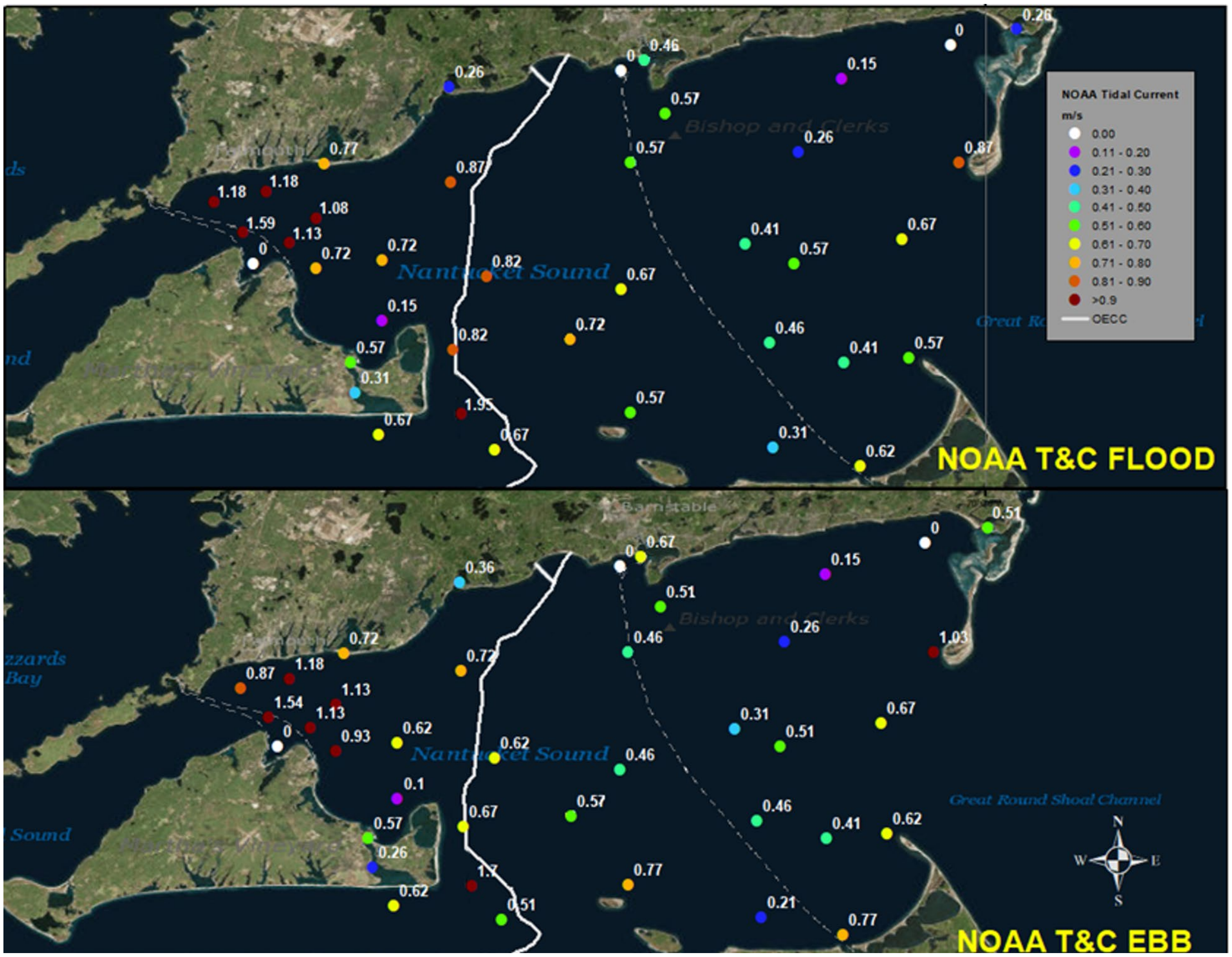

Figure 4.5: NOAA Tidal Current Predictions Locations and Magnitudes

During strong currents, maintaining proper vessel course can become challenging and maneuverability can be impacted. In addition, in the event of equipment failure and subsequent vessel breakdown, near-surface currents will dictate the direction and rate at which vessels will drift. The combination of these affects can pose challenges for vessels and therefore affect navigational risk. Local currents and conditions must be well understood and factored into vessel route planning and emergency protocols.

The Nortek Aquadopp Profiler aboard the FLiDAR buoy was used to measure current profiles and are presented at depths of 6.6 ft (2 m), 68.9 ft (21 m), 118.1 ft (36 m), and 128 ft (39 m) in Figure 4.6. As expected from the tidal influence, the current directions follow a strongly bimodal distribution at all depths with an approximate E – W alignment. Mean current speeds vary with depth and are greatest near the 68.9 ft (21 m) mark, at approximately 0.4 knots (0.2 m/s) on average. Currents decrease slightly towards the air-water interface, and also decrease to approximately 0.2 knots (0.10 m/s) or less near the bottom.

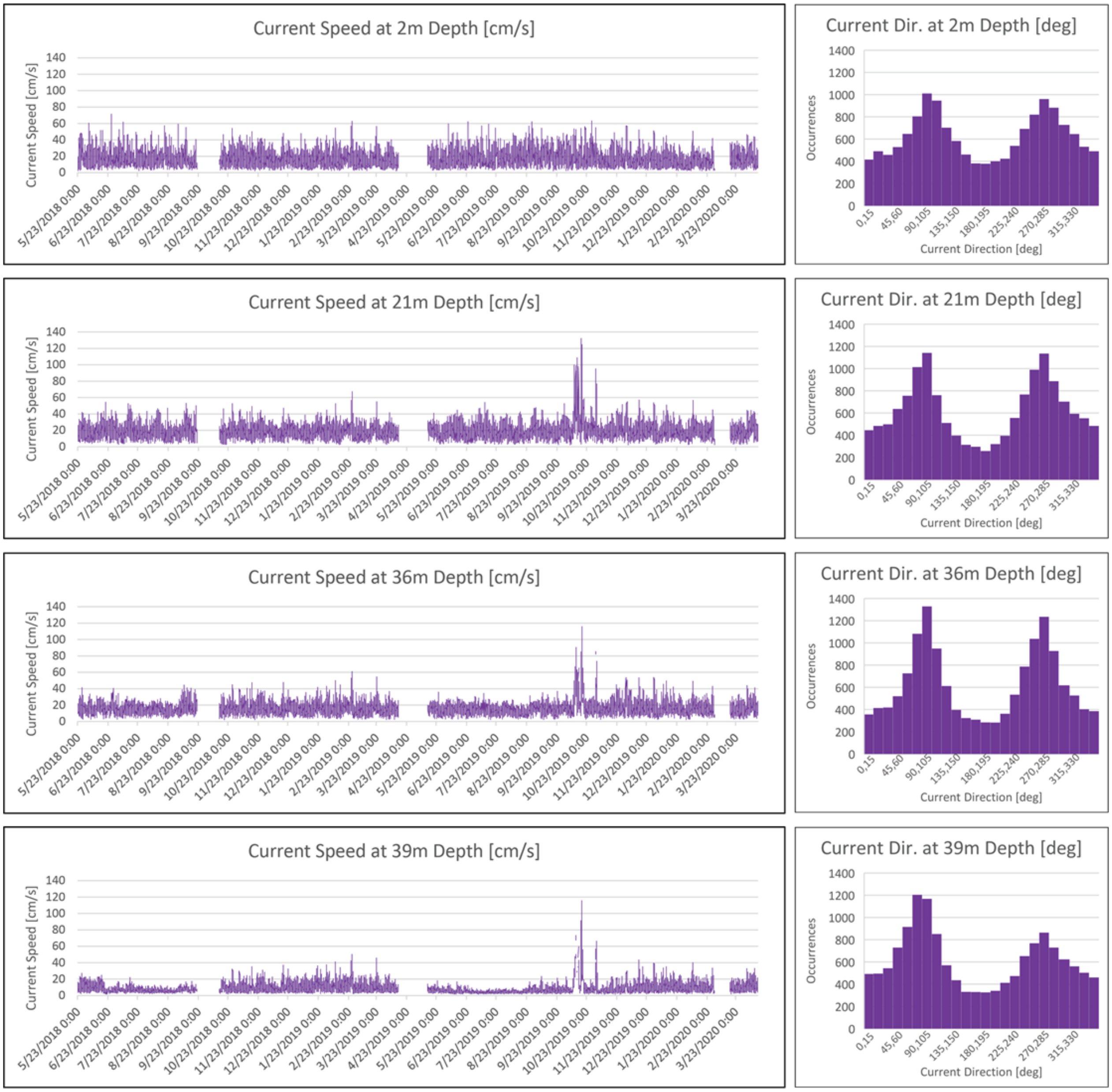

Figure 4.6: FLiDAR Current Speed and Direction

Figure 4.7 shows the mean, mode, and median current speeds with respect to depth at the buoy location. As mentioned, the currents tend to reach their maximum magnitude around the 69 ft (21 m) depth and decrease above and below this point, reaching 0.2 knots (0.10 m/s) or less near the bottom. The greatest variability between the mean, mode and median current speeds appears to be occurring at the surface and bottom of the profile, with the greatest consistency occurring near the 69 ft (21 m) depth.

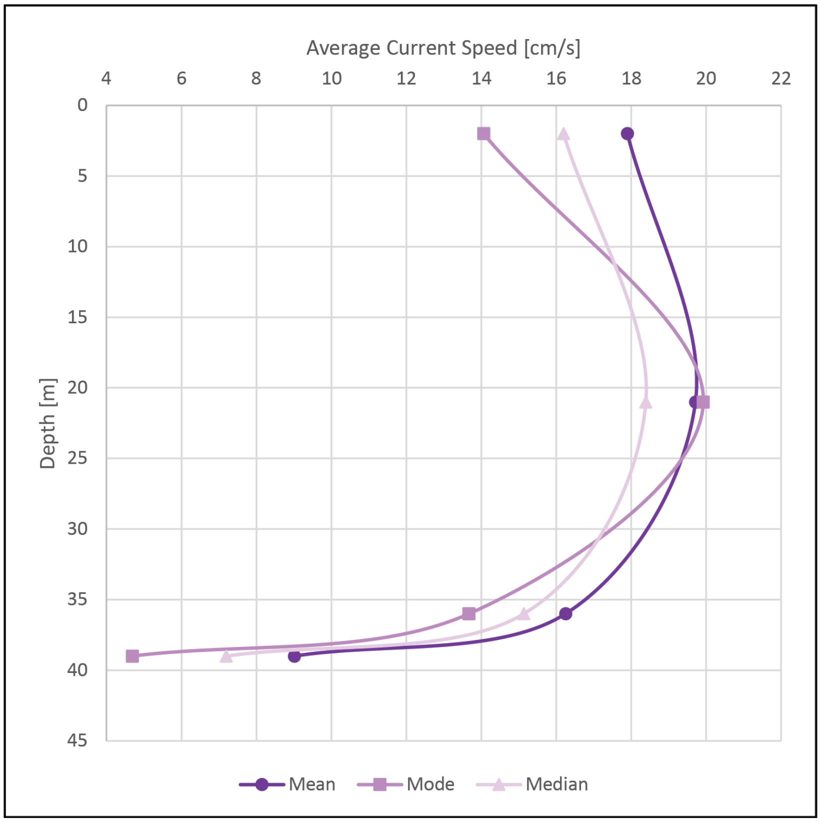

Figure 4.7: FLiDAR Current Profile

Given the wide spacing (1 NM [1.85 km]) and the relatively small in-water profile of the WTG/ESP foundations, it is not expected that the structures will cause changes in the set and rate of the tidal stream or ocean currents.

4.6 Ice

Ice can affect vessel navigation within an offshore wind farm by two means: (1) collision with floating ice; and (2) ice accretion on turbines rotors that is subsequently thrown by means of centrifugal force or simply falls. Both potential ice conditions were considered.

Review of the United States Coastal Pilot Volume 2 (2020) for the areas of Narragansett Bay and Vineyard Sound did not make any mention of the presence of floating ice offshore although there is risk of ice nearshore and within the confines of bays. This was confirmed through examination of Sentinel-2 (ESA, 2020) satellite imagery from a 5-year period from 2015-2020, which revealed no apparent risk due to ice formation of any form. As such, ice formation in open water is not considered a significant source of navigational risk within the vicinity of the SWDA.

Under certain meteorological conditions ice accretion may occur on WTG blades, presenting a possible falling ice risk if dislodged/ejected. Previous investigations have identified that air temperature, relative humidity, and wind speeds are they key factors controlling the ice accumulation rate (Hudecz [2014], Parent and Ilinca [2011]). Specifically, ice accumulation risk was greatest when air temperatures were less than 0°C, relative humidity (RH) was greater than 95%, and when wind speeds were relatively low (<5 m/s). To evaluate this risk, meteorological data from two National Data Buoy Centre (NDBC) ocean buoys (44008, 44017). Buoy 44008 is located approximately 69 NM (130 km) east-southeast of the SWDA and Buoy 44017 is located approximately 71 NM (132 km) west-southwest. Relative humidity data were only available at Martha's Vineyard Airport for a 20-year period.

These datasets are visualized in Figure 4.8 for stations for the two buoys. Points represent hourly observations, with increasing relative humidity (from Martha's Vineyard Airport) along the x-axis, increasing wind speed along the y-axis, and point size and color varying with air temperature. Using this visualization, blue points in the lower right corner represent hours when ice accretion would likely have occurred (wind speeds below 5 m/s, air temperatures below 0°C, and relative humidity above 95%). The analysis indicated only 2 to 3 hours of potential icing for Buoy 44008 and Buoy 44017, respectively, over the 20-year analysis period, which is 0.031% of the observations. (Note, periods when buoys were not operational were excluded, with these periods included the total time represents 0.0016% of entire analysis period.) It was concluded that the risk of ice formation on the turbine rotors is very low in this area.

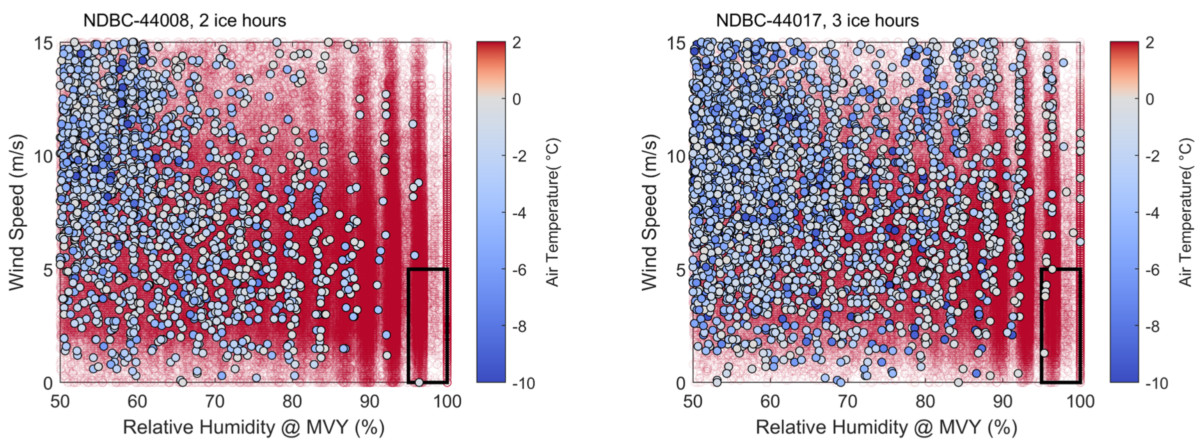

Figure 4.8: Visualization of Meteorological Conditions at Two Stations.

4.7 Visibility

Visibility data measured at Martha's Vineyard airport over the period of 1973 to present was obtained from Iowa State University's Iowa Environmental Mesonet database (IEM, 2020). This is the closest station to the SWDA and is considered generally representative of the conditions there. Figure 4.9 shows the probability and cumulative probability distributions of visibility observed over this time period. The majority of visibility conditions recorded were within the 3.2 to 3.8 NM (6 to 7 km) range, with more adverse conditions occurring approximately half as frequently. A smaller number of readings recorded visibility greater than 3.8 NM (7 km).

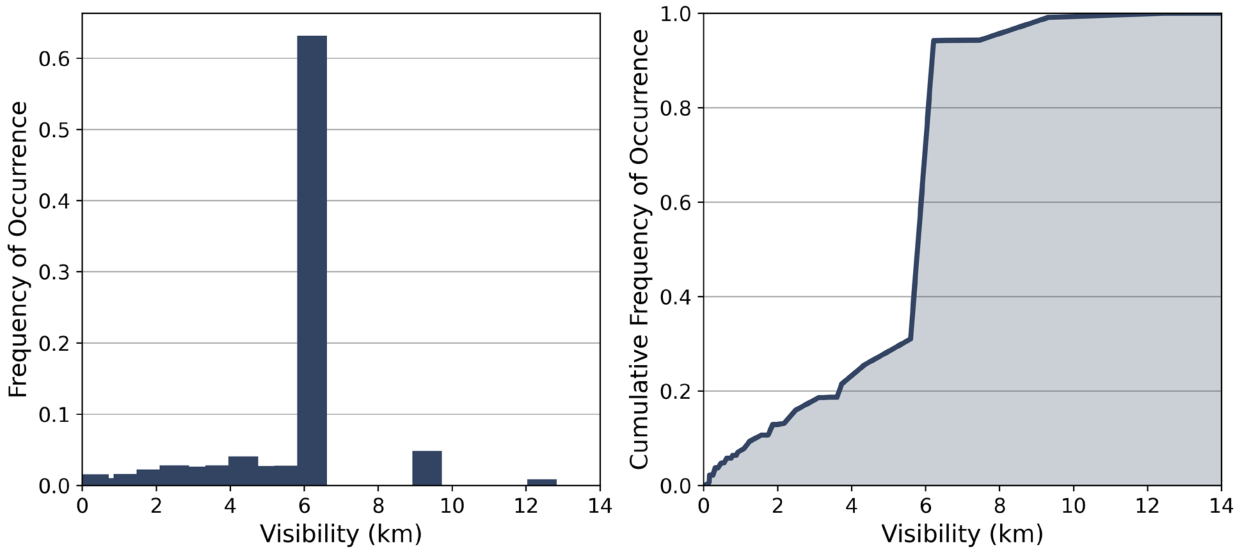

Figure 4.9: Martha's Vineyard Airport Visibility Conditions (1973 to present)

4.8 Tides

Tides within the SWDA experience semi-diurnal peaks; both the tidal amplitude and resulting tidal currents are key considerations for safe navigation of vessels. Data from the nearest NOAA CO-OPS tidal station (8449130) was extracted to understand the range of tidal conditions within the vicinity of the SWDA. This tidal station is located on Nantucket Island approximately 16 NM (30 km) northeast of the SWDA. The full set of tidal constituents for this station is available from the NOAA CO-OPS station page (NOAA, 2020) which can be used for tidal predictions. Table 4.4 summarizes the tidal conditions at this station, which are considered to be representative of conditions within the SWDA.

Table 4.4: NOAA CO-OPS 844910 Tidal Station Summary

Station Name	Station ID	Mean Tidal Range	Maximum Spring High Tide	Maximum Recorded Tide
Nantucket Island	8449130	3.04 ft (0.92 m)	3.57 ft (1.09 m)	4.30 ft (1.31 m)

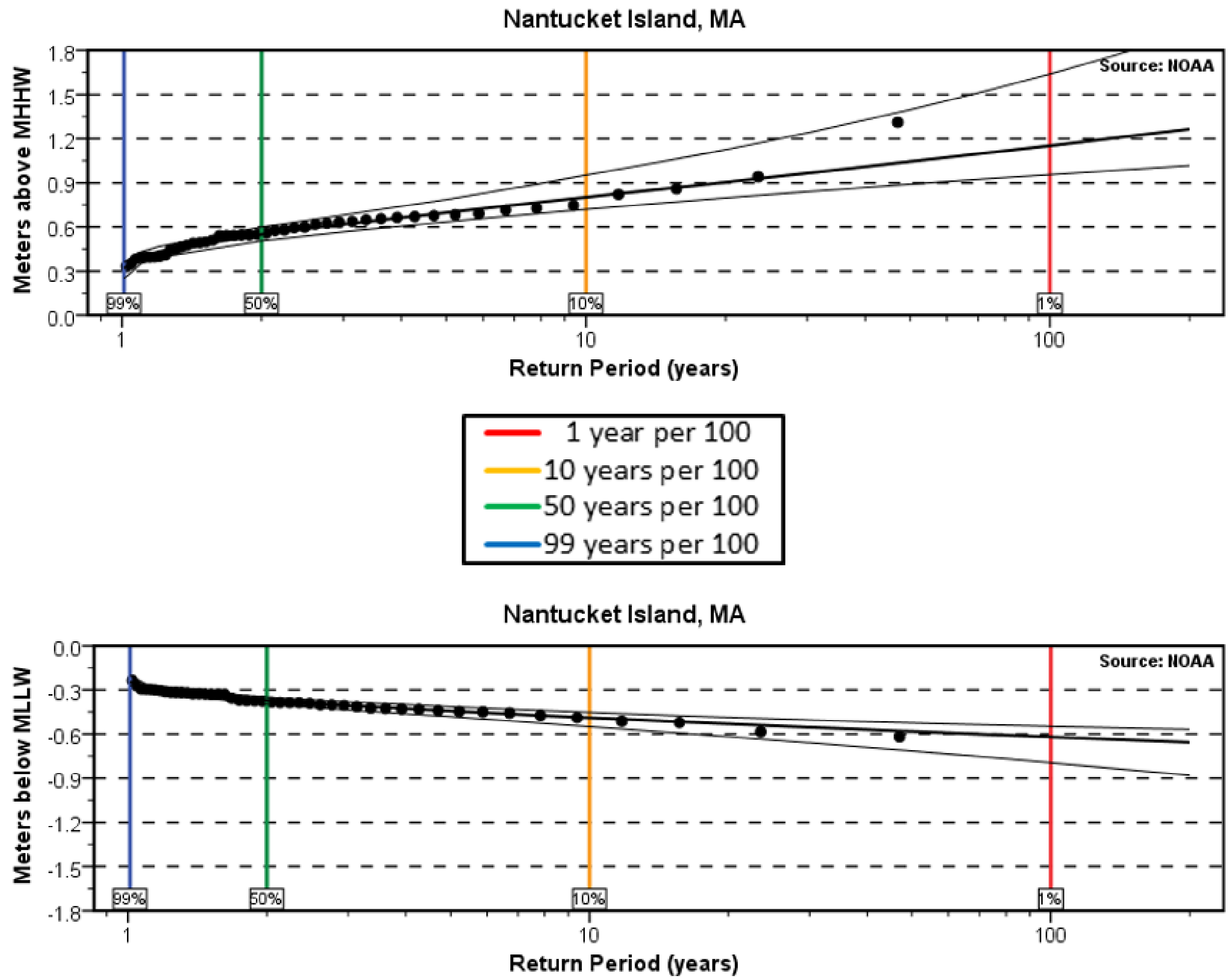

Figure 4.10: NOAA CO-OPS 844910 Tidal Station Extreme Water Levels (image from NOAA, 2020)

Figure 4.10 shows the extreme high and low water levels at this station, and their respective recurrence intervals.

4.9 Scour and Sedimentation Effects

Given the wide spacing (1 NM [1.85 km]) of the WTGs/ESPs, the relatively deep waters at the SWDA, and the relatively small in-water profile of the structure foundations, it is not expected that the structures will induce any significant effect on siltation or sedimentation patterns that would influence navigable water depths. It is possible that some localized scour could potentially occur around the foundations at the seabed. Scour potential will be addressed during the design process and scour protection may be placed around the structure foundations, if needed. It is anticipated that scour protection will be needed for the larger diameter monopiles and suction buckets but may or may not be needed for the smaller diameter piles used for jacket and bottom-frame foundations

4.10 Summary

An analysis was conducted on environmental data collected from a variety of sources, including a deployed FLiDAR buoy. This was done to understand the environmental conditions within the vicinity of the SWDA, and to identify potential effects on navigational risk. The analysis showed that winds blow predominantly from the southwest quadrant from approximately May to September, and the northwest quadrant from approximately November to March. Wind speeds typically range between 0 to 17.5 knots (0 to 9 m /s) and have historically reached speeds up to 80 knots (41 m/s). Waves predominantly approach from the south to southwest direction, with an average significant wave height of approximately 2.6 ft (0.8 m). Extreme waves have been noted to occur near the SWDA up to 31.2 ft (9.5 m) and can be heavily influenced by storm events. Currents in the SWDA are mainly tidally influenced but can be wind driven near the surface. Mean current speeds were recorded to be greatest near the 68.9 ft (21 m) mark. The generated tidal currents have an approximate E–W alignment, reaching a maximum of approximately 0.4 knots (0.20 m/s) on average.

An analysis into ice patterns in the area showed that open-water ice in any form is not expected to have an impact on navigational risk. Additionally, environmental conditions in the area only met the criteria required for ice accretion on WTG blades for 0.015% of a 20-year time-period, indicating a very low risk. Data from Martha's Vineyard revealed that the average visibility in the area is approximately 3 to 4 NM (6 to 7 km) and can reach extremes of less than 0.5 NM (1 km) approximately 8% of the time.

In terms of navigational risk, it is expected that the small currents, tidal effects, and ice in any form will be negligible. Waves, winds, and visibility in the vicinity of the SWDA will influence navigational risk. Adverse wave conditions can pose safety issues for mariners; average wave conditions near the SWDA may not be of concern but can pose significant issues during extreme weather events. High winds can dictate drifting vessel directions and speeds. Low visibility reduces the ability of operators to respond to potential accident scenarios and increases the overall risk.

Given the wide spacing (1 NM [1.85 km]) of the WTGs/ESPs, the relatively deep waters at the SWDA, and the relatively small in-water profile of the structure foundations, it is not expected that the structures will cause changes in the set and rate of the tidal stream or ocean currents, or in sedimentation patterns and navigable water depths in the SWDA.

5. Existing Waterway Characteristics

The SWDA (excluding the two separate aliquots that are closer to shore) is just over 17 NM (32 km) from the southwest corner of Martha's Vineyard, approximately 21 NM (38 km) from Nantucket, and approximately 11 NM (20 km) north of the Nantucket to Ambrose Safety Fairway westbound lane. The waterway characteristics are described in USCG Coast Pilot Vol. 2 section Cape Cod to Sandy Hook.

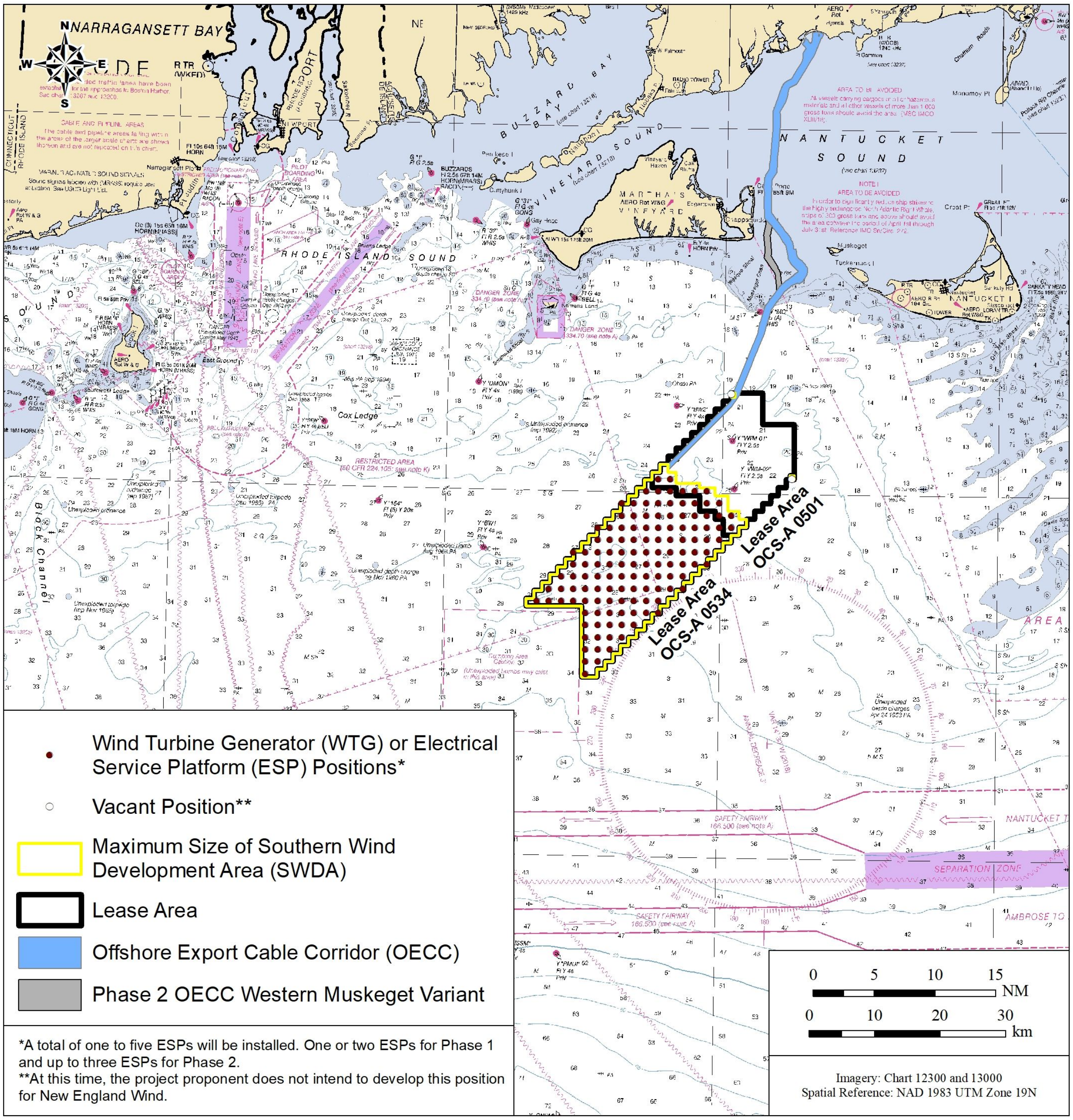

Figure 5.1: SWDA Navigation Features

5.1 Commercial Traffic Waterways

The SWDA is in deep water with depths of approximately 138 to 203 ft (42 to 62 m). The navigation features near the Offshore Development Area are depicted in Figure 5.1.

There are several vessel routing measures in the vicinity of the Offshore Development Area including, but not limited to, precautionary areas, a traffic separation scheme (TSS), fairways, recommended routes, two-way routes, and areas to be avoided (see Figure 5.1). Precautionary areas are defined areas where vessels must exercise particular caution and should follow the recommended direction of traffic flow. Implementing a TSS is one of several routing measures adopted by the International Maritime Organization (IMO) to facilitate safe navigation in areas where dense, congested, and/or converging vessel traffic may occur, or where navigation (particularly for deep-draft vessels) is constrained. A TSS separates opposing streams of vessel traffic by creating separate unidirectional traffic lanes and is typically designed to safely guide commercial vessels transiting to and from major ports. A TSS is not necessarily marked by an aid-to-navigation (ATON), but it is marked on National Oceanic and Atmospheric Administration (NOAA) nautical charts. Fairways are corridors in which no artificial islands or fixed structures (temporary or permanent) are permitted. These are used so vessels will have unobstructed approaches to major US ports. Recommended routes are corridors of undefined width, which are often marked by centerline buoys. Two-way routes aim to provide safe passage of vessels through waters where navigation is difficult or dangerous by establishing two-way traffic within defined limits. While there are vessel routing measures in the vicinity of the Offshore Development Area, there are no vessel routing measures within the SWDA (or more broadly, within the MA WEA or RI/MA WEA).

Commercial vessel traffic is described in Section 6.4. In general, large non-fishing commercial vessels do not frequently transit through the SWDA; most of these vessels transit along the marked fairways and channels. These include the Ambrose to Nantucket Traffic Lanes and Safety Fairway, and the Narraganset Bay and Buzzards Bay (Inbound and Outbound) Traffic Lanes. The Nantucket to Ambrose Safety Fairway (westbound) lies approximately 11 NM (20 km) south of the southern boundary of the SWDA. The Ambrose to Nantucket Safety Fairway (eastbound) lies approximately 19 NM (35 km) south. Each safety fairway has a width of 2 NM (3.7 km) with a separation of 6 NM (11 km) between them. The safety fairways extend to the Ambrose Channel approach to New York Harbor approximately 150 NM (278 km) to the west. As these safety fairways approach the Phelps Bank area (marked by ODAS “44008” ATON and for a distance of approximately 45 NM (83 km) starting just east of an extension of the eastern SWDA boundary), they become the Nantucket to Ambrose Traffic Lane and Ambrose to Nantucket Traffic Lane, respectively. Each traffic lane is 5 NM (9.2 km) in width with a 3 NM (5.6 km) separation zone between them.

Immediately southwest of the SWDA is a caution area marked as a Dumping Area that is noted to potentially contain unexploded ordinance. This area has an east—west dimension of approximately 11 NM (20 km) and a north-south dimension of approximately 10 NM (18.5 km). There is an unexploded bomb marked on the navigation charts approximately 9 NM (16.7 km) west of the southwestern extent of the SWDA. There is also an unexploded ordinance marked approximately 14 NM (25.9 km) to the west of the northwestern extent of the SWDA. There are no other designated ocean disposal or dredged material placement areas in proximity to the SWDA. The nearest ocean disposal site for dredged material is located east of Block Island, approximately 33 NM (61 km) northwest from the SWDA. There are three marked wrecks within the SWDA and one additional marked wreck within the Lease Area OCS-A 0501 There are numerous marked wrecks nearby but outside of the Lease Areas OCS-A 0501 and OCS-A 0534.

There is a pilot boarding area adjacent to the northern limit of the Narragansett Traffic Lane Inbound which is approximately 38 NM (70 km) northwest of the SWDA. Eastbound vessels entering Buzzards Bay can also meet pilots in the pilot boarding area located about 1 mile (1.6 km) northwest of Buzzards Bay Entrance Light which is approximately 30 NM (56 km) northwest of the SWDA.

There are several anchorages in the vicinity of the Offshore Development Area as designated in the Coast Pilot (Vol. 2, 2020). Woods Hole lies approximately 25 NM (46.3 km) north-northwest of the SWDA (straight line distance). Within or adjacent to Buzzards Bay, there are designated anchorages at both New Bedford Inner Harbor and Cuttyhunk Harbor. There are numerous other areas where smaller vessels anchor throughout Vineyard Sound, Nantucket Sound, and Buzzards Bay.

5.2 Aids to Navigation

Private Aids to Navigation (PATONs), federal Aids-to-Navigation (ATONs), and radar transponders are located throughout the Offshore Development Region. They consist of lights, sound horns, buoys, and onshore lighthouses. Most are marked on National Oceanic and Atmospheric Administration (NOAA) nautical charts and are intended to serve as a visual reference to support safe maritime navigation. ATONs are developed, established, operated, and maintained by the USCG in order to assist mariners in determining their position, identifying safe courses, and to warn of dangers and obstructions. PATONs are owned and maintained by individuals or organizations other than the USCG and are used to facilitate the safe movement of vessel traffic.

There are no USCG maintained ATONs within the SWDA. There are two PATONs within the leased area (VWM-01 and VWM-02) near the northeastern extent of the SWDA, but none within the SWDA.

There are radar transponders (racons) located on the Buzzards Bay Entrance Light approximately 4 NM (9 km) southwest of Cuttyhunk Island and at the Narraganset Bay Entrance Lighted Buoy located approximately 4 NM (9 km) east of Point Judith.

There are three buoys marking the Muskeget Channel into Nantucket Sound, with the nearest buoy "MC" located approximately 7 NM (13 km) north-northeast from the northern boundary of the SWDA. The OECC is just east of Muskeget Channel and these three ATONs. A single buoy ("1") between Nomans Island and Gay Head is approximately 14.5 NM (26.9 km) northwest from the northwestern end of the SWDA. A single PATON ("DMON") lies southwest of Nomans Land and is approximately 15 NM (27.8 km) northwest from the northwestern end of the SWDA. Another PATON ("154") is approximately 15 NM (27.8 km) northwest from the southwestern end of the SWDA. An additional unnamed PATON lies approximately 12 NM (22.2 km) southeast from the northeastern corner of the SWDA.

The Cape Poge Lighthouse, with a height of 65 ft (20 m), is on the northeastern tip of Martha's Vineyard near Edgartown. This lighthouse is approximately 17 NM (31.5 km) north of the SWDA and has a visible range of 9 NM (16.7 km). The Gay Head Lighthouse is on the western tip of Martha's Vineyard with a height of 175 ft (53 m). The lighthouse is approximately 20 NM (37 km) northwest from the closest point of the SWDA and has a visible range of 20 NM (37 km). The Sankaty Head Lighthouse, with a height of 158 ft (48 m), marks the eastern side of Nantucket, and is approximately 22 NM (40.7 km) from the northeastern boundary of the SWDA. This lighthouse has a visible range of 20 NM (37 km).

5.3 Other Navigational Features and Ocean Uses

There is a Vessel Movement Reporting System (VMRS) for Buzzards Bay that is monitored by the Buzzards Bay Control center. The VMRS covers the waters east and north of a line drawn from the southern tangent of Sakonnet Point, Rhode Island, in approximate position latitude 41.45333° N., longitude 71.19500° W., to the Buzzards Bay Entrance Light in approximate position latitude 41.39667° N., longitude 71°02.00′ W., and then to the southwestern tangent of Cuttyhunk Island, Massachusetts, at approximate position latitude 41.41000° N., longitude 70.95000° W., and including all of the Cape Cod Canal to its eastern entrance, except that the area of New Bedford harbor within the confines (north of) the hurricane barrier, and the passages through the Elizabeth Islands, is not considered to be "Buzzards Bay."

There is a designated naval operations area adjacent to Nomans Island, just southwest of Martha's Vineyard, per 33 CFR 334.70(a) with extents designated on NOAA Navigation Chart 13218. At its nearest point this designated area is approximately 13 NM (24 km) northwest of the SWDA. Other areas near the SWDA may be used for military exercises on but are not formally designated as marine cautionary zones. There are no existing or proposed offshore OREI/gas platform or marine aggregate mining areas in the SWDA vicinity. There are no known proposed structure developments near the SWDA, other than additional WTGs and ESPs associated with other wind developments. There is a marked dumping ground south of Newport approximately 37 NM (69 km) northwest from the SWDA.

6. Vessel Traffic Analysis

This section presents analysis of the vessels that navigate within or near the SWDA based on four years of AIS data. Section 9.3 presents a researched opinion based on computer simulation techniques of the risk of allisions and collisions both with and without New England Wind being constructed based on the vessel traffic data presented in this section. It is important to note that the AIS data is often only available for vessels larger than 65 ft (20 m) which are required to have AIS transponders. Smaller commercial vessels may be required to have AIS or operators may choose to install them. The rules for vessels required to have AIS systems is defined by the US Coast Guard and were implemented as of March 1, 2016 (33 CFR 164).

While AIS data is not installed on all vessels, it is the only data set available to quantitively analyze vessel tracks characteristics in space and time through and around the SWDA. The following sections examine all AIS equipped vessel traffic through the SWDA for the years of 2016, 2017, 2018 and 2019. The AIS data does not provide the complete details of the fishing vessel traffic that may trawl through the SWDA. The AIS data is also supplemented with VMS.

6.1 AIS Data Summary

AIS data were compiled in a consistent format from different data sets to the cover the period from 1 January 2016 to 31 December 2019. Table 6.1 summarizes the details of the AIS datasets available for each year. Figure 6.1 presents the spatial extent of the analysis regions adopted for the AIS data in this report which covered longitudes between 69.75°W to 72.1°W and latitudes between 40.2 °N to 41.7°N. The AIS data analysis has focused on the SWDA as defined in Section 2.1.

A scatter plot of vessel speed from a sample of the AIS data is reported in Figure 6.1. In total, there are 75,071,045 data records and a total of 10,660 unique vessels in the data set.

Table 6.1: Summary of AIS dataset analyzed (Data Source: Vessel Finder)

Parameter	2016	2017	2018	2019	2016-2019
Temporal Resolution (approx.)	5 min.	5 min.	5 min.	5 min.	-
Number of Unique Vessels	4,907	5,344	5,497	6,072	10,660
Number of Unique Fishing Vessels	484	540	552	616	779

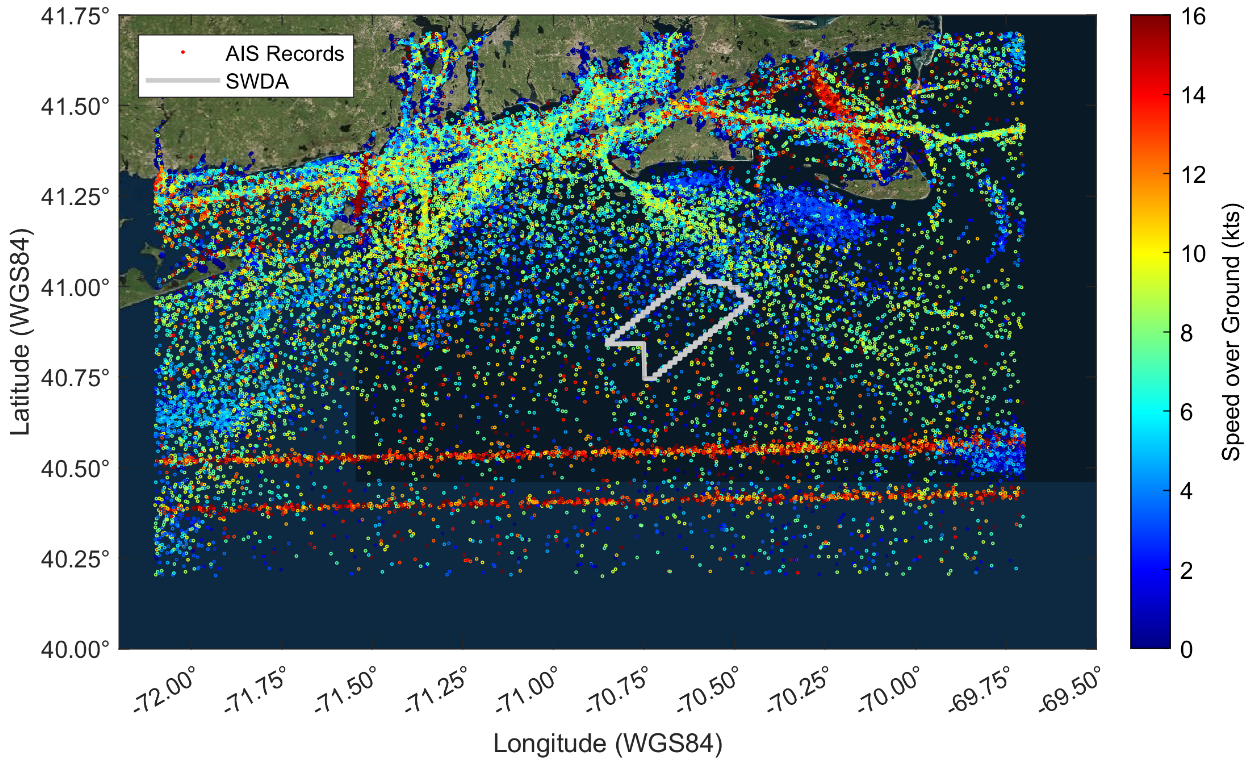

Figure 6.1: Scatter Plot of AIS Data Records (Pings) 2016-2019: Every 200th Point in Data Set Plotted

The AIS data has been processed to identify continuous vessel tracks using an automated algorithm. Vessel tracks can be difficult to assign due to the irregular transmission rate, particularly fishing vessels which have Class B AIS transmitters. The following rules have been applied to identify unique vessel tracks:

- Time interval between AIS data points for unique vessels (by name and MMSI): 45 minutes; and
- Distance interval between AIS data points for unique vessels (by name and MMSI): 8 NM.

Figure 6.2 presents a summary of vessel tracks that has been calculated from the algorithm presented above. The track data that has interacted with the SWDA is presented in the following sections.

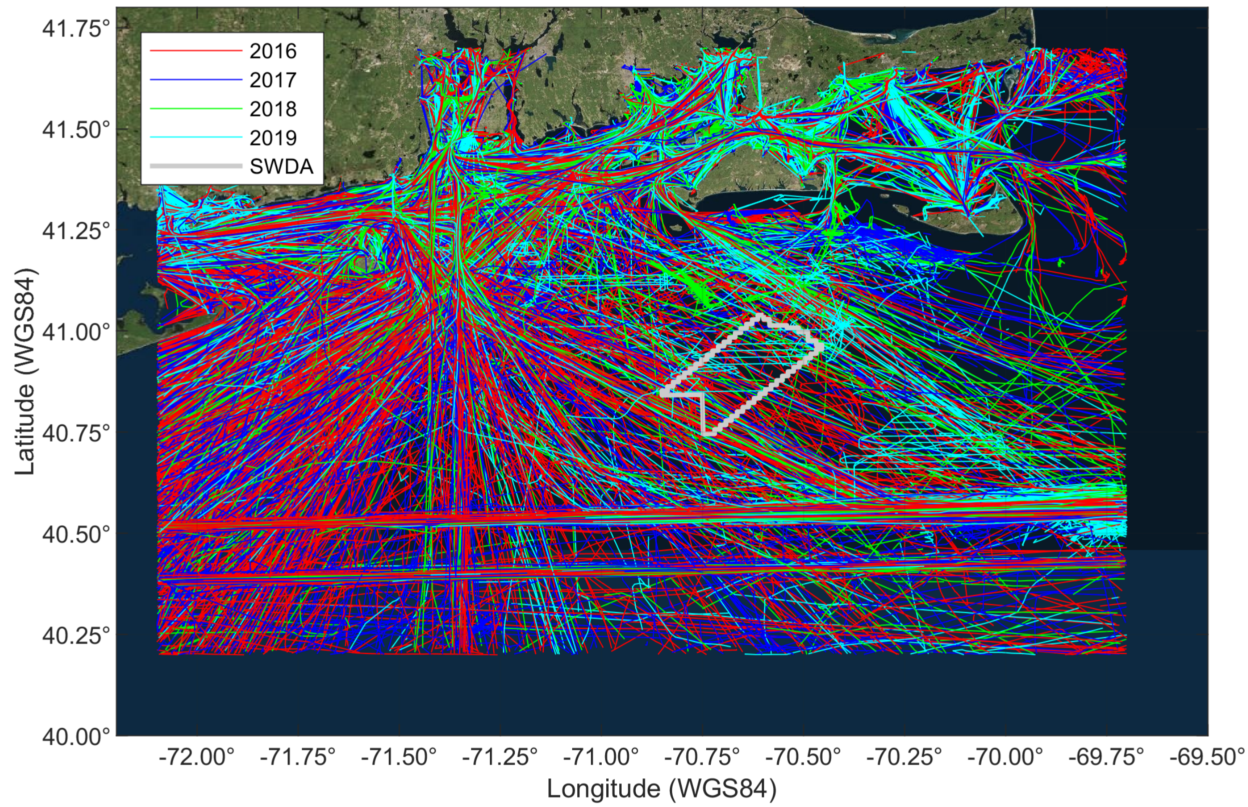

Figure 6.2: Vessel Track Plots by Year for Whole AIS Data Set – Every 50th Track Plotted

6.2 Consideration of Vessels Without AIS

It is important to recognize that AIS is only required on vessels 65 feet and longer and, as a result, not all vessels, particularly fishing vessels, are equipped with AIS equipment. In 2019, a comparison was made between the permitted fishing vessels and those equipped with AIS equipment for two of the larger fishing ports where fishing vessels transiting through the SWDA operate from (New Bedford and Point Judith – see Figure 6.18). It was concluded that a relatively large percentage (estimated at about 40% to 60%) of the fishing vessels operating in the area were AIS-equipped. Further, while the AIS data does not capture all the fishing vessel traffic which transits the SWDA, the AIS data represents the largest fishing vessels by length and beam. Length and beam are two of the more important vessel characteristics considered in the assessment of navigational safety, given the more limited maneuverability of larger vessels and the tendency of larger vessels to travel faster than smaller vessels.

The MARIPARS study completed by the USCG in 2020 considered non-AIS vessel traffic in that study but could not “evaluate them extensively” for the purpose of assessing navigation and use of the waterway in the wider MA WEA and RI/MA WEA. USCG (2020) assessed that non-AIS vessel transit tracks did not vary significantly from AIS equipped vessels.

6.3 Summary of Vessel Traffic in the SWDA

Overall vessel traffic by vessel type which transited through the SWDA is presented in Table 6.2. Table 6.3 presents data by month and year. Vessel traffic is concentrated in the months between May and October, with July, August and September having the highest vessel traffic each year. The vessel traffic varies by year, with 2016 having the highest number of unique vessels and vessel tracks while 2018 had the lowest.

Table 6.4 presents a summary of vessel traffic by month averaged across the 4-years. Annual vessel traffic is low, averaging 2.4 vessel tracks per day (for AIS equipped vessels). However, over the 4-years average vessels tracks in August have averaged 7.1 per day.

Figure 6.3 presents vessel tracks with vessel speed for all vessels with tracked through the SWDA in the AIS data. The vessel traffic is transiting to and from several ports and harbors throughout the wider region including the states of New York, Rhode Island, Massachusetts, and Maine.

Table 6.2: Vessel Types Within the SWDA Based on 2016–2019 AIS Data

	Unique Vessels		Unique Tracks	
	Number	Percentage	Number	Percentage
Cargo Vessels	112	13%	195	6%
Tankers	85	10%	169	5%
Passenger Vessels	17	2%	48	1%
Tug-barge Vessels	12	1%	15	0.43%
Military Vessels	7	1%	11	0.32%
Naval Sail Training Vessels[1]	2	0.2%	2	0.06%
Recreational Vessels	325	39%	697	20%
Fishing Vessels, In Transit [2]	228	27%	1688	49%
Fishing Vessels, Fishing [2]	92	11%	582	17%
Other Vessels	42	5%	172	5%
Total (2016–2019)	841	100%	3449	100%
Annual Average Vessel Tracks	-	-	862	-

1. Refers to tall sailing ships that are registered to the USCG and Portuguese Navy – see Section 6.5.2.
2. There is some double counting of vessels between transiting and fishing. For the purposes of this analysis, it is assumed that fishing vessels with speeds less than 4 knots (~2 meters per second) are trawling while those with speeds greater than 4 knots are transiting the SWDA. Some fishing vessels have speeds both above and below 4 knots while in the SWDA and thus are counted as both in transit and trawling.

Table 6.3: Summary of AIS Vessel Traffic Through the SWDA by Year

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2016													
Number of Unique Vessels	8	11	19	9	31	81	86	85	90	40	31	18	311
Number of Unique Vessel Tracks	12	15	26	12	47	124	197	329	325	70	46	26	1202
2017													
Number of Unique Vessels	19	19	18	27	39	110	101	78	59	41	12	3	329
Number of Unique Vessel Tracks	42	26	32	45	53	152	182	157	126	48	12	3	845
2018													
Number of Unique Vessels	5	5	4	24	66	83	86	69	34	24	10	11	262
Number of Unique Vessel Tracks	6	5	4	24	101	135	132	111	55	33	11	15	613
2019													
Number of Unique Vessels	5	3	9	30	57	77	86	91	60	32	18	10	286
Number of Unique Vessel Tracks	5	4	11	44	77	133	171	194	86	56	19	11	791

Table 6.4: Summary of AIS Vessel Traffic Through the SWDA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Track Summary													
Total Number of Tracks (2016-19)	65	50	73	125	278	544	682	791	592	207	88	55	3451
Average Tracks per Month and Year	16.3	12.5	18.3	31.3	69.5	136.0	170.5	197.8	148.0	51.8	22.0	13.8	862.8
Average Tracks per Day	0.5	0.4	0.6	1.0	2.2	4.5	5.5	6.4	4.9	1.7	0.7	0.4	2.4
Average Days between Tracks*	1.91	2.24	1.70	0.96	0.45	0.22	0.18	0.16	0.20	0.60	1.36	2.25	0.41
	Winter		Spring			Summer			Autumn			Winter	
Seasonal Average Tracks per Day	0.5		1.3			5.5			2.5			0.5	
Seasonal Average Days between Tracks*	2.13		1.03			0.19			0.72			2.13	

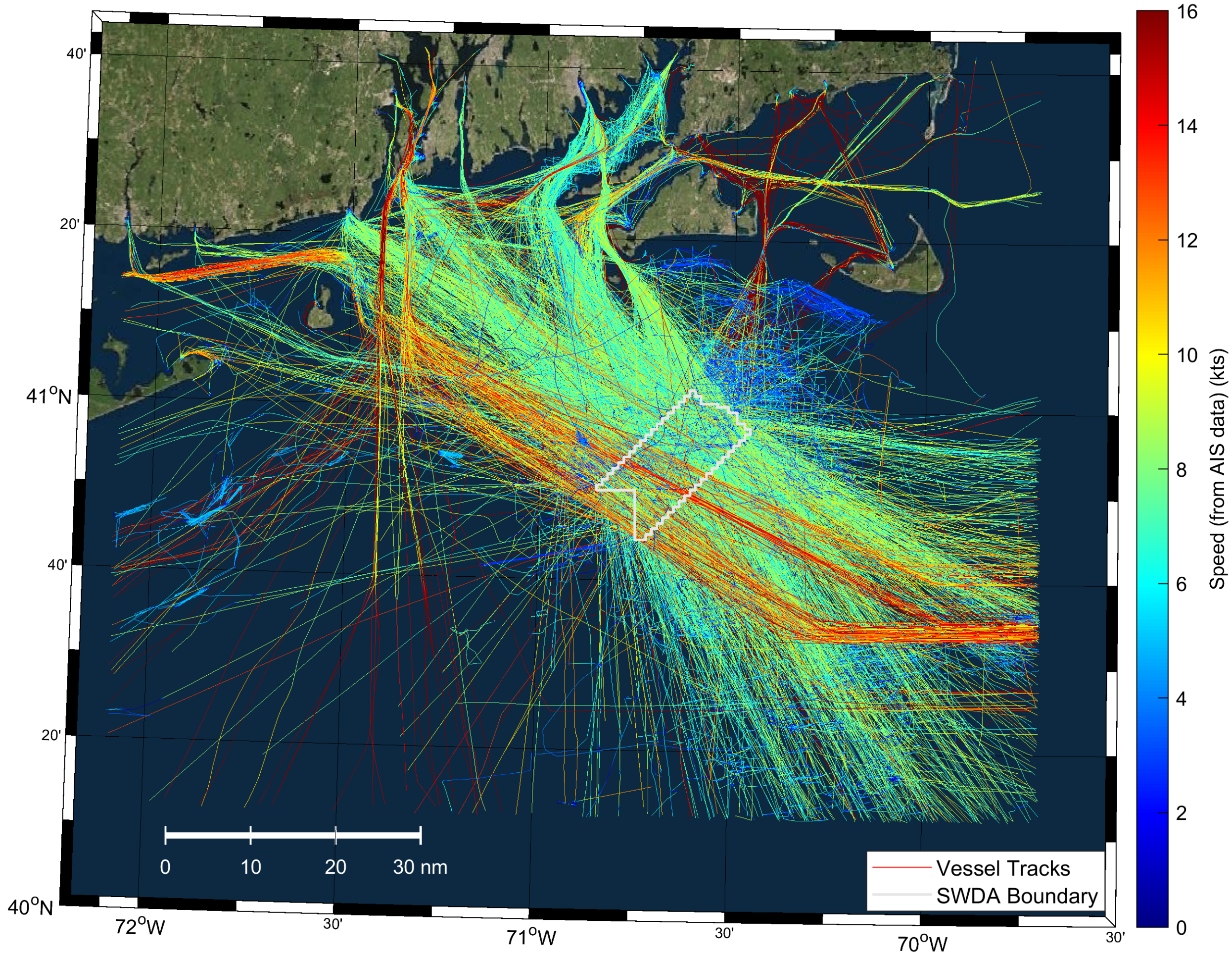

Figure 6.3: Vessel Tracks which Passed Through the SWDA – All Tracks Plotted, Research Vessels Excluded

6.4 Commercial Traffic

A summary of the various commercial vessels that transited through the SWDA is presented in the following sections.

6.4.1 Passenger Vessels

A total of 17 unique passenger vessels transited through the SWDA during the 4-year AIS data record. The total vessel tracks through the SWDA was 48. Table 6.5 summarizes the vessel details for the ten largest (LOA) passenger vessels that transited through the SWDA. A histogram of vessel length is presented in Figure 6.4. Vessel sizes range from 300 to 1083 ft (91 to 330 m) LOA.

Figure 6.5 presents a plot of all passenger vessel tracks which indicates that tracks generally follow steady southeast-northwest courses and transect the middle and southern sections of the SWDA.

Table 6.5: Vessel Details – 10 Largest Passenger Vessels Transiting the SWDA

Vessel Name	AIS Code	MMSI Number	IMO Number	LOA (ft)	LOA (m)	Beam (ft)	Beam (m)
ROYAL PRINCESS	60	310660992	9584712	1083	330	144	44
REGAL PRINCESS	69	310673984	9584724	1083	330	144	44
NORWEGIAN DAWN	69	311307008	9195169	968	295	105	32
CELEBRITY SUMMIT	60	249047008	9192387	965	294	105	32
NORWEGIAN GEM	69	309951008	9355733	965	294	105	32
CARIBBEAN PRINCESS	60	310423008	9215490	951	290	164	50
ARCADIA	60	310459008	9226906	935	285	105	32
ZUIDERDAM	60	245304000	9221279	935	285	105	32
CRYSTAL SERENITY	60	311536000	9243667	820	250	105	32
ROTTERDAM	69	246167008	9122552	784	239	105	32

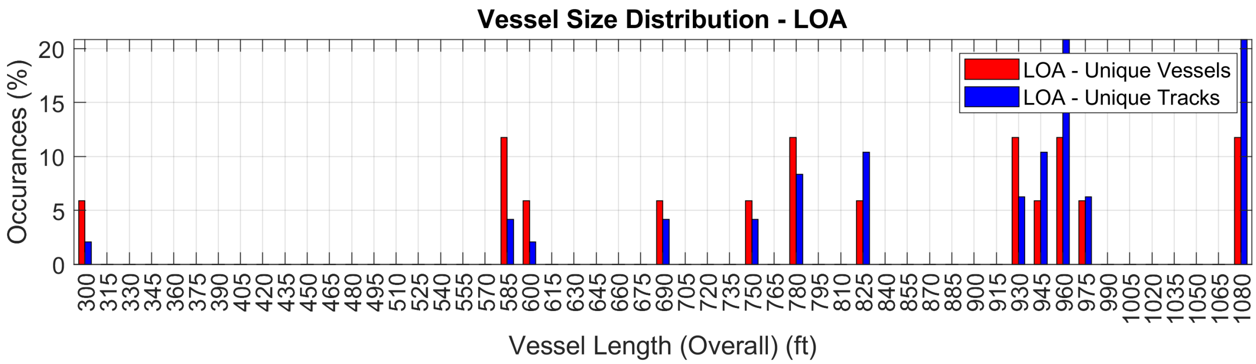

Figure 6.4: Histogram of Passenger Vessel Size (LOA) Transiting Through the SWDA

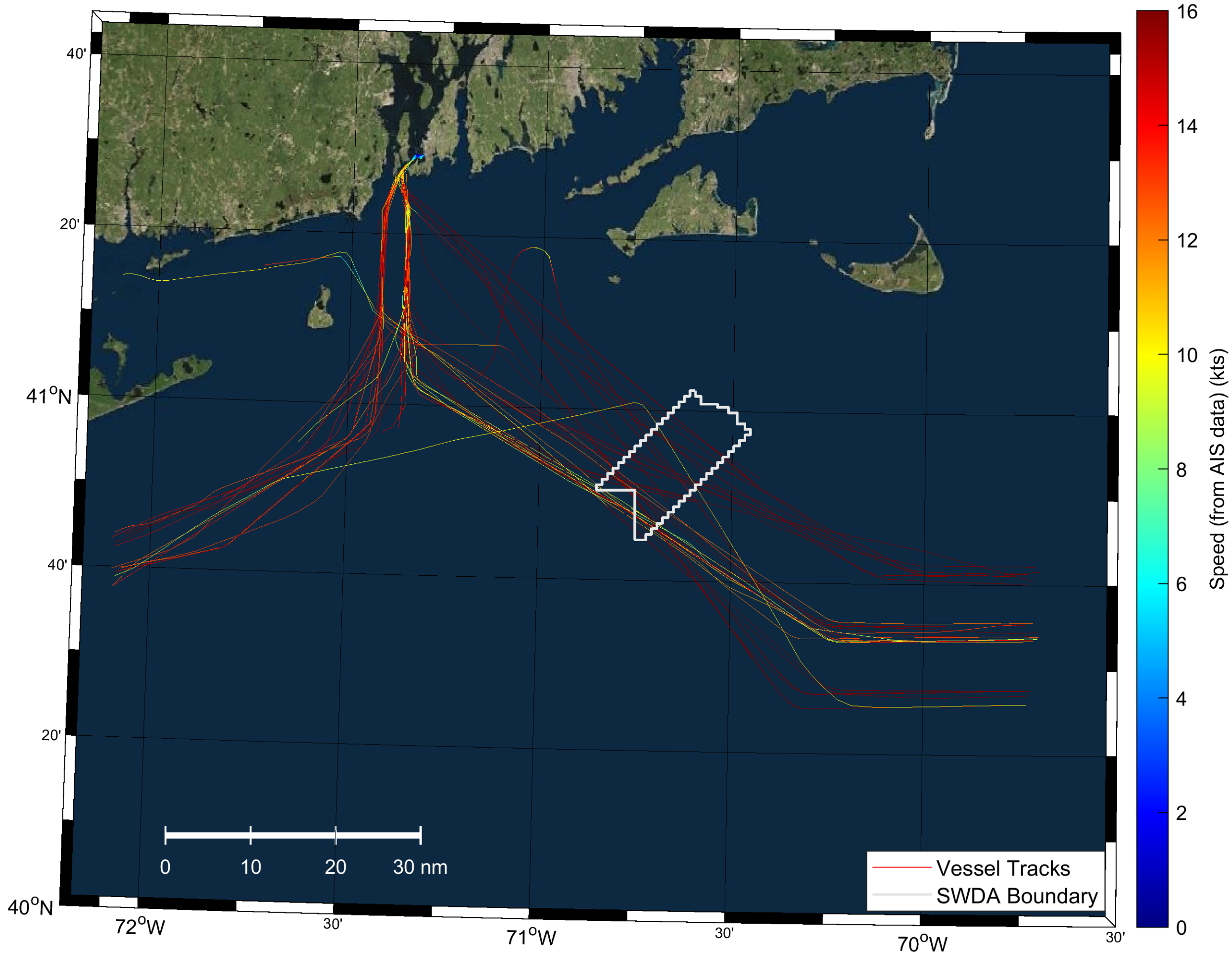

Figure 6.5: Passenger Vessel Tracks Through the SWDA

6.4.2 Tankers

A total of 85 unique tanker vessels transited through the SWDA during the 4-year AIS data record. The total vessel tracks through the SWDA was 169. Table 6.6 summarizes the vessel details for the 10 largest (LOA) tankers vessels that transited through the SWDA. A histogram of vessel length is presented in Figure 6.6 with the majority of tankers 600 ft (183 m) LOA (approx.).

Figure 6.7 presents a plot of all tanker vessel tracks and indicates that tracks generally follow steady southeast-northwest courses and transect the southern sections of the SWDA.

Table 6.6: Vessel Details – 10 Largest Tanker Vessels Transiting the SWDA

Vessel Name	AIS Code	MMSI Number	IMO Number	LOA (ft)	LOA (m)	Beam (ft)	Beam (m)
SAN JACINTO	80	538006720	9730373	899	274	157	48
NS LOTUS	80	636013248	9339337	817	249	144	44
NS CONCEPT	81	636012352	9299707	801	244	138	42
FLAGSHIP WILLOW	80	538005312	9512484	755	230	105	32
KINGS ROAD	80	636016128	9594872	748	228	105	32
SCF PROVIDER	89	636015040	9577094	748	228	105	32
NAVE CIELO	80	319767008	9301976	748	228	105	32
STROFADES	80	240678000	9319545	745	227	105	32
CHEMICAL PIONEER	80	366032000	6806444	686	209	98	30
ELKA SIRIUS	80	636012608	9234513	650	198	105	32

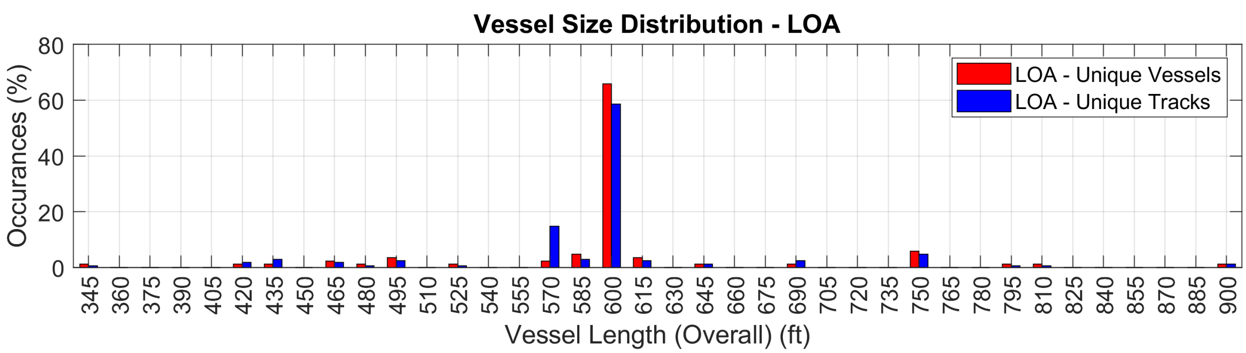

Figure 6.6: Histogram of Tanker Vessel Size (LOA) Transiting Through the SWDA

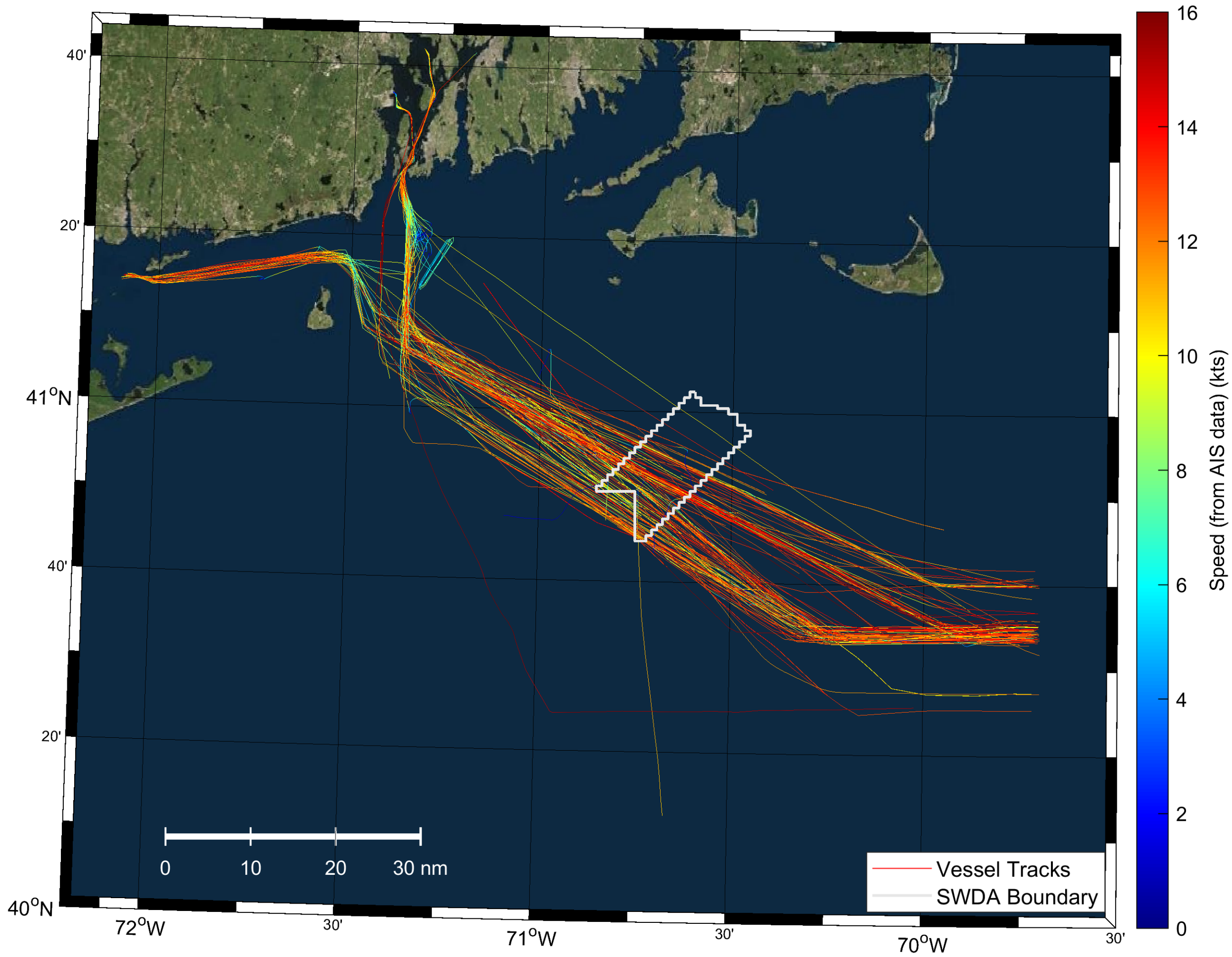

Figure 6.7: Tanker Vessel Tracks Through the SWDA

6.4.3 Dry Cargo

A total of 112 unique cargo vessels transited through the SWDA during the 4-year AIS data record. The total vessel tracks through the SWDA was 195. Table 6.7 summarizes the vessel details for the 10 largest (LOA) cargo vessels that transited through the SWDA. A histogram of vessel length is presented in Figure 6.8 with the majority of cargo vessels 660 ft (200 m) LOA (approx.).

Figure 6.9 presents a plot of all tanker vessel tracks which indicates that tracks generally follow steady southeast / northeast courses and transect the southern sections of the SWDA.

Table 6.7: Vessel Details – 10 Largest Dry Cargo Vessels Transiting the SWDA

Vessel Name	AIS Code	MMSI Number	IMO Number	LOA (ft)	LOA (m)	Beam (ft)	Beam (m)
PARSIFAL	74	636018112	9318060	1089	332	138	42
PAMINA	71	538006016	9326782	965	294	105	32
CMA CGM PUGET	71	255806112	9248124	925	282	105	32
MSC JULIA R.	71	636016448	9227338	919	280	105	32
CARDIFF	70	636016192	9629457	889	271	141	43
CPO NEW YORK	71	636091648	9440772	860	262	105	32
ARGOS	71	636016256	9477787	853	260	105	32
CUCKOO HUNTER	70	636016960	9238789	853	260	105	32
ITEA	71	636015680	9157698	846	258	105	32
CSL METIS	70	308976000	7926162	755	230	105	32

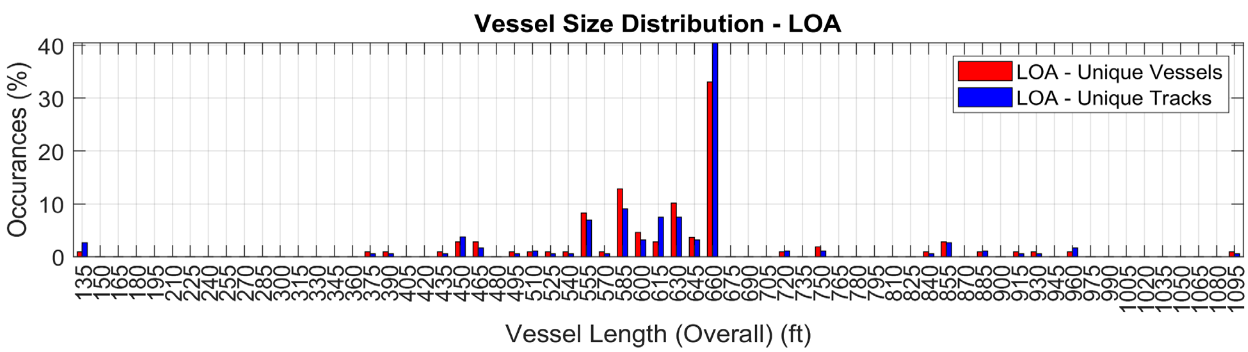

Figure 6.8: Histogram of Dry Cargo Vessel Size (LOA) Transiting Through the SWDA

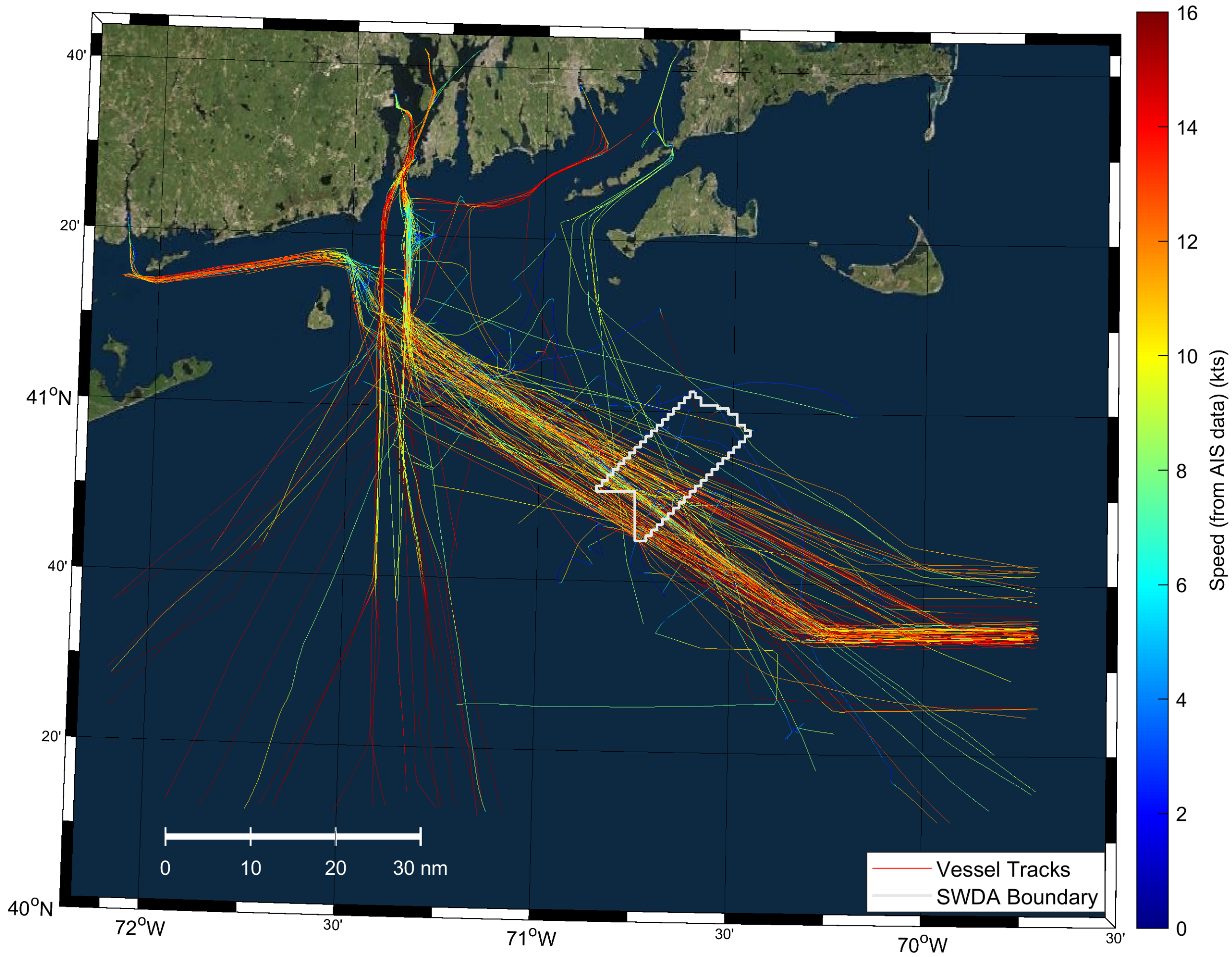

Figure 6.9: Dry Cargo Vessel Tracks Through the SWDA

6.4.4 Military

A total of 17 unique military vessels transited through the SWDA during the 4-year AIS data record. The assessment of military vessels has included AIS reporting code 51 (Search and Rescue) and 55 (Law Enforcement) that were identified as USCG vessels. The total vessel tracks through the SWDA was 32. Table 6.8 summarizes the vessel details for the 10 largest unique military vessels that transited through the SWDA. A histogram of vessel length is presented in Figure 6.10 with the vessels between 108 and 223 ft (32 to 68 m) LOA (approx.).

Figure 6.11 presents a plot of all military vessel tracks which indicates that tracks generally transected the northern sections of the SWDA.

Table 6.8: Vessel Details – 7 Military Vessels Transiting the SWDA

Vessel Name	AIS Code	MMSI Number	IMO Number	LOA (ft)	LOA (m)	Beam (ft)	Beam (m)
CG JUNIPER	35	366952000	9155535	223	68	46	14
CG OAK	35	369905984	9259953	223	68	46	14
NAVY RELENTLESS	35	367574816	8967553	141	43	43	13
CG KEY LARGO	35	367924992	-	112	34	20	6
CG SANIBEL	35	367940000	-	112	34	20	6
CG TYBEE	35	367912000	-	108	33	20	6
CANADIAN WARSHIP 332	35	316127008	-	N/A	N/A	N/A	N/A

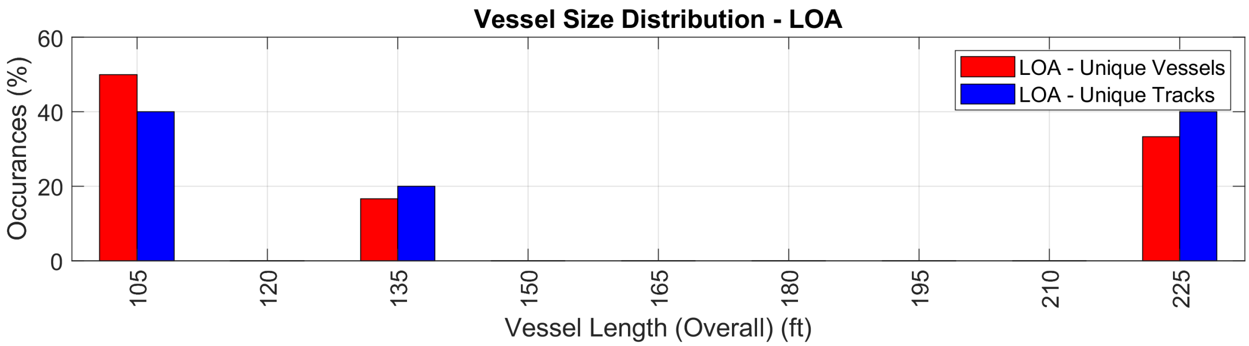

Figure 6.10: Histogram of Military Vessel Size (LOA) Transiting Through the SWDA

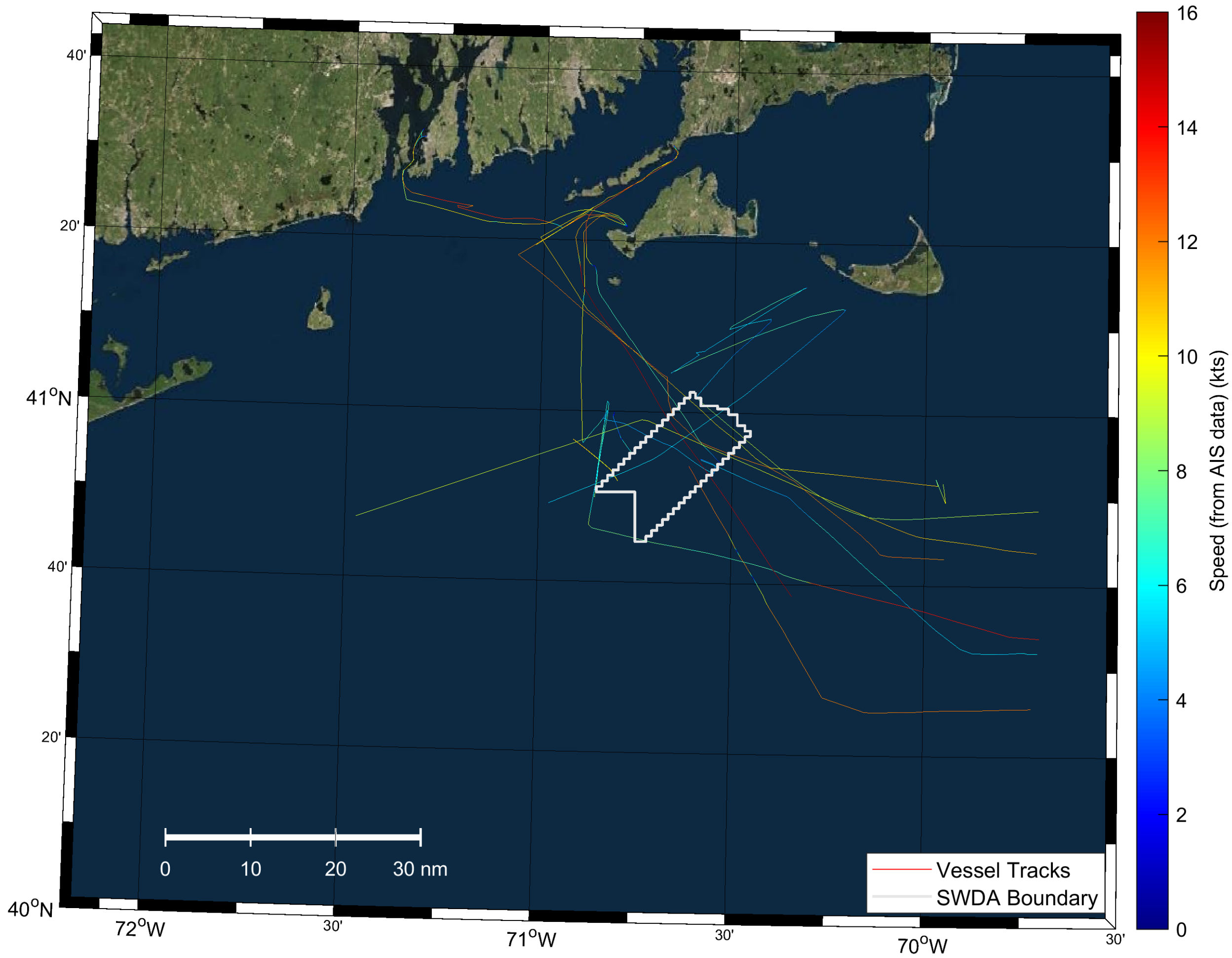

Figure 6.11: Military Vessel Tracks Through the SWDA

6.4.5 Towing Vessels

A total of 12 unique towing vessels transited through the SWDA during the 4-year AIS data record. The total vessel tracks through the SWDA was 15. Table 6.9 summarizes the vessel details for the 12 unique towing vessels that transited through the SWDA. A histogram of vessel length is presented in Figure 6.12 with the vessels between 23 and 502 ft (7 and 153 m) LOA (approx.). It should be noted that if a vessel is undertaking a tow of another vessel (including barge), the total towing length and beam may be significantly larger than presented in Table 6.9 and Figure 6.12. The AIS data indicated that the longest reported towing voyage through the SWDA was completed by the Genesis Liberty with a reported LOA of 502 ft (153 m) and beam of 79 ft (24.1 m).

Figure 6.13 presents a plot of all towing vessel tracks which indicates that vessels tracks were typically along an east-west axis distributed through the SWDA.

Table 6.9: Vessel Details – 11 Towing Vessels Transiting the SWDA

Vessel Name	AIS Code	MMSI Number	IMO Number	LOA (ft)	LOA (m)	Beam (ft)	Beam (m)
DOLPHIN	31	366920992	7319010	135	41.1	33	10.1
GENESIS LIBERTY	31	367586912	8207604	126*	38.4	37*	11.3
SAPPHIRE COAST	52	367002656	8109723	125	38.1	39	11.9
BERT REINAUER	52	368015488	9826146	125	38.1	39	11.9
LA CHEVAL	52	367019872	7826910	118	36.0	36	11.0
IONA MCALISTER	31	367149888	8023618	118	36.0	33	10.1
GENESIS VIGILANT	31	338531008	8973928	115	35.1	39	11.9
SARAH DANN	52	303028992	-	98	29.9	36	11.0
BUCKLEY MCALLISTER	52	367617024	9665449	98	29.9	59	18.0
SEA CRESCENT	52	367667552	8984563	95	29.0	26	7.9
GENESIS VISION	31	338343008	8973916	66	20.1	33	10.1

* Note: The largest reported dimensions for the Genesis Liberty when towing was 502 ft (153 m) LOA and 79 ft (24.1 m) beam.

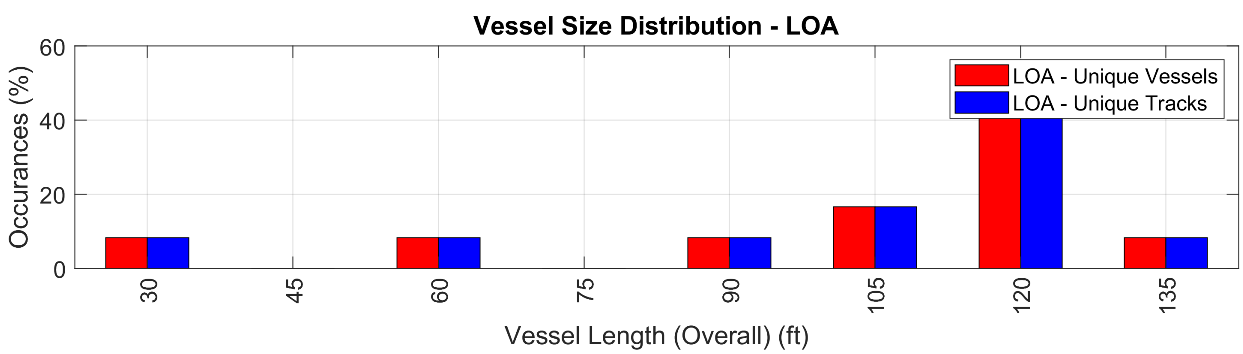

Figure 6.12: Histogram of Towing Vessel Size (LOA) Transiting Through the SWDA

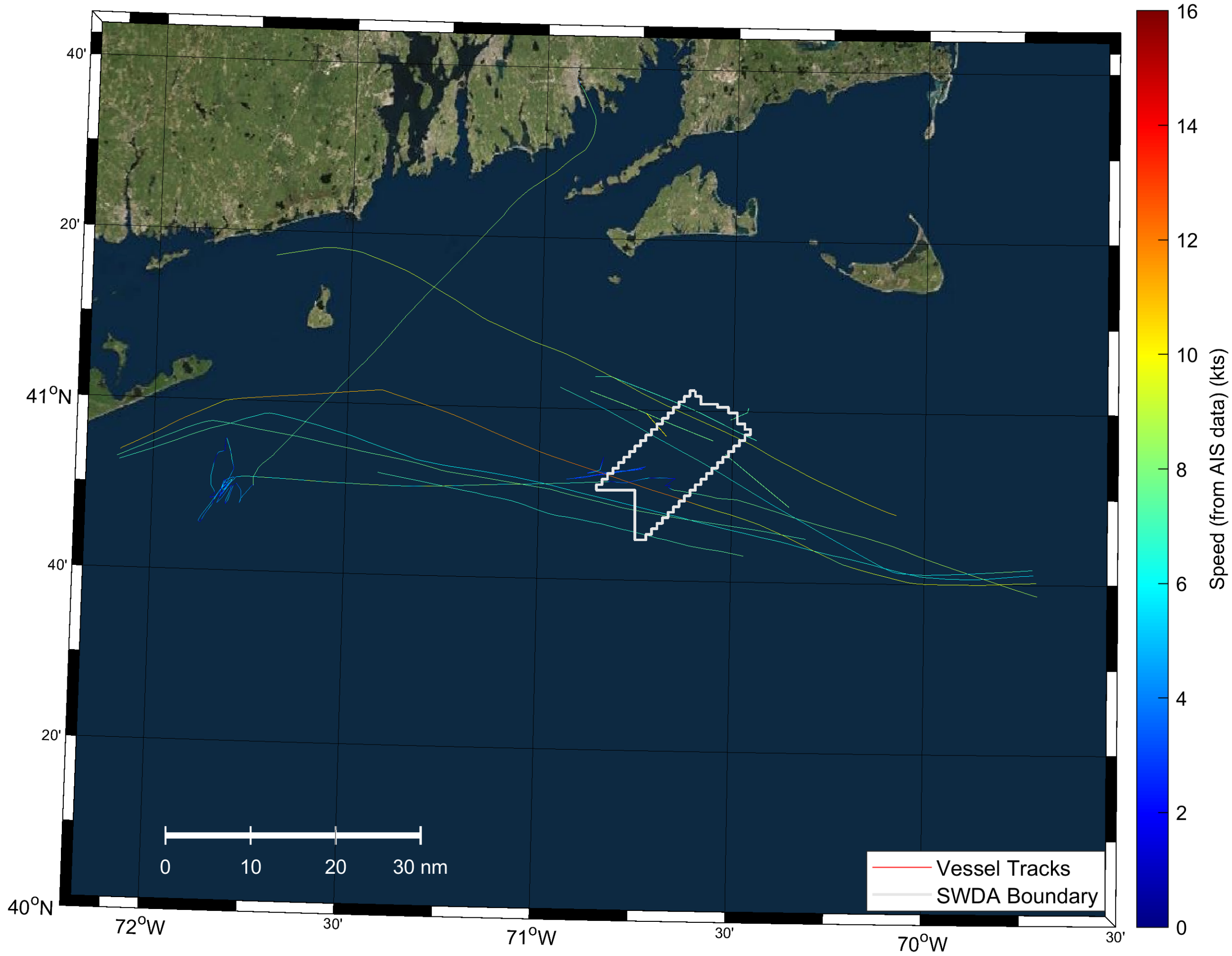

Figure 6.13: Towing Vessel Tracks Through the SWDA

6.4.6 Other Commercial Vessels

A total of 42 unique commercial vessels of various types not covered by previous categories transited through the SWDA during the 4-year AIS data record. The 42 unique vessels are a range of different types including car carriers and survey vessels. All commercial fishing vessels transiting through the SWDA are presented in Section 6.4.7. The total vessel tracks through the SWDA was 172. Table 6.9 summarizes the vessel details for the 10 largest unique (other) commercial vessels that transited through the SWDA. It should be noted that Coast Guard search and rescue vessels with an AIS reporting code of 51 are included in the other military vessel traffic – see Section 6.4.4. A histogram of vessel length is presented in Figure 6.12 with the vessels between 36 and 653 ft (11 and 199 m) LOA (approx.).

Figure 6.13 presents a plot of all other commercial vessel tracks which indicates that vessels tracks were distributed through the SWDA.

Table 6.10: Vessel Details – 10 Largest Other Commercial Vessels Transiting the SWDA

Vessel Name	AIS Code	MMSI Number	IMO Number	LOA (ft)	LOA (m)	Beam (ft)	Bea m (m)
GRANDE TORINO	90	247379504	9782675	653	199	118	36
PAUL MCLERNAN	57	369262016	9827671	604	184	72	22
BIWH601	90	367698752	-	358	109	82	25
FUGRO SYNERGY	33	311019808	9452488	341	104	66	20
GEOSEA	90	311063392	9242431	279	85	49	15
ATLANTIS	34	367240992	9105798	272	83	52	16
THOMAS G THOMPSON	90	366344992	8814419	272	83	52	16
CG SPENCER	51	367257984	-	269	82	39	12
CG SENECA	51	367284992	-	269	82	39	12
CG TAHOMA	51	367288000	-	269	82	39	12

Vessel Name	AIS Code	MMSI Number	IMO Number	LOA (ft)	LOA (m)	Beam (ft)	Beam (m)
GRANDE TORINO	90	247379504	9782675	653	199	118	36
PAUL MCLERNAN	57	369262016	9827671	604	184	72	22
BIWH601	90	367698752	-	358	109	82	25
FUGRO SYNERGY	33	311019808	9452488	341	104	66	20
GEOSEA	90	311063392	9242431	279	85	49	15
ATLANTIS	34	367240992	9105798	272	83	52	16
THOMAS G THOMPSON	90	366344992	8814419	272	83	52	16
CG SPENCER	51	367257984	-	269	82	39	12
CG SENECA	51	367284992	-	269	82	39	12
CG TAHOMA	51	367288000	-	269	82	39	12

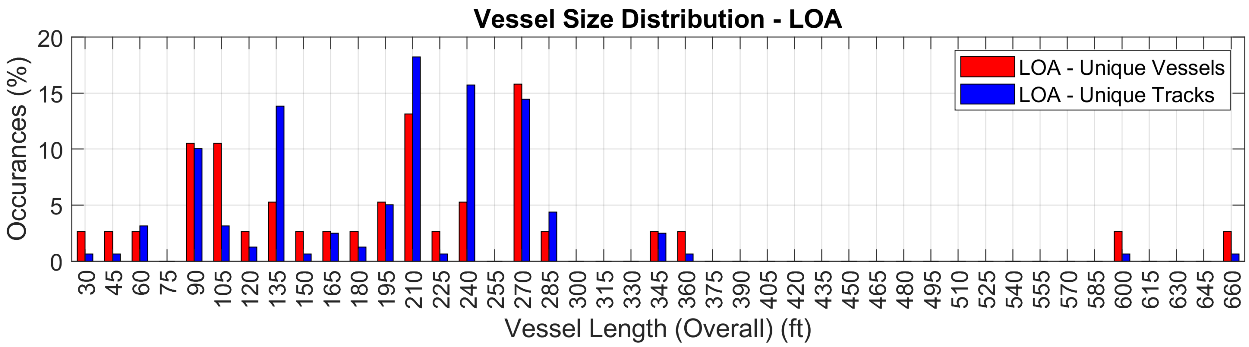

Figure 6.14: Histogram of Other Commercial Vessel Size (LOA) Transiting Through the SWDA

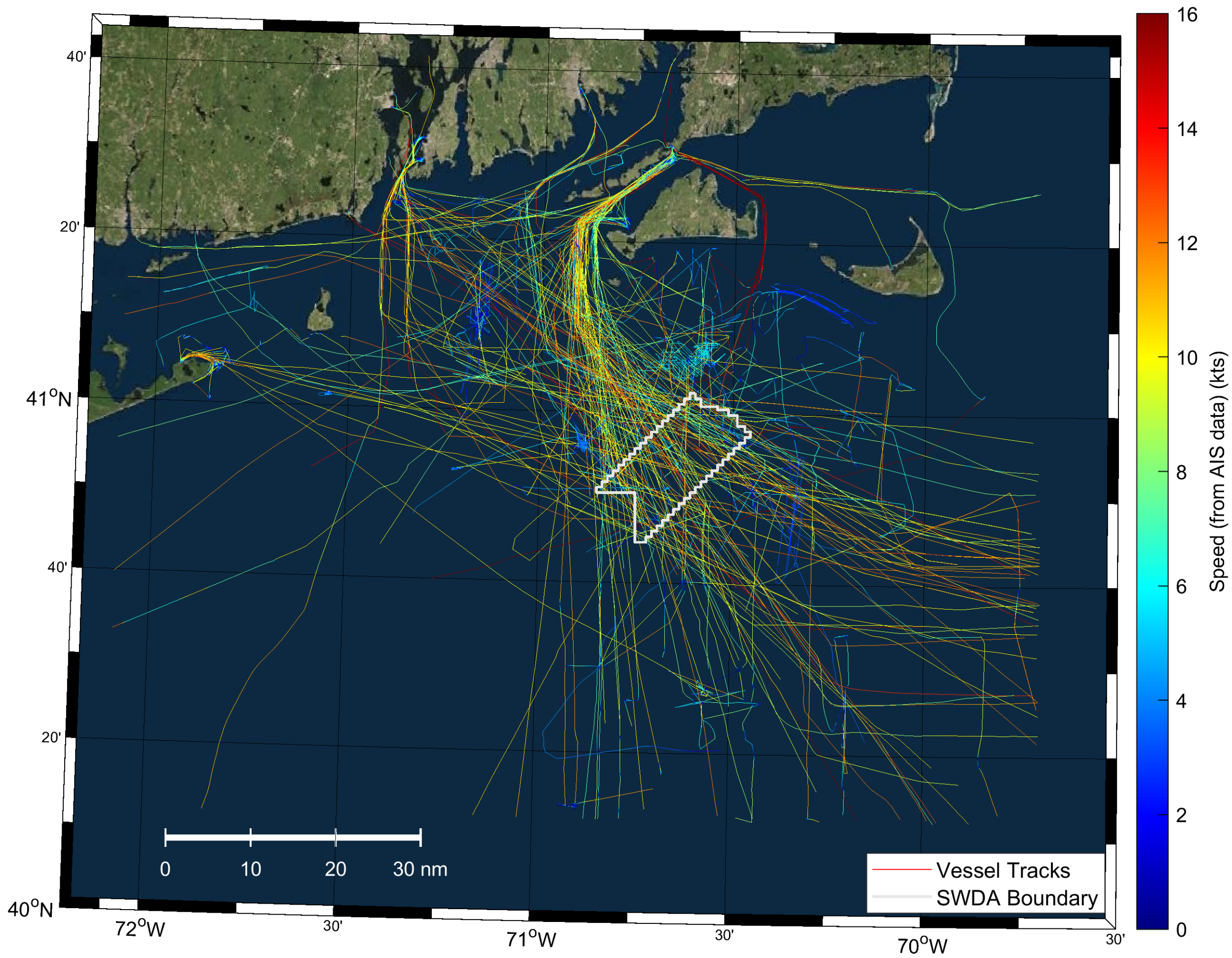

Figure 6.15: Other Commercial Vessel Tracks Through the SWDA

6.4.7 Fishing Vessels

The analysis of fishing vessel traffic through the SWDA is presented in the following sections. Analyses for fishing vessels include:

- Assessment of port locations that vessels are transiting to and from (see Section 6.4.7.1);
- Analysis of AIS vessel data including separation of traffic into transiting vessels (greater than 4 knots speed) and vessels that are likely to be trawling or fishing which has based on AIS data when vessel speed is less than 4 knots (see Section 6.4.7.2); and
- Presentation and discussion of NOAA VMS data which is a more comprehensive data set of actual fishing activities near and within the SWDA but does not have information on individual vessels and traffic.

6.4.7.1 Port of Transit (to/from)

The ports that fishing vessels (entering the SWDA) are transiting to and from has been analyzed. Based on the four years of AIS data, the most common port that fishing vessel tracks originate and finish at has been assessed for each unique vessel. The analyses have been completed for all fishing vessels that transited through the SWDA (see Figure 6.16) and vessel tracks that were assessed as trawling through the SWDA (see Figure 6.17). The most common ports of transit for vessels that tracked through the SWDA are New Bedford and Point Judith.

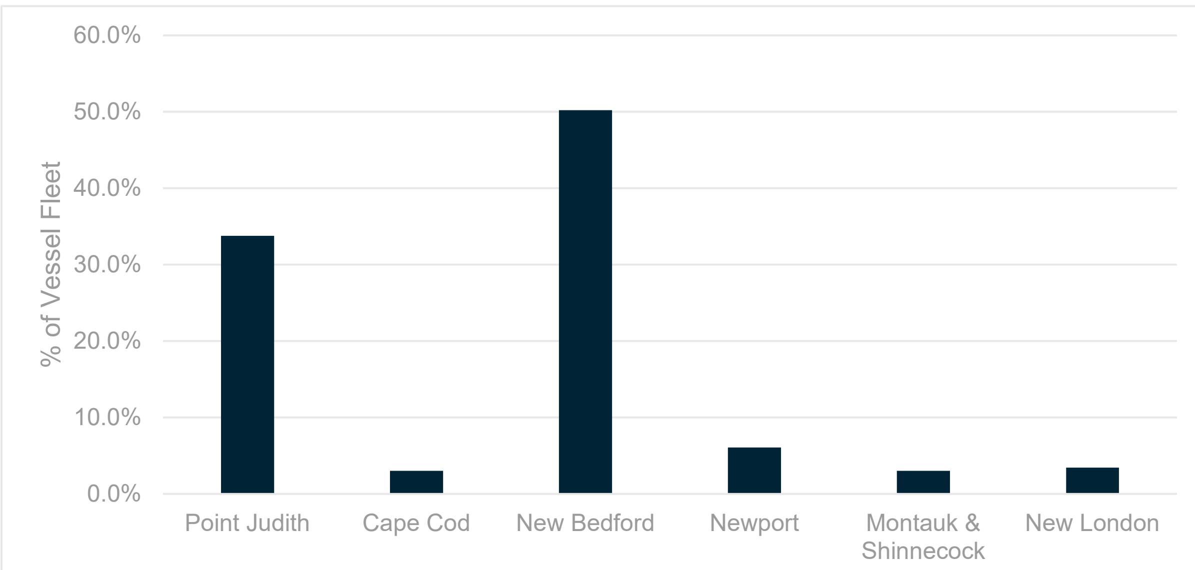

Figure 6.16: Most Common Port of Transit for All Fishing Vessels that Enter the SWDA

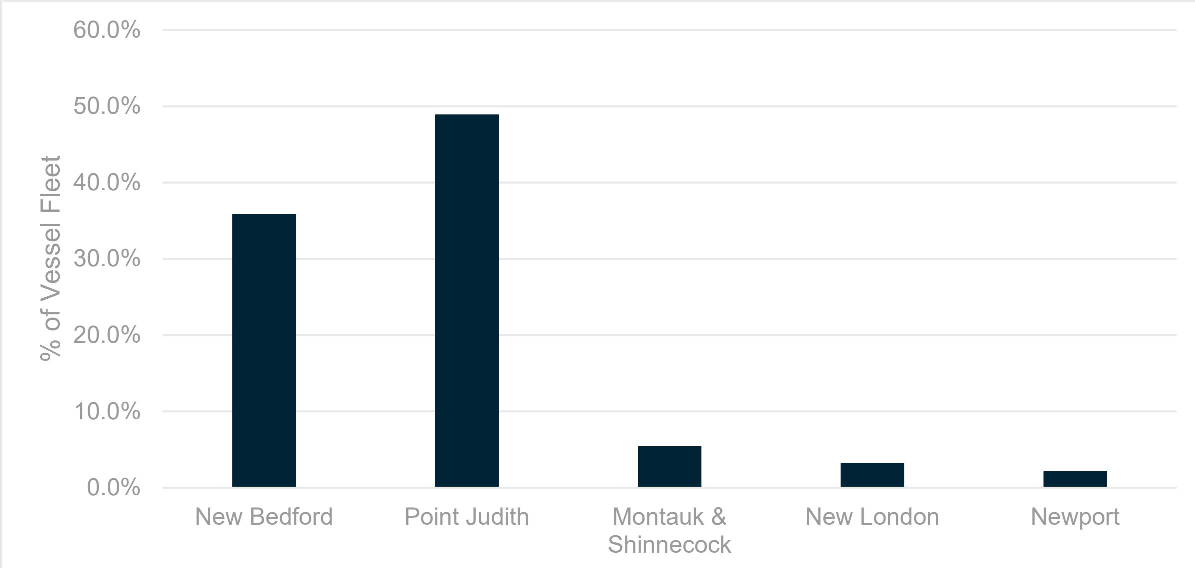

Figure 6.17: Most Common Port of Transit for Fishing Vessels Trawling within the SWDA (< 4 Kts)

Figure 6.18 is a conceptual schematic indicating the linkages between the destination fishing grounds for the fishing fleets at various ports of origin in the region compiled in Baird (2019) from a range of data sources including AIS and survey of vessels at various ports of origin in the region. The lines linking the ports and fishing grounds in the figure do not indicate the relative volume or specific routes of vessel traffic but simply show that a particular fishing practice is being undertaken by certain vessels of a particular port. It is also important to recognize that the fishing grounds do not represent a specific location but rather a general fishing area. The SWDA intersects the most direct route for several offshore fishing areas to the southeast of the SWDA; however, the direct path routes from harbors to fishing grounds (and vice-versa) presented in Figure 6.18 indicates that vessels could adjust transit routes to bypass the SWDA with increases in transit distance. The potential operational impacts on the fishing fleet is discussed in Section 9.2.2.

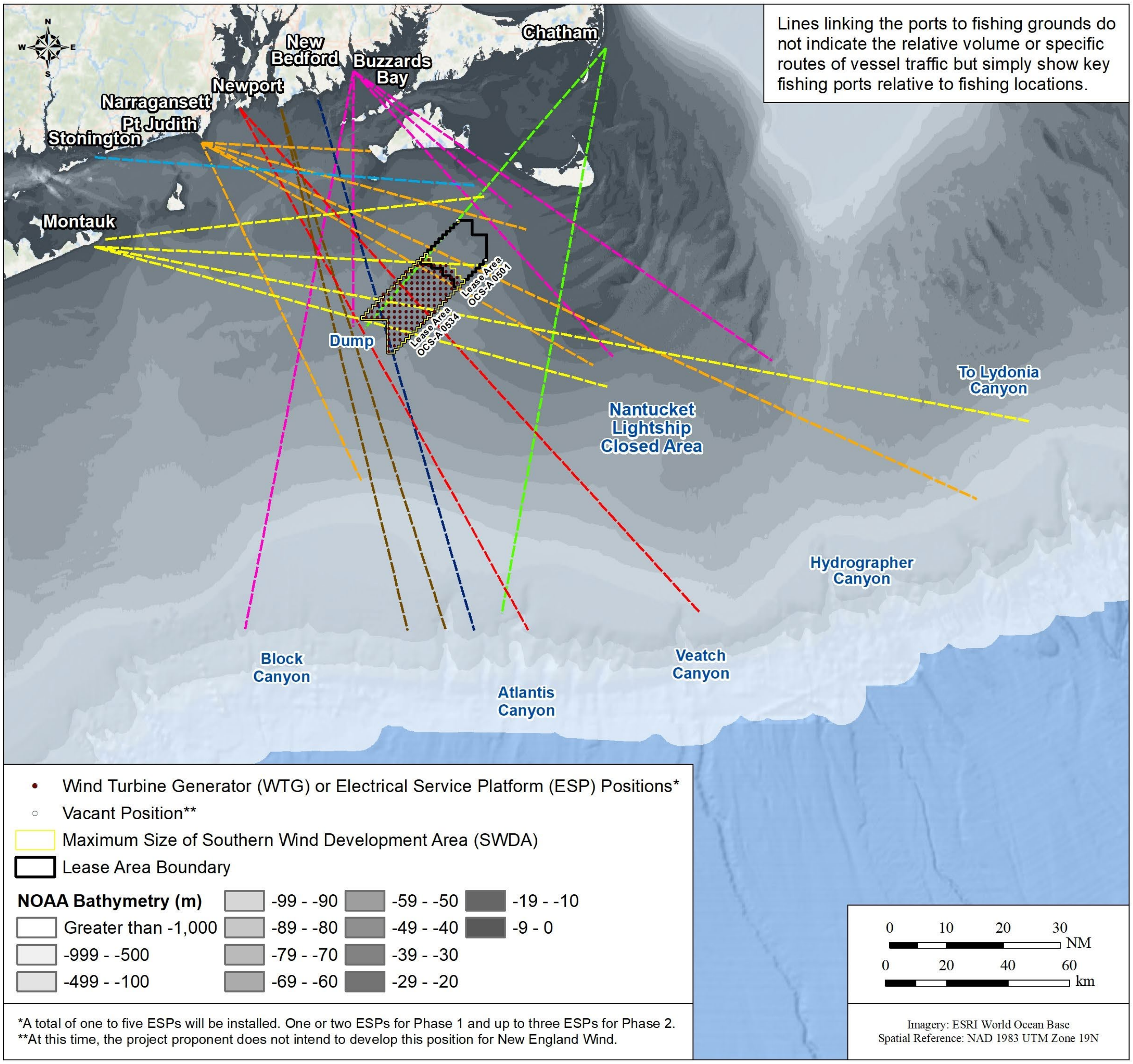

Figure 6.18: Key Fishing Ports Relative to Fishing Ground Locations Surrounding the Rhode Island/Massachusetts and Massachusetts Wind Energy Areas

6.4.7.2 AIS Data

A total of 231 unique commercial fishing vessels of various types transited through the SWDA during the 4-year AIS data record. The total commercial fishing vessel tracks through the SWDA was 2029 indicating that compared to other commercial vessels presented in previous sections, several fishing vessels regularly transit through the SWDA. Table 6.11 summarizes the vessel details for the 10 largest fishing vessels that transited through the SWDA. It should be noted that there were three vessels in the AIS data set that were reporting erroneous length and beam data, or could not have their dimensions verified on a ship database, and those have been excluded from the data Table 6.11. A histogram of vessel length is presented in Figure 6.19 with the vessels between 36 and 161 ft (11 and 49 m) LOA (approx.).

Figure 6.20 presents a plot of all fishing vessel tracks which indicates that vessel tracks were typically along an east-west axis distributed through the SWDA.

Table 6.11: Vessel Details – 10 Largest Fishing Vessels Transiting the SWDA

Vessel Name	AIS Code	MMSI Number	IMO Number	LOA (ft)	LOA (m)	Beam (ft)	Beam (m)
F/V E S S PURSUIT	30	367411968	0	146	44	43	13
RELENTLESS	30	367394048	0	138	42	33	10
PERSISTENCE	30	367717984	0	128	39	30	9
STARRFISH	30	338211072	0	115	35	39	12
F/V OSPREY	30	367341024	0	109	33	28	9
LADY BRITTANY	30	366983264	0	104	32	30	9
F/V HARVESTER	30	367336032	0	102	31	23	7
BATTLE WAGON	30	367705728	0	102	31	20	6
NORDIC EXPLORER	30	367444960	0	99	30	30	9
F\VCRYSTAL&KATIE	30	367334784	0	94	29	27	8

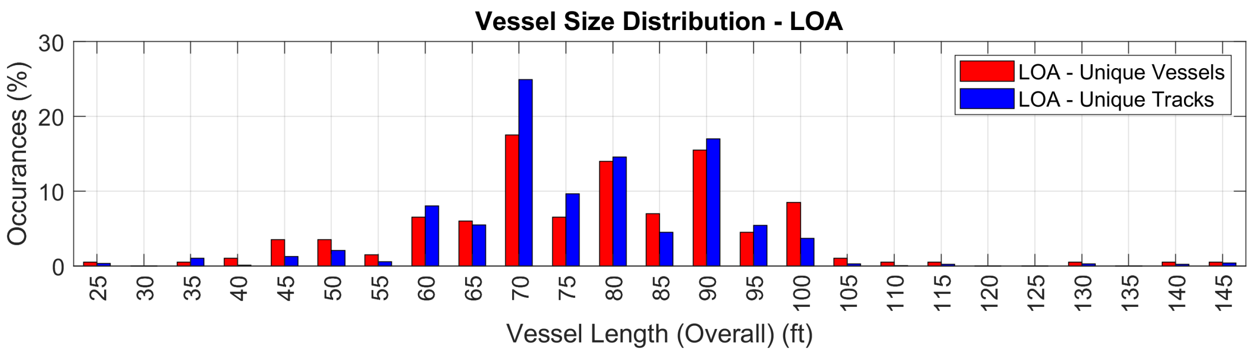

Figure 6.19: Histogram of Fishing Vessel Size (LOA) Transiting Through the SWDA

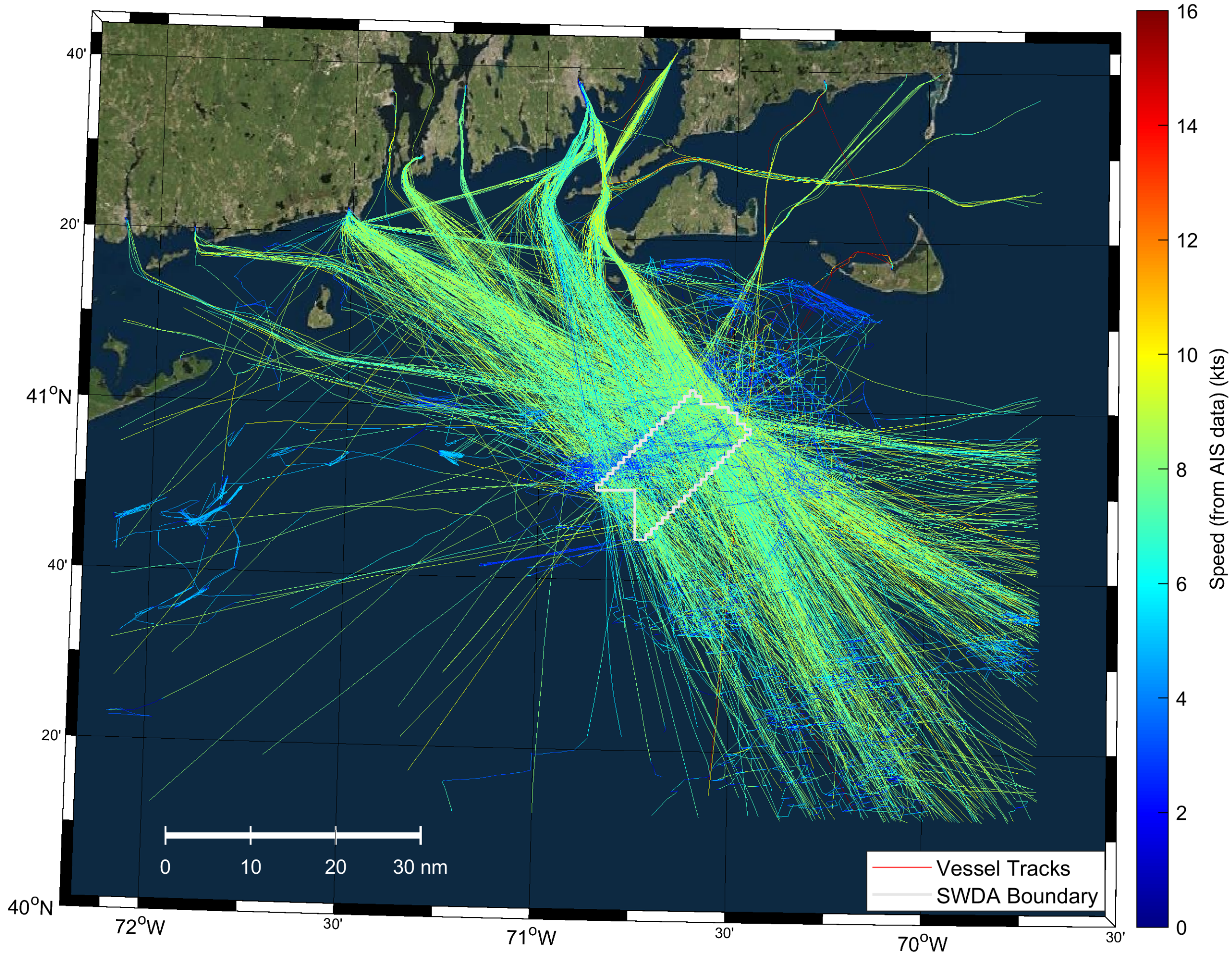

Figure 6.20: Fishing Vessel Tracks Through the SWDA for All Transit Speeds

Analyses have been completed to separate transiting fishing vessels and those fishing vessels that are likely to be trawling or fishing. The separation of fishing vessels trawling and transiting has been based a speed threshold of 4 knots (< 4 knots trawling, > 4 knots transiting). It is noted that NOAA Fisheries and BOEM have used a 5 knot speed cutoff for scallop fishing based on VMS data; however, the AIS data does not allow for distinction of different types of fisheries. Figure 6.21 presents the vessel tracks for fishing vessels that transected the SWDA during their trawling or fishing track. Figure 6.22 presents the distribution of vessel heading for trawling or fishing tracks through the SWDA. The most common track directions were along the east-west axis.

Figure 6.23 presents the vessel tracks for fishing vessels that transected the SWDA during their transit. Figure 6.24 presents the distribution of vessel headings for transiting tracks through the SWDA. The most common track directions were along the southeast-northwest axis.

An analysis was also conducted to assess the relative duration of trawling within the confines of the SWDA. That is, for each trawler track that entered the SWDA, the track duration was analyzed to determine the amount of time spent within and outside the SWDA. The results indicated that approximately 25% of the total trawl time was spent inside the SWDA versus 75% of the time outside.

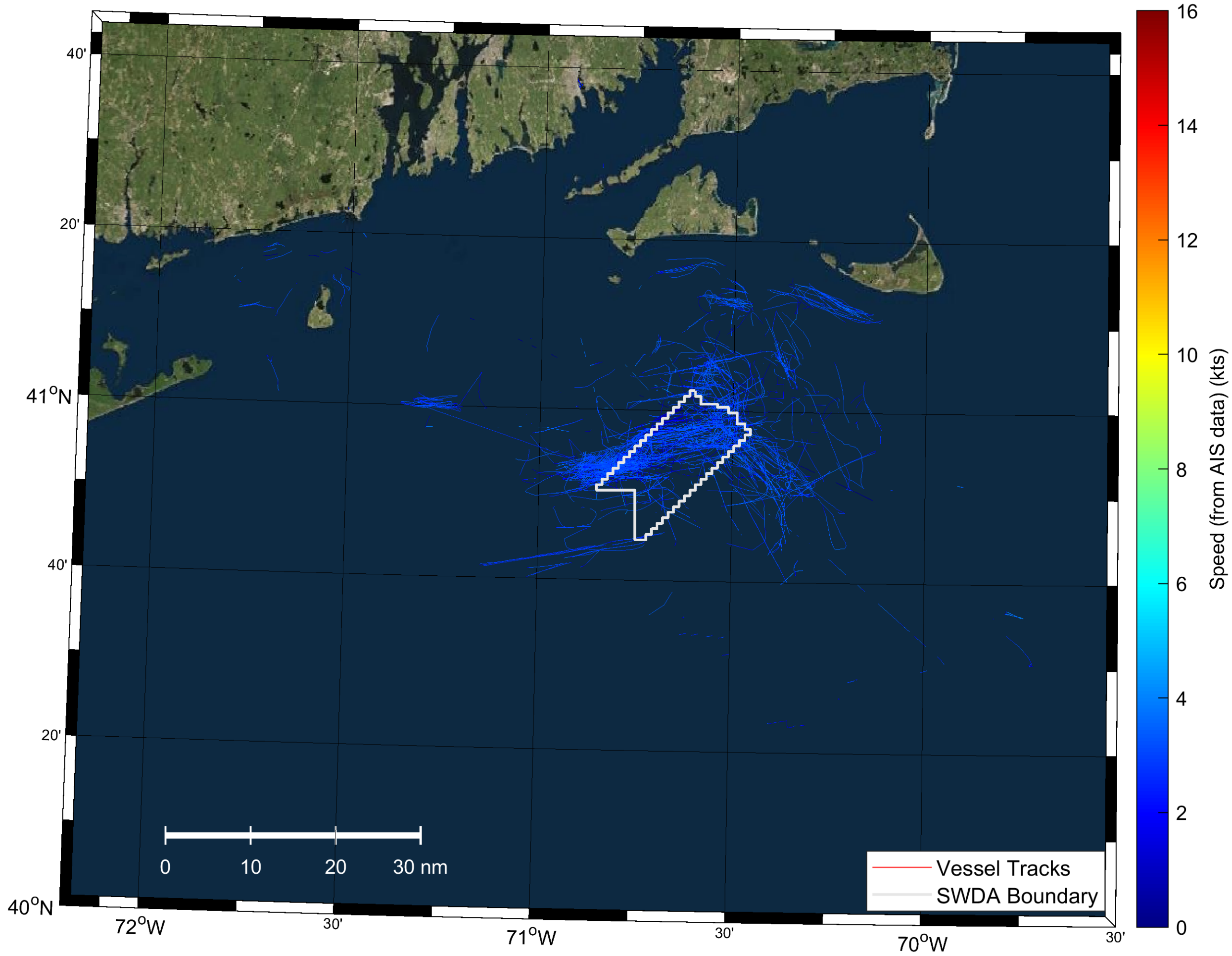

Figure 6.21: Fishing Vessel Tracks Through the SWDA Trawling or Fishing (<4 kts)

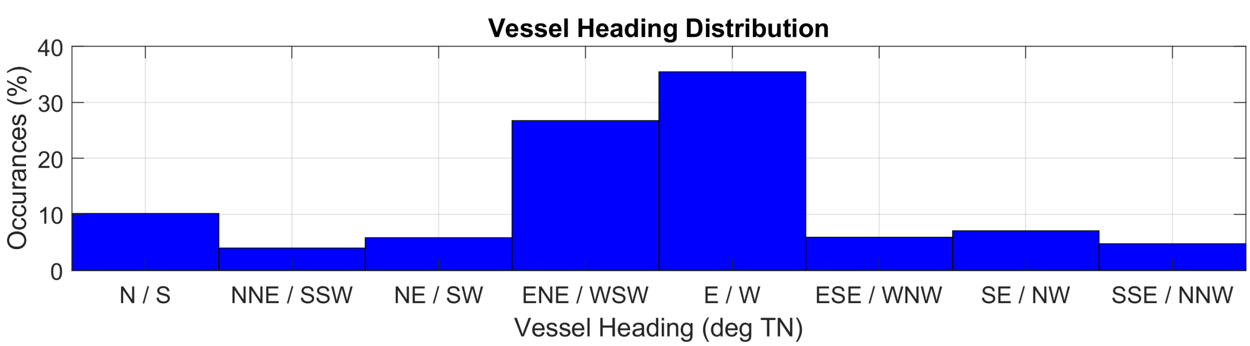

Figure 6.22: Vessel Heading Distribution for Fishing Vessel Tracks Through the SWDA Trawling or Fishing (<4 kts)

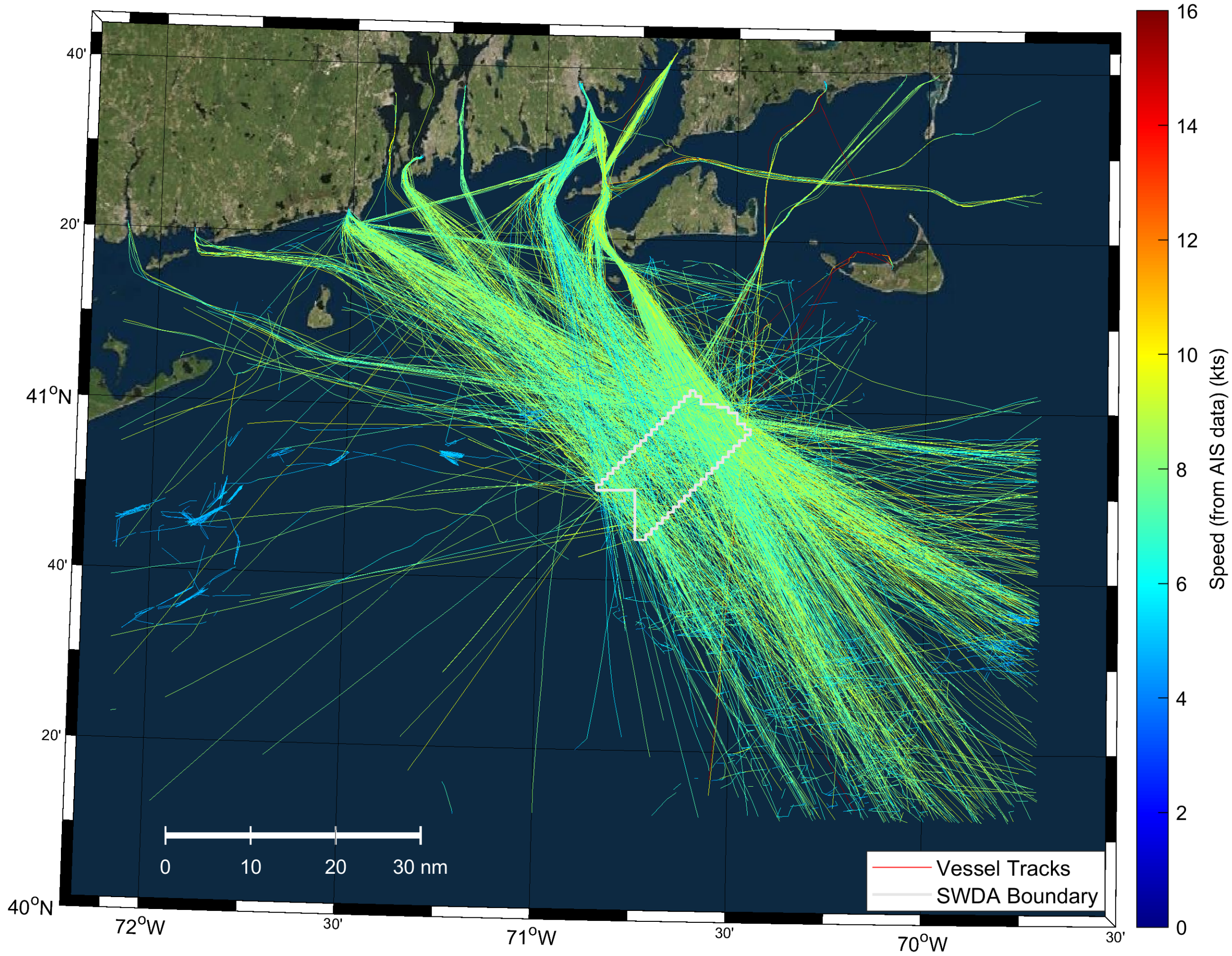

Figure 6.23: Fishing Vessel Tracks Transiting Through the SWDA (>4 kts)

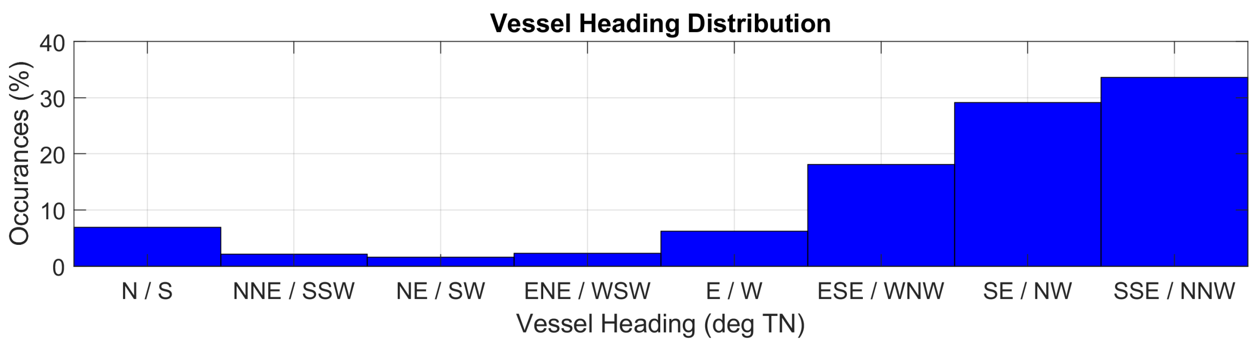

Figure 6.24: Vessel Heading Distribution for Fishing Vessel Tracks Transiting Through the SWDA (>4 kts)

Table 6.12 presents a summary by month and year of fishing vessel traffic in the SWDA. The fishing vessel traffic is highly seasonal, with most traffic between June and October. Significant inter-annual variation also is evident with the highest total traffic in 2016 and with 2019 having the second highest traffic. 2016 had significantly higher traffic of vessels that appeared to be fishing compared to the other three years of data. A summary of the monthly AIS fishing vessel traffic averaged across the 4-years of data is presented in Table 6.13. Overall, the AIS data indicate relatively low levels of fishing effort in the SWDA.

Table 6.12: AIS Fishing Vessel Traffic Through the SWDA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2016													
Number of Unique Vessels (fishing)	0	0	1	1	2	3	6	20	42	6	2	2	56
Number of Unique Vessel Tracks (fishing)	0	0	2	1	4	3	20	156	220	12	2	2	421
Number of Unique Vessels (transiting)	1	6	12	6	11	17	26	34	52	18	11	9	85
Number of Unique Vessel Tracks (transiting)	1	10	19	9	26	46	71	118	125	34	18	15	487
Number of Unique Vessels (all)	1	6	12	7	11	17	26	35	56	18	11	10	88
Number of Unique Vessel Tracks (all)	1	10	19	10	27	48	77	225	273	40	18	16	759
2017													
Number of Unique Vessels (fishing)	0	0	0	1	3	3	6	4	18	6	0	0	33

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Number of Unique Vessel Tracks (fishing)	0	0	0	1	3	3	8	15	34	6	0	0	70
Number of Unique Vessels (transiting)	8	13	6	14	19	26	32	35	35	15	3	0	96
Number of Unique Vessel Tracks (transiting)	29	18	10	24	28	48	73	92	81	20	3	0	417
Number of Unique Vessels (all)	8	13	6	14	19	27	32	35	36	16	3	0	97
Number of Unique Vessel Tracks (all)	29	18	10	24	28	49	74	100	100	21	3	0	447
2018													
Number of Unique Vessels (fishing)	0	0	0	0	5	2	1	3	3	2	0	0	14
Number of Unique Vessel Tracks (fishing)	0	0	0	0	7	3	2	3	10	3	0	0	28
Number of Unique Vessels (transiting)	2	1	1	12	39	39	38	36	22	7	3	1	98

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Number of Unique Vessel Tracks (transiting)	2	0	1	12	66	85	70	62	34	10	4	1	339
Number of Unique Vessels (all)	2	1	1	12	39	39	38	36	22	7	3	1	98
Number of Unique Vessel Tracks (all)	2	0	1	12	66	86	71	63	37	10	4	1	345
2019													
Number of Unique Vessels (fishing)	0	0	0	1	0	2	5	12	12	1	0	0	29
Number of Unique Vessel Tracks (fishing)	0	0	0	1	0	5	6	25	23	4	0	0	63
Number of Unique Vessels (transiting)	1	1	6	19	34	38	46	51	33	10	6	2	124
Number of Unique Vessel Tracks (transiting)	1	2	8	25	50	72	111	125	42	15	6	2	446

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Number of Unique Vessels (all)	1	1	6	19	34	38	46	53	37	10	6	2	127
Number of Unique Vessel Tracks (all)	1	2	8	25	50	74	113	136	59	16	6	2	479
Average: 2016-2019													
Number of Unique Vessels (fishing)	0	0	0	1	3	3	5	10	19	4	1	1	33
Number of Unique Vessel Tracks (fishing)	0	0	1	1	4	4	9	50	72	6	1	1	146
Number of Unique Vessels (transiting)	3	5	6	13	26	30	36	39	36	13	6	3	101
Number of Unique Vessel Tracks (transiting)	8	8	10	18	43	63	81	99	71	20	8	5	422
Number of Unique Vessels (all)	3	5	6	13	26	30	36	40	38	13	6	3	103

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Number of Unique Vessel Tracks (all)	8	8	10	18	43	64	84	131	117	22	8	5	508

Table 6.13: Summary of AIS Fishing Vessel Traffic Through the SWDA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Number of Tracks (2016-19)													
Fishing	0	0	2	3	14	14	36	199	287	25	2	2	582
Transiting	12	21	25	51	103	120	142	156	142	50	23	12	403
All Vessels	33	30	38	70	170	251	325	397	282	79	31	18	1689
Average Tracks Per Day													
Fishing	0.0	0.0	0.0	0.0	0.1	0.1	0.3	1.6	2.4	0.2	0.0	0.0	0.4
Transiting	0.1	0.2	0.2	0.4	0.8	1.0	1.1	1.3	1.2	0.4	0.2	0.1	0.6
All Vessels	0.3	0.3	0.3	0.6	1.4	2.1	2.6	3.2	2.4	0.6	0.3	0.1	1.2
Average Days Between Tracks*													
Fishing	31.0	28.0	31.0	30.0	8.9	8.6	3.4	0.6	0.4	5.0	30.0	31.0	2.5
Transiting	10.3	5.3	5.0	2.4	1.2	1.0	0.9	0.8	0.8	2.5	5.2	10.3	1.7
All Vessels	3.8	3.7	3.3	1.7	0.7	0.5	0.4	0.3	0.4	1.6	3.9	6.9	0.9

Seasonal Average Tracks per Day	Winter	Spring	Summer	Autumn	Winter
Fishing	0.0	0.1	0.7	0.9	0.0
Transiting	0.1	0.5	1.1	0.6	0.1
All Vessels	0.2	0.8	2.6	1.1	0.2

* Average days between tracks is the reciprocal of average tracks per day.

6.4.7.3 NOAA VMS Data Summary

Another source of fishing vessel traffic data is the US NOAA Vessel Monitoring System (VMS), which is a satellite surveillance system primarily used to monitor the location and movement of commercial fishing vessels within US jurisdiction and treaty areas. The system uses satellite-based communications from on-board transceiver units, which certain vessels are required to carry. The transceiver units send position reports that include vessel identification, time, date, and location, and are mapped and displayed on the end user's computer screen. The system is used to support fisheries law enforcement initiatives and to prevent violations of laws and regulations.

The raw VMS data were not available due to privacy constraints but GIS mapping of the resultant analyses of fishing traffic density are provided. Appendix C provides density maps for several fish species:

- Herring
- Monkfish
- Scallop
- Squid
- Surfclam / Ocean Quahog
- Multispecies (Groundfish)
- Pelagics (Herring/Mackerel/Squid)

Vessel speed is used to distinguish vessels that are actually fishing as opposed to transiting. For most species, vessels sailing at less than 4 knots are considered fishing but for scallop fishing the vessel speed is assumed as 5 knots. Thus, Appendix A contains two density maps for each species: (1) while fishing and (2) at all vessel speeds.

Also provided in Appendix C are polar histograms of the VMS data showing the frequency of occurrence of average vessel course by direction as provided by BOEM (2021a). Note that these histograms were prepared for vessels entering the both Lease Area OCS-A 0501 and Lease Area OCS-A 0534, not just the SWDA. The directional characteristics of the overall VMS data (all VMS fisheries combined) are consistent with that of the AIS data. The vessels actively transiting follow approximate northwest/southeast track orientations while those vessels actively fishing are on east/west and east-northeast/west-southwest orientations.

Figure 6.25 provides an example density plot for squid fishing. It may be noted that the highest density of fishing activity occurs to the north of the SWDA near the islands of Martha's Vineyard and Nantucket. There is some activity in the northern part of Vineyard Wind 1, which diminishes in New England Wind. This is consistent with what was observed for fishing activity in the AIS dataset (see Figure 6.27).

Figure 6.26 shows traffic density for scallop fishing vessels. It may be noted that much of this traffic transits on a northwest-southeast traffic to the north of the SWDA.

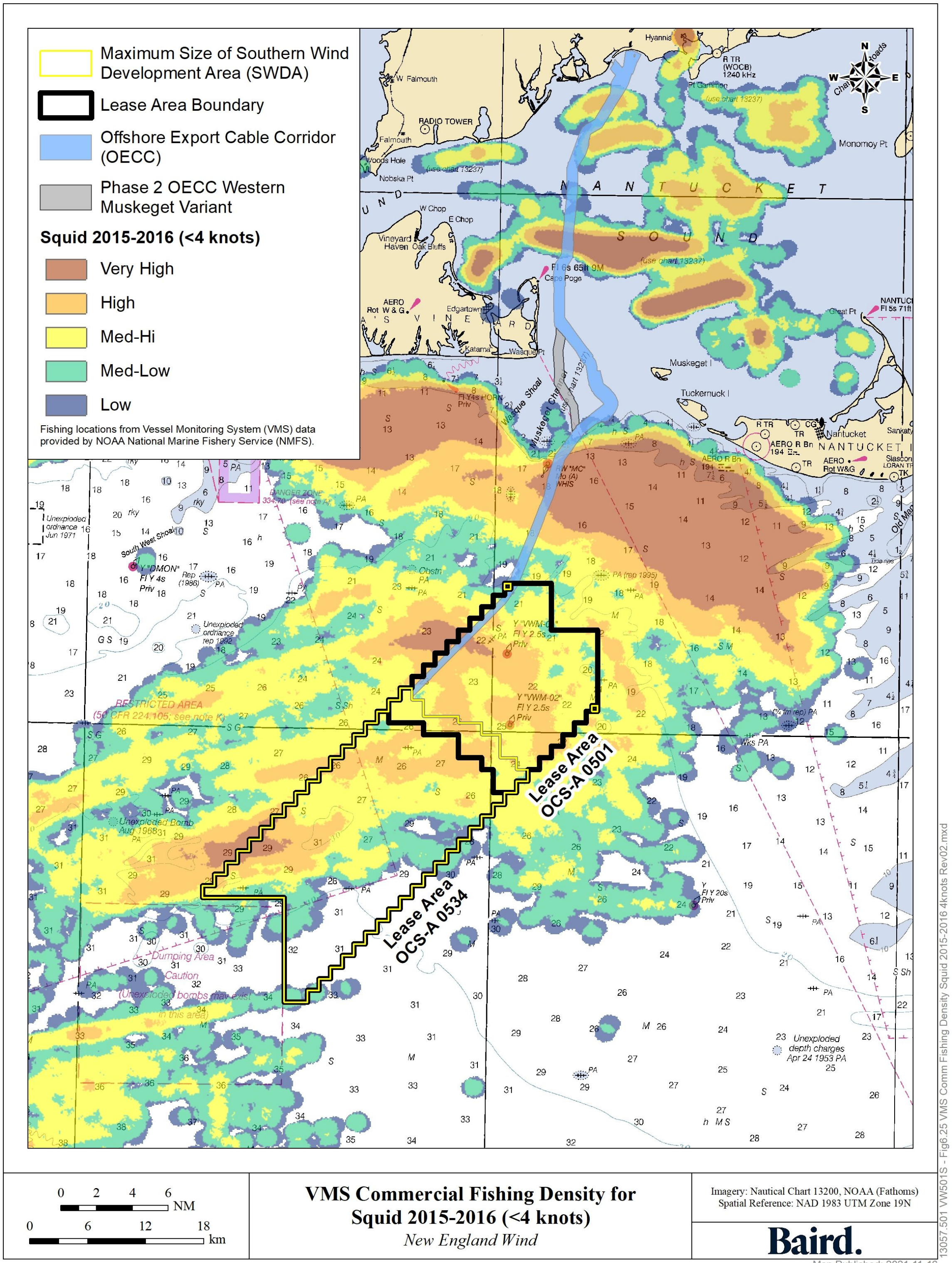

Figure 6.25: VMS Density for Squid While Fishing (2015-16)

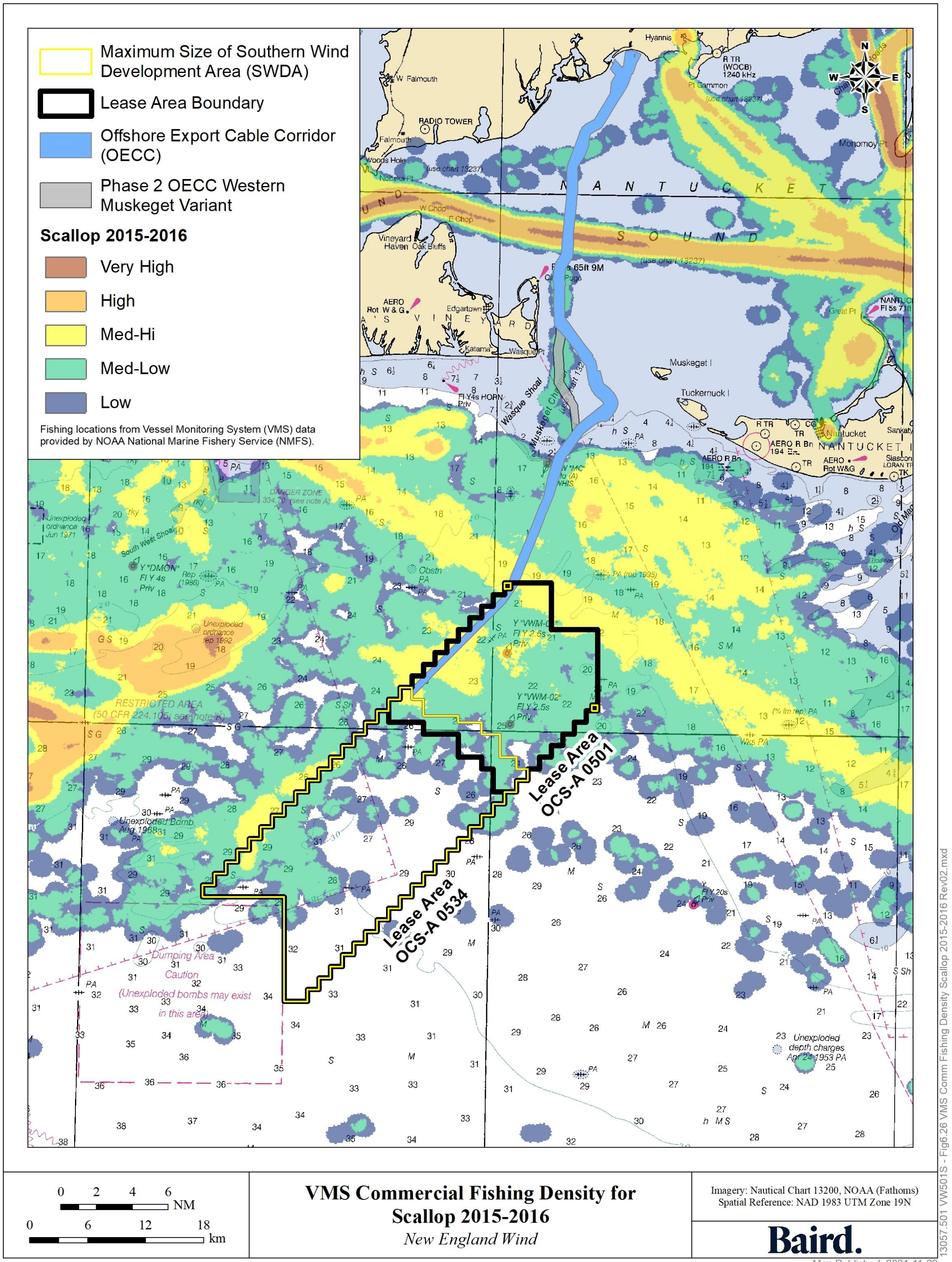

Figure 6.26: VMS Density for Scallop – All Vessel Speeds (2015-16)

6.4.8 Transit Routes

Vessel transit routes have been investigated based on track density analyses within the SWDA and the surrounding area. Figure 6.27 presents the vessel track density for all vessels across the AIS data coverage area (see Table 6.1). The highest AIS vessel traffic density areas are northeast, north, west, and south of the SWDA.

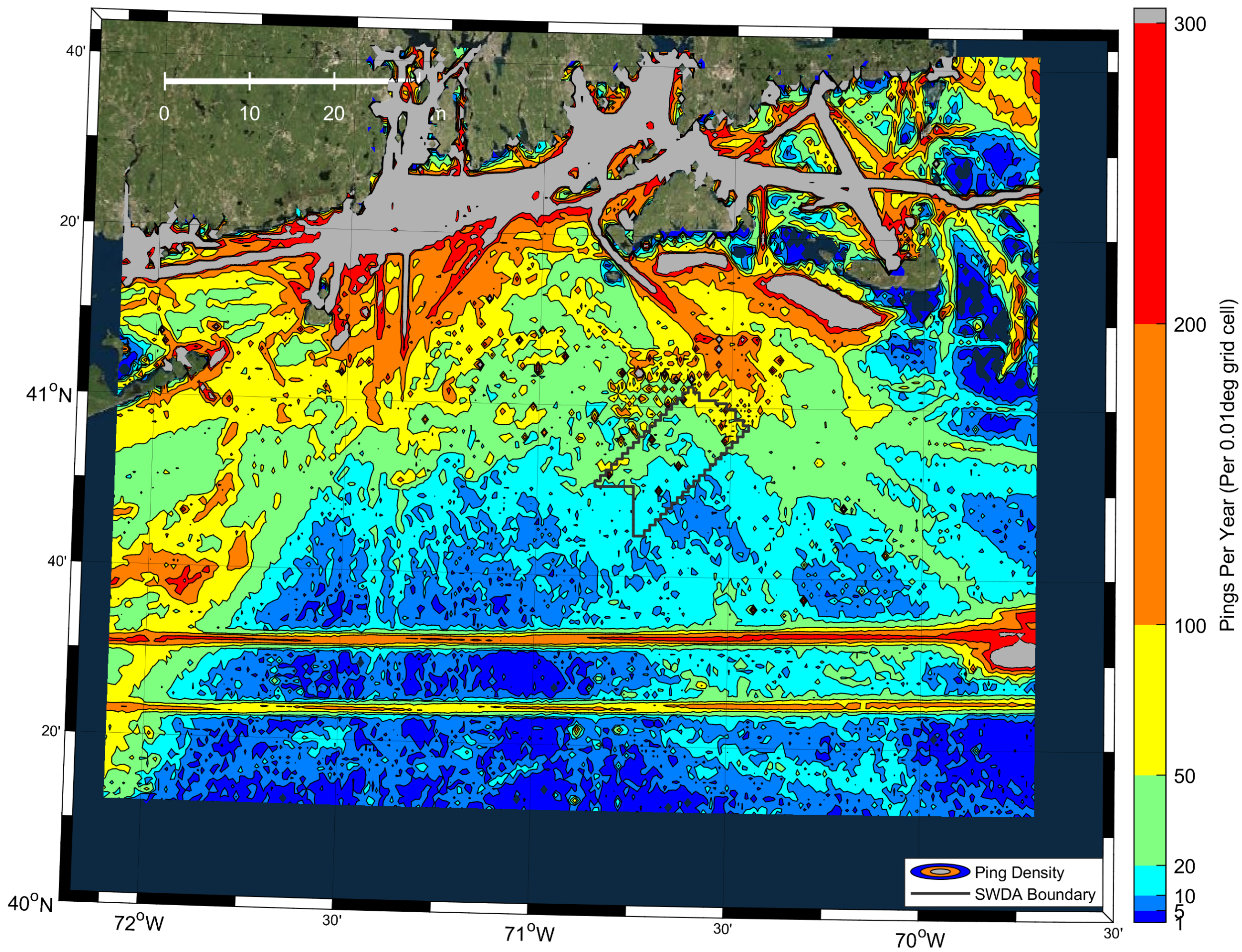

Figure 6.27: AIS Vessel Traffic Density for All Vessels

Traffic density for the largest vessels (passenger, cargo and tankers) that have transited through the SWDA is presented in Figure 6.28. The relative traffic density within the SWDA is low compared to the surrounding region. The large commercial vessels generally transit south and west of the SWDA.

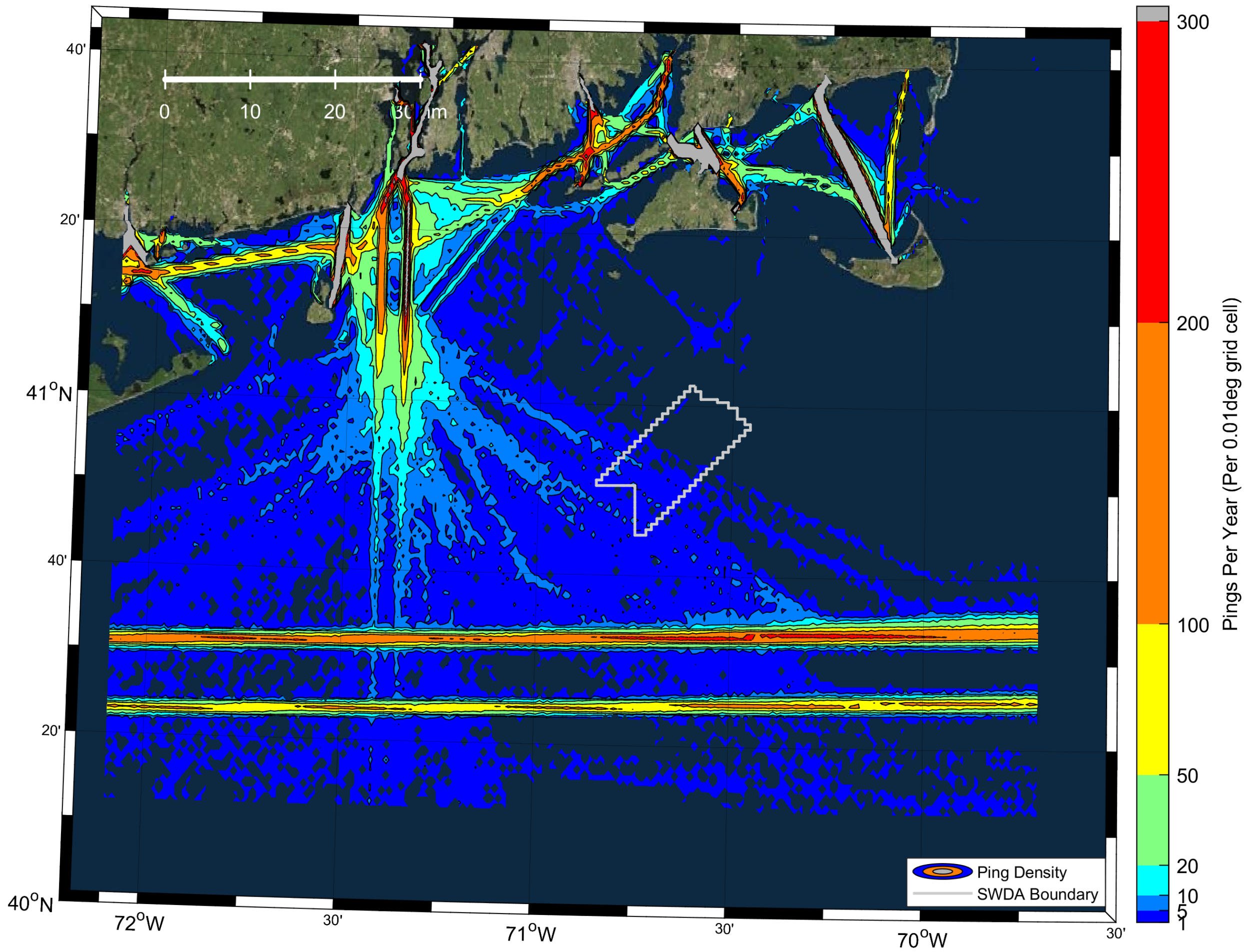

Figure 6.28: AIS Vessel Traffic Density for Passenger, Cargo and Tanker Vessels

Traffic density for transiting fishing vessels in the region is presented in Figure 6.29. The relative traffic density within the SWDA is lower than the surrounding region with the highest transiting density through the northeast section of SWDA with the vessel traffic along a northwest-southeast corridor.

Traffic density for trawling fishing vessels in the region is presented in Figure 6.30. The relative traffic density within the SWDA is lower than the surrounding region with the highest trawling density to the northeast of the SWDA.

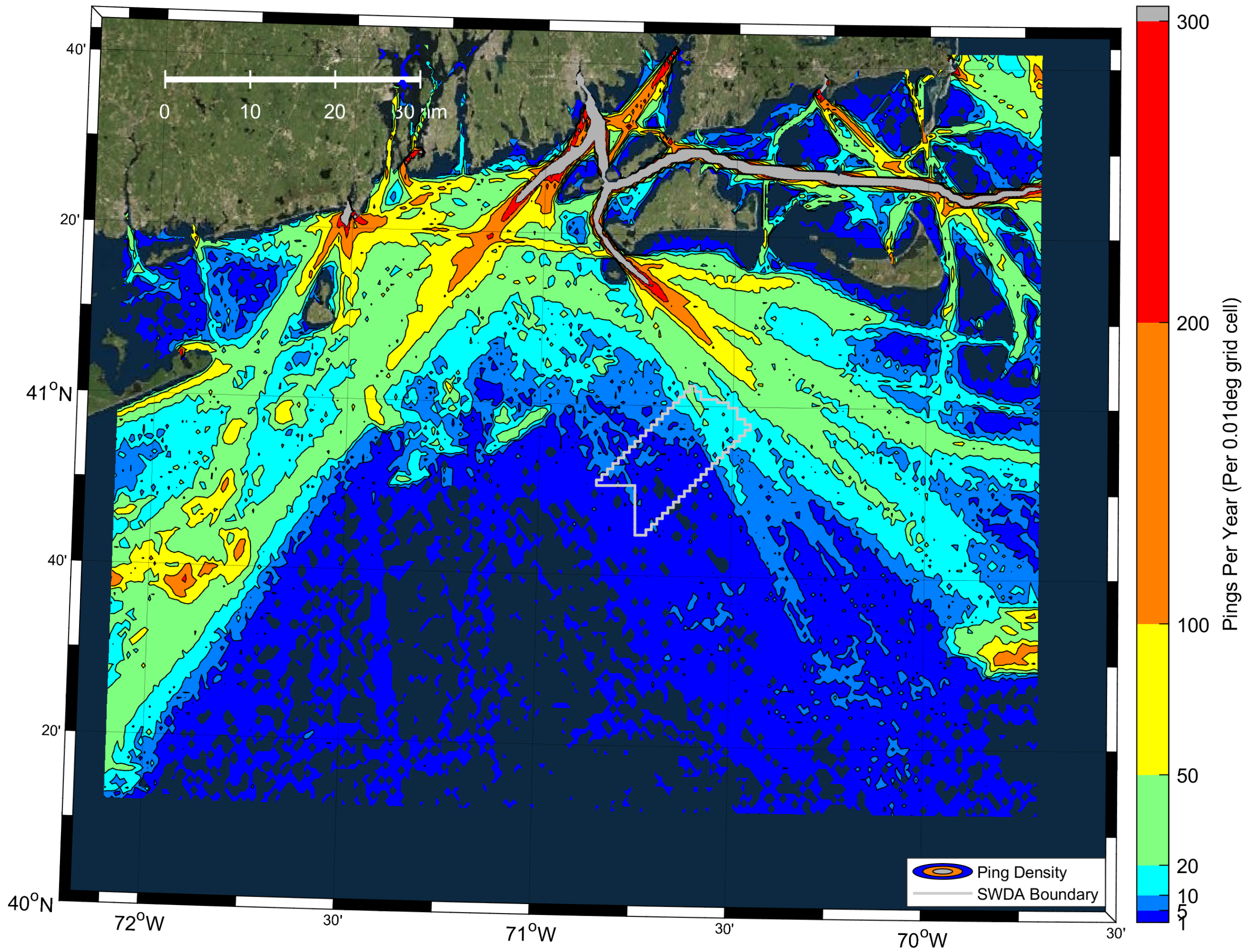

Figure 6.29: AIS Vessel Traffic Density for Transiting Fishing Vessels (> 4 knots)

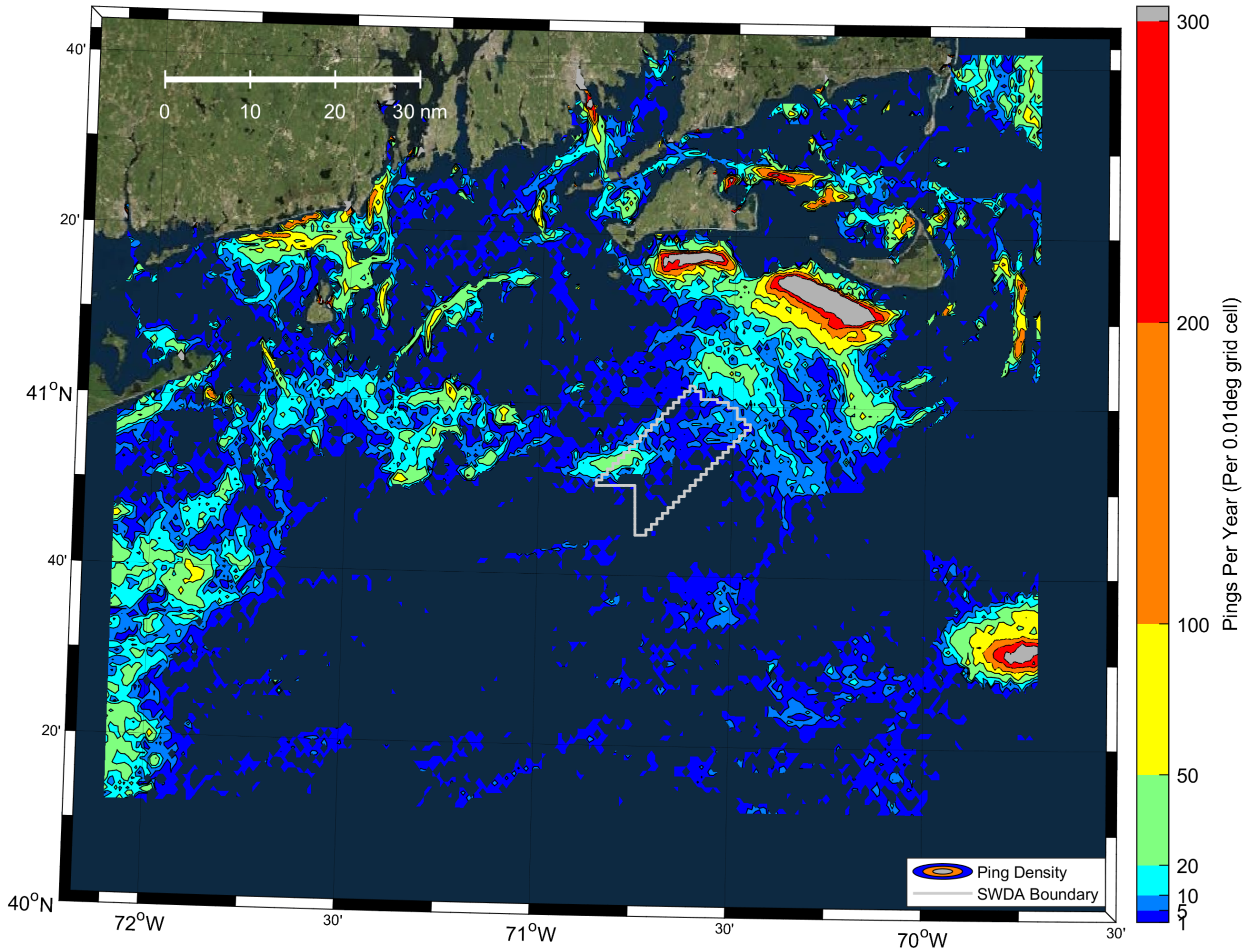

Figure 6.30: AIS Vessel Traffic Density for Trawling Fishing Vessels (< 4 knots)

6.5 Recreational and Sailing Traffic

6.5.1 Fleet Mix (Excluding Naval Sail Training Vessels)

A cumulative total of 330 unique recreational and sailing vessels of various types transited through the SWDA during the four-year AIS data record. This vessel list excludes naval sail training vessels; NRP SAGRES and CGC EAGLE vessels that are registered to navies and militaries but are reporting as AIS code 36 for sailing vessels. Those vessels are reported in Table 6.14 summarizes the vessel details for the 10 largest (LOA) recreational and sailing vessels that transited through the SWDA. A histogram of vessel length is presented in Figure 6.31 with the vessels typically 45 to 60 ft (13 to 18 m), and a small number of vessels 150 ft (45 m) LOA or longer. It is noted that many sailing and recreational vessels, particularly smaller vessels, either do not carry AIS transceivers or transmit at lower power levels which may not be captured in the dataset.

Figure 6.32 presents a plot of all recreational vessel tracks which indicates that vessels tracks were distributed throughout the SWDA typically along northwest-southeast, and north-south tracks. Figure 6.33 provides a map of recreational vessel traffic density from the Northeast Ocean Data portal. This map illustrates that the major recreational transit routes occur outside the SWDA.

Table 6.14: Vessel Details – 10 Largest Recreational and Sailing Vessels Transiting the SWDA

Vessel Name	AIS Code	MMSI Number	IMO Number	LOA (ft)	LOA (m)	Beam (ft)	Beam (m)
FOUNTAINHEAD	37	319028096	1010753	279	85	49	15
ADIX	36	232398000	1000150	210	64	26	8
LADY BRITT	37	319593984	1011056	207	63	36	11
ROCK.IT	37	319072896	1012347	200	61	36	11
HAMPSHIRE	37	319662016	1006881	197	60	33	10
BLUE MOON	37	319984000	1008360	197	60	36	11
ROSEHEARTY	36	235011232	8995926	184	56	33	10
MADSUMMER	37	319304000	1008413	180	55	33	10
HONEY	37	319251008	9423401	164	50	33	10
COMPASS ROSE	37	367500256	-	161	49	39	12

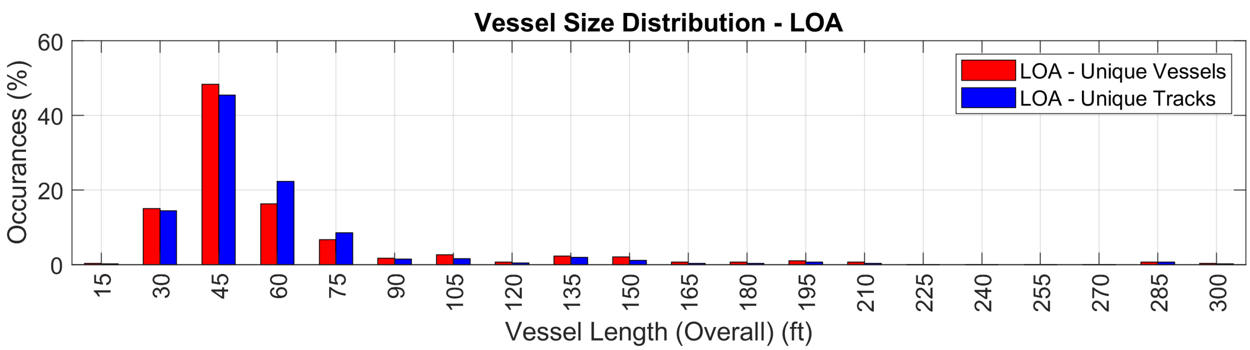

Figure 6.31: Histogram of Recreational and Sailing Vessel Size (LOA) Transiting Through the SWDA

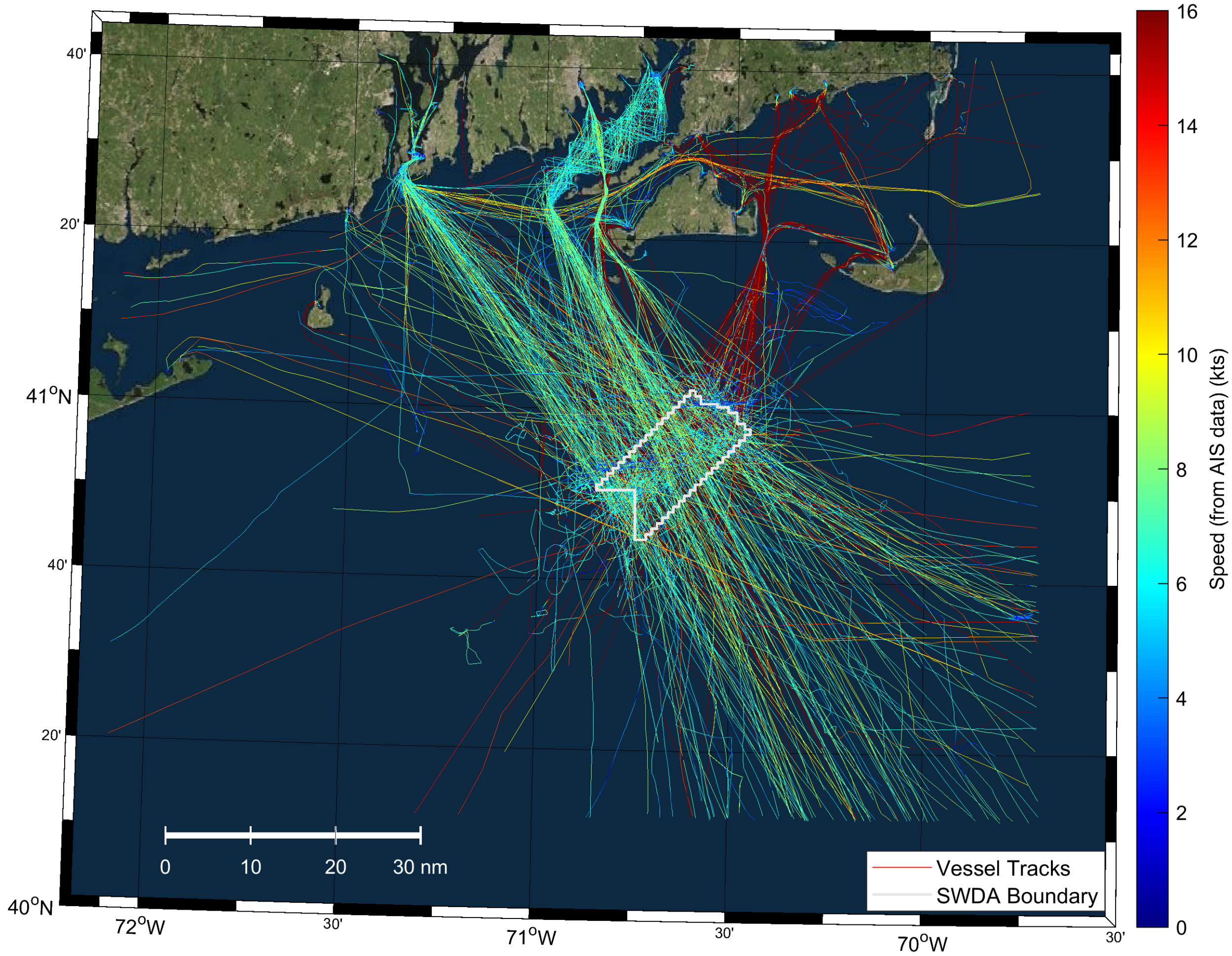

Figure 6.32: Recreational and Sailing Vessel Tracks Through the SWDA

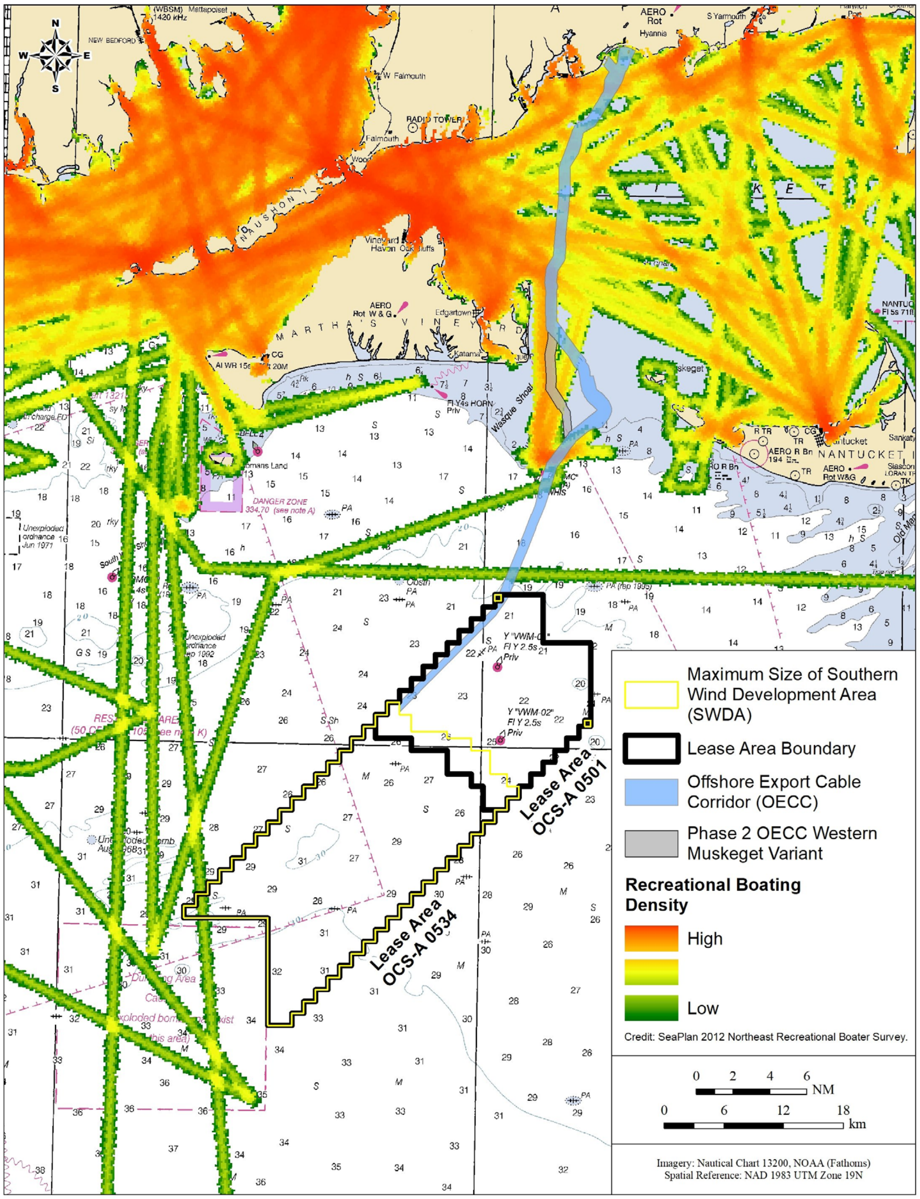

Figure 6.33: Recreational Boater Density (Source: Northeast Ocean Data Portal)

Vessel transit routes for sailing and recreational vessels were investigated based on track density analyzed within the SWDA and the surrounding area. Figure 6.34 presents the vessel track density for sailing and recreational vessels across the AIS data coverage area (see Table 6.1). The traffic density through the SWDA is lower than the surrounding region. Although Figure 6.32 indicates that the recreational vessels traffic is higher than many commercial vessel types, the tracks for the sailing and recreational vessels do not follow consistent transit consistent routes and corridors. It is noted that many sailing and recreational vessels, particularly smaller vessels, either do not carry AIS transceivers or transmit at lower power levels which may not be captured in the dataset.

Figure 6.35 shows the routes for the major sailing races that could potentially interact with the SWDA. Note that the routes shown are generally straight lines between origin and destination and do not necessarily reflect the path of a sailing vessel. The routes that potentially interact with the SWDA include:

- The Corinthians race between Stonington, CT and Boothay, ME.
- The Marion to Bermuda race between Marion, MA and St. David's Head, Bermuda
- The Atlantic Ocean leg of the Volvo Ocean Race.

All three of these races cover long distances, and a diversion around the SWDA would not add appreciably to travel time. The Newport to Bermuda race straight-line path also lies just southwest of the SWDA.

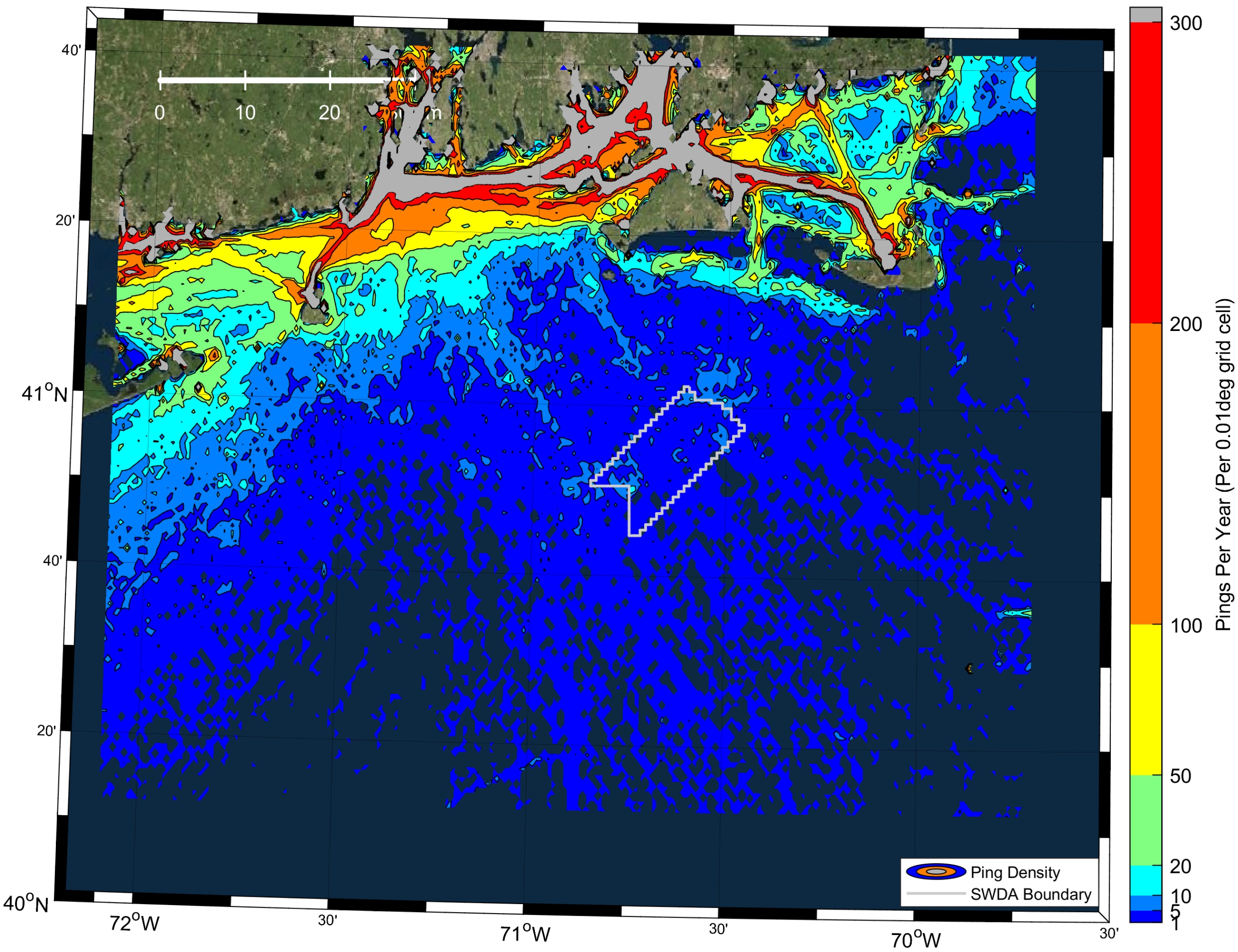

Figure 6.34: AIS Vessel Traffic Density for Recreational and Sailing Vessels

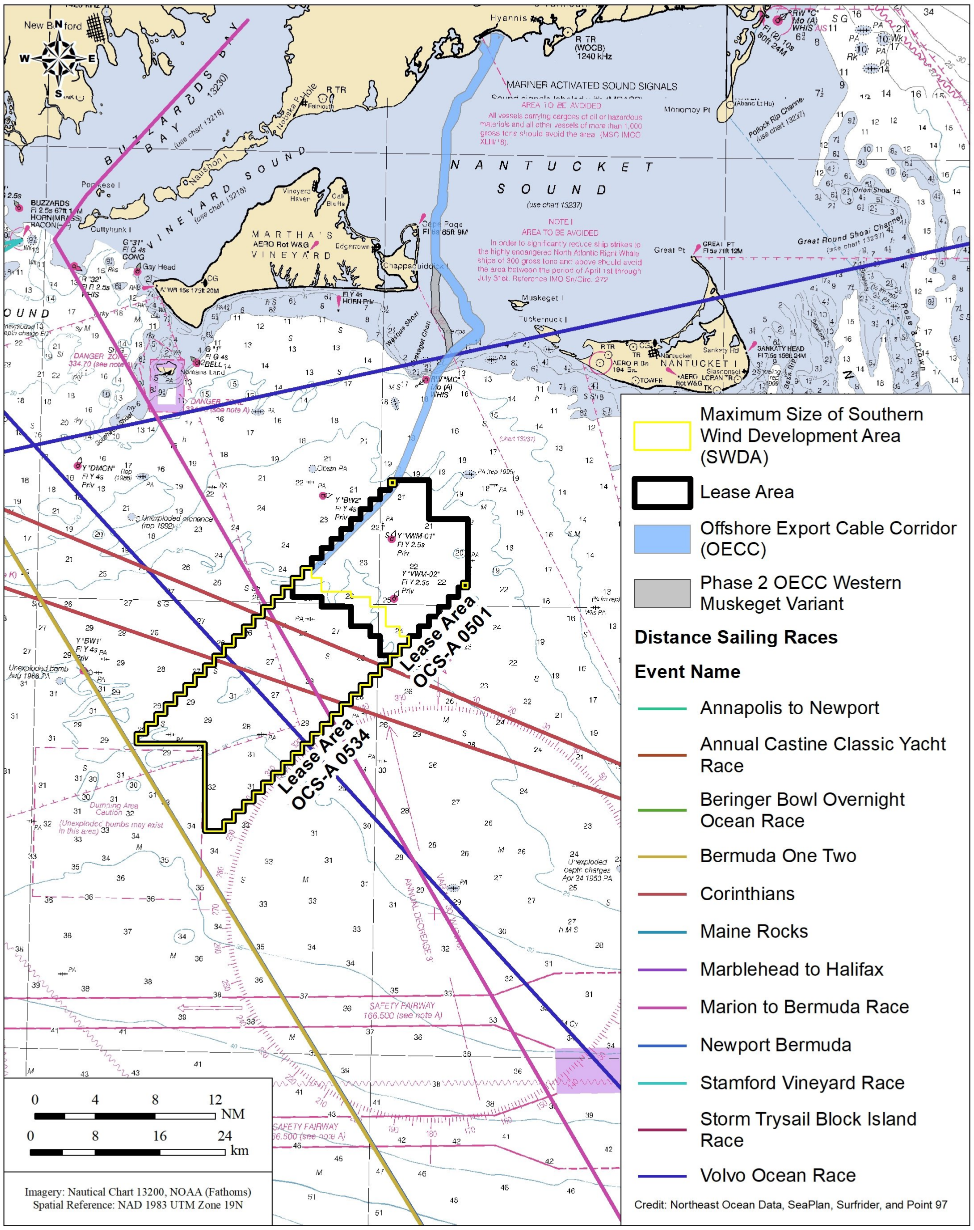

Figure 6.35: Major New England Sailing Races (Source: Northeast Ocean Data, published by the Northeast Regional Ocean Council)

6.5.2 Fleet Mix – Naval Sail Training Vessels

The AIS data between 2016 to 2019 included two tracks from large, naval sail training vessels; NRP SAGRES and CGC EAGLE that are registered to navies and militaries but are reporting as AIS code 36 for sailing vessels. Those two vessels are large, and their details are presented in Table 6.15. Figure 6.36 presents a track plot for the NRP SAGRES and CGC EAGLE. The two vessels transited all the southern edge of the SWDA and appeared to be sailing between port and deep water.

Table 6.15: Vessel Details – Two Naval Sail Training Vessels that Transited the SWDA

Vessel Name	AIS Code	MMSI Number	IMO Number	LOA (ft)	LOA (m)	Beam (ft)	Beam (m)
NRP SAGRES	36	263140992	0	295	90	79	24
CGC EAGLE	36	303990016	0	292	89	39	12

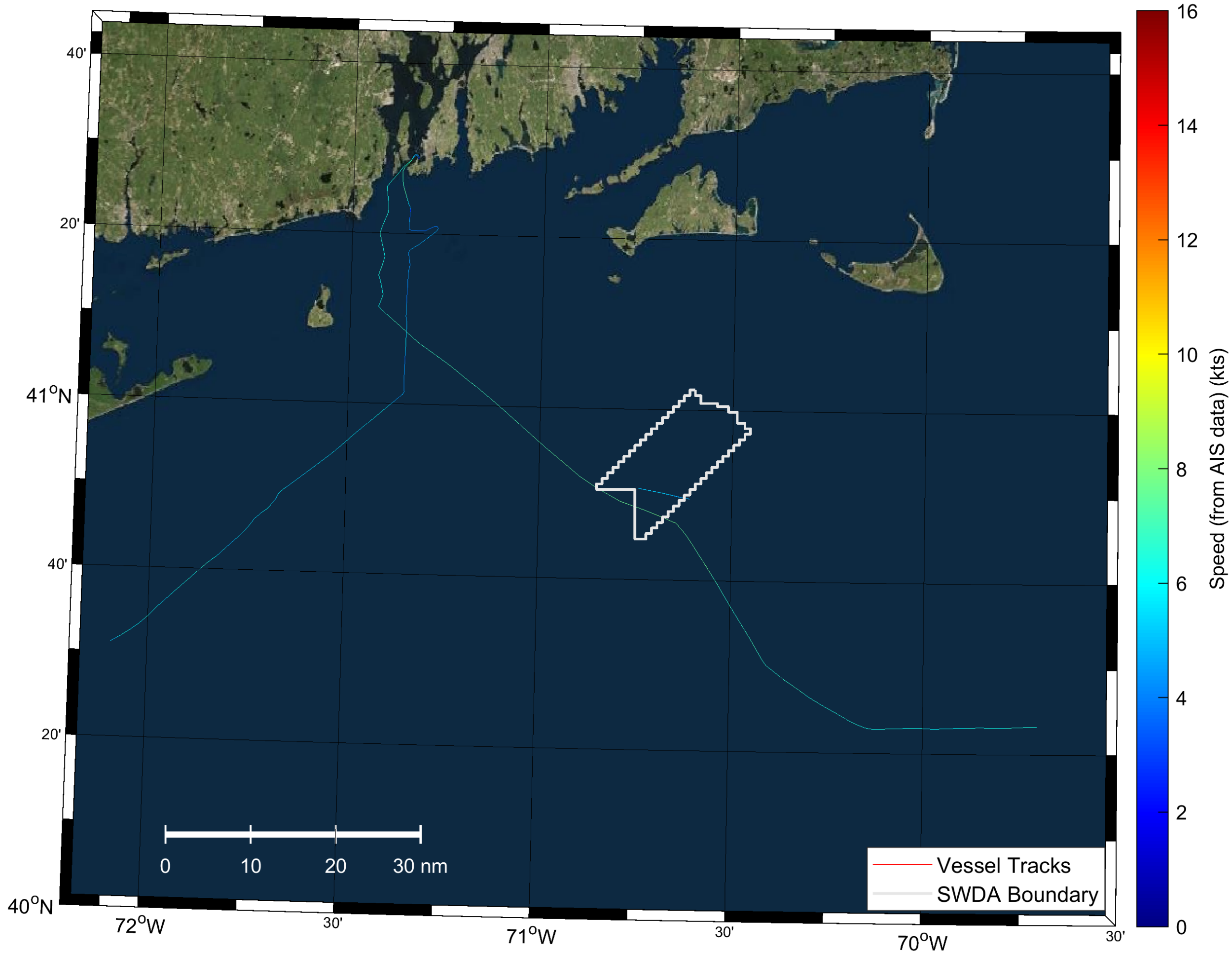

Figure 6.36: Naval Sail Training Vessel Tracks Through the SWDA

6.5.3 Port of Transit (to/from)

The ports / marinas that recreational vessels (entering the SWDA) are transiting to and from has been analyzed. Based on the 4-years of data, the most common port that recreational vessel tracks originate and finish at has been assessed for each unique vessel and is presented in Figure 6.37. The most common ports of transit for recreational vessels that tracked through the SWDA are Newport and New Bedford. A limitation of this analysis is that only port and marina locations within the AIS data coverage area (see Table 6.1) have been assessed.

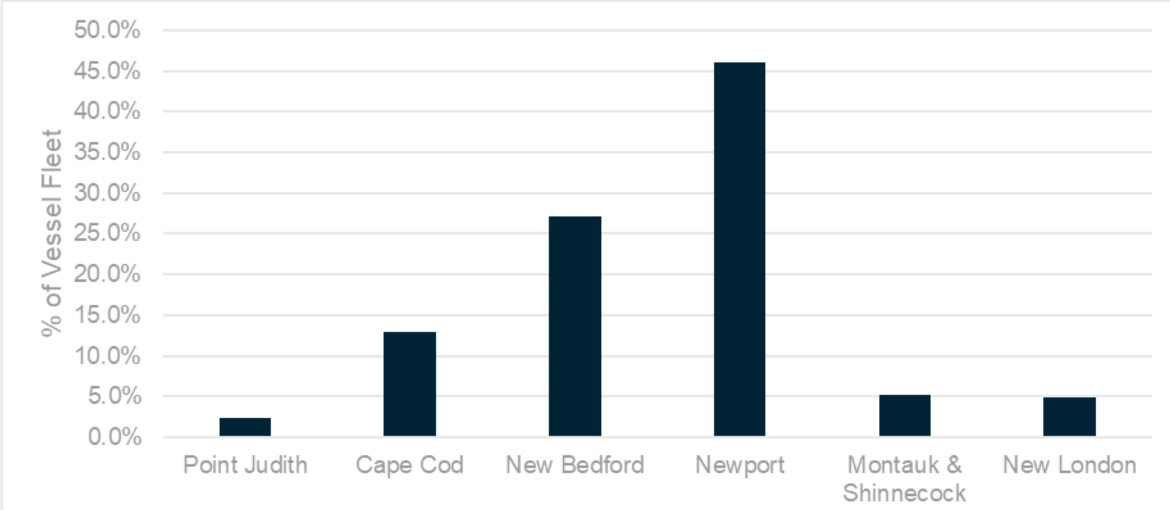

Figure 6.37: Most Common Port of Transit for All Recreational Vessels that Enter the SWDA

6.6 Vessel Proximity Analysis

6.6.1 Vessels within the SWDA

The AIS data from 2016 to 2019 has been analyzed to assess the vessel proximity and vessel density within the SWDA. Analysis of the AIS data set indicated that the time interval between consecutive data points captured in the dataset for maneuvering vessels was typically 3 to 5 minutes but could be up to 10 to 15 minutes on some occasions. As a result, the vessel proximity analysis for the SWDA utilized a 15-minute time interval to assess the number of all vessels maneuvering within the SWDA (including < 4 knots). It is important to note that the vessel proximity analysis is reporting the closest proximity for two AIS equipped vessels within a 15-minute window and it is likely that the calculated closest proximity of vessels is from AIS data pings that were transmitted at different times within that particular 15-minute window. It is also possible that two vessels transited closer to each other along their respective tracks at a time when one or neither vessel reported a position through their AIS transmitter.

In this analysis, the number of unique vessels found within the confines of the SWDA was counted over each 15-minute time interval in the 4-year data set. The analysis was completed based on all vessel types in the AIS dataset. Across the 4-year data set, the average cumulative time there were two or more unique AIS vessels in the SWDA was 124 hours per year. Figure 6.38 presents a histogram for the unique vessels in the SWDA. The maximum number of vessels in the SWDA was 14, occurring on 14 September 2016. The majority of vessels in the SWDA at that time were fishing vessels at speeds of less than 4-knots.

It should be noted that smaller vessels not equipped with AIS could be present in the analysis region and their interaction with other non-AIS and AIS vessels were not considered in this analysis. The available information on recreational vessels presented in Figure 6.33 and Figure 6.35 indicates that the SWDA is unlikely to have a high volume of recreational vessel traffic.

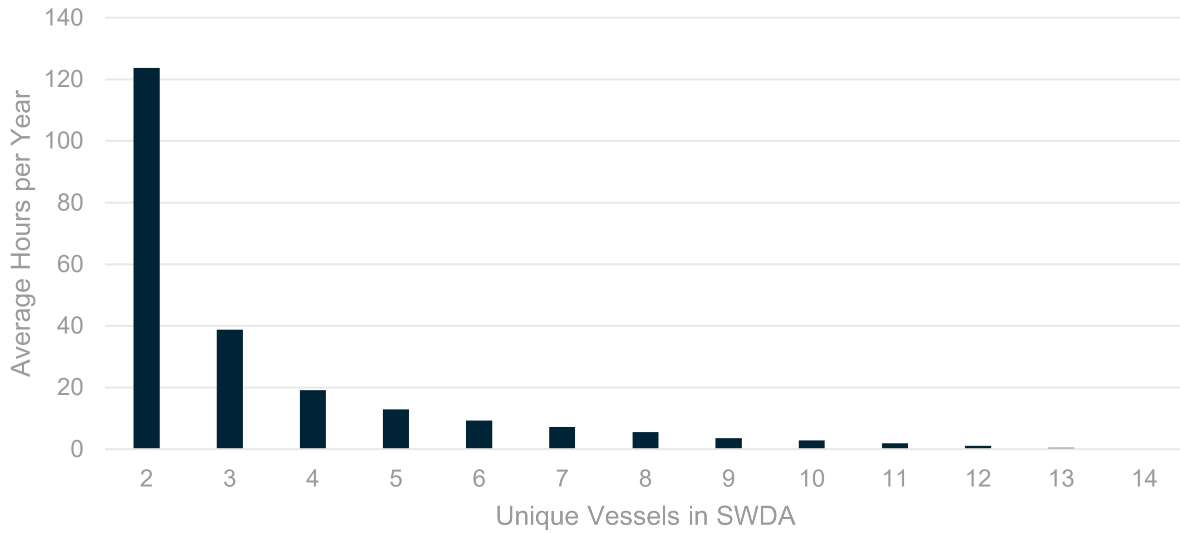

Figure 6.38: Histogram of Unique Vessels in SWDA per Year

6.7 Vessel Traffic in the OECC

As noted in Section 2.4, four or five offshore export cables will be used to transmit electricity generated by the WTGs in both Phase 1 and Phase 2 to onshore transmission systems in the Town of Barnstable, Massachusetts. Of these offshore export cables, two will transmit electricity from the Phase 1 ESP(s), and two or three cables will transmit electricity from the Phase 2 ESP(s).

These Phase 1 and Phase 2 offshore export cables will be installed within the Offshore Export Cable Corridor (OECC) shown in Figure 1.1 and will be buried beneath the seafloor at a target depth of 5 to 8 ft (1.5 to 2.5 m). If detailed engineering or other technical issues arise demonstrating that installation of all Phase 2 cables within a portion of the OECC in the Muskeget Channel area is not feasible, the Proponent would exercise the option to install one or two Phase 2 offshore export cables within the Phase 2 OECC Western Muskeget Variant.

An AIS data analysis was carried out for both the OECC and the Phase 2 OECC Western Muskeget Variant to evaluate the location and frequency of vessel crossings.

6.7.1 Offshore Export Cable Corridor (OECC)

Figure 6.39 shows the tracks of the vessel crossings distinguished by speed of the vessel, while Figure 6.40 gives a vessel traffic density map for the OECC. Most of the vessel crossing traffic occurs between Martha’s Vineyard and the mainland of Cape Cod. Overall, vessel traffic density along the OECC is relatively low, with the highest concentration of traffic midway through Nantucket Sound.

Table 6.16 summarizes the vessels that have crossed the OECC by year and type for the 2016 to 2019 period. The majority of the vessels were either fishing or recreational.

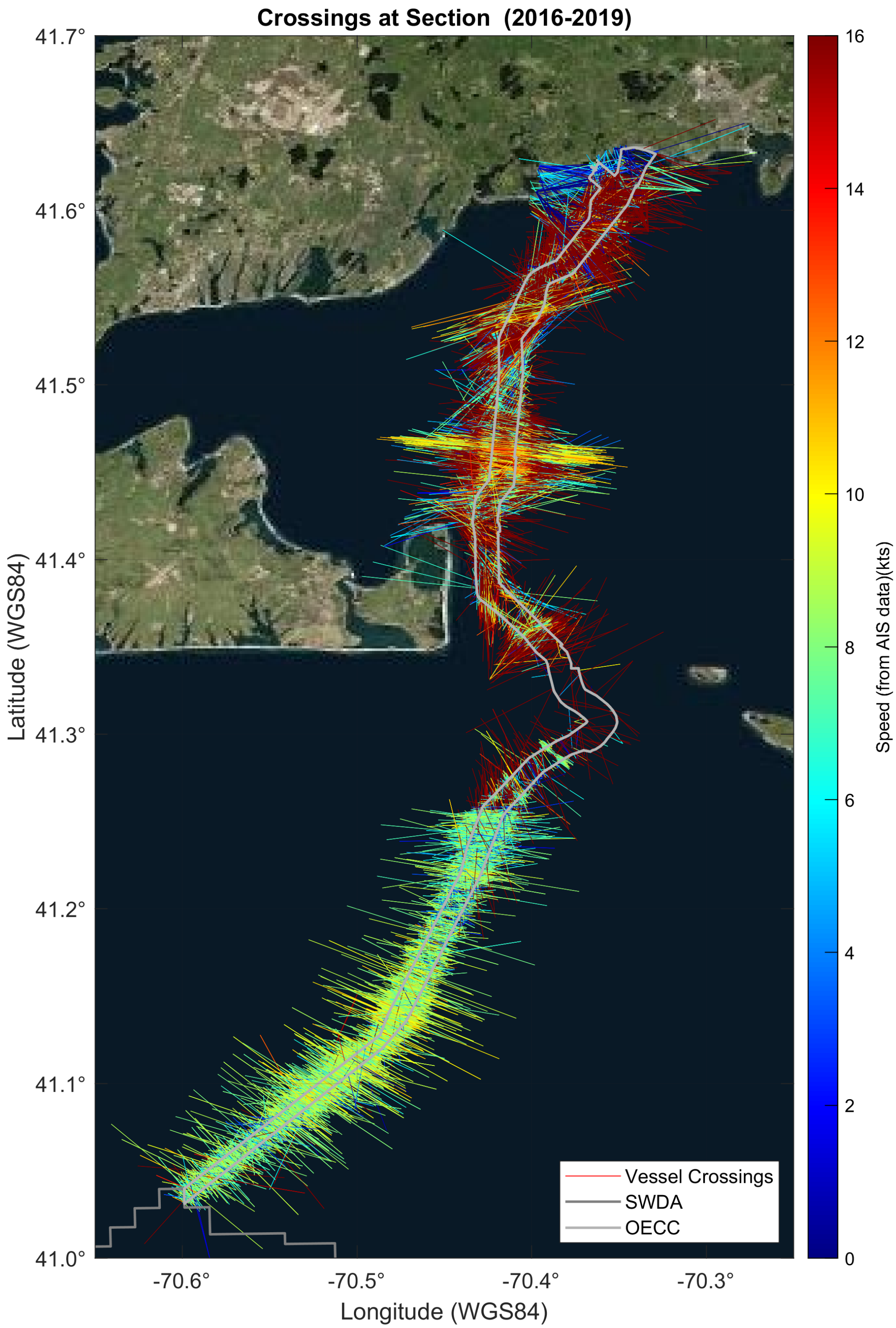

Figure 6.39: Vessel Tracks for Vessels Crossing the OECC

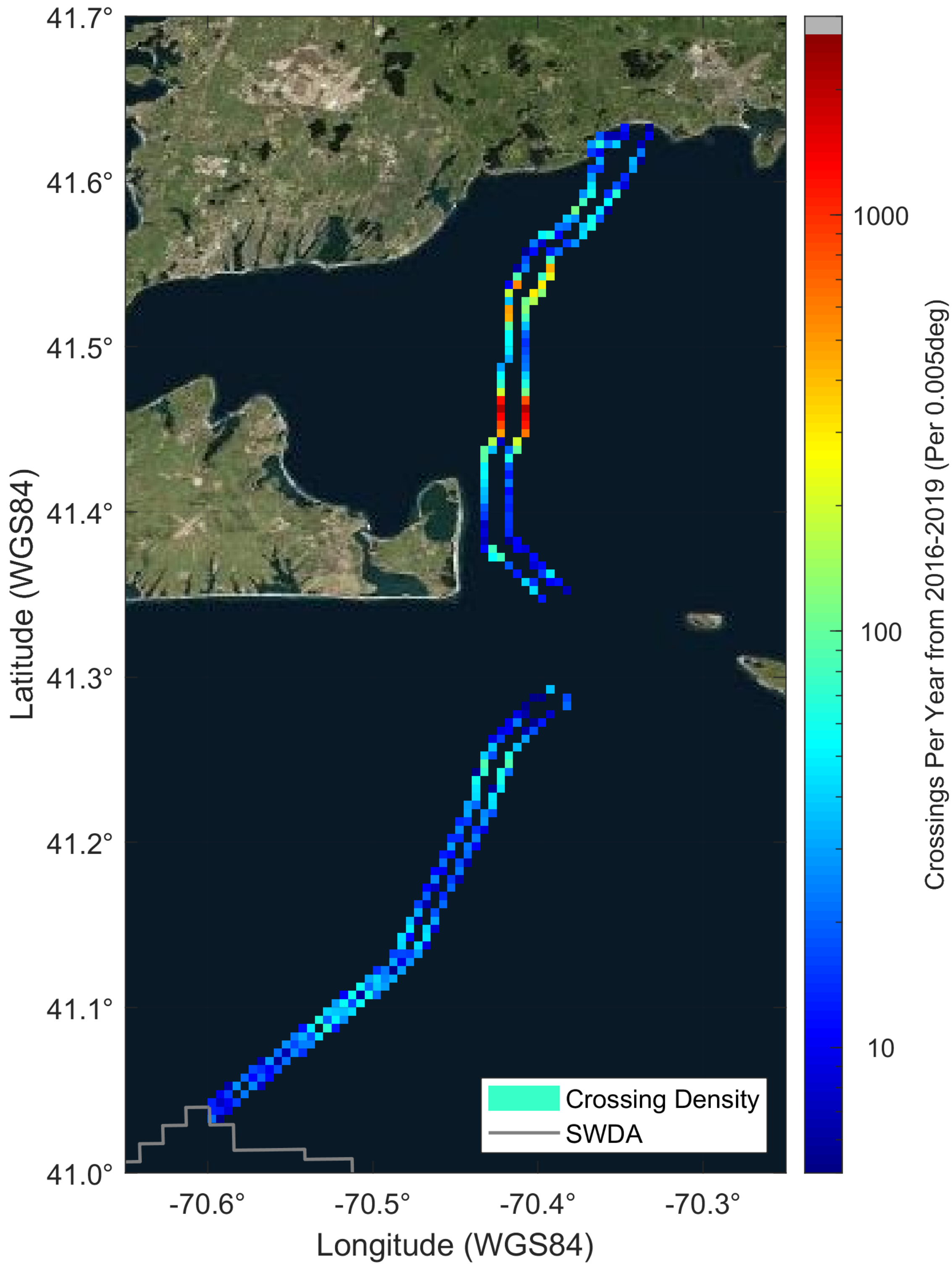

Figure 6.40: Vessel Traffic Density Map for Vessels Crossing the OECC

Table 6.16: OECC Vessel Crossings by Type and Year

Vessel Type	2016	2017	2018	2019
Fishing	10402	10674	9459	10277
Passenger	1223	334	383	904
Cargo	8	14	34	14
Tanker	0	8	52	82
Recreational	6252	8313	8567	8625
Military	589	569	738	583
Tug-Tow	602	915	846	786
Other	3857	5800	5393	5228
Total	**22933**	**26627**	**25472**	**26499**
Avg. Crossings per Day	**63**	**73**	**70**	**73**

6.7.2 Phase 2 OECC Western Muskeget Variant

Figure 6.41 shows the tracks of the vessel crossings distinguished by speed of the vessel, while Figure 6.42 gives a vessel traffic density map for the Phase 2 OECC Western Muskeget Variant. The patterns are largely similar to those of the OECC crossings, in that most of the vessel crossing traffic occurs between Martha's Vineyard and the mainland of Cape Cod. On average, the number of daily vessel crossings does not change compared to the OECC and the total number of crossings estimated over the 2016 to 2019 period changes by less than one percent.

Overall, vessel traffic density along the Phase 2 OECC Western Muskeget Variant is relatively low, with the highest concentration of traffic midway through Nantucket Sound. Table 6.17 summarizes the vessels that have crossed the Phase 2 OECC Western Muskeget Variant by year and type for the 2016 to 2019 period. The majority of the vessels were either fishing or recreational.

Table 6.17: Phase 2 OECC Western Muskeget Variant Vessel Crossings by Type and Year

Vessel Type	2016	2017	2018	2019
Fishing	10412	10624	9491	10271
Passenger	1223	334	383	904
Cargo	8	14	34	14
Tanker	0	8	52	82
Recreational	6371	8491	8635	8812
Military	591	573	746	585
Tug-Tow	602	913	846	786
Other	3906	5796	5375	5187
Total	**23113**	**26753**	**25562**	**26641**
Avg. Crossings per Day	**63**	**73**	**70**	**73**

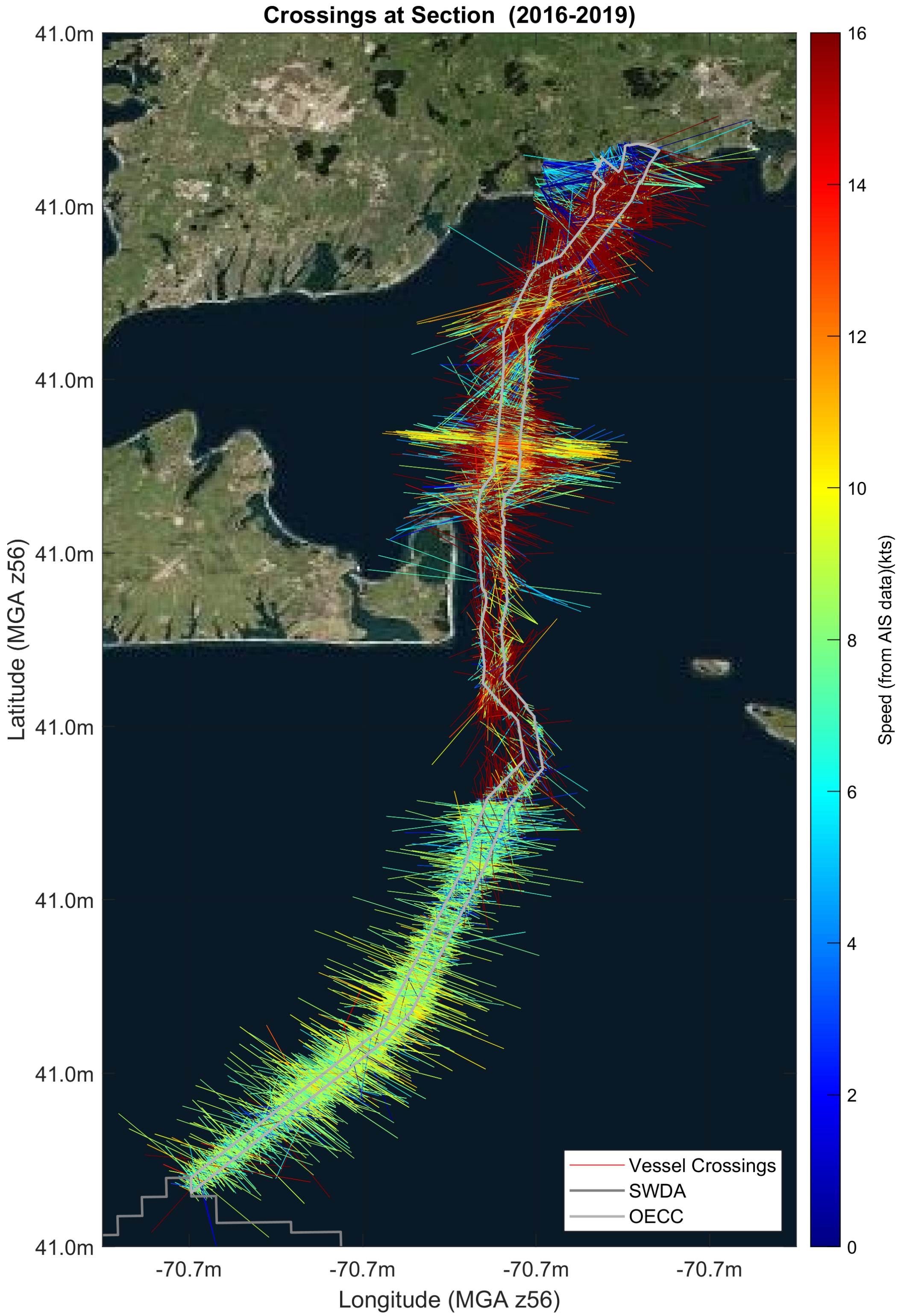

Figure 6.41: Vessel Tracks for Vessels Crossing the Phase 2 OECC Western Muskeget Variant

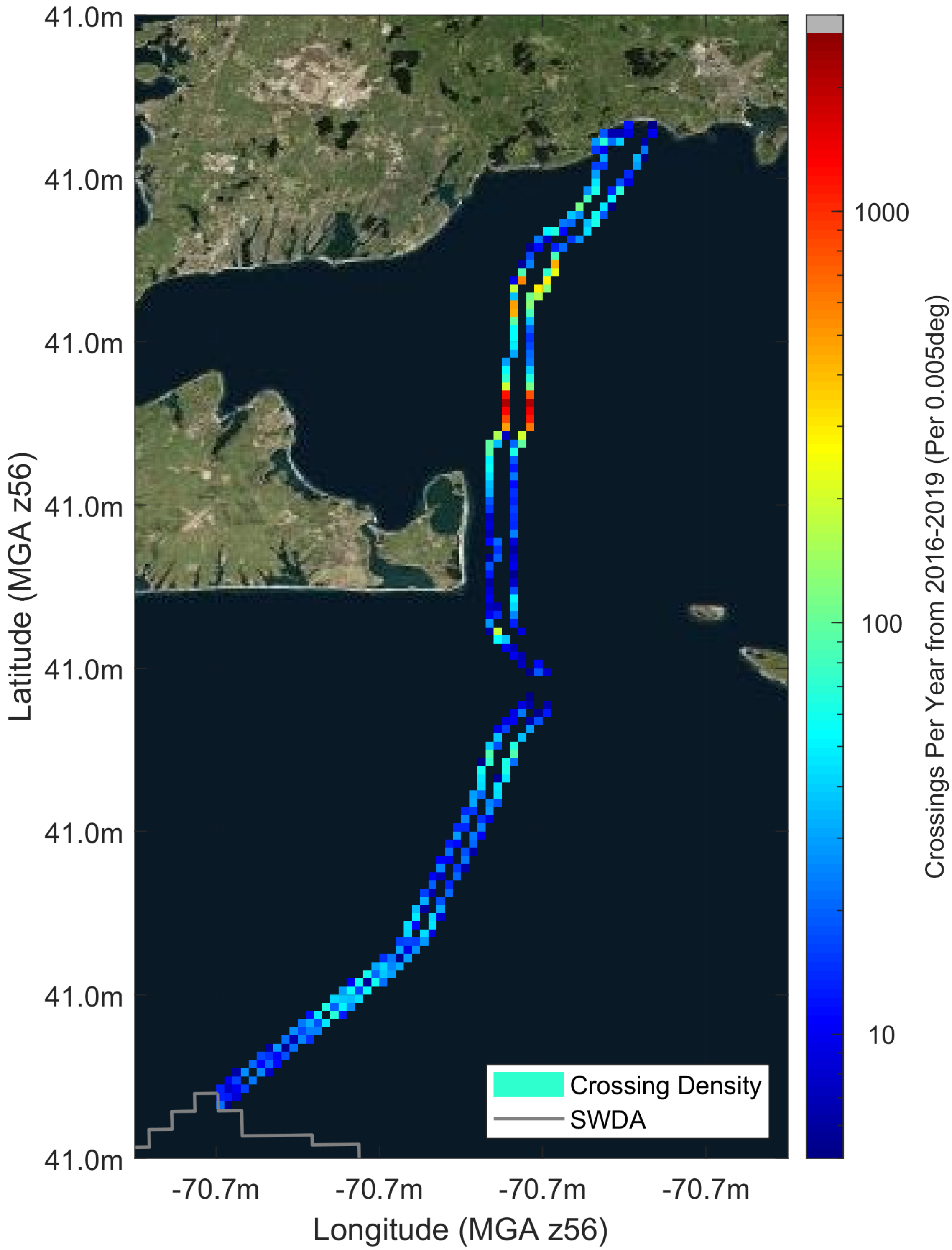

Figure 6.42: Vessel Traffic Density Map for Vessels Crossing the Phase 2 OECC Western Muskeget Variant

6.8 Summary

The data and analysis in this section have highlighted that fishing vessels are the most frequent vessels that transit through the SWDA; however, fishing vessel traffic levels are relatively low. Based on the AIS data, the total vessel traffic time in the SWDA is 581 hours per year (i.e., an AIS equipped vessel is present within the SWDA for 6.6% of the year) on average and for fishing vessel traffic that is AIS equipped the traffic time (transiting and trawling) is 341 hours per year (i.e., an AIS-equipped fishing vessel is present within the SWDA 3.9% of the time) on average. Overall, fishing vessels (transiting and trawling) represented 59% of total vessel traffic based on unique transits through the SWDA and recreational vessels account for 19% of unique transits.

Fishing vessels have a wide range of tracks through the SWDA with the most frequent transit directions along east to west tracks (and vis-versa), and east-northeast to west-southwest tracks (and vis-versa). Fishing vessels are typically 60 to 80 ft LOA, and there is likely to be a sample of fishing vessels less than 65 ft LOA, which transit through the SWDA but are not transmitting AIS data. Those vessels have been excluded from the detailed traffic analysis, but based on an assessment of the fishing vessel fleet at New Bedford and Point Judith, the AIS data is estimated to represent 40% to 60% of the fishing vessel traffic. The frequency and density of trawling activities within the SWDA is variable between years. It appears that during August and September 2016, the amount of trawling activities within the SWDA was high, and throughout 2016 over 500 unique tracks while vessels were trawling occurred. For the last 3-years, less than 100 unique tracks per year were observed in the AIS data set.

Recreational vessels transit the SWDA on a regular basis with an average of 174 unique transits per year through the SWDA over the 4-year data period. Most recreational vessels 30 to 60 ft (15 to 20 m) LOA. A small number of large motor and sailing recreational vessels greater than 200 ft LOA transit through the SWDA.

The likelihood of two or more AIS equipped vessels having intersecting transit courses through the SWDA is low, with only two or more vessels in the SWDA for 124 hours per year. The vessel proximity analysis included in this section has been adopted in the navigation risk model to assess the likelihood of collision potential within the SWDA for the current condition and the operations phase of the SWDA.

There is existing use of the waterway by larger commercial vessels including passenger, dry cargo and tanker vessels. Over a 4-year period, on average 103 of those vessels transited through the SWDA each year and with the typical vessel size of 600 ft (182 m) or greater.

7. Historical Emergency Response Activity

Search and rescue (SAR) activity may be affected by the proposed wind farm. This report section summarizes historical emergency SAR response activity by both the USCG operations and local commercial salvors.

7.1 Historical USCG SAR Operations

Historical USCG activity was compiled from two different references: (1) the Vineyard Wind 1 analysis and (2) the USCG (2020) MARIPARS analysis.

7.1.1 Vineyard Wind 1 Dataset

USCG SAR and pollutant incident data were compiled from the Marine Information for Safety and Law Enforcement (MISLE) database for an approximate 10-year period from June 2006 through September 2016. Though the search area for this analysis is not explicitly defined, Figure 7.1 shows the spatial positioning of the SAR incidents that were obtained in this dataset. The incidents range from Block Island, RI to (and including) portions of the Lease Areas OCS-A 0534 and OCS-A0501.

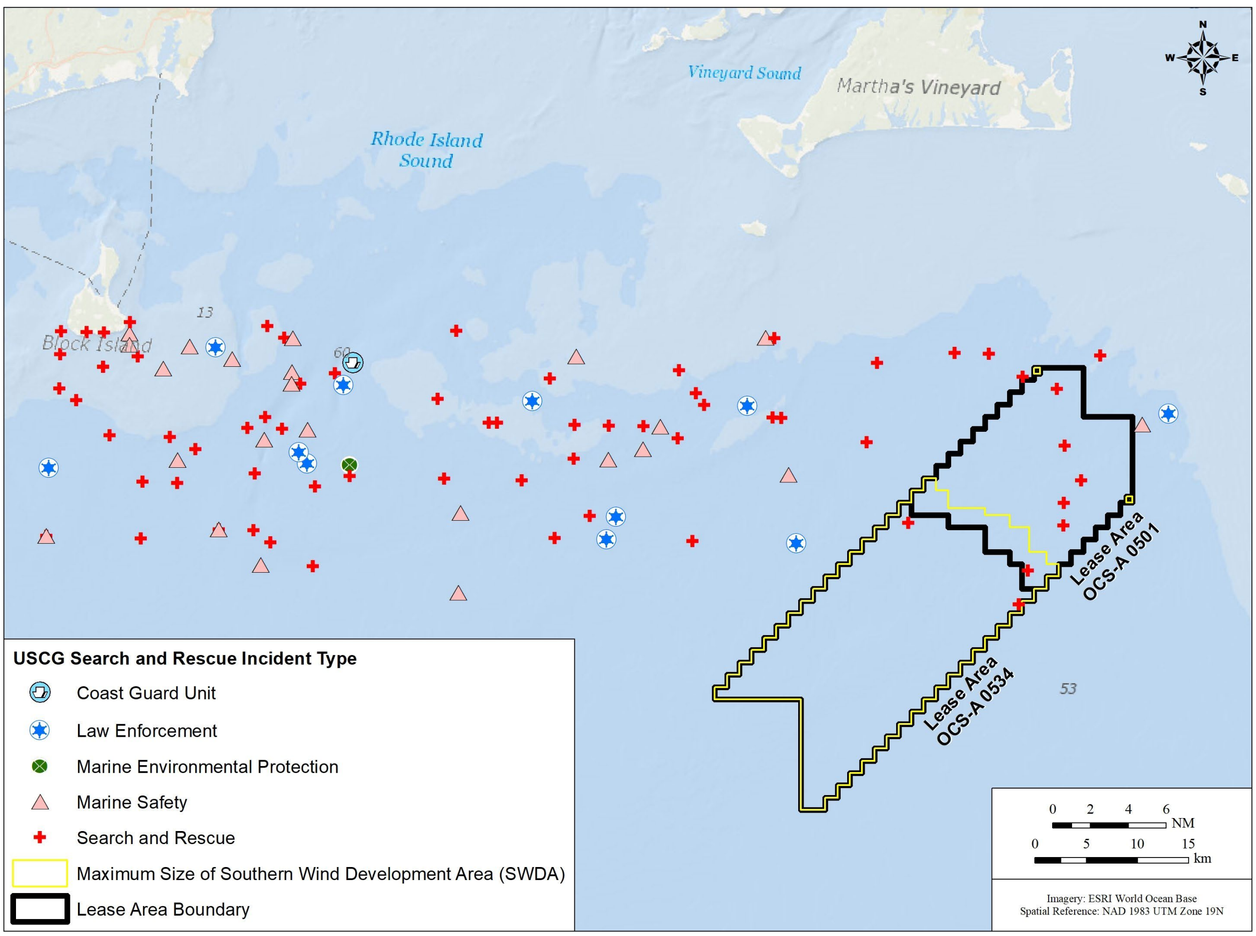

Figure 7.1: SAR and Pollutant Incident Data from MISLE Database (June 2006 – September 2016)

Over this time, 103 missions were carried out by the USCG. Of these 103 missions, 43% occurred during nighttime hours, while the remaining 57% occurred during daylight hours. Additionally, 65% of these missions were for SAR response, 11% were law enforcement, 1% were for marine environmental protection, 22% were for marine safety (equipment failures), and 1% were "Coast Guard Unit" (responding to incident on own vessels). Only 20 of the missions fell within a 10 NM (19 km) radius of the SWDA, and only 3% occurred within the SWDA. In total, SAR missions related to four collisions were recorded over this time, though they occurred farther than 10 NM (19 km) from the SWDA.

Within the SWDA and its immediate vicinity (defined as a 10 NM (19 km) radius), 20 incidents were reported over this 10-year period. Most of these were SAR missions, with some cases related to Marine Safety and Law Enforcement. Table 7.1 shows a breakdown of the cases by type.

Table 7.1: Incidents from MISLE Database within Lease Area OCS-A 0501 and Lease Area OCS-A 0534 (June 2006 – September 2016)

Category	Number of Incidents	Type
SAR	16	Disabled or distressed vessel
Marine Safety	2	Equipment failure
Law Enforcement	2	Personal conflict

A Freedom of Information Act (FOIA) request for more recent SAR data has been submitted to the USCG, and data covering the period from 2005 to 2020 are expected in the near future.

7.1.2 MARIPARS Analysis

Historical SAR data were analyzed by the USCG in the MARIPARS study within the vicinity of the MA WEA and RI/MA WEA for the period of 2005 through 2018. The search area of this analysis is shown in Figure 7.2. During this time, there were approximately 9.5 incidents annually, on average. In total, 133 separate incidents occurred over this time.

Table 7.2 summarizes the breakdown of the incidents by year, Table 7.3 summarizes the incidents by type, and Figure 7.2 shows the search area and spatial positioning of the SAR incidents.

It is important to note that this set of USCG SAR data represents only incidents that originated within the search area shown in Figure 7.2. The incidents do not reflect responding USCG assets that transit through the MA WEA and/or RI/MA WEA to reach a SAR location, SAR cases that drift into the confines of the MA WEA and/or RI/MA WEA, or subjects of SAR cases which are towed or otherwise transported through the MA WEA and/or RI/MA WEA. No collisions were reported to have occurred within the search area for the analyzed review period.

A portion of the SWDA is within the USCG's enhanced digital selective calling (DSC) VHF (Rescue 21) coverage area as shown in Figure 7.3. The Rescue 21 system uses DSC system to improve USCG response for vessels generally within 20 miles of the coastline (based on site distance radio horizon with transceiver 2 m above sea level). The system sends an automated digital distress alert containing the vessels Maritime Mobile Service Identity (MMSI) number, position (if interfaced with GPS), and the nature of distress to other DSC-equipped vessels and rescue facilities. This allows USCG to respond more quickly and accurately to reported incidents or emergencies.

Table 7.2: Number of SAR Incidents by Year

Year	Number of SAR Incidents
2005	8
2006	11
2007	12
2008	5
2009	12
2010	3
2011	9
2012	10
2013	9
2014	8
2015	7
2016	15
2017	16
2018	8
Total	**133**

Table 7.3: Number of SAR Incidents by Type

Incident Type	Number of SAR Incidents
Disabled Vessel	45
Distress Alert (needs assistance, but not in immediate danger)	21
MEDEVAC	16
Taking on Water	13
MEDICO	9
Fire	6
Uncorrelated MAYDAY (hoaxes)	4
Unreported Vessel / Overdue Vessel	10
Capsized Vessel	3
MAYDAY Broadcast (international radio distress signal)	3
Beset by Weather (unable to move or maneuver under its own power because of weather)	2
Lost / Disoriented Vessel	1
Total	**133**

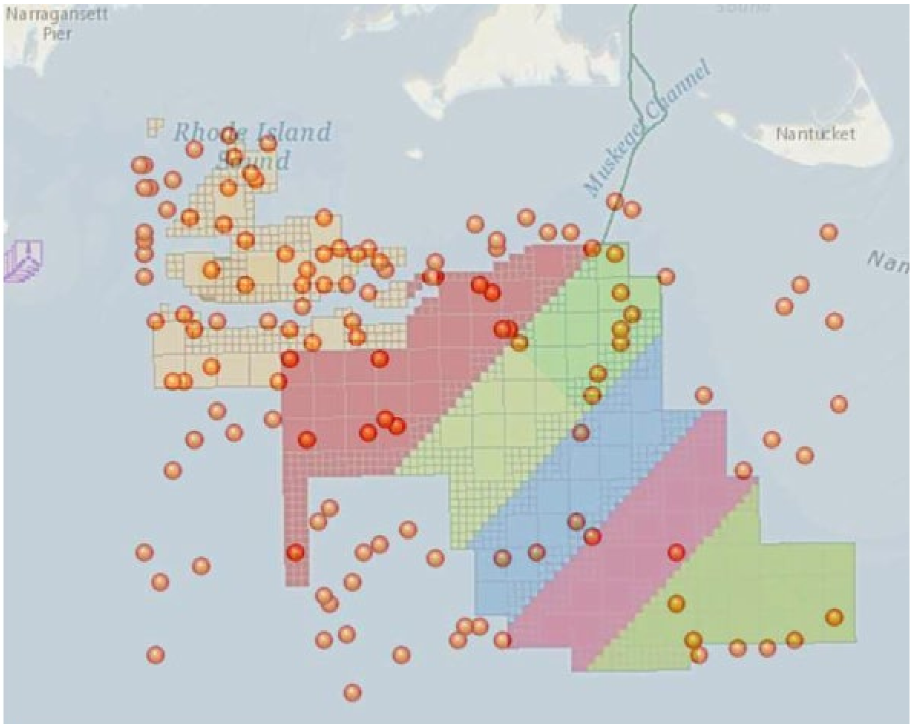

Figure 7.2: Search Area used for USCG SAR data (image from USCG, 2020)

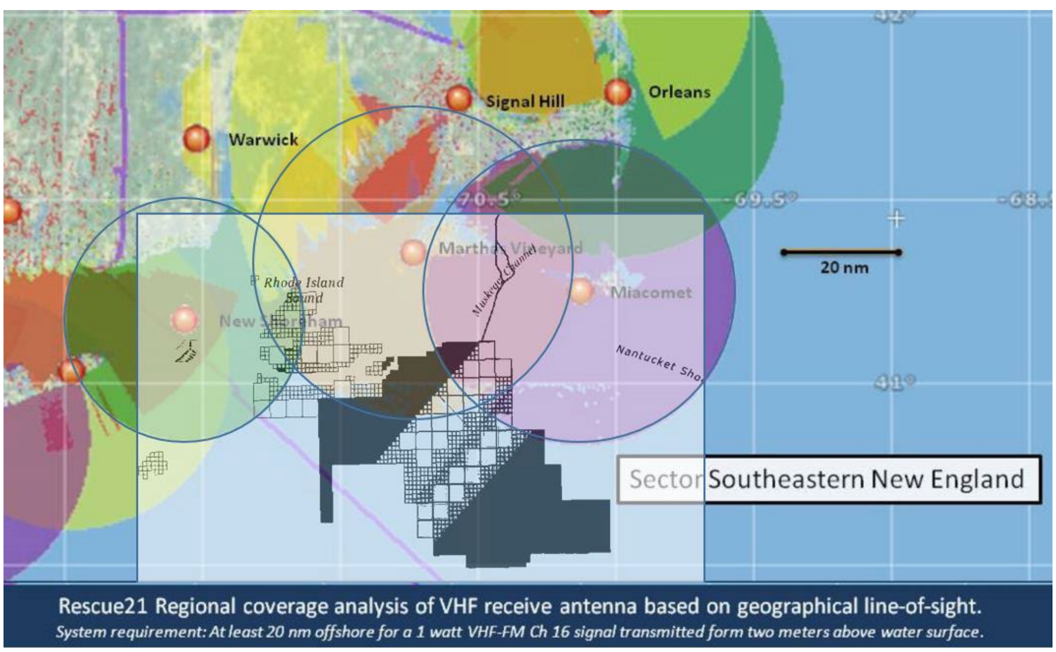

Figure 7.3: USCG Rescue 21 Coverage Areas (image from MARIPARS)

7.2 Historical USCG MER Operations

The USCG MISLE database includes spill and environmental pollution incidents and responses in the region. Based on the 2006 to 2016 analysis of the data for Vineyard Wind 1, no marine environmental response (MER) activities occurred within the SWDA during this time period. However, within the broader region of the MA WEA and RI/MA WEA there was one MER reported approximately 33 miles (53 km) west of the SWDA in 2011. There were 300 spill and environmental pollution incidents occurring during this time period in nearby ports and harbors of Narragansett Bay and Buzzards Bay including New Bedford, Providence, and Fall River. Historically there have been larger liquid cargo spills in the region including the M/V World Prodigy incident in 1989 which spilled 300,000 gallons (1.1 million L) of oil near the entrance of Narragansett Bay due to a grounding with a root cause of human error. In 1996 the M/V North Cape grounded near Moonstone Beach (RI) and spilled approximately 820,000 gallons (3.1 million L) of home heating oil. In 2003, the Bouchard 120 barge struck a bedrock ledge in Buzzards Bay and spilled approximately 98,000 gallons (370,000 L) of oil.

7.3 Commercial Salvors

Commercial salvors also exist in the area that provide a range of marine services to recreational and commercial boaters, such as: towing, engine start, vessel salvage, and general assistance to mariners. Commercial salvors have also historically assisted the USCG in SAR operations. The commercial salvors tend to operate during the boating season (April through October) and are generally located in boating communities and ports. Below is a list of nearby commercial salvors that service the area around the SWDA:

- TowBoatUs New Bedford – New Bedford, MA;
- TowBoatUS Falmouth – Falmouth, MA;
- TowBoatUS Bass River, Cape Cod, Nantucket – South Yarmouth, MA;
- TowBoatUS Provincetown – Provincetown, MA;
- Sea Tow South Shore – Marshfield, MA;
- Safe/Sea RI – North Kingstown, RI;
- Baywatch RI – Warwick, RI.; and
- Tucker Roy Marine Salvage – Mattapoisett, MA.

Based on discussions with personnel from TowBoatUS New Bedford, they only respond to recreational vessel calls. In an average boating season, they may respond to approximately 30 calls in the area south of Nomans Land, which is located off the southwest corner of Martha's Vineyard. Most of these incidents occur within the range of 3 to 5 NM (5 to 10 km) south of Nomans Land, near the northern extent of the SWDA, although some have occurred further south. The calls are typically for towing vessels, and TowBoatUS estimates they typically rescue approximately 25 vessels per year. TowBoatUS is also equipped to aid USCG with SAR missions south of Martha's Vineyard and has done so in the past. Comprehensive information detailing all operations and their spatial distribution was not available.

7.4 Summary of SAR Assets

The SWDA is within the District 1 – USCG Atlantic Area jurisdiction, in the Southeastern New England Sector. This sector is tasked with the area that covers the SWDA and is serviced by USCG assets from stations nearby. The closest USCG marine stations to the SWDA are listed below in order of distance from the SWDA:

- USCG Station Menemsha, Martha's Vineyard, MA
- USCG Station Woods Hole, Woods Hole, MA

- USCG Station Castle Hill, Newport, RI
- USCG Station Brant Point, Nantucket, MA

The closest is USCG Station Menemsha, which is located approximately 19 NM (35 km) northwest from the extents of the SWDA.

7.4.1 Marine Assets

The USCG maintains a fleet of vessels at these stations for use in SAR and environmental response missions. Table 7.4 summarizes the USCG vessel fleet in the Southeastern New England Sector:

Table 7.4: USCG Marine Assets in Southeastern New England Sector – District 1 Jurisdiction

Vessel Name	Type	Home Port
USCG Cutter Tybee	110 ft (34 m) USCG Patrol Boat	Woods Hole, MA
USCG Cutter Sanibel	110 ft (34 m) USCG Patrol Boat	Woods Hole, MA
USCG Cutter Cobia	87 ft (27 m) USCG Patrol Boat	Woods Hole, MA
USCG Cutter Steelhead	87 ft (27 m) USCG Patrol Boat	Newport, RI

The following USCG stations also have additional vessels active in the area:

Table 7.5: Marine Assets Active at USCG Stations near the SWDA

Station	Type	Quantity
USCG Station Menemsha	47 ft (14 m) Motor Life Boats	2
	29 ft (9 m) Response Boat – Small	1
USCG Station Castle Hill	45 ft (14 m) Response Boat – Medium	3
	29 ft (9 m) Response Boat – Small	2
USCG Station Woods Hole	45 ft (14 m) Response Boat – Medium	2
	29 ft (9 m) Response Boat – Small	1
USCG Station Brant Point	47 ft (14 m) Motor Life Boats	2
	29 ft (9 m) Response Boat – Small	1

This group of USCG station and vessel assets coordinates as an integrated team to conduct active patrols, SAR missions and environmental response missions. The vessels listed in Table 7.4 are active in the area surrounding the SWDA and are capable of multiple-day-at-sea missions. The vessels listed in Table 7.5 are geared towards rapid response missions near their home-port locations and USCG Stations.

7.4.2 Aviation Assets

The USCG has one aviation facility in the northeast United States called Air Station Cape Cod (ASCC), approximately 32 NM (59 km) north of the SWDA. This facility has a mission area spanning from New Jersey to the Canadian border. The base is located at the Joint Base Cape Cod (JBCC) in Bourne, MA. This base is a full scale, joint-use base that is home to five military commands training for missions both domestic and abroad, conducting airborne SAR missions, and intelligence command and control.

Aviation assets at ASCC include MH-60T Jayhawk helicopters and HC-144A Ocean Sentry fixed-wing aircraft. These assets can be operational within 30 minutes of a distress call in any weather, all year round. The USCG completes approximately 250 SAR missions per year from ASCC (USCG, n.d.). The Jayhawk helicopters are designed for high maneuverability and are capable of performing hoisting operations and deploying dewatering equipment in SAR mission scenarios. The Sentry aircraft are designed for high-speed response and reconnaissance and are capable of longer flight times and distances than the Jayhawk helicopters; the Sentry aircraft are typically used for long range missions.

8. Summary of Stakeholder Engagement

The Proponent began conducting outreach to mariners and fishing vessel crews in the context of the Vineyard Wind 1 project as early as 2010 and continues to engage with stakeholders on all of its projects, including New England Wind. Stakeholder feedback gathered during the Vineyard Wind 1 project informed the siting and design of New England Wind. In particular, New England Wind's 1 NM by 1 NM WTG/ESP grid layout was adopted in direct response to feedback from the commercial fishing industry who consistently expressed the need for WTGs to be oriented east to west with 1 NM spacing to accommodate traditional fishing patterns within the RI/MA WEA and MA WEA, including the "gentlemen's agreement" (see Sections 2.1 and 9.1).

For all New England Wind projects, the Marine Operations Liaison Officer will serve as the strategic maritime liaison between the Proponent's internal parties and all external maritime partners and stakeholders, including USCG, US Navy, port authorities, state and local law enforcement, marine patrol, and commercial operators (e.g., ferry, tourist, cargo vessels, tankers, fishing boat operators, and other offshore wind leaseholders). The Marine Operations Liaison Officer and supporting staff are actively engaged in outreach to mariners and fishing vessel crews through an email distribution list and the Proponent's Fisheries Representatives. Consultation with port authorities, such as bi-weekly meetings with the New Bedford Port Authority, has and will continue to occur for all of the Proponent's projects. The Proponent is also exploring options for conducting outreach with cargo vessel and tanker companies/operators, such as including project information in trade magazines and working with maritime pilot groups to obtain information about incoming vessels.

The Marine Operations Liaison Officer is responsible for coordinating and issuing Offshore Wind Mariner Update Bulletins to notify maritime stakeholders of the Proponent's offshore activities. The Offshore Wind Mariner Update Bulletins include detailed information such as vessel information, a description of the activities, anticipated dates, charts showing the location of planned operations, vessel contact information, contact information for the Proponent's Onboard Fisheries Liaisons (per the request of a Fisheries Representative), and images of the vessel and/or equipment to be deployed. These notices are published on the Proponent's website, social media channels, and sent via email and SMS text alert to known fisheries contacts and other mariners who have opted-in to receive notifications from the Proponent. At the request of the Rhode Island Coastal Resources Management Council (CRMC) and several fishing vessel crews, who indicated that it is challenging to keep track of the various notifications that they receive, the Proponent recently implemented a weekly email update to recirculate active Offshore Wind Mariner Update Bulletins.

Additional communication with stakeholders has been conducted through various channels including directly through email, SMS text message alerts, letter mailings, webinars, phone calls, meetings (in person prior to March 2020 and virtual thereafter), information published on the Proponent's website and social media channels, and at in-person monthly Port Hours conducted jointly with other offshore wind developers. Prior to March 2020, the Proponent had regularly hosted information tables at regional trade shows and conferences whose target audience included fishing vessel crews and mariners in Southeastern New England. Since March 2020, the proponent has adapted outreach efforts because of COVID-19, including increased use of digital communications and information published on the Proponent's website and social media channels. Additional outreach methods specific to fisheries stakeholders are discussed further in Section 8.1.

The Proponent is continuing to develop methods of communication to mariners and fishing vessel crews. The Proponent has consistently received feedback from the Responsible Offshore Development Alliance (RODA), individual fishing vessel crew members, and mariners that they would prefer one centralized location to access information on various offshore wind developers' activities. In response, the Proponent is working with a consultant to develop a cellphone app that shows all of New England Wind's offshore activities on an interactive map and provides a portal for fishing vessel crews and mariners to submit inquiries directly to the fisheries team. With the Proponent's assistance, the app developers are also connecting with fishing vessel crews and mariners to gather feedback about the tool. Once the app is tested and validated in the field, other offshore wind developers will be encouraged to contribute to the tool and consider adopting it. The goal is for the app to provide a single, consolidated location for fishing vessel crews and mariners to connect with and view information from all the RI/MA WEA and MA WEA leaseholders to help reduce email/text clutter and reduce uncertainty about which developer activities apply to that fishermen's operations.

Mariners and fishing vessel crew members also frequently express their concerns regarding the potential impacts of WTGs on marine radar systems. In response, the Proponent is undertaking efforts to better understand how marine radar may potentially be affected by its projects. As described in Section 11.2.3, BOEM is currently sponsoring a study by the National Academies of Sciences, Engineering, and Medicine to evaluate impacts of WTGs on marine vessel radar and identify potential mitigation measures. The study will consist of a literature review and may also include modeling, in order to better characterize potential effects and identify actions to reduce impacts. Additional mitigation measures for potential radar impacts will be assessed following completion of this study.

As part of the MARIPARS preparation, the USCG also conducted stakeholder outreach. This included the Federal Register notice and other outreach efforts, which included announcements via a Marine Safety Information Bulletin (MSIB), publication in the Local Notice to Mariners (LNM), and social media posts. The outreach also included seven public meetings targeted to marine industries in the region as well as three open public meetings in Massachusetts, Rhode Island, and New York. USCG communicated and coordinated with appropriate federal and state agencies, non-governmental organizations, and other public stakeholders listed in Appendix D. Additionally, the USCG coordinated with the Massachusetts Coastal Zone Management, CRMC, National Oceanic Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS), World Shipping Council, American Waterways Operators, and Passenger Vessel Association representatives. All comments and supporting documents are available in the public docket (USCG-2019-0131). The MARIPARS provides a summary of the comments received from the public notice and stakeholder coordination meetings.

8.1 Outreach to Fisheries Stakeholders

Communication with fisheries stakeholders, and particularly fishing vessel crews, is a priority of the Proponent. Staff are in regular communication with fisheries stakeholders across the region, including individual commercial (fixed and mobile gear) and recreational fishing vessel crew members. The Proponent has a full-time Fisheries Liaison dedicated to fisheries outreach and communications as well as other staff supporting the effort. As described above, communication is conducted through various channels (e.g., email, SMS text message alerts, letter mailings, webinars, phone calls, meetings, the Proponent's website, social media channels, etc.), although the Proponent has adapted outreach efforts because of COVID-19.

Also, when appropriate and weather permitting, the Proponent's Fisheries Liaison holds Port Hours outside at ports in New Bedford, MA, Narragansett, RI, Stonington, CT, and Montauk, NY. These events are typically held jointly with Fisheries Liaisons from other offshore wind development companies to provide information to fishing vessel crews who fish in or transit through multiple wind development areas.

The Proponent engages with Fisheries Representatives within various fisheries sectors. Fisheries Representatives represent the interests of different fisheries and fishing communities to the Proponent and help make sure that the Proponent is hearing concerns from fishing vessel crews. The Fisheries Liaison has bi-weekly meetings with the Fisheries Representatives and proactively seek their input on a variety of different issues, including the content of the Fisheries Communication Plan (FCP) and the design of fisheries programs and protocols. Fisheries Representatives also help share information about the Proponent's projects directly with fishing vessel crews. Fisheries Representatives represent the interests of fishing vessel crews, not the company, and are compensated for their time by the Proponent.

The Proponent has implemented a program to hire local fishermen as Onboard Fisheries Liaisons on vessels contracted to the Proponent whenever possible. The role of the Onboard Fisheries Liaisons is to avoid and mitigate conflicts with fishing vessels, help survey vessels avoid fixed gear, and communicate with fishing vessel crews on the water. The Onboard Fisheries Liaisons are the main point of contact with fishing vessel crews on the water and work closely with the Proponent's Fisheries Liaison. Based on feedback gathered from fishing vessel crews (who have indicated a preference for having other fishermen monitor for fishing gear), the Proponent employs Onboard Fisheries Liaisons on both their geotechnical and geophysical survey vessels.

The Proponent participates in various working group meetings, is a member of the Responsible Offshore Science Alliance (ROSA), and attends industry events and meetings to have ongoing dialogue and share information. The Proponent uses its membership and participation in these groups to provide project updates, better understand fisheries stakeholders' concerns, build relationships, and collaborate on research and education. For example, in 2020, RODA's Aids to Navigation working group worked to address the industry's concerns regarding aids to navigation in the RI/MA WEA and MA WEA. As part of this effort, members of the Proponent's team collaborated with the working group members to develop a survey to collect the fishing industry's preferences on aids to navigation for offshore wind projects. The survey found that the fishing industry prefers alphameric markings that are larger than in Europe, are retroreflective (rather than illuminated by lights), are located both above and below the transition piece, and follow a consistent pattern across all lease areas in the RI/MA WEA and MA WEA. Through the survey, the fishing industry also expressed a desire for cell phone coverage within the lease areas and the use of AIS to mark WTGs. The working group presented the results of this survey to the USCG. As described in Section 11, the Proponent will light and mark its WTGs and ESPs in accordance with USCG's *ME, NH, MA, RI, CT, NY, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance,* which aligns with the feedback collected from the fishing industry.

A Request for Information (RFI) was issued in December 2020 to engage with vessel owners and fishing vessel crews who may be interested in offering services. To date, over 50 responses have been received from recreational and commercial fishing vessel owners. This RFI is helping the Proponent to evaluate opportunities to hire local vessels and to identify individuals who may be interested in such opportunities. The Proponent's Fisheries Liaisons are conducting individual outreach to fishing vessel crews to evaluate opportunities to hire local vessels. The Proponent has already hired local fishing vessels to operate as scout vessels, which work ahead of survey vessels to locate and report fixed gear locations that could potentially impact survey operations. Scout vessels help communicate with fishing vessels in their area, sharing information on the survey vessel's activity and timeline of operation. The use of local fishing vessels as scout vessels is a direct result of feedback from fishing vessel crews who indicated that it would be useful to have other fishing vessels monitoring for the presence of their gear. Based on feedback received through the RFI, the Proponent is also working with fishing vessel crews to provide safety training, support safety equipment upgrades, and secure funding for fishing vessel operators to obtain their Captain's License to facilitate safe navigation and fishing activities within the RI/MA WEA and MA WEA.

9. Operational Impacts

This report section addresses the potential navigational impacts that may occur during the operations phase of New England Wind. Section 9.1 summarizes the key points from the MARIPARS study conducted by the USCG (2020). Although the focus of the study was the entire MA WEA and RI/MA WEA; the findings of the study are considered as generally applicable to the SWDA. In Section 9.2, corridor spacing in SWDA is discussed in reference to vessel sizes, leading into quantitative estimates of navigational risk in Section 9.3. Issues such as air draft clearance, potential impact on radar and communication systems, potential noise impacts and USCG search and rescue are addressed in subsequent report sub-sections.

9.1 MARIPARS Analysis

As noted in Section 3.2.2, the MARIPARS was conducted according to the methodology outlined in USCG Commandant Instruction 16003.2B, Marine Planning to Operate and Maintain the Marine Transportation System (MTS) and Implement National Policy. The public was afforded a 60-day comment period, and three public meetings were held (one each in Massachusetts, Rhode Island, and New York) to receive public input.

MARIPARS showed that the bulk of the traffic (from AIS data) was from fishing and recreational vessels. The analysis also revealed that traffic volumes within the MA WEA and RI/MA WEA tend to increase up to four-fold during summer months, compared to reduced traffic volumes in the winter months of January and February. The general traffic pattern for transiting fishing vessels appeared to be in a reciprocal northwest–southeast alignment, while the recreational traffic appeared variable. It was also noted from comments from local mariners that there is a well-known “gentlemen’s agreement” for fixed and mobile gear fishing vessels in the area to prevent entanglement of equipment, and that there is a significant amount of east–west aligned fishing activity that may not be accurately represented by the AIS data. Most of these vessels are smaller fishing vessels that are not required to employ an AIS or VMS transponder.

A literature review of UK experience and discussions with pilots and industry trade groups revealed the consensus that most of the large commercial ships will choose to avoid the turbine arrays and follow the defined deep-draft transit lanes. Under this assumption, large vessels would be required to re-route around the MA WEA and RI/MA WEA, which could increase travel distances and times.

The MARIPARS further stated that future waterway uses by other classes of vessels, such as general recreational vessels, excursion vessels, and recreational fishing vessels, are expected to increase based on post-construction activity. These increases have been observed in European wind farms and around the Block Island Wind Farm. Additionally, a significant amount of port development activity is currently planned in the region, but it is predominantly intended to support the evolution of the wind energy industry. Bridgeport and New London, Connecticut, as well as Port Jefferson, New York, have announced upgrade projects to support offshore wind supply and construction. This may result in a slight increase in traffic for vessels of certain characteristics, but it is not expected to pose any concerns for navigational risk during the operations phase of New England Wind.

In addition to the expected increase in overall vessel traffic in the future, it is expected that the USCG will replace some or all of the existing marine assets that service the region (see Table 7.4) with larger vessels which are 360 ft (110 m) in length.

MARIPARS recommends WTGs should contain a minimum of three lines of orientation. The bulk of the transiting traffic should use a northwest–southeast alignment with spacing of 0.6 to 0.8 NM (1.1 to 1.5 km). Lanes for commercial fishing vessels actively engaging in fishing within the MA WEA and/or RI/MA WEA should be oriented east–west with 1 NM (1.8 km) spacing. Lastly, it is recommended have north–south and east–west orientation lines to accommodate SAR operations by the USCG.

MARIPARS also recommends that, in general, mariners transiting through the MA WEA and/or RI/MA WEA should make a careful assessment of all factors associated with their voyage to reduce navigational risk during the operations phase. The factors to be considered should at minimum include:

- The operator's experience and condition with regard to fitness and rest;
- The vessel's characteristics, which should include the size, maneuverability, sea keeping ability, the overall reliability and operational material condition of propulsion, steering, and navigational equipment;
- Weather conditions – both current and predicted, including sea state and visibility;
- Up-to-date information regarding the positions of under-construction or completed WTGs and their associated construction vessels; and
- Careful consideration to whether the transit will be conducted during the day or night.

9.2 Vessel Transits Through the SWDA

Vessels, particularly fishing and recreational vessels, are expected to choose to transit through the SWDA and trawlers are expected to continue to fish in the area. The navigational safety for these activities has been evaluated based on turbine spacing and size of vessels. Given the relatively deep water at this site (141 to 203 ft [43 to 62 meters]), navigation is not limited by water depth.

Although there are various international guidelines that address required spacing between commercial shipping lanes and the perimeter of an offshore wind development (e.g., PIANC 2018; UK Maritime MGN 543), there is no specific guidance provided regarding the routing of vessels through a wind turbine field. In the Supplementary Navigational Risk Assessment conducted for Vineyard Wind 1 (Baird, 2019), turbine corridor width was evaluated based on various criteria, including the sizing of harbor approach channel dimensions based on PIANC (2014), the ability to turn safety to avoid a vessel collision, and the ability to turn a trawler with gear extended.

The USCG MARIPARS study (2020) assessed turbine corridor width based on the UK Maritime Guidance document MGN 543, which recommended the following provisions:

- Standard turning circles for collision avoidance of vessels that are six times vessel length;
- Requirements for stopping in an emergency; and
- Adequate space for vessels to safely pass and overtake each other, equivalent to a lane width of two to four vessel lengths depending on traffic density.

The last consideration derives from a Government of Netherlands White Paper on Offshore Wind Energy (2014). If there are less than 4,400 vessels per year transiting the corridor, a corridor width of four ship lengths of the "standard design vessel" are considered. If there is greater than 4,400 and less than 18,000 vessels per year, a corridor width of six ship lengths is considered. If greater than 18,000 vessels per year, then a corridor width of 8 ship lengths is recommended. Note that the standard design vessel is considered to be the 98.5th percentile vessel length (i.e., exceeded by 1.5% of vessels).

Figure 9.1 illustrates the spacing assumed between the turbines in the MARIPARS. It is made up of the following components:

- Navigational spacing of eight ship lengths. It was recognized that this spacing, which would accommodate over 18,000 vessel transits in a single corridor, is conservative and gives additional buffering space and allowances for inclement weather and vessel emergencies.

- A collision avoidance zone on either size of 1.5 vessel lengths.
- A safety margin of six ship lengths on either side of the corridor.
- A safety zone that may range from 0 to 500 meters (0 to 1,640 ft) in total for the corridor. It has been assumed that 250 m (820 ft) is applied on either side of the corridor, as shown in Figure 9.1.

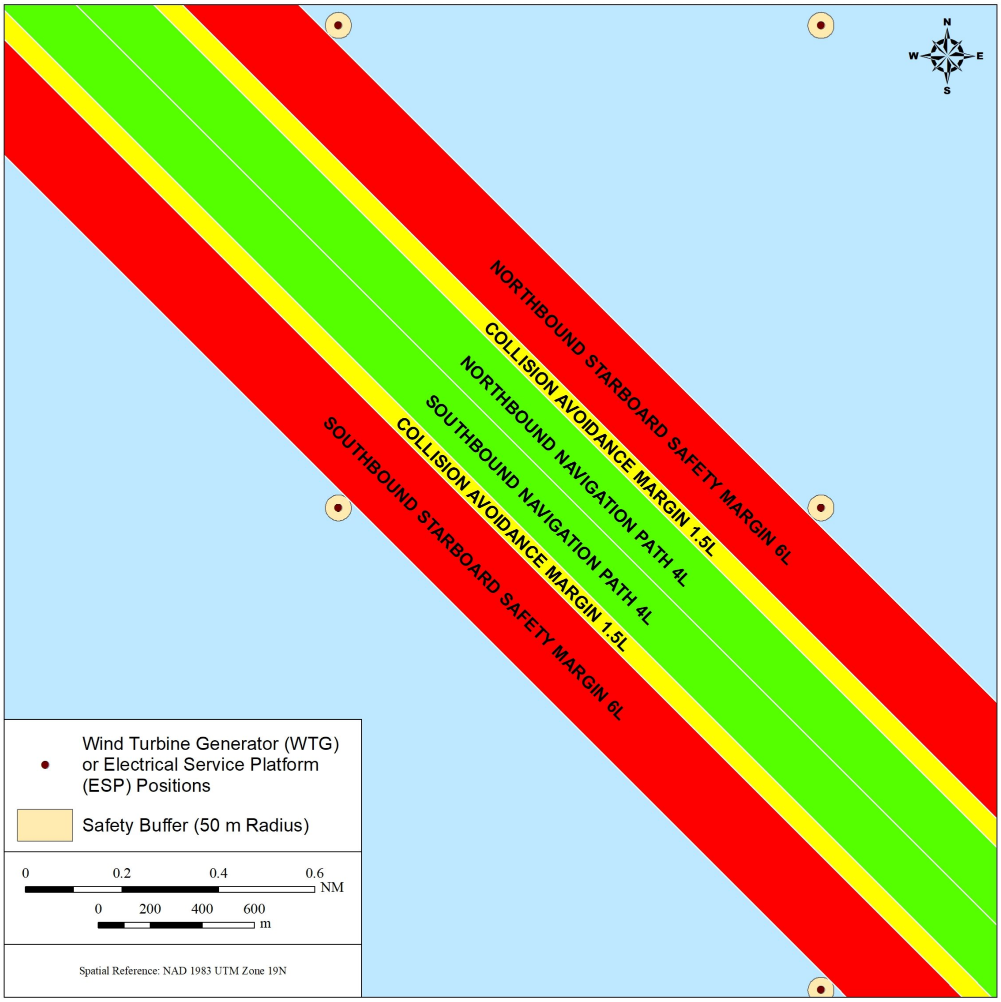

Figure 9.1: MARIPARS Corridor Width

The USCG assumed a maximum safety zone of 500 m might be considered in the future based on consideration of international regulations (IMO/UNCLOS) for safety zones around oil and gas platforms and similar.

An alternative approach from MGN 543 (UK Maritime & Coastguard Agency, 2016), which specifically considers offshore renewable energy installations (OREIs), states “The mention of the IMO/UNCLOS safety zone limited to 500 meters does not imply a direct parallel to be applied to OREIs.” Further, MGN 543 allows for a safety zone of 50 m around turbines during operation. This suggests that a 500 m (1,640 ft) safety margin during operation, as presented in MARIPARS, is conservative for OREIs. The 500 m (1,640 ft) safety zone was really developed in consideration of offshore structures of high value and risk with the nearby passage of large commercial cargo vessels, not fishing and recreational vessels.

A safety zone of 500 m (1,640 ft) in addition to a safety margin of six times the vessel length may be overly conservative, particularly when considering the already conservative assumption for navigation path width.

In this NSRA, Baird has applied the MARIPARS approach for defining corridor widths based on three different safety factors, ranging from 0 to 250 m (0 to 820 ft) per side. Table 9.1 below shows the maximum allowable vessel length for the two different corridor widths present in the SWDA: (1) 1 NM (1.85 km) east-west and north-south; and (2) 0.7 NM (1.3 km) northwest-southeast and southwest-northeast.

Table 9.1: Allowable Vessel Length by Corridor Width – MARIPARS Analysis

	Allowable Vessel Length		
	No Safety Zone	50 m Safety Zone Per Side	250 m Safety Zone Per Side
1 NM Corridors	264 ft (80 m)	250 ft (76 m)	193 ft (59 m)
0.7 NM Corridors	185 ft (56 m)	171 ft (52 m)	114 ft (35 m)

It is very important to recognize that the corridor widths are notional and not actual channels with physical limits at the channel edges. Vessels can certainly navigate from one corridor to the next without restriction. In the case the diagonal corridors, the turbines which define the corridor "edges" are offset from one another.

9.2.1 Commercial Fishing Vessel Traffic

The relative size of fishing vessels with respect to corridor spacing within the SWDA is an important consideration for navigational safety. The largest fishing vessels will have the greatest risk due to their size and reduced maneuverability. Table 9.2 summarizes the five largest fishing vessels found transiting and trawling the SWDA from the AIS analysis (outlined further in Section 6.4.7):

Table 9.2: Vessel details – Five largest fishing vessels transiting and trawling the SWDA

Transiting			Trawling		
Vessel Name	LOA (ft)	Beam (ft)	Vessel Name	LOA (ft)	Beam (ft)
F/V E S S PURSUIT	146 (44 m)	43 (13 m)	STARRFISH	115 (35 m)	39 (12 m)
RELENTLESS	138 (42 m)	33 (10 m)	COURAGEOUS	102 (31 m)	30 (9 m)
PERSISTENCE	128 (39 m)	30 (9 m)	SUSAN ROSE	98 (30 m)	26 (8 m)
STARRFISH	115 (35 m)	39 (12 m)	F/V BULLDOG	98 (30 m)	26 (8 m)
F/V OSPREY	109 (33 m)	28 (9 m)	VANQUISH	98 (30 m)	26 (8 m)

Based on a comparison to the allowable vessel lengths given in Table 9.1, all of these vessels can readily navigate down the 1 NM (1.85 km) corridors and down the 0.7 NM (1.3 km) corridors for the 0 and 50 m safety zones. In the case of the most restrictive safety zone (250 m), approximately 95% of the fishing fleet can readily navigate the 0.7 NM (1.3 km) corridors.

In relation to the proposed spacing of the WTGs within the SWDA, the largest fishing vessels are relatively small. However, when trawling equipment is deployed, the maneuverability of fishing vessels is significantly decreased. This can introduce a source of collision or allision risk when a turn may be required while entering the SWDA from outside the MA WEA and/or RI/MA WEA.

An assessment of the achieved turning diameters for various trawling vessels was completed using the period of most trawling activity in the SWDA, which occurred in August and September 2016 (example tracks shown in Figure 9.2). It should be noted that this assessment was completed as part of Vineyard Wind 1 and not within the SWDA, and the results were considered representative for New England Wind. A list of turns analyzed is given in Table 9.3, indicating that while turn diameters of 0.4 NM (2,430 ft) or less are frequently achieved, there are tracks where trawling vessels have conducted turns with diameters of up to 0.86 NM (5,225 ft). It is important to recognize that these vessels were not necessarily trying to execute a tight turn. In particular, the vessel with the largest turn diameter (0.86 NM) did not appear to be attempting a 180-degree turn. Based on this and the results in Table 9.3, a maximum turn diameter of 0.70 NM has been assumed for assessment purposes.

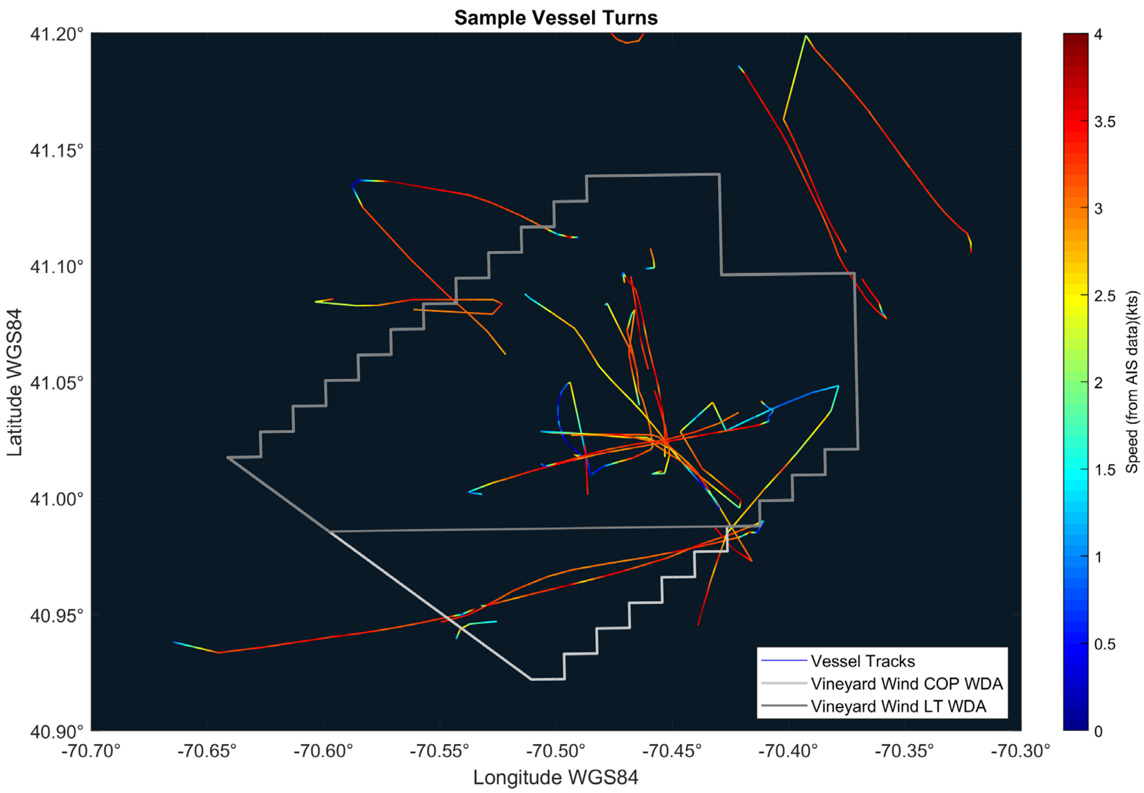

Figure 9.2: Trawling vessel turning analysis – selected vessel turns

Table 9.3: Trawler turns analyzed from the AIS dataset

No.	Date / Time	Turn Diameter (NM)
1	24-Aug-2016 15:01	0.86
2	29-Aug-2016 11:39	0.24
3	29-Aug-2016 14:26	0.16

No.	Date / Time	Turn Diameter (NM)
4	30-Aug-2016 01:56	0.20
5	30-Aug-2016 04:17	0.20
6	30-Aug-2016 05:57	0.36
7	01-Sep-2016 13:01	0.26
8	31-Aug-2016 18:53	0.70
9	31-Aug-2016 20:17	0.38
10	01-Jul-2017 23:37	0.18
11	15-Jul-2017 13:03	0.30
12	15-Jul-2017 17:39	0.26
13	29-Aug-2018 00:53	0.18
14	29-Aug-2018 02:58	0.18
15	29-Aug-2018 07:24	0.18

The AIS data suggests that trawling fishing vessels tend to follow more random distribution of directions than transiting fishing vessels and would consequently have to more closely consider WTG location in relation to their proposed routes. Within the vicinity of the SWDA, there is an existing informal agreement between local fishing vessels where fixed gear such as traps, pots and fill nets are presently laid out along Loran lines of approximate west southwest–east northeast orientation at approximately 0.5 NM (0.9 km) spacing between rows. During the operations phase of New England Wind, a uniform grid pattern with turbines oriented in the east-west and north-south direction would allow fixed gear to be placed along east-west turbine rows (where the turbines could serve as a point of reference for setting fixed gear). Trawling could continue to occur in an east-west direction, between turbine rows. This arrangement would minimize the risk of entanglement with mobile gear.

While the previous analysis shows that the proposed corridors are adequate for fishing vessel transit, some fishing vessels may choose to divert around Lease Areas OCS-A 0501 and OCS-A 0534 rather than transit through them. Figure 9.3 shows some key existing fishing vessel pathways for vessels traveling from Buzzards Bay, Newport, and Point Judith to fishing grounds (based on commercial fishing vessel tracks derived from AIS data) along with possible routes should these vessels choose to divert around Lease Areas OCS-A 0501 and OCS-A 0534. The start and end points for the possible routes to divert around the Lease Areas were determined using existing AIS vessel traffic patterns (i.e., start and end points were set at clusters of existing vessel tracks). The most common ports of transit for vessels that enter the SWDA are New Bedford, Point Judith, and Newport (see Figure 6.16). Table 9.4 summarizes the estimated average increase in distance and time associated with re-routing around Lease Areas OCS-A 0501 and OCS-A 0534 assuming a vessel speed of 7.6 knots. The percentage increase in transit time is calculated for the transit paths shown in Figure 9-3.

Table 9.4: Estimated Increase in Fishing Vessel Transit Distances and Times with Re-Routing Around Lease Areas OCS-A 0501 and OCS-A 0534

Transit Path	Increase in Distance (NM)	Average Increase in Transit Time (minutes)	Percentage Increase in Transit Time
Transit 1 (Blue)	1.6	12	2%
Transit 2 (Orange)	3.0	24	4%
Transit 3 (Yellow)	0.8	6	1%
Transit 4 (Red)	1.5	12	2%
Transit 5 (Green)	5.8	46	7%

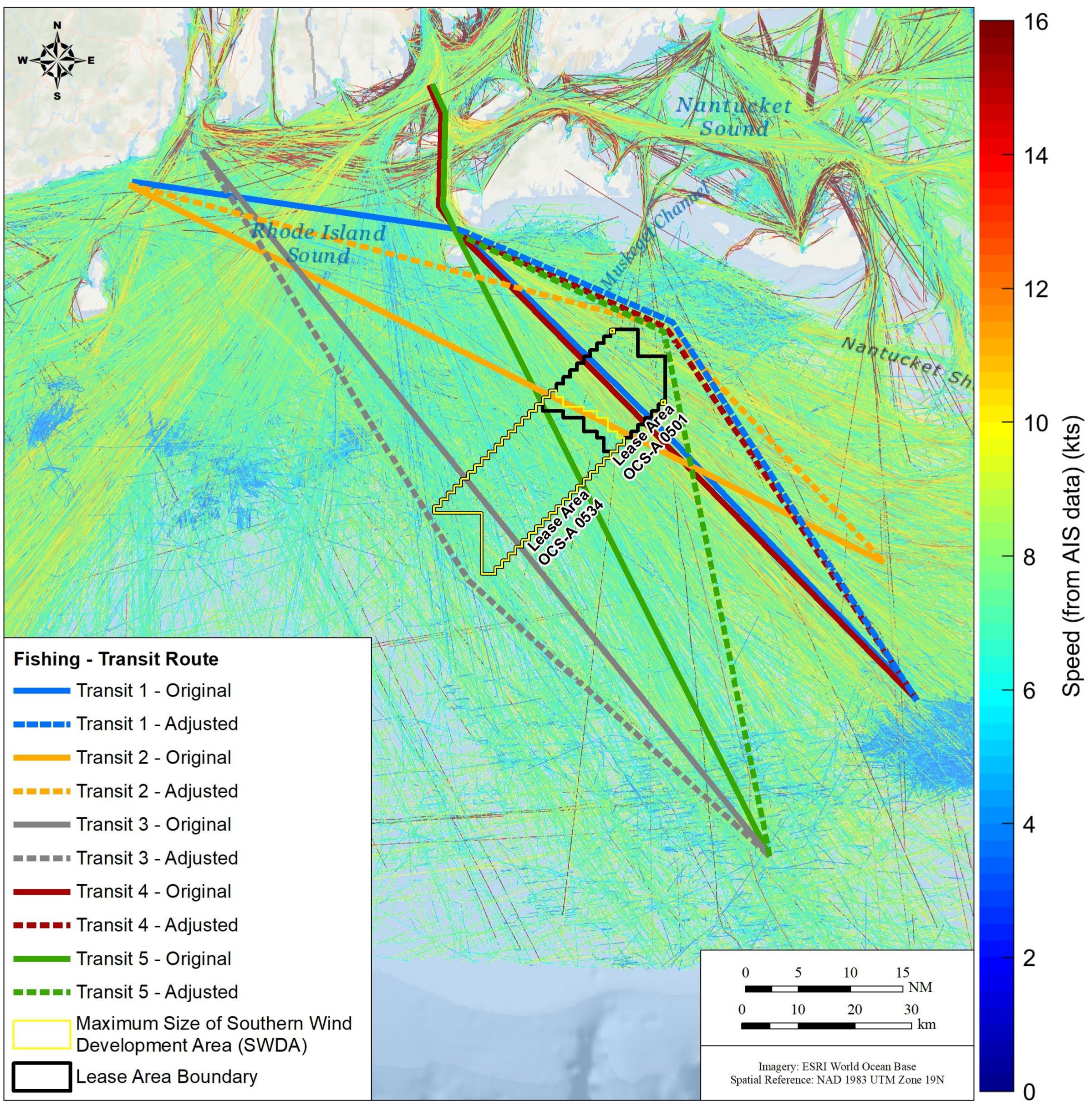

Figure 9.3: Schematic Showing Possible Fishing Vessel Re-Routing Around Lease Areas OCS-A 0501 and OCS-A 0534

9.2.2 Commercial Vessel Traffic (Non-Fishing)

The volume of commercial vessels transiting through the SWDA is considerably lower than for fishing and recreational vessels, as most of these vessels currently transit south of the SWDA. Section 6.4 summarizes the commercial vessel traffic characteristics through the SWDA.

During the operational period of New England Wind, it is expected that these larger commercial vessels will re-route around Lease Areas OCS-A 0501 and OCS-A 0534 to avoid any interaction and associated risk with the wind farm. As the AIS data has shown, many of these vessels are transiting between the Narragansett Bay traffic lanes, the Buzzards Bay traffic lanes, and the Ambrose-Nantucket TSS. Figure 9.4 shows the dominant existing transit route and a possible route further south to avoid travelling through Lease Area OCS-A 0534. The change in overall distance is small (1.0 NM) with an increase in travel time of 5 minutes at a speed of 12 knots.

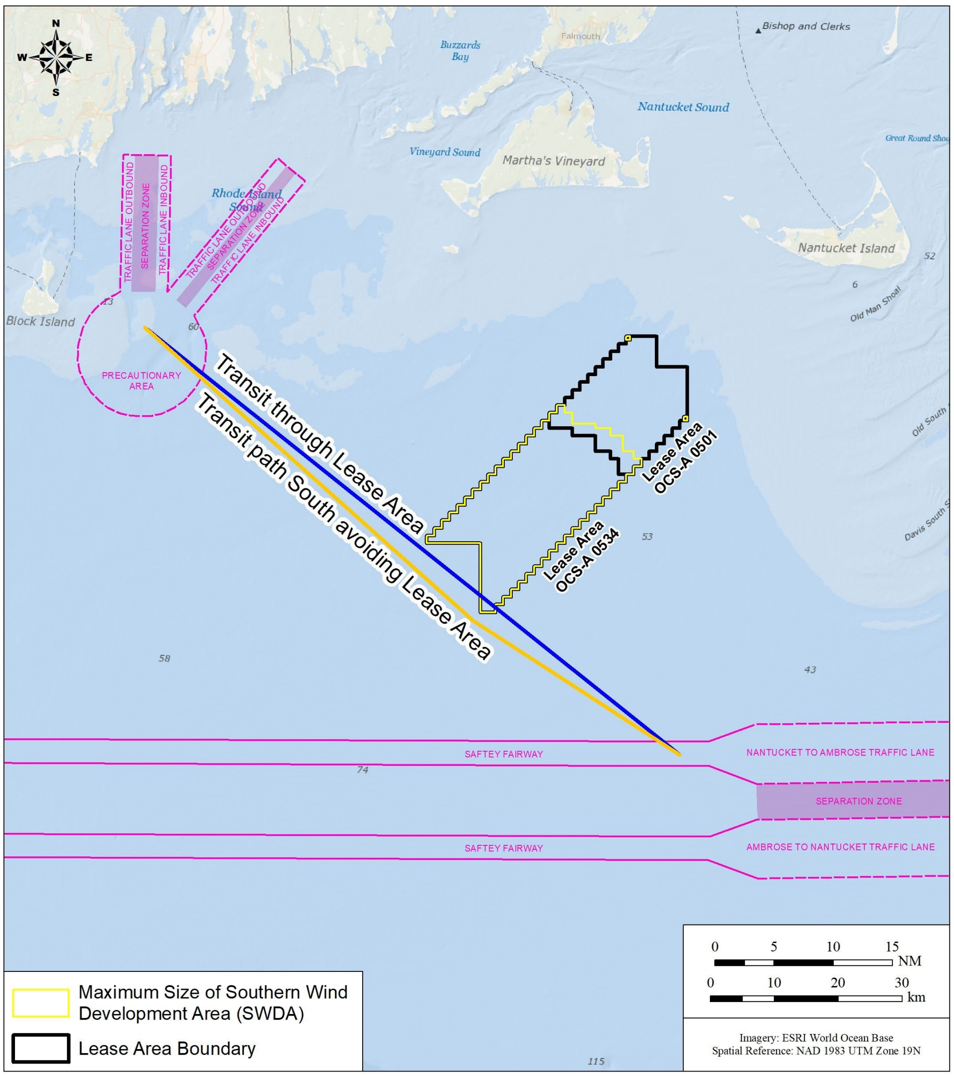

Figure 9.4: Schematic Showing Possible Large Commercial Vessel Re-Routing Around the Lease Area OCS-A 0534

9.2.3 Recreational Vessel Traffic

The general trend of recreational vessel traffic tends to follow a mostly northwest–southeast to north–south alignment. The five largest recreational vessels transiting the SWDA, identified from the AIS analysis, are summarized in Table 9.5. More information regarding the recreational vessel traffic is detailed in Section 6.5.

Table 9.5: Vessel Details – Five Largest Recreational Vessels Transiting the SWDA

Vessel Name	LOA (ft)	LOA (m)	Beam (ft)	Beam (m)
FOUNTAINHEAD	279	85.0	49	15
ADIX	210	64.0	26	8
LADY BRITT	207	63.1	36	11
ROCK.IT	200	61.0	36	11
HAMPSHIRE	197	60.0	33	10

Table 9.6: Recreational Vessel Length Overall (LOA) by Percentile

Vessel Size Percentile	LOA (ft)
Recreational - Max LOA	279
Recreational - 98.5% LOA	209
Recreational - 97.5% LOA	197
Recreational - 95% LOA	158
Recreational - 90% LOA	121

Based on a comparison to the allowable vessel lengths given in Table 9.1, all of the recreational vessels other than the single largest (Fountainhead) can readily navigate the 1 NM (1.85 km) corridors with 0 and 50 m safety zones. Approximately 90% of the vessels can readily navigate both the 1 NM (1.85 km) and 0.7 NM (1.3 km) corridor widths considering all of the various safety zones.

It is important to recognize that these vessels are identified as “recreational” in terms of the AIS categories but are actually large commercial vessels with a professional trained captain and a full crew complement. Many of these large vessels will likely choose to divert around Lease Areas OCS-A 0501 and OCS-A 0534.

Interactions can occur between recreational vessels and larger vessels such as passenger, cargo, or tanker vessels. The fact that these larger types of vessels are expected to re-route around Lease Areas OCS-A 0501 and OCS-A 0534 introduces a degree of traffic separation between these groups of vessels. In this sense, the likelihood of recreational vessels being involved in these types of events may be decreased, at least when within the SWDA.

For larger recreational and sailing vessels that may choose to bypass the SWDA, there are alternative routes to the north and south as shown in Figure 9.5. The start and end points for the possible routes to divert around Lease Areas OCS-A 0501 and OCS-A 0534 were determined using existing AIS vessel traffic patterns (i.e., start and end points were set at clusters of existing vessel tracks). The increase in distance and time due to re-routing around Lease Areas OCS-A 0501 and OCS-A 0534 is given in Table 9.7. The percentage increase in transit time is calculated for the transit paths shown in Figure 9-5. This type of change in traffic behavior could introduce additional traffic volume in localized areas around the perimeter of Lease Areas OCS-A 0501 and OCS-A 0534 that could increase navigational risk; this is addressed in the navigation safety risk assessment modelling presented in Section 9.3.

Table 9.7: Estimated Increase in Recreational Vessel Transit Distances and Times with Re-Routing Around Lease Areas OCS-A 0501 and OCS-A 0534

Transit Path	Increase in Distance (NM)	Average Increase in Transit Time (minutes)	Percentage Increase in Transit Time
Transit 1 (Blue)	1.4	11	2%
Transit 2 (Orange)	7.5	56	8%
Transit 3 (Gray)	0.1	1	0.05%

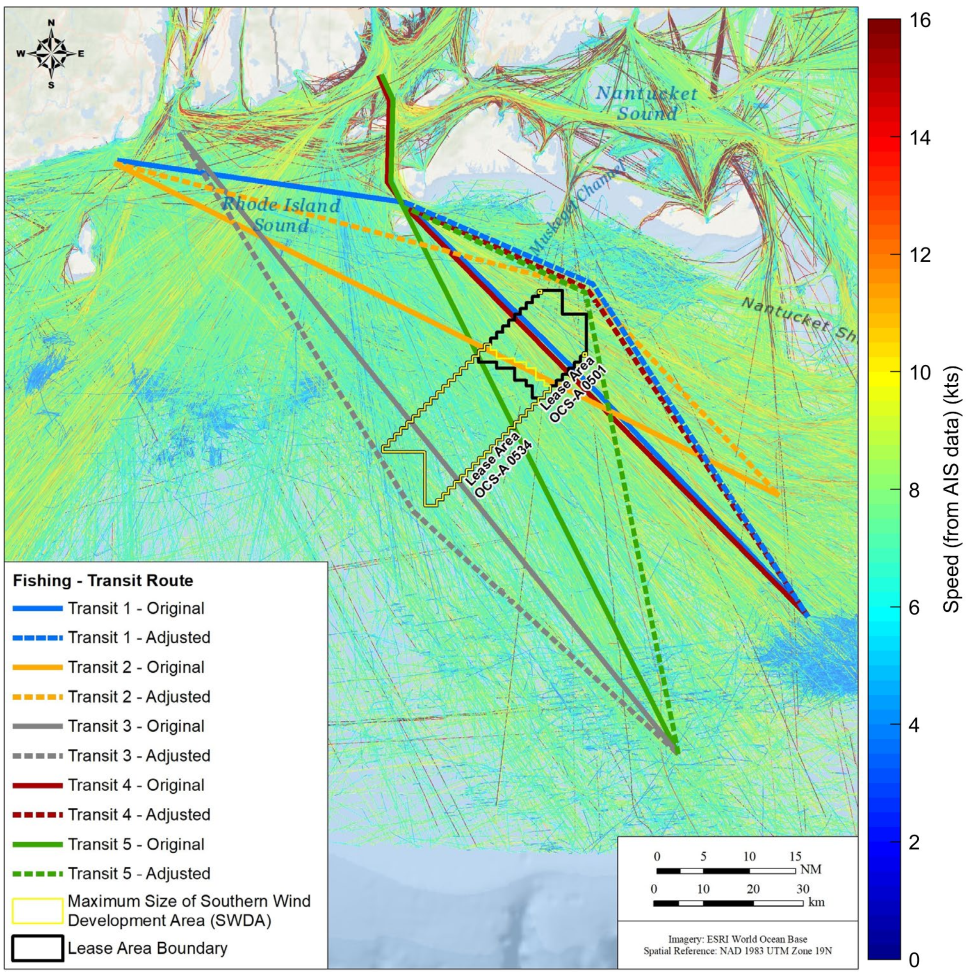

Figure 9.5: Schematic Showing Possible Recreational Vessel Re-Routing Around Lease Area OCS-A 0501 and Lease Area OCS-A 0534 (Every 10th AIS Track Shown)

It is theoretically possible for a large sailing vessel to be at risk for having the mast struck by a turbine blade; these vessels must carefully consider air draft restrictions and the characteristics of their vessels. This could only occur if the vessel was very close to the turbine foundation, which would likely only occur with a mechanical breakdown of the vessel. Section 9.4 presents information on the air draft restrictions within the SWDA.

9.3 Risk of Grounding, Collision, and Allision

A quantitative navigational risk assessment was conducted for both Lease Area OCS-A 0501 and Lease Area OCS-A 0534 (that is, Vineyard Wind 1 and New England Wind) for both the pre-construction and operations phases of the wind farms, to determine the impact and relative change in navigational risk due to the installation of the WTGs and ESPs. The combined area was evaluated as the presence of both the Vineyard Wind 1 project and New England Wind would influence the navigation of vessels through Lease Areas OCS-A 0501 and OCS-A 0534. For simplicity, it was assumed that the pre-construction condition was open ocean, though this is a conservative assumption for New England Wind since Vineyard Wind 1 will be constructed prior to New England Wind. It was assumed that Vineyard Wind 1 has a consistent WTG layout to New England Wind (i.e., it is assumed that both Vineyard Wind 1 and New England Wind use a 1 NM by 1 NM layout). The navigation risk assessment was carried out using Baird's proprietary Navigational and Operational Risk Model (NORM); refer to Appendix B for an outline of the model capabilities and methodology, and Section 9.3.2 for more details pertaining to NORM.

9.3.1 Accident Scenarios

The assessment was carried out for three main categories of accident scenarios: vessel grounding, vessel collisions, and vessel allisions with WTGs and ESPs. The navigational risk assessment resulted in occurrence frequencies and recurrence intervals of each potential accident scenario, followed by consideration of the consequences.

9.3.1.1 Grounding

Grounding occurs when a vessel impacts the seabed or waterway side and is among the most common marine accidents. This action may be intentional (i.e., for beaching, careening, etc.) or unintentional due to operator error, adverse conditions, equipment failure, etc. This typically occurs in shallow areas where the water depth is comparable to the draft of the vessel or where shoals exist, resulting in localized increases in bathymetric elevations.

Figure 9.6 shows the outline of the two Lease Areas, with bathymetric contours overlaid. Within the Lease Areas, the bathymetric contours are in the range of -115 to -203 ft (-35 to -62 m) MSL. Compared to the draft of even the largest vessels observed in the traffic analysis, the water depths present in the Lease Areas (and SWDA) are sufficient enough such that grounding is not considered a significant source of navigational risk for either the pre-construction or operations phases of New England Wind. Thus, grounding was not included in the risk model.

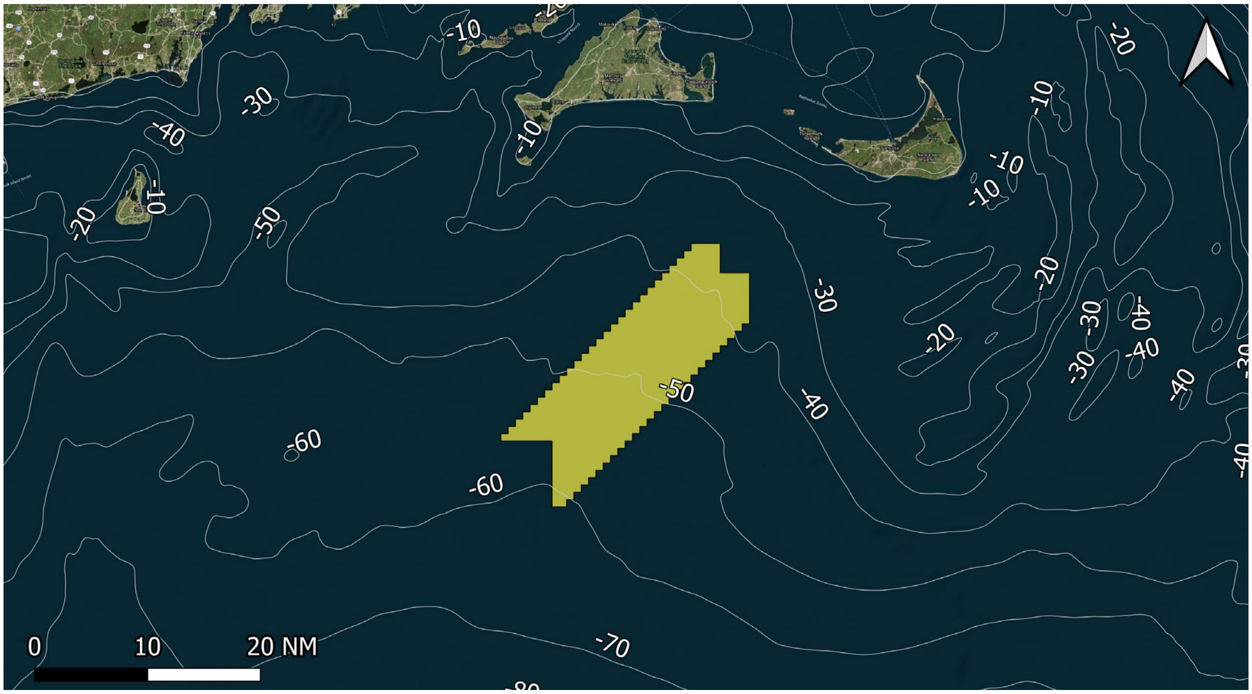

Figure 9.6: Bathymetry Conditions near Lease Area OCS-A 0501 and Lease Area OCS-A 0534 (m MSL) from NOAA (2017)

9.3.1.2 Collisions

Collisions are defined as the event of one vessel striking or contacting another vessel. Vessel collisions can result in substantial damage to vessels, cargo, and pose serious safety risks to personnel onboard. In a worst-case scenario this could result in loss of life and/or loss of cargo containment. In recent decades, as new and larger types of vessels have emerged, and traffic patterns have become increasingly complex, understanding the risk of ship collision has never been more important. Three different collision scenarios were investigated as part of the navigational risk assessment: head-on, overtaking, and crossing. These collision scenarios are depicted in Figure 9.7 and further explained in the following sections.

Head-on

Head-on collisions occur when vessels are approaching from parallel but opposite directions. These types of collisions are most common in defined waterways, navigational channels, or within corridors of a turbine field where possible directions of travel are defined and parallel or nearly parallel. This is because the vessels are physically restricted in the lateral direction. Many navigational risk models approximate vessel position in a waterway using a probabilistic distribution (most commonly Gaussian, see Figure 9.7) based on observed traffic patterns. Thus, in a defined waterway, there is a probability that the track of each vessel is overlapping with the other resulting in a potential head-on collision. In general, the risk of a head-on collision is dependent on vessel characteristics (i.e., LOA, beam, speed), traffic volumes, waterway characteristics (i.e., width, length), vessel lane distributions, and both vessel and operator capabilities. Please refer to Appendix B for more information on how NORM calculates head-on collision risk.

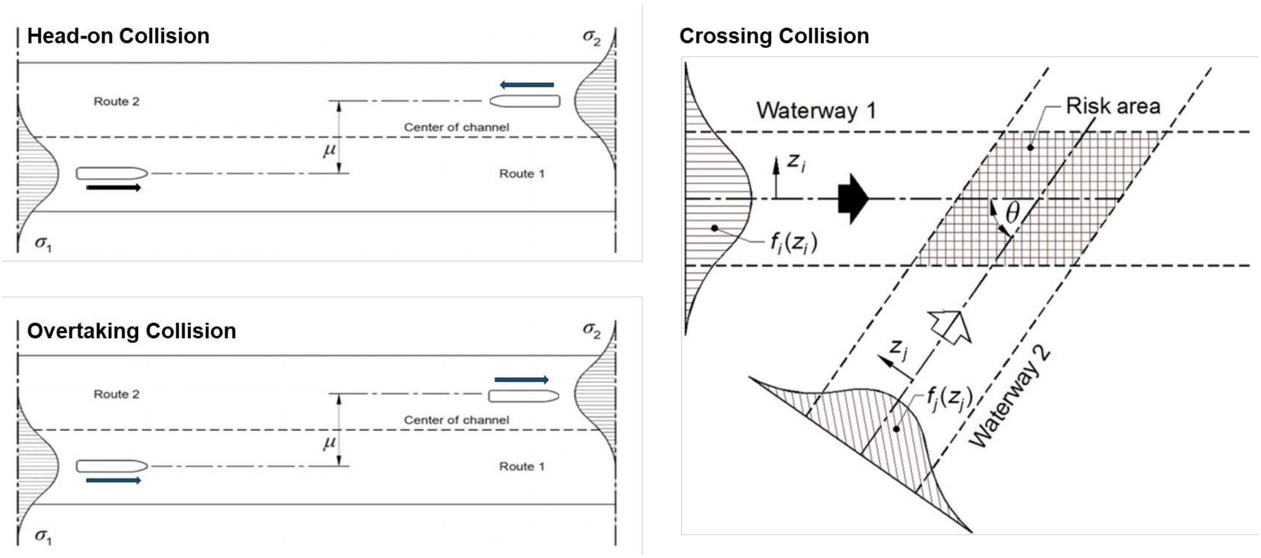

Figure 9.7: Collision Scenarios considered by NORM (images adopted from Zhang et al., 2019)

Overtaking

Overtaking collisions are similar to head-on collisions but occur when two vessels are travelling in the same direction at different speeds. In this scenario, it is assumed that the vessel travelling at a faster speed will deviate course, overtake the slower vessel, then return to its original track. During this overtaking process there is a probability that the vessel tracks will overlap and result in a collision. It is generally dependent on the same factors as head-on collisions; please refer to Appendix B for more information on how NORM calculates overtaking collision risk.

Crossing

Crossing collisions occur when two vessel tracks intersect at a significantly non-parallel angle. This could happen at intersections in defined waterways, navigational channels, intersections within a turbine field, or in open water conditions. In open water conditions with generally random traffic patterns (as is the case in the SWDA for fishing and recreational vessels in particular), this may be the dominant accident scenario given that the probability of vessels travelling along near parallel tracks may be low. Along with the aforementioned factors affecting head-on and overtaking risk, crossing risk is also a function of vessel course or the direction of travel along their routes, and the probability of vessels along intersecting tracks being near the intersection at the same time. Please refer to Appendix B for more information on how NORM calculates crossing collision risk.

9.3.1.3 Allisions - Powered and Drifting

Allisions are defined as the event of a vessel striking or contacting a fixed structure. Allisions can occur with any type of fixed structure within a waterway or body of water, such as offshore oil platforms, bridge piers, and offshore wind turbines. NORM considers both powered and drifting allisions as part of the navigational risk assessment. Powered allisions occur when the engine is still providing propulsive power to the vessel, whereas drifting allisions occur after a vessel experiences loss of propulsion, or some other form of damage that renders the vessel inoperable. Both powered and drifting allisions are depicted in Figure 9.8. Due to the different nature of these allision scenarios, powered allision have potential to be more severe than drifting allisions. While the overall chance of an allision is low, the consequences could be potentially catastrophic; in a worst-case scenario this could result in loss of life, loss of cargo containment, and/or loss of vessels and offshore installations.

Powered allisions are similar to head-on collisions in that they generally depend on the same factors, but the second vessel, or fixed structure in this case, has a speed of zero and a fixed location. Drifting collisions are much more random and difficult to quantify. Once a vessel has broken down, the drifting direction and rate may depend on many factors (i.e., wind, wave and current conditions, the relative area each of these contributing forces is acting on, vessel characteristics and force coefficients, etc.). Please refer to Appendix B for more information on how NORM calculates allision risk.

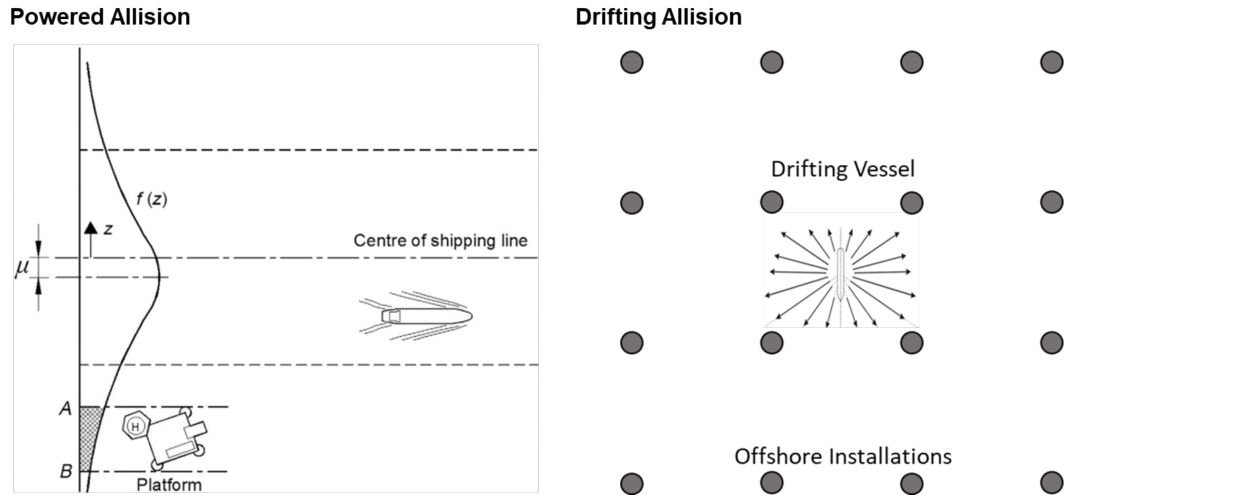

Figure 9.8: Allision scenarios considered by NORM (Powered Allision image adopted from Zhang et al., 2019)

9.3.2 Navigational and Operational Risk Model (NORM)

This section briefly outlines the capabilities and methodology of NORM, discusses the required inputs and resulting outputs of the model, and outlines any specific considerations made for the navigational risk assessment. A more detailed description of NORM and the model elements discussed in the following subsections can be found in Appendix B.

NORM is a model developed by Baird to assess and quantify navigational risk for both open water and defined waterway conditions. It is a statistically based model that uses raw AIS traffic inputs, metocean conditions, and fixed structure information (i.e., WTGs and ESPs) to calculate the risk of various accident scenarios. NORM can calculate the occurrence frequency of vessel grounding, head-on collisions, overtaking collisions, crossing collisions, powered allisions and drifting allisions. These calculations can be performed for intra-class, inter-class, and overall traffic risk analyses.

NORM employs a widely adopted and accepted methodology for calculating navigational risk that is described in the below equation:

$$N_a = P_a * n = P_g * P_c * n$$

Where N_a is the number of accidents occurring over a given time period (typically one year), P_a is the probability of an accident occurring, n is the number of vessels over a given time period, P_g is the geometric probability of an accident occurring, and P_c is the causation probability. The causation probability is the probability that a potential accident will in fact occur once on a potential collision/allision course.

The number of vessels considered (*n*) was obtained from AIS data, while the geometric and causation probabilities have been derived from literature. For calculating the geometric probability of an accident, a widely adopted methodology outlined in Zhang et al. (2019) is employed, which stems from original work outlined in Pedersen (2010).

Causation probabilities have historically been computed using fault tree analysis, Bayesian networks, or derived from historical accident data. NORM utilizes the base causation factors developed by Fuji and Mizuki (1998), rooted in historical observations. These causation factors have been widely applied in the industry and have been used as default factors for navigational risk models as such IWRAP (IALA, n.d.); the causation factors are summarized in Table 9.8.

Table 9.8: Accident Causation Factors used in NORM

Accident Scenario	Base Causation Factor
Head-on Collision	0.5E-04
Overtaking Collision	1.1E-04
Crossing Collision	1.3E-04
Grounding	1.6E-04
Powered Allision	1.86E-04

Note that causation factors relate to the ability of the vessel to avoid a potential collision or powered allision. Thus, drifting allisions do not make use of causation factors as the vessel is assumed to have lost the ability to maneuver. Instead, a probability (based Zhang et al., 2019) is used to quantify the frequency of vessels becoming inoperable and being in a potential drifting allision scenario.

The base causation factors may be subsequently modified to account for site specific conditions, including such considerations as pilotage, tug use, weather conditions, VTS and similar.

9.3.2.1 Study Area

To perform the navigational risk assessment, a study area must be carefully chosen to only contain traffic that may be affected by the offshore installation. If an overly large area is chosen, it may contain a considerable amount of traffic that may never actually experience any impacts due to the offshore installation, resulting in an underestimation of the change in navigational risk. If an overly small area is chosen, then the study may be focused on vessels that experience an extreme impact and could result in an overestimation of the change in navigational risk.

The study area used for the navigational risk assessment is shown in Figure 9.9, the study area encompasses a 6.5 NM (12 km) region around the extents of the Lease Areas OCS-A 0501 and OCS-A 0534. As mentioned above, this area was chosen to best capture only the vessel traffic that may be appreciably affected by the installation.

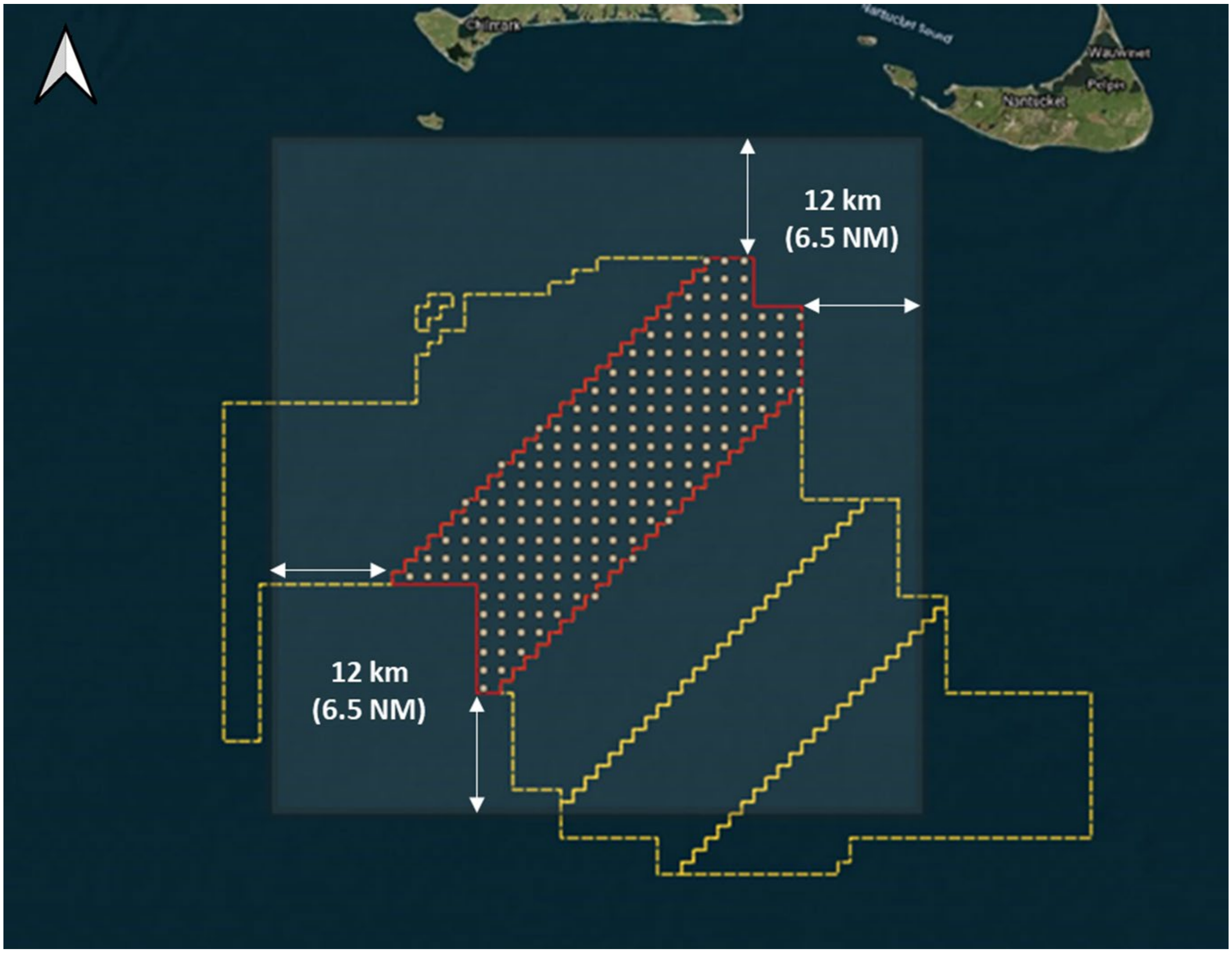

Figure 9.9: Study area considered by NORM

9.3.2.2 AIS Traffic Inputs

NORM makes use of raw AIS inputs to analyze vessel and traffic patterns and characteristics and is also used to develop relationships used for the risk calculations. For this study, the full set of AIS data was used from 2016 to 2019, clipped to the extents of the NORM study area. The AIS data was processed and analyzed to determine distributions of vessel characteristics within the NORM study area (i.e., LOA, beam, speed, annual volume, etc.) as well as to determine the range and distribution of track characteristics (i.e., lengths, crossing angles, etc.). The AIS data was also used to develop a proximity analysis to assess the frequency of potential ship encounters based on historical data (see Section 6.6 for more details on the proximity analysis). Appendix B outlines the NORM's use of AIS data in further detail; the various analyses in this "pre-processing" step that occur before the risk calculations is also depicted in a flow chart in Figure 9.11. As previously noted, it is estimated that 40 to 60% of fishing and recreational vessels transiting the area are not equipped with AIS; therefore, it was assumed in the model that AIS tracks represented only 50% of traffic in these fleets (the mid-point of the estimate). For the risk calculations, the traffic volume of fishing and recreational vessels were doubled to account for this underestimation of traffic.

9.3.2.3 Metocean Inputs

Wind

Wind is used as a model input for NORM; both the recorded wind data from the FLiDAR buoy and long-term CFSR wind fields were considered for the analysis. The time series of wind speeds and direction is then binned into ten-degree intervals and converted to a probabilistic distribution of wind conditions. The wind conditions are specifically used for the drifting allision risk calculations, whereby the direction and speed of the drifting vessel is directly correlated with the speed and direction of the winds acting on it.

Visibility

A time series of visibility conditions from Martha's Vineyard Airport was obtained and analyzed. The distribution of historical conditions revealed that visibility was equal to or less than 0.5 NM (1 km) approximately 8% of the time. Adverse visibility conditions in potential accident scenarios can reduce vessel reaction and response time and lead to increased navigational risk. According to Fujii and Mizuki (1998), the causation factors utilized by NORM were obtained from historical data where visibility was less than 0.5 NM (1 km) approximately 3% of the year. They also state that the influence of adverse visibility conditions on the causation probability (and thus navigational risk) is approximately inversely proportional to the inverse of the visibility. Suggestions are then provided to scale the causation factors by a factor of two if the frequency of visibility less than 0.5 NM (1 km) is between 3% to 10%, and by a factor eight if it is between 10 to 30%. NORM thus uses a modified version of these causation factors whereby they have been scaled by a factor of two.

9.3.2.4 GIS and Geometric Inputs

To calculate the navigational risk in the presence of the constructed offshore installations, GIS layers of the Lease Areas and turbine positions were used as inputs for NORM. The layout dictates the geometric characteristics of the corridors through the structures that can be safely transited, and relative positioning of structures with respect to transiting vessels. This in turn influences all collision and allision scenarios for the operations phase.

The layout used by the NORM model is showed in Figure 9.10. At the two grid positions outlined in red in Figure 9.10, co-located ESP structures were assumed. The co-located ESPs consist of two ESP structures centered around the 1 NM by 1 NM grid position but separated by 500 ft (152 m) in a north-south alignment. Co-located ESPs would be smaller structures installed on monopile foundations.

In addition to the layout, the dimensions of the structure foundations at the waterline are required. In this case, 46 ft (14 m) diameter monopiles and 105 ft (32 m) width jacket structures were assumed. The 46 ft (14 m) diameter monopile dimension was based on the diameter of the monopile (43 ft [13 m]) itself with an assumed 3 ft (1 m) allowance for the transition piece. The 105 ft (32 m) jacket width dimension was determined from the geometry of the structure at an assumed water level of MLLW. Note that the allision calculations in the model assume the maximum projected dimension of the jacket of 147 ft (45 m), which is the distance between piles on the diagonal. For Phase 1, two ESPs were assumed, and in order to assess the maximum design scenario they were assumed to be co-located at the position shown in Figure 9.10. For Phase 2, three ESPs were assumed. In order to assess the maximum design scenario two of these ESPs were assumed to be co-located at the position shown in Figure 9.10. Given the uncertainty in the final position, the remaining ESP was placed along the western boundary of Phase 2.

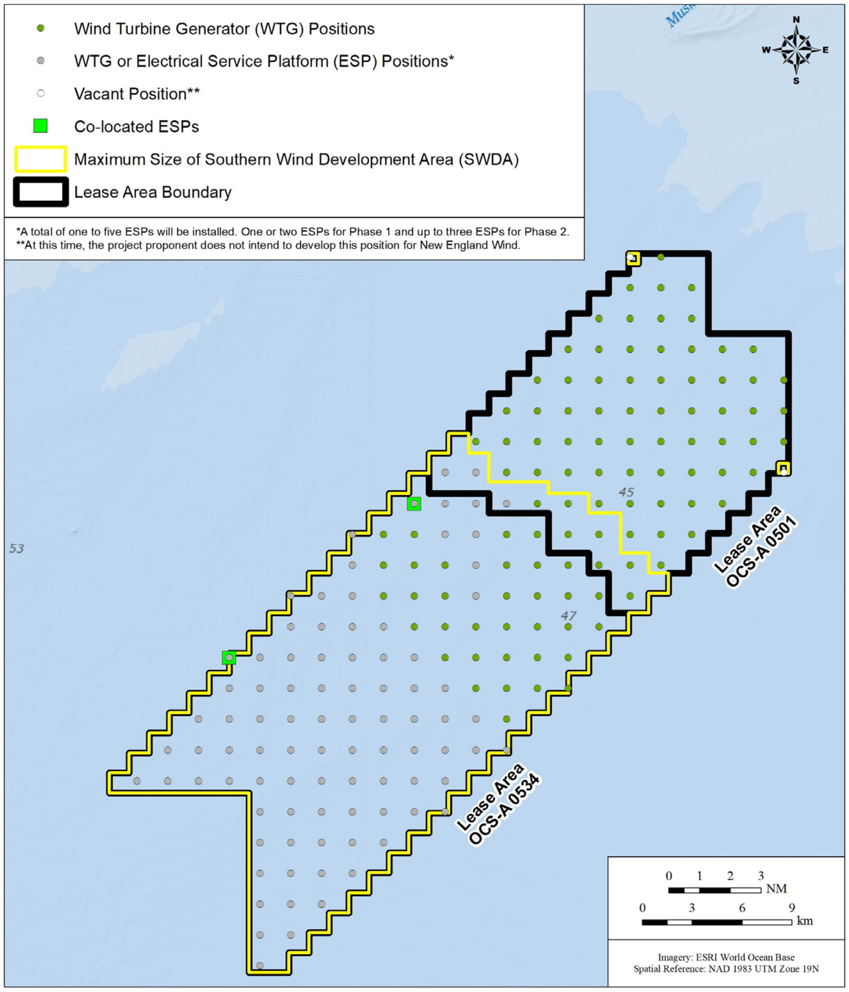

Figure 9.10: Layout used by NORM model

9.3.2.5 Data Adjustments

While contributing to overall navigational risk, vessels that do not meet AIS requirements may not be equipped with transponders, and thus may not be transmitting data. This can lead to an underestimation of vessel traffic, particularly for recreational and small fishing vessels. An analysis of the proportion of recreational and fishing vessels not equipped within the surrounding area revealed that approximately only half of these vessel had AIS transmitters (Baird, 2019). Thus, to account for non-AIS equipped vessels, a factor of two was applied to the traffic volume for these types of vessels.

Trawlers typically require a much larger area to operate when the trawl and dredge gear is fully extended. In this study, it has been assumed that the gear will extend a maximum of 600 ft (180 m) and that the vessel might utilize outriggers giving the vessel an overall effective beam of 175 ft (53.3 m). The outrigger width calculation assumed a maximum trawler beam of 35 ft with outriggers on either side of the vessel having a length of two times the vessel beam. The gear length extension was based the gear typically used at this site and on consideration of the water depths present in the area.

9.3.2.6 General Assumptions and Limitations

To compute accident frequencies using NORM, several assumptions were necessary. These assumptions lead to inherent limitations in the modeling approach that are listed and briefly described in this section.

The inputs were used in NORM's pre-processing step to calculate various relationships and for the risk calculations. Due to the capabilities of NORM, navigational risk calculations can be performed on an inter-class, intra-class, and overall traffic basis. All relationships and distributions used by NORM were calculated on an inter-class and bulk traffic basis. Inter-class risk calculations utilized inter-class inputs, while the intra-class and overall traffic risk calculations both utilized the overall traffic inputs.

For the vessel characteristics used in the risk calculations (i.e., LOA, beam, speed, etc.), the median value observed in the AIS data within the NORM study area was considered representative of typical vessel size and used for each type of vessel. It should be noted that PIANC (2018) recommends using the 98.5th percentile vessel LOA for each class to assess navigation corridor widths required. For the NORM model, where the focus is on estimating the accident probabilities for all vessels in each vessel class, the median parameters are more appropriate to represent the most likely vessel size characteristics.

As part of NORM's capabilities, an inter-class overtaking calculation is performed. This calculation would then essentially have two representative vessels of the same type travelling at the same speed, resulting in a null risk of overtaking collision. To account for this limitation, it was assumed that in this situation one of the vessels would be traveling at 75% of the speed of the other.

The metocean conditions were used as inputs for NORM's drifting allision methodology, to determine the drift direction following a vessel breakdown. Due to the magnitude of near-surface currents recorded by the FLiDAR buoy and the relative size of the area of a vessel above the waterline compared to below, it was assumed that windage would be the dominant force driving drifting direction. Thus, it was assumed that the drift direction distribution is equal to the wind direction distribution. Secondly, a constant drift speed was assumed of 1 knot (0.5 m/s). While the drift speed will ultimately determine the maximum drift extent during a given time period (and thus how many WTGs and ESPs are within this extent), sensitivity testing of this parameter revealed only the 1 to 2 closest set of WTGs and ESPs surrounding a disabled vessel contribute nearly all of the potential risk.

For collision scenarios within the turbine array in the operations phase, an assumption regarding lane distributions within corridors was necessary. While transiting alone through Lease Areas OCS-A 0501 and OCS-A 0534, it is expected (based on past experience and discussions with experienced operators) that vessel may tend towards the middle of the corridor. However, it is assumed that with additional traffic present, these vessels would stay to the starboard side of a given corridor.

The causation factors used by NORM are derived from historical accident data and have been widely used in many navigational risk studies (Fuji and Mizuki, 1998). While they are in general agreement with causation factors independently determined from different historical datasets (IALA, n.d.), all of these datasets have the limitation that they were derived from a particular location with particular conditions that may not necessarily be reflective of another location's conditions. The relative uniformity in the spread of causation factors independently determined suggests that the values employed by NORM are generally representative and applicable to Lease Areas OCS-A 0501 and OCS-A 0534. As well, the probability of causation was kept consistent between the pre-construction and operations phase scenarios so the relative change in risk could be evaluated.

As a conservative assumption, the two vacant positions shown in Figure 9.10 were included as part of the NORM model. The position further south was modelled as a WTG with the same dimensions as the rest of the

WTGs in the model. The position further north was modelled as a larger structure with a foundation with of 50 m (164 ft) at the waterline, with a 71 m (232 ft) diagonal distance across the foundation.

9.3.2.7 Summary Flow Chart

The flow chart shown in Figure 9.11 depicts NORM's overall process. The inputs are used for the pre-processing steps where they are analyzed to compute vessel and track statistics, vessel lane distributions, crossing angle distributions, vessel-vessel proximity probabilities, metocean conditions, and potential routing of vessels through Lease Areas OCS-A 0501 and OCS-A 0534 during operations phase.

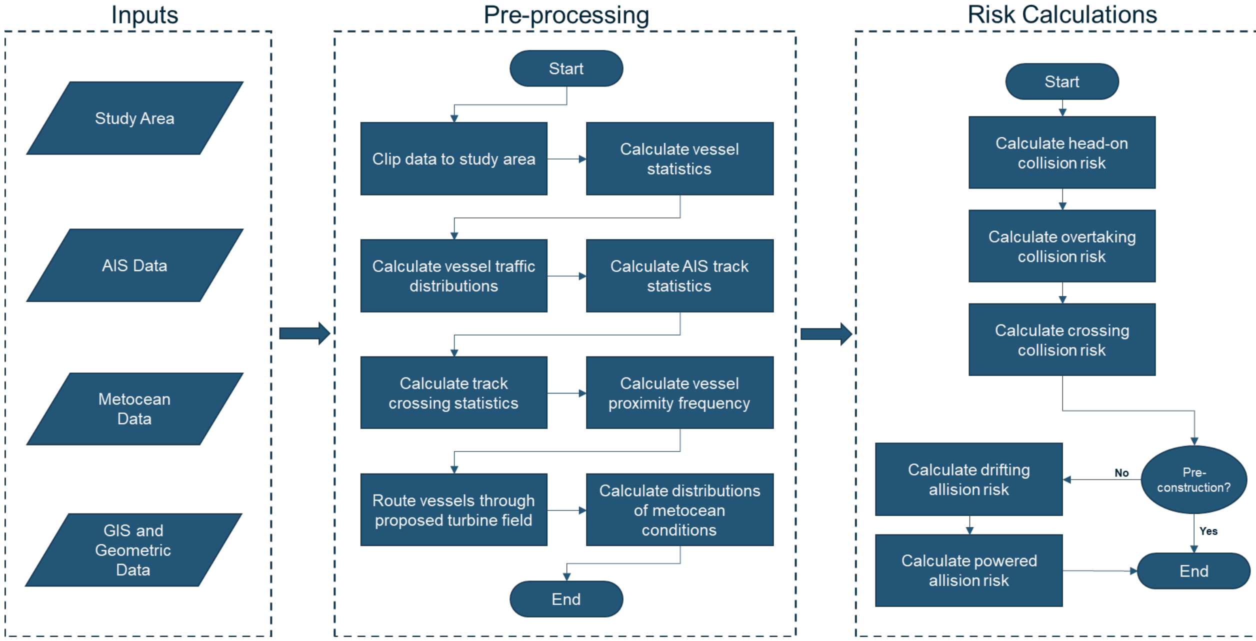

Figure 9.11: Overview of NORM Modeling Procedure

9.3.3 Navigational Risk Results

This subsection presents the results of the quantitative navigational risk assessment. Two scenarios were modeled using NORM; one for the pre-construction (present) conditions, and another for the operations phase conditions. Performing these two scenarios individually allows for a comparison of the relative change in risk.

9.3.3.1 Pre-construction

The AIS data used in NORM covers 2016 to 2019 inclusive. The navigational risk calculated using inputs from this period is considered as the reference point for future comparisons. These values are also referred to as the pre-construction inter-class collision annual frequencies. Table 9.9 and Table 9.10 present NORM's output for this scenario in terms of average collision frequency per year and as average recurrence intervals. The average recurrence interval, or "return period," is computed as the inverse of the annual frequency. It is a statistical measure of the average time between "events" (i.e., a collision).

As can be seen in Table 9.9, much of the pre-construction navigational risk is associated with fishing and recreational vessels. This is in agreement with the AIS analyses outlined in Section 6, as the vast majority of the AIS data recorded within the NORM study area belongs to these vessel types. As noted previously, the volume of traffic for these two classes of vessels was doubled to account for non-AIS equipped vessels.

Much of the pre-construction navigational risk is a result of crossing collisions as opposed to head-on or overtaking collisions. Given the current open water conditions and the somewhat random nature of the vessel tracks through the NORM study area, it was expected that the largest proportion of collisions would occur with oblique approach angles, and thus fall under the crossing collision scenario.

Table 9.9: Estimated Number of Collisions Per Year under Existing Conditions [1]

Vessel Class	Annual Collision Frequency
All	0.061
Cargo	0.0013
Tanker	0.00081
Passenger	0.00036
Military	0.00006
Fishing - Trawling	0.029
Fishing - Transiting	0.024
Recreational	0.0053
Tug-Tow	0.00011

1. These values are also referred to as the pre-construction inter-class collision annual frequencies.

Table 9.10: Estimated Average Number of Years Between Collisions under Existing Conditions[1]

Vessel Class	Average Years Between Collisions
All	16.3
Cargo	759
Tanker	1238
Passenger	2752
Military	17829
Fishing - Trawling	33.9
Fishing - Transiting	42.1
Recreational	190
Tug-Tow	9415

1. The average number of years between collisions is also referred to as the average recurrence interval.

Overall, the total frequency of all accident scenarios for all vessel classes was calculated to be 0.061 accidents per year, corresponding to an approximately 16-year average recurrence interval. As discussed in Section 7, there were no collisions identified within the study area based on analyses of historical USCG SAR data. This finding is consistent with the lack of collisions and may represent a conservative interpretation of risk in this area.

9.3.3.2 Operations Phase

The operations phase (post-construction) scenario was carried out in NORM using the same inputs as the pre-construction scenario, but with the WTG and ESP layout considered. The vessel characteristics, traffic conditions, and relationships developed during the pre-processing stage were assumed to be unchanged outside of Lease Areas OCS-A 0501 and OCS-A 0534. However, it was assumed that cargo, tanker, passenger, military, and tug-tow vessels would not transit through Lease Areas OCS-A 0501 and OCS-A 0534, but rather re-route around them.

For travel within or through Lease Areas OCS-A 0501 and OCS-A 0534, the remaining types of vessels (fishing and recreational) were “routed” through the corridors between the array of structures. The algorithm used for this routing isolates vessel tracks that intersect with the Lease Areas and determines the appropriate corridor of travel based on the intersection location and angle. The closest corridor with the greatest directional alignment with the vessel course when it enters the grid is chosen. It is assumed that no turning occurs during transit through Lease Areas OCS-A 0501 and OCS-A 0534; that is, an optimal route analysis was not performed for this step. The results of this routing process are shown in Figure 9.12.

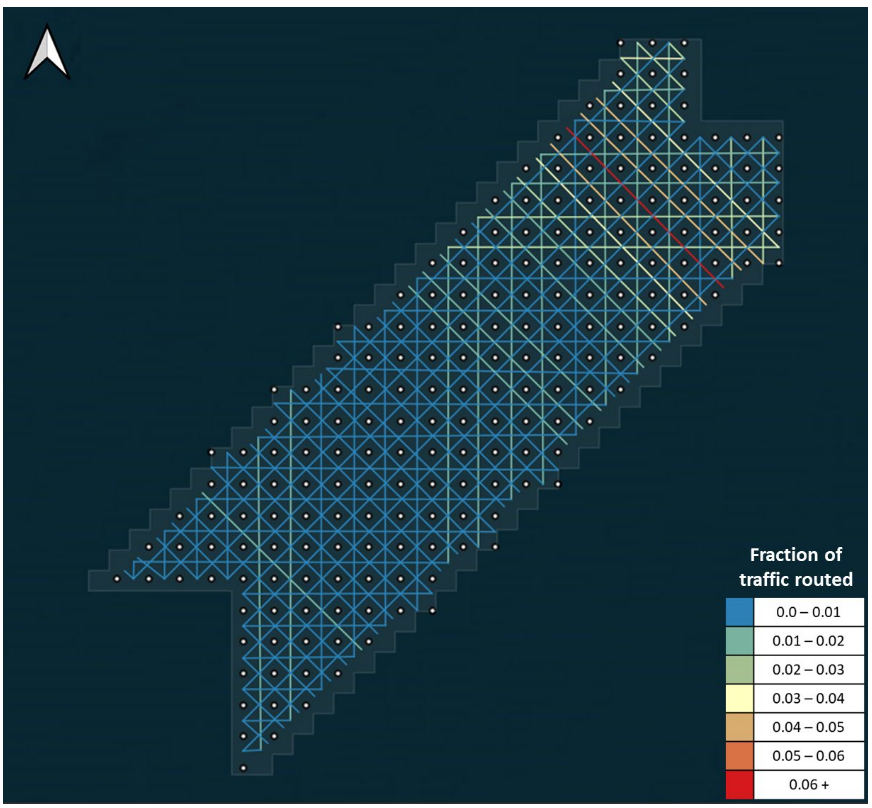

Figure 9.12: Corridors within Lease Areas OCS-A 0501 and OCS-A 0534 colored by Fraction of Total Routed Traffic

In addition, both New England Wind's and the Vineyard Wind 1 project's O&M vessels are expected to transit to and from, as well as within, Lease Areas OCS-A 0501 and OCS-A 0534. This was accounted for in the NORM model by creating synthetic vessel tracks from Vineyard Haven to the Lease Areas. (For Phase 1, the Proponent will likely establish a long-term SOV O&M base in Bridgeport, Connecticut and operate CTVs and/or the SOV's daughter craft out of Vineyard Haven and/or New Bedford Harbor. Phase 2 will likely use O&M facilities in Bridgeport, Vineyard Haven, and/or New Bedford Harbor. Vineyard Haven was selected for the NORM modeling as the use of CTVs produced the largest number of transits from O&M activities.) It was also assumed that the O&M vessels would return along the same path that was used to get there, to account for their potential interaction with other vessels transiting in and out of Lease Areas OCS-A 0501 and OCS-A 0534 during the round trip. The volume of O&M traffic was estimated to be up to approximately 530 round trips per year (less than two vessel trips per day on average). It was assumed that these vessels will consist largely of CTVs originating from Vineyard Haven as the use of CTVs produced the largest number of transits from O&M activities. The CTVs were assigned a 98 ft (30 m) LOA, 33 ft (10 m) beam, and an average speed of 10 knots. For transits within the Lease Areas, a uniform distribution of O&M traffic down each corridor in the WTG grid was assumed.

Outputs from the NORM analysis of the Lease Areas for the operations phase of both New England Wind and Vineyard Wind 1 are summarized in Table 9.11. Note that results for both the monopile and jacket structure scenarios are presented with the latter shown in brackets. Table 9.12 present the same results in terms of average recurrence intervals.

Table 9.11: Estimated Number of Collisions and Allisions Per Year during Operations[1]

Vessel Class	Annual Collision Frequency[2]	Annual Allision Frequency[2]	Total Annual Accident Frequency[2]
All	0.075 (0.075)	0.00085 (0.0028)	0.076 (0.078)
Cargo	0.0014 (0.0014)	-	0.0014 (0.0014)
Tanker	0.00082 (0.00082)	-	0.00082 (0.00082)
Passenger	0.00037 (0.00037)	-	0.00037 (0.00037)
Military	0.000057 (0.000057)	-	0.000057 (0.000057)
Fishing - Trawling	0.035 (0.035)	0.00011 (0.00034)	0.035 (0.035)
Fishing - Transiting	0.027 (0.027)	0.00054 (0.0017)	0.028 (0.029)
Recreational	0.0061 (0.0061)	0.00010 (0.00032)	0.0062 (0.0064)
Tug-Tow	0.00011 (0.00011)	-	0.00011 (0.00011)
O&M	0.0039 (0.0039)	0.00011 (0.00035)	0.0040 (0.0043)

1. These values are also referred to as the estimated operations phase inter-class accident annual frequencies.

2. Note that results for both the monopile and jacket structure scenarios are presented; results for the jacket structure scenario are shown in brackets.

Table 9.12: Estimated Average Number of Years Between Collisions and Allisions during Operations[1]

Vessel Class	Average Years Between Collisions[2]	Average Years Between Allisions[2]	Average Years Between Total Accidents[2]
All	13.3 (13.3)	1173 (363)	13.2 (12.9)
Cargo	738 (738)	-	738 (738)
Tanker	1215 (1215)	-	1215 (1215)
Passenger	2674 (2674)	-	2674 (2674)
Military	17395 (17395)	-	17395 (17395)
Fishing - Trawling	28.7 (28.7)	9516 (2944)	28.6 (28.4)
Fishing - Transiting	36.5 (36.5)	1853 (573)	35.8 (34.4)
Recreational	164 (164)	10013 (3096)	161 (156)
Tug-Tow	9115 (9115)	-	9115 (9115)
O&M	254 (254)	9298 (2875)	248 (234)

1. The average number of years between accidents (collisions and allisions) is also referred to as the average recurrence interval.

2. Note that results for both the monopile and jacket structure scenarios are presented; results for the jacket structure scenario are shown in brackets.

An important distinction between the pre-construction and operations phase risk calculation methodology is how traffic is handled both inside and outside Lease Areas OCS-A 0501 and OCS-A 0534. For the operations phase calculations, portions of the traffic are both inside and outside of the Lease Areas. Vessels within the Lease Areas are constrained by the physical geometry of the WTGs and ESPs and are thus likely to have more overlap in vessel lane distributions than when transiting outside of Lease Areas OCS-A 0501 and OCS-A 0534.

As with the pre-construction scenario, much of the operations phase navigational risk arises from fishing and recreational vessels. Also, the navigational risk is generally dominated mainly by crossing collisions. For the operations phase, there are also the contributions from the allision scenarios with the results from NORM suggesting that drifting allisions are considerably more likely than powered allisions.

Overall, the total frequency of all operations phase accident scenarios for all vessel classes was calculated to be 0.076 to 0.078 accidents per year (7.6 to 7.8% annual probability), depending on the type of the turbine foundation considered for the allision calculations. These accident rates correspond to an approximately 13-year average recurrence interval, which is slightly more frequent than the average recurrence interval during the pre-construction scenario. Compared to the estimated pre-construction collision risk, this is a small increase in risk (approximately 0.015 to 0.017 additional accidents per year) and equates to an additional vessel collision once every 59 to 67 years, on average, depending on foundation type. Much of the increase in risk is associated with New England Wind and Vineyard Wind 1 O&M vessel traffic (1,060 transits or 530 round trips), which represents an approximately 13% increase in vessel traffic in the NORM study area and a 34% increase in traffic within Lease Areas OCS-A 0501 and OCS-A 0534. However, is important to recognize that the CTVs will be modern, highly specialized vessels manned by professional crew. They will be outfitted with recent technology in terms of marine radar, AIS, and chart display. These vessels also will have specified weather thresholds in which transits will not be carried out. These additional safety factors associated with the CTVs have not been taken into account in the modeling.

It is important to recognize that the model has simulated the risk associated with the both Lease Area OCS-A 0501 and Lease Area OCS-A 0534, not just the SWDA. Of this total risk, the risk associated with the Vineyard Wind 1 project is estimated as approximately 0.0664 accidents per year. Thus, the increase in overall risk associated with the SWDA itself is approximately 0.010 to 0.012 additional accidents per year, or one additional accident every 86 to 104 years. Note that some of this risk increase occurs in the Vineyard Wind 1 Wind Development Area since it was assumed that the New England Wind O&M vessels will transit across the Vineyard Wind 1 Wind Development Area to reach the SWDA.

9.3.3.3 Impact on Navigational Risk

The NORM model estimated a small increase in accident frequencies associated with construction of WTGs and ESPs throughout Lease Areas OCS-A 0501 and OCS-A 0534 (Vineyard Wind 1 and New England Wind considered together) with a 0.061 annual frequency pre-construction changing to 0.076 to 0.078 annual frequency during O&M. This represents an additional vessel collision once every 59 to 67 years on average and is considered a small change in risk. The increase in overall risk associated with the SWDA itself is approximately 0.010 to 0.012 additional accidents per year, or one additional accident every 86 to 104 years, which is also considered a small change in risk. As noted previously, much of this risk is associated with New England Wind's and the Vineyard Wind 1 project's O&M vessels. It is important to note that the risk associated with these O&M vessels may be slightly over-estimated in the model given that these vessels will generally transit during fair weather conditions.

The overall risk of allision is small with average recurrence intervals for all classes of vessels in the range approximately of 363 to 1,173 years. Of the allisions, much of the risk was associated with drifting allisions. A powered allision is considered of very low probability.

It is important to note that the causation probability for collisions and powered allisions (i.e., essentially the probability that human error will occur) was unchanged between the existing and future cases in the model.

9.3.3.4 Potential Consequences of an Allision with a WTG or ESP

There are two types of potential allision, drifting and powered, with different potential consequences. A drifting allision is the result of an inoperable vessel (generally, a mechanical breakdown) and drifting due to environmental conditions. During such an event, the vessel drift speed will be low (1 knot or 0.5 m/s) as it is moved by the actions of wind and current, and result in a smaller amount of energy transfer during impact as compared to a powered allision. Given that the traffic expected to be transiting within the SWDA operations phase is comprised of recreational and fishing vessels with relatively small sized vessels, is not anticipated that there would be any appreciable structural damage to the WTGs for either type of allision. A drifting allision may result in structural damage to the vessel; however, given the low speed of impact, it is unlikely that it would result in life-safety risk or immediate sinking of a vessel. If a vessel continues to founder at a structure and repeatedly allides with the foundation due to waves and other forces on the vessel, then the consequences to the vessel would correspondingly increase.

For a direct powered allision event, the consequences could be severe depending on the vessel characteristics and approach conditions. Most of the traffic expected to transit through the SWDA after construction (and thus be at risk to powered allisions) will be either recreational or fishing vessels. As such, the small size of the vessels in relation to the WTG structures would likely result in only minor consequences for the WTG or ESP and likely more damage to the vessel. The damage to a vessel involved in a direct powered allision would vary depending on the size, type, and speed of the vessel; however, it could result in consequences up to life-safety risk and/or immediate sinking of the vessel. Fishing vessels undertaking trawling activity in the SWDA would be travelling low speeds, typically less than 4 knots. At these lower speeds, the consequences to the vessel may be severe but are unlikely to have life-safety risk or result in immediate sinking of a vessel.

Larger vessels (i.e., cargo, tanker, passenger, etc.) will likely be present near the perimeter of the SWDA as they are expected to re-route around Lease Areas OCS-A 0501 and OCS-A 0534. In the unlikely event one of these larger vessels drifts off-course and strikes a perimeter WTG or ESP at speed, the consequences could be significant. Structural damage could be experienced by the WTG or ESP structure, though the design of the WTGs and ESPs considers an allision potential. The vessel may also be significantly damaged, the crew may be injured including possibly fatalities, and/or the vessel may lose cargo containment. As noted previously, the overall risk of allision is very small with average recurrence intervals in hundreds to thousands of years.

9.4 Air Draft Restrictions

It is important to check the vertical clearance between the top of the largest vessels and the turbine rotor. Figure 9.13 shows that the minimum rotor tip clearance from Mean Lower Low Water (MLLW) is 89 ft (27 m). Mean Higher High Water (MHHW) is 3.57 ft (1.1 m) above MLLW based on NOAA tidal station 8449130 at Nantucket Island. Therefore, the minimum possible tip clearance from a high tide level is approximately 80 ft (24.4 m), allowing for a 5 ft (1.5 m) safety margin. This is the allowable maximum vessel “air draft” under calm conditions. Air draft refers to the maximum distance from the water line to the highest point on the vessel.

Waves induce vertical motions of vessels and will reduce the required vertical clearance. PIANC (2014) provides a means to estimate the vertical motion of vessels due to wave action. The largest vertical response tends to occur when the length of the vessel is approximately equal to wavelength. For wave periods of 10 to 12 s, the wavelength ranges from 480 ft to 640 ft (146 m to 194 m), which is the approximate size of the larger vessels. The estimated vertical response for such vessels would be approximately 1.5 times the magnitude of the significant wave height. The tallest sailing vessel to historically transit the SWDA is the Adix, which has a main mast height of approximately 130 to 150 ft (40 to 45 m) above the vessel water line. The mast of such a vessel is at risk of allision with the turbines.

Note that both the cargo and sailing vessels are at little risk of interacting with the WTG blades under normal conditions but the risk increases considerably should the vessel lose power and/or steerage and become adrift, or if there is a breakdown in navigational capability under poor visibility conditions. The vessel must be in very close proximity to the WTG in order for turbine strike to be feasible and would likely be associated with a co-incident allision between the vessel and the turbine base.

Based on the above, it is recommended that the air draft restrictions with the SWDA be identified by means of Notice to Mariners (NTMs) and on the navigational chart, subject to US Coast Guard practices and regulations.

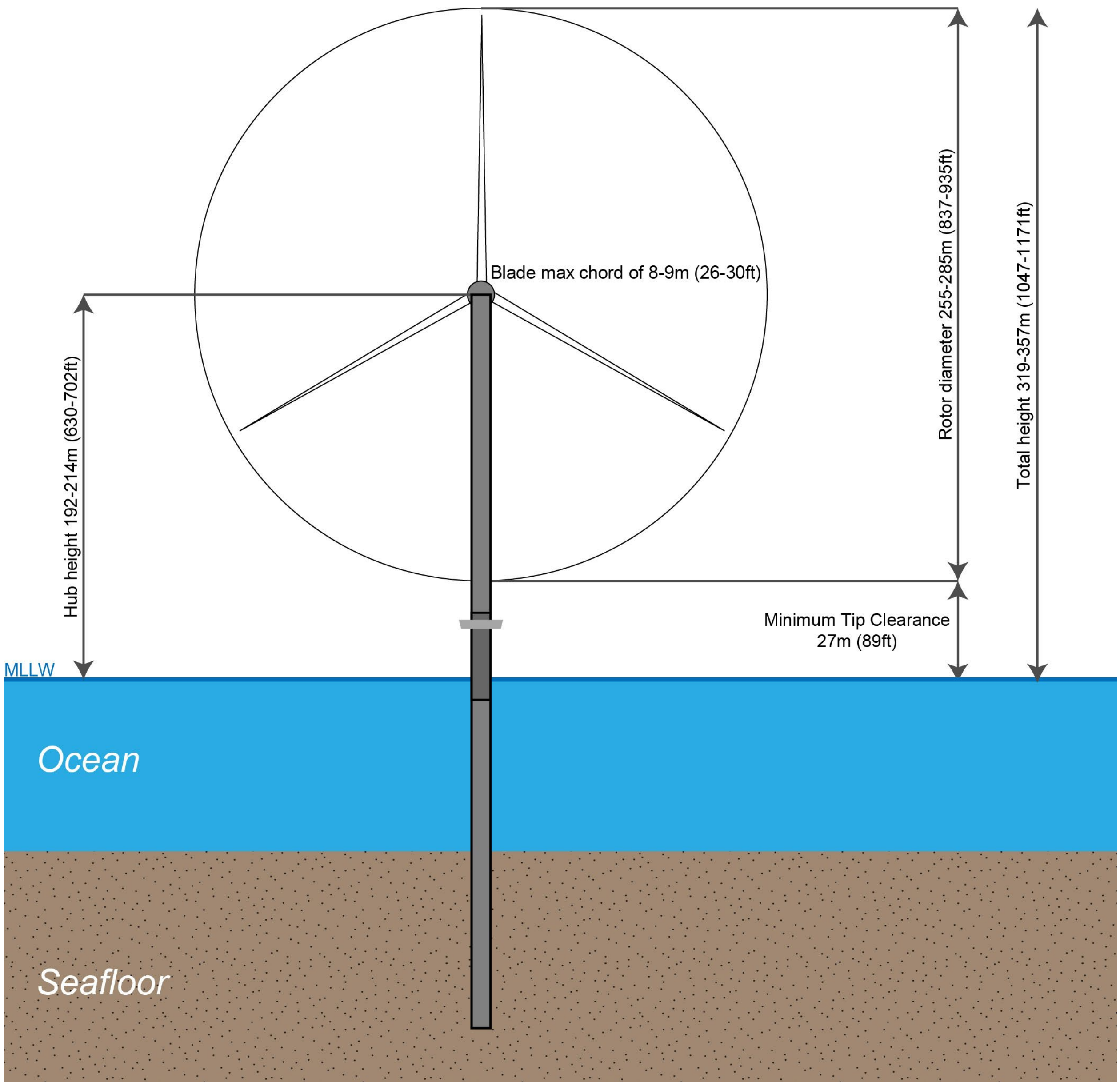

Figure 9.13: WTG Vertical Dimensions

9.5 Radar, Navigation Equipment, and Communication Equipment Impacts

Wind turbines and/or ESPs may theoretically distort various types of electromagnetic signals (PIANC, 2018) including:

- Radar systems, such as aviation, weather, and ship-borne systems;
- Radio communications, such as VHF;
- Automatic Identification Systems (AIS);
- Global positioning systems (GPS); and

- Compasses, including conventional magnetic and electronic fluxgate compasses.

The WTG and/or ESP structure and the moving blades of the turbine may result in scattering and shadowing of electromagnetic energy that may affect the operation of communication and object detection systems based on these technologies. This report section provides detail related to radar impact and discussion of influences on VHF radio communications and AIS. Details regarding mitigation measures for communication impacts and response procedures for incidents that may occur within the SWDA are addressed in Sections 11.2.5 and 11.3.

9.5.1 Radar

Radar is an electromagnetic system that utilizes radio waves and/or microwaves for the detection, location, and recognition of objects. It consists of a transmitter producing electromagnetic waves, a transmitting antenna, a receiving antenna (generally coinciding with the transmitting antenna), and a receiver with processor to determine the characteristics of the objects detected. Radio waves from the transmitter reflect off the object and return to the receiver, giving information about the object's location and speed. Depending on purpose, radars operate in different frequency bands termed L-band (1.0 to 2.0 GHz), S-band (2.0 to 4.0 GHz) or X-band (8.0 to 12.0 GHz).

Ships tend to operate the simplest types of radar system (due to cost) and utilize a single antenna that transmits a signal on a 360-degree circle around the ship. Marine radar operates in both X-band and S-band. X-band is used for accurate navigation and to detect objects around the ship. S-band is used for long distance detection and navigation and is less sensitive to sea and rain clutter (unwanted echoes). Studies (PIANC, 2018) have identified that at distances less than 1.5 NM (2.8 km) from a wind farm, interference from WTGs can generate false targets, see an example in Figure 9.14. There are three potential sources of signal interference:

- Side lobes detections – False targets can show up on the radar display that are at the same distance as the actual targets but are located on a different angle relative to the ship.
- Multiple reflections – When the ship’s radar is operating in close proximity to the wind turbines, “ghost” targets and clutter can show on the display due to the interaction of the radar signal with the turbines and ship structure. Re-reflections of the radar signal occur between the ship and turbine.
- Shadowing – When turbines are in the line of sight of the radar, shadowing can occur which reduces the reflected signal of an object that is behind the turbine.

In addition, wind turbines can mask or shadow weaker signal returns from smaller objects within the turbine field (Angulo et al., 2014). There have been simplified numerical models developed (e.g., Grande, 2014; Cascon et al., 2013) to assess the influence of WTGs on radar as it is a concern both with offshore and terrestrial wind farms.

Numerous studies of this issue cite the comprehensive investigations of the British Wind Energy Association (BWEA) into marine radar effects at the Kentish Flat Offshore Wind Farm (BWEA, 2007). In that study, the effect of an existing wind turbine array on the marine radar systems of various types and sizes of vessels passing in close proximity to the wind farm were documented. The majority of the systems tested (two-thirds) experienced false echoes and clutter; however, the spurious echoes were often generated by the ship’s structures in combination with the reflection characteristics of the turbines. Trained navigators were able to discern these reflection effects and were able to track other vessels near and within the wind farm. If a small vessel operated in close proximity to a WTG, the return signal of the vessel merged with the signal of the WTG itself and rendered the vessel invisible on the radar system. When the detecting ship was travelling within the turbine array, small vessels proved to be less detectable. Adjustment of the gain setting on the radar could improve the detection in these situations but did require a skilled operator. The Kentish study did identify that often the radar scanner was installed at a poorly selected location on the ships, accentuating the spurious echoes due to the proximity of the ship structures.

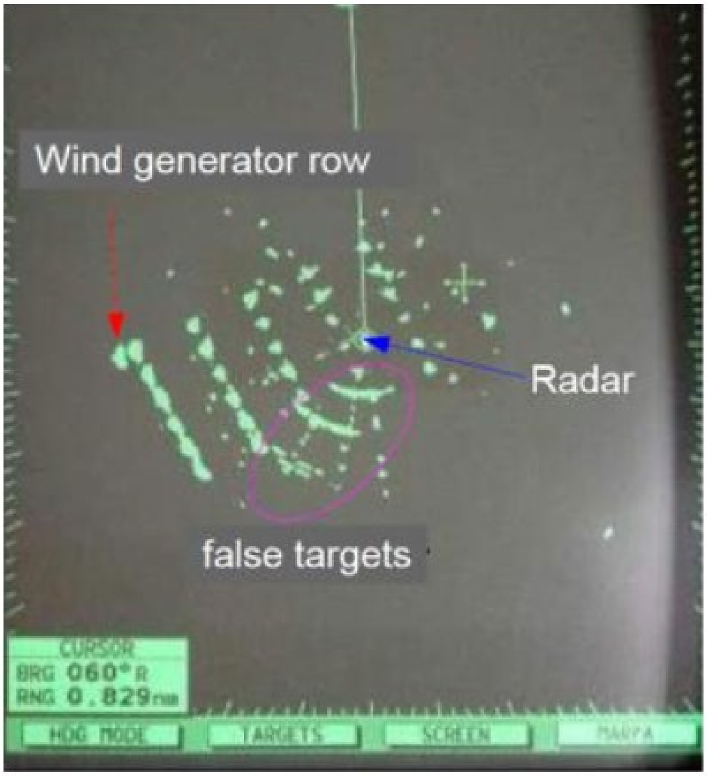

Figure 9.14: False Targets on the Radar Display [Source: PIANC, 2018]

The US Coast Guard evaluated the potential issues associated with marine radar at a proposed wind farm development in Nantucket Sound (USGC, 2009). The Coast Guard concluded:

- The wind farm would not adversely impact the ability of a ship located either inside or outside the wind farm to detect another ship located outside the wind farm.
- The wind farm would adversely impact the ability of a ship located either inside or outside the wind farm to detect another ship located within the wind farm array. The Radar operator would need to pay close attention to the radar scope to distinguish between a valid and false return, but it was feasible to discern vessels within the wind farm.

In 2015, an investigation of the potential impact of the Deepwater Block Island Wind Farm on Vessel Radar Systems was carried out (QinetiQ, 2015). The Block Island Wind Farm (BIWF) consists of five 6-MW wind turbine generators aligned linearly in an area located southeast of Block Island, see Figure 1.1. QinetiQ conducted numerical modeling to assess the radar reflection characteristics of the proposed WTGs and the potential effect on X-band and S-band ship radar systems. Two reference vessels were assumed to be present behind the turbines. The radars were assumed to be representative of typical small fishing vessels and a larger commercial vessel. It was determined that the radar systems, when utilized at maximum sensitivity, would exhibit the usual clutter and spurious echo artifacts, but that this clutter could be reduced through reducing the gain on the radar systems without loss of detection of the reference vessels.

The potential effects of the turbines creating shadows was assessed. It was concluded that shadowing would not affect the detection of the reference vessels. The shadowing occurred in 0.05 NM (100 m) wide strips behind the WTGs and would only be significant for detecting small vessels at some distance from the turbine. The shadowing effect did not prevent detection of these vessels due to the movement of the ship with the radar and/or the reference vessel.

Although New England Wind's offshore facilities have a much larger footprint than the Block Island Wind Farm, the potential issues of radar clutter and turbine shadowing would be similar for the SWDA when two vessels are operating in close proximity to each other amongst the WTGs.

The MARIPARS noted that the potential for interference with marine radar is site specific and dependent on many factors, such as: turbine size, array layouts, number of turbines, construction material(s), and vessel types. As part of the MARIPARS, the USCG reviewed several studies related to wind turbine induced radar interference and concluded that they were not aware of any authoritative scientific study that confirms or refutes the concern that WTGs will degrade marine radar.

A review of modern vessel radar systems did show that there have significant advances in radar technology in recent years, including Frequency Modulated Continuous Wave transmissions, target detection through Doppler effect, and other similar developments. Modern radar systems generally allow for the integration of AIS receivers into the display system.

In summary, it appears likely that New England Wind facilities, as with many other similar facilities around the world, may have an impact on certain marine radar systems. The largest risk with this issue appears to be the shadow effect and the detection of vessels that are located within the turbine field. The issue of radar clutter and false targets when navigating outside the turbine field is common to wind farms in Europe, some of which are located adjacent to heavily used shipping channels. Vessels do safely navigate outside these wind farms despite the radar impacts.

Rashid and Brown (2011) have noted that it is feasible to reduce spurious signal returns from wind farms using digital filtering kits, but these solutions only work with large Doppler-based radars such as in use for air traffic control. This type of solution will not work with the typical marine radar. It was also noted that other technologies are being evaluated to reduce the radar scattering caused by a turbine through adjustments to the shape of the turbine tower and through use of Radar Absorbing Materials.

9.5.2 High Frequency Radar for Current Measurement

NOAA maintains a network of high-frequency radar stations along the coastline which are capable of measuring currents and wave heights offshore. These systems provide data which is used for a variety of purposes including aiding search and rescue missions, oil spill response, and marine navigation. The system operates on a frequency band of approximately 5 to 12 MHz and uses doppler effects to derive ocean currents. There is a documented effect of wind turbines on the doppler shifts used to measure currents and wave heights. However, it is possible that the known interference effects can be partially or fully addressed with additional filtering and software improvements. BOEM sponsored research is currently underway to address and develop mitigations for WTG impacts on high frequency radar systems used for oceanographic measurements.

9.5.3 VHF Radio, Rescue 21 and AIS

Marine vessels communicate by means of VHF radio; with each other, with shore-based facilities (ports, locks, bridges, etc.), and with the US Coast Guard as required. In general, VHF is intended mainly for short range communications ("line of sight," normally 10 to 20 NM at sea), although range is affected by the transmission power, height, and quality of the transmitting and receiving antennae. Marine VHF radio has several uses, voice and digital/data applications, and there are several pre-designated channels regulated by law (see for Table 9.13 for a partial listing).

Table 9.13: US VHF Channel Information

Frequency (MHz)	Channel	Use
156.45	9	Boater calling, commercial and non-commercial
156.6	12	Port operations
156.65	13	Bridge-to-bridge safety
156.8	16	International distress, urgency, and safety priority calls
157.1	22A	US Coast Guard Maritime Safety Information Broadcasts
156.525	70	Digital Selective Calling
161.975	87B	Automatic Identification System (AIS1)
162.025	88B	Automatic Identification System (AIS2)
162.4 to 162.55	WX1 to WX 7	NOAA Weather Radio marine forecasts, tide predictions, etc.

Source: https://www.navcen.uscg.gov/?pageName=mtvhf

VHF operates in a significantly lower frequency band than marine radar (i.e., 156 to 174 MHz compared to 9.4 GHz for X-band radar), and consequently is much less affected by WTGs (see for example MCA and QinetiQ, 2004). Review of various European studies at sites such as Horns Rev Wind Farm (Elsam Engineering, 2004) in Denmark, the Horns Rev 3 Wind Farm (Orbicon, 2014), and the North Hoyle Wind Farm (Howard and Brown, 2004) indicated that WTGs did not have any significant impact on VHF communications. It was also observed in the Kentish Flat Offshore Wind Farm (BWEA, 2007) that AIS equipped vessels (AIS operates with VHF) did not experience any loss of signal either outside or within the wind farm.

The USCG Rescue 21 system and AIS also operate on the VHF frequency band and would be expected to be potentially impacted by WTGs similarly to VHF and DSC.

9.5.4 Compasses

Compasses may be affected by electromagnetic fields generated around turbines' generators (located in the nacelle) and/or offshore cables. The electromagnetic fields around cables decrease in strength rapidly with increasing distance from the cable. Given the depth of burial and water depth (more than 20 m in total in most areas), there will be no appreciable effect on compasses used for surface navigation. Similarly, the electromagnetic fields around turbine generators are located at a sufficient height above the water surface that there will be no appreciable effect on compasses used for surface navigation.

9.6 Noise and Underwater Impacts as Affecting Navigation

9.6.1 Noise

Throughout the operations phase of New England Wind, noise will be generated at various levels within the SWDA. Studies on the performance and impacts of the operation of WTGs have shown that acoustic waves will be generated in air, and low frequency vibrations will be generated in water. European experience has also shown that WTGs of similar size to those proposed within the SWDA may increase ambient noise levels at the turbine to approximately 100 to 120 dB but will rapidly decrease with distance. Within a 0.5 NM (1 km) radius of a WTG it is expected that noise levels will fall below thresholds set by the US EPA for outdoor recreational areas (CHC, 2018). As such, it is not expected that the noise generated by WTGs within the SWDA will produce any appreciable effect on navigational risk. The noise levels, both above and below water, are not expected to create any physical risks to the health or safety of vessel crews operating within the SWDA.

9.6.2 Sonar

Sonar is used by vessels to find fish, determine depth, bathymetric conditions, map the seabed, and to identify potential underwater hazards. Also referred to as “depth sounders” or “echo sounders,” these instruments have been used by vessels for decades to determine depth, and for safe navigation.

Sonar uses the principle of echolocation to determine the relative position of objects. In active sonar, a sound wave is emitted from a sonar transducer aboard the vessel, which bounces off the object and returns an “echo.” The lag time between the emission and response is used in conjunction with the speed of sound underwater to determine distance. In passive sonar, the system does not emit a signal, but only “listens” for signals. Sonar transducers typically emit frequencies in the 2 to 200-kHz range.

Technological advancements in this field have led to multi-functional sonar systems being more common. Sonar systems today can often detect multiple objects within the water column, in addition to the seabed. For example, “Fishfinder” echo sounders have become popular with recreational and commercial fishing vessels. The advancements have also impacted marine surveying techniques. Nowadays, many types of sonar-related bottom and sub-bottom imaging equipment are used to map the bottom of the ocean.

WTGs tend to produce low frequency vibrations underwater. It is expected that the WTGs would produce vibrations that fall well below the operational range of any sonar equipment. As such, the vibrations emitted from the WTGs are not expected to have any appreciable effect on sonar systems or navigational risk within the SWDA.

9.7 Visual Navigation and Existing Aids to Navigation

The WTGs and ESPs will result in a degree of visual blockage for objects or vessels that lie directly beyond and opposite (i.e., behind) the structure from the viewer. The size of object or vessel fully obscured depends on the relative distance between the visual obstruction and both the viewing vessel and the obscured vessel (Figure 9.15). Tables of the maximum size of object fully obscured, as well as the maximum amount of time a 45 ft vessel is fully obscured, are presented in Table 9.14 through Table 9.16 for WTGs with both monopile and jacket foundations as well as ESPs with jacket foundations. It is noted that jacket foundations have large amounts of open space between structural members and would result in an object being partially obscured rather than fully obscured. This analysis presumes that the line of sight is perpendicular to the viewing vessel’s direction of travel, that the viewing vessel is traveling at 8 knots, and that the object being sighted is stationary.

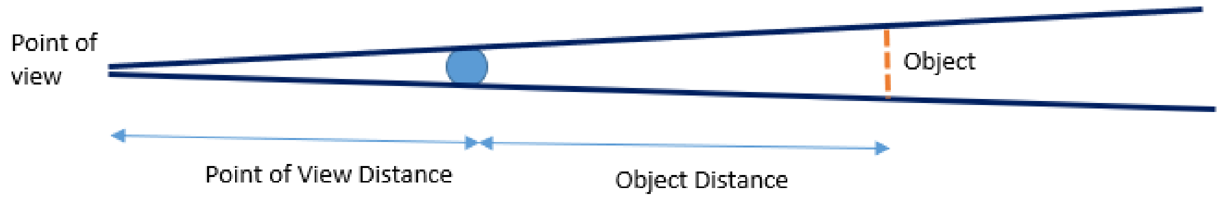

Figure 9.15: Visual Blockage Conceptual Diagram

Table 9.14: Visual Blockage Object Size and Time 45 ft Vessel is Fully Obscured at 8 knots Speed for WTG Monopile Foundations

Size of Object Blocked (ft)			
	Object Distance (ft)		
Point of View Distance (ft)	500	1000	1500
500	79	118	157
1000	59	79	98
1500	52	66	79
Time 45 ft Vessel is Fully Obscured at 8 knots (s)			
	Vessel Distance (ft)		
Point of View Distance (ft)	500	1000	1500
500	2	5	8
1000	1	2	4
1500	1	2	2

Table 9.15: Visual Blockage Object Size and Time 45 ft Vessel is Partially Obscured at 8 knots Speed for WTG Jacket Foundations

Size of Object Blocked (ft)			
	Object Distance (ft)		
Point of View Distance (ft)	500	1000	1500
500	262	394	525
1000	197	262	328
1500	175	219	262
Time 45 ft Vessel is Partially Obscured at 8 knots (s)			
	Vessel Distance (ft)		
Point of View Distance (ft)	500	1000	1500
500	16	26	36
1000	11	16	21
1500	10	13	16

Table 9.16: Visual Blockage Object Size and Time 45 ft Vessel is Partially Obscured at 8 knots Speed for ESP Jacket Foundations

Size of Object Blocked (ft)			
	Object Distance (ft)		
Point of View Distance (ft)	500	1000	1500
500	656	984	1312
1000	492	656	820
1500	437	547	656
Time 45 ft Vessel is Partially Obscured at 8 knots (s)			
	Vessel Distance (ft)		
Point of View Distance (ft)	500	1000	1500
500	45	70	94
1000	33	45	57
1500	29	37	45

As described in Section 5.2, there are no USCG maintained ATONs within the SWDA. The closest lighthouse to the SWDA is the Gay Head Lighthouse, located in Aquinnah, Martha's Vineyard (-70.834° E, 41.348° N). This lighthouse stands at 170 ft (51.8 m) tall, atop a bluff with an elevation of 148 ft (45 m) MSL; the light elevation is 299 ft (91 m) MSL. At this elevation, the lighthouse would typically be visible from sea level at approximately 20 NM (37 km) in clear conditions. Given the distance to the northern extent of the SWDA (approximately 21 NM [39 km]), it is expected that Gay Head Lighthouse would not be visible at sea level at any location within the SWDA.

Similarly, the Sankaty Head Lighthouse on the eastern side of Nantucket is within the vicinity of the Offshore Development Area. The light has a height of 158 ft (48 m) and has a visible range of 20 NM (37 km). The light is approximately 22 NM (40.7 km) from the northeastern boundary of the SWDA, and it is expected that the Sankaty Head Lighthouse would not be visible at sea level at any location within the SWDA. The WTGs and ESPs are not expected to obscure the visibility of the lighthouse for long enough to appreciably affect navigation. With only a small portion of the vessels able to see the lighthouse from the SWDA, New England Wind would have minimal impact on visibility of lighthouse signals for vessels.

Nearby, a red and white bell buoy marks the southern entrance to the Muskeget Channel, and a green can buoy marks the southern entrance to Nantucket Sound. The buoy marking the southern entrance to Nantucket Sound is approximately 12.4 NM (23 km) from the northern extent of the SWDA not lit. It is only visible in daylight hours from approximately 3.3 NM (6 km) at sea level, thus would not be visible from any location within the SWDA. This is in the range of the vessels observed in the AIS data. However, as with lighthouse visibility, it is expected that the WTGs will not obscure the visibility of the buoy in daylight hours for long enough to appreciably affect navigation, and all vessels would lose sight of these buoys shortly after entering the SWDA.

9.8 Effect on Emergency Response

According to the USCG's (2020) MARIPARS, "SAR capabilities in the WEA will be impacted by the presence of structures in the ocean where before there were no such structures." As described in the NSRA, the presence of the New England Wind WTGs and ESPs can increase the risk of incident with SAR vessels and the presence of WTGs may affect the USCG's airborne SAR assets.

However, the 1 NM by 1 NM WTG/ESP layout of New England Wind is consistent with the USCG's WTG spacing recommendations to accommodate SAR operations contained in the MARIPARS. The MARIPARS found that, "One NM spacing between WTGs allows aircrews to safely execute turns to the adjacent lane using normal flight procedures in visual conditions" and "may allow sufficient navigational room for aircrews to execute USCG missions in diverse and challenging weather conditions or deal with an aircraft emergency and/or navigational malfunction." In fact, New England Wind may facilitate SAR operations as the WTGs and ESPs will be marked and lighted and New England Wind vessels will operate frequently within the SWDA. According to the MARIPARS, a standard and uniform WTG/ESP layout will assist SAR in favorable weather conditions. Alphanumeric markings on the WTGs may also aid mariners in reporting their position during distress calls.

As described in Section 7, the USCG responds to multiple emergency, environmental, and law enforcement related matters a year in the area surrounding and containing the SWDA. During the operations phase of New England Wind, the primary impacts related to SAR operations will be confined to the immediate vicinity surrounding the SWDA.

The WTG spacing and minimum tip clearance of the blades is not expected to impact the operation of USCG marine assets that are in use in the area. It is expected that these marine assets will be able to safely navigate and maneuver adequately within the SWDA. Given the WTG spacing and relative size, it is not expected that New England Wind will significantly affect travel times to and within the SWDA by vessels responding to SAR distress calls. Section 9.5 outlines potential impacts to radar and communication within the SWDA during the operations phase; further investigation is required to fully quantify the subsequent impact on USCG SAR operations. No major impact is expected to affect the operation of emergency transponder systems used by many ocean-going vessels.

Response times for USCG aviation assets should not be impacted by New England Wind, except for missions directly within the SWDA, where aviation assets may have their operations impacted when near a physical WTG. The Proponent will work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested New England Wind WTGs to be engaged within a specified time upon request from the USCG during SAR operations and other emergency response situations. USCG ASCC pilots recommend a minimum spacing of 1 NM (1.8 km) between turbines for search paths; this would leave a 0.5 NM navigational buffer between turbines where aviation assets could safely navigate (USCG, 2020). Helicopter operations for USCG SAR missions typically travel at speeds of 70 to 90 knots (36 to 46 m/s) and are able to turn with a diameter from 0.8 to 1 NM (1.5 to 1.8 km) at these speeds. The 1 NM (1.8 km) spacing of the WTGs is considered adequate for the maneuverability of USCG aviation assets within the SWDA.

The specific mitigations for SAR operations are discussed in Section 11.2.5.

9.9 Effect on Marine Spill Response

Given the relative size of vessels used by USCG for SAR and MER operations, the WTG and ESP spacing relative to vessel maneuverability should pose no issues. In addition, travel times to incidents within the SWDA are not expected to have any significant increase due to the placement of WTGs. Thus, it is expected that New England Wind will have minimal impact on USCG MER operations. As outlined in Section 7, MISLE data over an approximately 10-year period reveal no spills within the SWDA. Historical data also shows that MER incidents are highly unlikely to occur within the SWDA.

Based on the minimal expected impact to USCG MER operations and low frequency of MER incidents, it is expected that New England Wind will not have any appreciable effect on the response to marine spills or pollution events. No additional MER incidents are expected as a result of New England Wind.

9.10 Effect on Anchoring

There will not be any impediment to vessels anchoring within the SWDA other than the presence of the WTGs and ESPs (and associated scour protection) and limited placement of cable protection (estimated to occur along no more than 2% of the offshore cables within the SWDA). The WTG and ESP spacing allows ample space for emergency anchoring of vessels between the structures, including allowance for an anchor sweep radius. All inter-array, inter-link, and offshore export cables within the SWDA will be buried beneath the seafloor at a target depth of 5 to 8 ft (1.5 to 2.5 m). The Proponent's engineers have determined that the target burial depth is more than twice the burial depth required to protect the cables from fishing activities and also provides a maximum of 1 in 100,000 year probability of anchor strike, which is considered a negligible risk.

9.11 Effect on Sailing Vessels

Potential impacts from New England Wind on sailing vessels, beyond the air draft and other impacts described in the sections above, are expected to be minimal. A slight degree of wind masking and/or increased turbulence in proximity to the WTGs is expected, particularly at higher elevations; however, based on Cunliffe (2021), the impact to sailing vessels is expected to be minimal.

9.12 Proximity to Dredge Disposal Sites

There are no active dredge material placement areas in proximity to the SWDA for which dredge navigation would be affected by the WTGs or ESPs. The nearest ocean disposal site for dredged material is located east of Block Island, approximately 33 NM (61 km) northwest from the SWDA.

9.13 Vessel Emissions

The SWDA is located within the North American Emission Control Area (ECA). More stringent emission and fuel sulfur content standards apply to ships operating within the North American ECA, which extends approximately 200 NM from the US coastline. Fuel switching activities to comply with the North American ECA fuel standards would occur at the ECA boundary well outside of the SWDA. Thus, there are no anticipated effects resulting from changes in emission/fuel standards upon entering the North American ECA on vessel traffic patterns or collision/allision risks in the Offshore Development Area.

9.14 Temporary Safety Buffer Zones

If in-water maintenance activities are required during O&M, there could be temporary safety buffer zones established around work areas in limited areas of the SWDA or along the OECC. See Section 11.1 for a description of temporary safety buffer zones.

10. Construction Phase Impacts

This report section discusses the potential effects of construction and installation activities on navigational risk as offshore construction proceeds for each Phase of New England Wind. Section 2.5 has previously defined the types and numbers of vessels that are anticipated for use. Section 11 addresses mitigation measures for both the operations and construction periods of New England Wind.

10.1 Vessel Traffic in the SWDA

Although an average of 30 vessels will be present in the SWDA during the construction of each Phase, most of the vessels will be in the immediate vicinity of the working area for days or weeks at a time. It is anticipated that temporary safety buffer zones will be established around the working areas to reduce hazards during construction activities. (As described in Section 11.1, it is currently understood that temporary safety buffer zones located beyond the 12 NM territorial sea boundary would be non-regulatory and would be implemented by the Proponent.) The Proponent will maintain regular contact with the USCG as to the area under construction, and it is expected that existing vessel traffic will divert around this area. Thus, there will be limited interaction between the construction vessels and existing traffic. The temporary safety buffer zones would only impact a small portion of the overall SWDA.

Partially constructed WTGs and ESPs will be marked and lit (in accordance with USCG guidance and permitted as PATONs) to improve visibility for mariners.

As described in Section 11.1, the Proponent will provide Offshore Wind Mariner Update Bulletins and coordinate with the USCG to issue NTMs advising vessel operators of construction and installation activities. The Proponent will also coordinate with state and local law enforcement, marine patrol, port authorities and commercial operators.

Overall, it is not anticipated that there will any significant disruption to navigational patterns within the SWDA other than the presence of safety zones, and some limited movement of vessels to and from the various supply ports (16 transits per day on average).

10.2 Vessel Traffic Along and Across the OECC

As noted in Section 6.7, there are on average 63 to 73 AIS-equipped vessels per day that cross the proposed OECC (including the Western Muskeget Variant). However, this traffic is highly seasonal with much of the recreational and fishing traffic occurring in the summer months, and there would be a considerable volume of vessels without AIS transponders. During the peak summer months (July and August), vessel traffic may be in the range of 200 to 300 vessels per day. The majority of these crossings take place in Nantucket Sound. Part of this traffic would include regular ferries between Falmouth, Hyannis Port and other locations, and the islands of Martha’s Vineyard and Nantucket.

As noted in Section 2.5, an average of approximately seven vessels may be used for cable laying activities with up to approximately 15 vessels during the peak months of activity. Although temporary safety buffer zones may be established around these vessels (see Section 11.1), these vessels should not result in any significant obstruction to local traffic. The Proponent will work with local ferry operators and harbor pilots to mitigate risks and minimize schedule delays.

10.3 Vessel Traffic to Ports

Estimated vessel trips to and from various ports that will be used to support construction are identified and summarized in Section 2. The largest number of trips is expected between New Bedford Harbor and the SWDA with an average of 7 round trips per day and up to 15 round trips per day during the peak of construction activity.

The Port of New Bedford houses over 300 fishing vessels and receives more than 500 large commercial vessel calls each year. Several ferry services operate from the port, including fast ferries to the islands of Martha's Vineyard and Nantucket. The harbor is protected by a large hurricane barrier (breakwater) that has storm surge gates across the entrance channel. The channel has a width of 150 ft (45 m) at this location, which is the controlling width for entrance of ships. The USACE operates the gates and coordinates traffic management with a number of marine stakeholders such as the USCG, the Northeast Pilots Association, the New Bedford Harbormaster, the Fairhaven Harbormaster, and the New Bedford Harbor Development Commission.

To understand the potential impact on existing vessel traffic, an analysis of AIS data was conducted for New Bedford Bay, as summarized in Table 10.1. An average of 7 vessel round trips per day (or an equivalent 14 transits per day) is expected for New England Wind, as compared to an existing average of 45 transits per day for AIS-equipped vessels. Peak traffic typically occurs in July and August, with an existing average of 86 daily transits. The actual total number of existing transits may be significantly higher, possibly by a factor of two or three, due to the numerous smaller vessels that do not utilize AIS.

Table 10.1: Vessel Transits in New Bedford Bay Identified in AIS Data (2016-19)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
Fishing	1716	1954	2419	3182	3744	3841	4089	4017	2976	2922	2527	2087	35474
Recreational	61	72	57	137	885	2153	3952	3968	1975	821	245	103	14429
Passenger	110	120	143	199	348	461	670	695	438	221	104	122	3631
Cargo	16	17	19	7	8	1	2	7	10	23	27	19	156
Tanker	27	19	22	15	29	22	47	39	28	23	21	21	313
Other	566	494	588	632	1163	1780	1932	1952	1122	795	595	614	12233
All Vessels	2496	2676	3248	4172	6177	8258	10692	10678	6549	4805	3519	2966	66236
Total (2016-19)	2496	2676	3248	4172	6177	8258	10692	10678	6549	4805	3519	2966	66236
Transiting Vessels per Day	20.1	23.7	26.2	34.8	49.8	68.8	86.2	86.1	54.6	38.8	29.3	23.9	45.3

Overall, it is anticipated that there will be a noticeable increase in the number of large vessels transiting into and out of New Bedford Harbor during construction. However, this increase will correspond to less than a 10% increase in total transits at the harbor and is within the level of day-to-day variability in number of transits. The increased transits are not expected to result in significant delays or congestion. Movements through the hurricane barrier will need to be carefully managed. Potential risk mitigation actions are discussed in Section 11.1.

10.4 Communication and Radar Impacts

Similar to impacts during the operations phase of New England Wind, the presence of WTGs (both completed and partially constructed) will have an effect on marine radar systems, including the potential for spurious images and clutter on screen. Given that vessels will not be navigating through the safety zones around working areas, these potential effects would only be of consideration in the portion of the turbine field already constructed. As noted in the MARIPARS study, the USCG is not aware of an authoritative scientific study that confirms or refutes the concern that WTGs will degrade marine radar.

VHF communication effects would be similar to those experienced during the operations phase of New England Wind (outlined in Section 9.5.3). The mitigations measures identified with respect to the operations phase (outlined in Section 11.2) would also be relevant for the construction phase.

10.5 Effect on Emergency Response

The effect on SAR activities will be similar to those experienced during the operations phase, as outlined in Section 9.8. SAR activities may be facilitated to some degree due to the presence of several vessels within the SWDA.

11. Risk Mitigation Measures and Monitoring

The Proponent will employ a variety of measures to mitigate impacts of New England Wind on navigation safety in the SWDA and other affected areas. These measures are outlined in the following sections for both the construction and operation of New England Wind.

11.1. Mitigation Measures – Construction

Coordination among the USCG, port authorities/operators, ferry operators, local pilots, and other entities will be necessary to ensure that impacts from New England Wind's construction and installation vessels are minimized. The Proponent is committed to working with each stakeholder to address navigation and other concerns during each Phase of New England Wind. As part of this effort, the Proponent plans to develop and implement a marine communications procedure to engage these stakeholders.

During construction of each Phase of New England Wind, the Proponent will employ a Marine Coordinator to manage all construction vessel logistics and implement communication protocols with external vessels at the harbor and offshore. During construction, the Marine Coordinator will be the primary point of contact for day-to-day operations with the USCG, port authorities, state and local law enforcement, marine patrol, and commercial operators. As such, the Marine Coordinator will be responsible for coordination with USCG regarding any required NTMs. The Marine Coordinator will operate from a marine coordination center that is established to control vessel movements throughout the Offshore Development Area. Daily meetings will be held by the Proponent to coordinate between contractors and avoid unnecessary simultaneous operations at the port facilities and routes to the Offshore Development Area.

As noted above, the Proponent will provide Offshore Wind Mariner Update Bulletins and coordinate with the USCG to issue NTMs advising other vessel operators of New England Wind's construction and installation activities. Local port communities and local media will also be notified and kept informed as the construction progresses. The Proponent's website will be updated regularly to provide information on the construction activities and specific New England Wind information. The Proponent will regularly provide updates as to the locations of installed WTGs and ESPs to the USCG and NOAA for use in navigational charts.

To minimize hazards to navigation, all New England Wind -related vessels and equipment will display the required navigation lighting and day shapes. New England Wind -related vessels will be also equipped with operational AIS and will comply with applicable US or Safety of Life at Sea (SOLAS) standards, with regards to vessel construction, vessel safety equipment, and crewing practices.

The WTGs and ESPs will become PATONs once they are installed. Temporary marine navigation lighting and marking will be installed on the foundation structures as they are being constructed, depending on the timing and sequence of foundation installation. Per USCG's *ME, NH, MA, RI, CT, NY, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* contained in District 1 Local Notice to Mariner (LNM) 44/20, all temporary base, tower, and construction components preceding the final structure completion will be marked with Quick Yellow (QY) obstruction lights visible 360 degrees around the structure at a distance of 5 NM. The USCG will be notified as temporary lights are planned and activated in order for the USCG to provide appropriate marine notices and broadcasts until the final structure marking is established.

The Proponent is committed to working with the USCG to mitigate safety concerns during construction. During construction, the Proponent will request from the USCG the establishment of 500 m temporary safety buffer zones around active work sites within the SWDA and along the OECC. The temporary safety buffer zones would be adjusted as construction work areas change within the SWDA or along the OECC, allowing fishing vessels and other stakeholders to use portions of the Offshore Development Area not under construction. These temporary safety buffer zones will be published in LNMs, Broadcast Notice to Mariners, and in all of the Proponent's standard communication methods. The Proponent may employ safety boats to provide guidance to mariners and fishing vessels, explain the ongoing activities, and request that they remain at least 500 m from the active work boats. These safety boats will have no enforcement authority; the safety boats will only provide guidance and document any concerns. Additional resources (e.g., safety vessels, personnel) will be in close proximity to construction and installation activities to respond to safety or environmental concerns, as they may arise.

While the USCG's jurisdiction for safety zones may be extended, it is understood that under current regulations, the USCG has the authority to enforce the temporary safety buffer zones that are established within the 12 NM territorial sea boundary, whereas temporary safety buffer zones located beyond 12 NM are voluntary and are not enforceable. However, it is very unlikely that USCG will have vessels actively monitoring the safety zones within their jurisdiction (unless there are compliance issues). It is more likely that the Proponent's safety boats will monitor the zones, document any compliance issues, and report those issues to the USCG who will then investigate the incident and issue fines or warnings to the owner of the vessel.

Additional construction-related vessel traffic at individual port facilities, as identified in Section 10.3, will result in a relatively small increase in traffic at these facilities and the adjacent waterways. NTM's will be issued by the USCG to address potential conflicts which may be identified.

11.2. Mitigation Measures – Operations and Maintenance

The following are mitigation approaches affecting vessel operations that could be adopted to reduce the impacts of New England Wind on navigation:

- The USCG could advise mariners of the air draft restriction within the SWDA by means of Notice to Mariners (NTMs).
- The use of a 1 NM by 1 NM east-west layout would allow fixed fishing gear to be placed along the east-west turbine alignment in line with the WTGs, so it is visually apparent where this gear is potentially located and is not within the corridors between turbine rows. This is consistent with the current practice of placing such gear along east-west LORAN lines.
- Similarly, the use of a 1 NM by 1 NM east-west layout would allow trawlers to utilize the east-west corridors between turbine rows.
- NOAA could update navigational charts to show the turbine locations and providing guidance as to limits to air draft and vessel lengths. Each wind turbine should be marked with an alphanumeric designation to serve as a point of reference for mariners when visually determining their position within the wind farm.

The following sections provide additional information on proposed mitigation and monitoring measures during New England Wind's operations and maintenance phase. All mitigation measures described below would be maintained constantly throughout the life of New England Wind to ensure navigational safety.

11.2.1 Aids to Navigation and Structure Identification Marking, Lighting, and Sound Signals

Each WTG and ESP will be permitted as a PATON and appropriate markings and lighting will be installed in accordance with USCG's *ME, NH, MA, RI, CT, NY, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* contained in District 1 LNM 44/20. Per USCG guidance, the Proponent will include unique alphanumeric identifiers on each WTG tower and/or foundation; alphanumeric marking of structures is expected to be consistent across the MA WEA and RI/MA WEA lease areas. All PATONs will meet USCG availability standards and will be maintained throughout the life of New England Wind, including maintaining procedures to correct any discrepancies.

Based on current USCG, BOEM, and Federal Aviation Administration (FAA) guidance, the following lighting, marking, and signaling requirements are expected; however, all structures will be marked and lit in accordance with USCG, BOEM, and FAA guidance in effect at the time each Phase of New England Wind is being constructed and operated.

Structure Color:

- Each WTG will be no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey in color; the Proponent anticipates that the WTGs will be painted off-white/light grey to reduce their visibility against the horizon.
- Visible portions of each foundation above the waterline are expected to be coated in high-visibility yellow paint.

Structure Identification Marking:

- Each structure (i.e., WTG and ESP) will be uniquely lettered and numbered in an organized pattern of rows and columns
- Letters and numbers labels will be as near to 3 m high as possible
- Identification markings will be visible above any servicing platforms (e.g., transition piece platform)
- Identification markings will be visible throughout a 360-degree arc from the water's surface
- Identification markings will also be visible at night through use of retro-reflective paint and lettering/numbering materials
- Structures will also be labelled below the servicing platform, if feasible

Structure Lighting:

- Lighting will be located on all structures, preferably on the servicing platform, visible throughout a 360-degree arc from the water's surface
- WTGs and ESPs designated as Significant Peripheral Structures (SPSs) (i.e., located at corners or other significant points on the periphery of the wind farm) will be lighted with quick flashing yellow (QY, 0.3s on/0.7s off, 60 flashes per minute) lights energized at a 5 NM range
- Other WTGs or ESPs along the outer boundary will be lighted with yellow 2.5 second (FL Y 2.5s, 1.0s on 1.5s off, 12 flashes per minute) lights energized at a 3 NM range
- All remaining, interior WTGs and ESPs will be lighted with yellow 6 second (FL Y 6,1.0s on 5.0s off, 10 flashes per minute) or yellow 10 second (FL Y 10, 1.0s on 9s off, 6 flashes per minute) lights energized at a 2 NM range
- All lights will be synchronized by their structure location within the field of structures

Sound Signals:

- Sound signals will be located on all structures designated as SPSs.
- Sound signals will sound every 30 seconds (4 second Blast, 26 seconds off)
- Sound signals will be set to project at a range of 2 NM
- Sound signals will not exceed 3 NM spacing
- Sound signals will be Mariner Radio Activated Sound Signals (MRASS) activated by keying VHF Radio frequency 83A five times within 10 seconds

- Sound signals will be timed to energize for 45 minutes from the last VHF activation

11.2.2 Aviation Obstruction Lighting

The WTGs will include an aviation obstruction lighting system in compliance with FAA and/or BOEM requirements. The aviation obstruction lighting system will consist of two synchronized FAA L-864 red flashing aviation obstruction lights placed on the nacelle of each WTG. If the WTGs' total tip height is 699 ft (213 m) or higher, there will be at least three additional low intensity L-810 flashing red lights on the tower at a point approximately midway between the top of the nacelle and sea level. If approved by BOEM and the FAA, 30 flashes per minute will be utilized for air navigation lighting. Other temporary lighting (e.g., helicopter hoist status lights) may be utilized for safety purposes when necessary.

The Proponent is working to reduce lighting to lessen the potential impacts of nighttime light on migratory birds and to address potential visual impacts. The Proponent expects to use an Aircraft Detection Lighting System (ADLS) that automatically activates all aviation obstruction lights (any FAA lights on both the nacelle and tower) when aircraft approach the Phase 1 WTGs, subject to BOEM approval. For Phase 2, the Proponent would expect to use the same or similar approaches to reduce lighting used for Phase 1, including the use of an ADLS. A report on how often the ADLS system would likely be activated is included in Appendix III-K for informational purposes. If the use of ADLS is not approved, reduced lighting schemes will be reviewed and discussed with BOEM. Aviation concerns are further discussed in Section 7.9 of COP Volume III.

The ESP(s) will include aviation lighting similar to the lighting described for the WTGs. If an ESP exceeds an overall height of 200 ft (61 m) above ground level/above mean sea level or exceeds any obstruction standard contained in 14 CFR Part 77, the ESP will include an aviation obstruction lighting system in compliance with FAA and/or BOEM requirements. If approved by BOEM and the FAA, 30 flashes per minute will be utilized for air navigation lighting. Subject to BOEM approval, aviation lights on the ESP(s) will also be activated by the Proponent's ADLS system. Other temporary lighting (e.g., helipad lights) may be utilized for safety purposes when necessary.

11.2.3 Marine Radar

BOEM is currently sponsoring a study by the National Academies of Sciences, Engineering, and Medicine to evaluate impacts of WTGS on marine vessel radar and identify potential mitigation measures. The study will consist of a literature review and may also include modeling, in order to better characterize potential effects and identify actions to reduce impacts. Mitigation for radar impacts (if needed) as well as communications consistency measures are expected to be based on regional efforts which would be implemented in conjunction with other MA WEA and RI/MA WEA developers. Possible mitigation measures that may be considered are presented below; however, it is noted that these are preliminary concepts, and it is expected that such regional mitigation measures will be refined and updated pending ongoing consultations with BOEM, USCG, and other MA WEA and RI/MA WEA developers:

- Communications and training could be provided to local marine radar users regarding spurious signals and clutter that can occur in the vicinity of offshore structures as well as the recommend approaches for reducing these effects.
- Investigation of the use of more advanced radar systems that may provide improved filtering of spurious signals and the tracking of small vessels.
- Investigation of the use of AIS in smaller vessels as a more reliant means of navigating in a turbine field.

11.2.4 AIS and VHF Systems

AIS systems are used to collect, exchange, present, and analyze information onboard vessels and ashore by electronic means. All New England Wind-related vessels will be equipped with operational AIS. AIS transponders are also included in the design of offshore structures (WTGs and ESPs) where appropriate as discussed above to enhance marine navigation safety. These AIS markers would supplement the information on the electronic chart and/or radar overlay. AIS markers will be used to mark all wind turbines in the SWDA and can be viewed on an electronic chart display and information system (ECDIS), radar overlay, or a minimum keyboard and display (MKD). The addition of AIS markers will supplement the radar overlay; however, it should be noted that not all vessels have the capacity to receive AIS data and hence, physical aids to navigation would also be employed as described above. The following outlines the AIS reporting all structures based on current USCG guidance, which may be modified by the time New England Wind becomes operational:

- AIS transponder signals will be transmitted superimposed at all SPSs
- AIS transponders will be capable of transmitting signals to mark all locations of all structures throughout New England Wind
- AIS transponder specifics will be coordinated with the USCG District 1 and approved by USCG headquarters level (CG-NAV)

Subject to USCG's recommendations the AIS marker system could be installed prior to construction of the turbines in order to facilitate adaption of the changed navigational approach in the SWDA. AIS systems operate on VHF frequency band. Vessels that are equipped and using Class B AIS systems could be recommended to have dual channel receivers to improve the reliability of frequent AIS data updates from multiple targets in the range of reception.

Based on a review of various studies conducted for existing offshore wind fields, the New England Wind WTGs are expected to have little impact on very high frequency (VHF) and digital select calling (DSC) communications or AIS reception.

11.2.5 Mitigation Measures for Emergency Response Activities

To mitigate potential impacts to SAR aircraft operating in the SWDA, the Proponent will work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested New England Wind WTGs to be engaged within a specified time upon request from the USCG during SAR operations and other emergency response situations. The protocol will include formal procedures that will enable efficient, effective processes for communicating and engaging the braking mechanism requests during SAR operations and other emergency response situations. These communications and shutdown procedures, as well as the brake systems, will be satisfactorily tested at least twice per year. The Proponent will participate in periodic USCG-coordinated training and exercises to test and refine notification and shutdown procedures and to provide SAR training opportunities for USCG vessels and aircraft.

The Proponent will maintain continuously operated (24 hours per day) operations center(s) throughout the life of New England Wind. The center(s) can assist the USCG in the response to distress calls through active control over the WTG braking system. The operations center personnel will have access to charts providing GPS position and identification numbers for each structure. The USCG will also be provided with this chart. The contact telephone number for the operations center(s) will be provided to the USCG and posted in various public notices which are issued.

If the ESPs include a helipad, the helipad will be designed to accommodate USCG HH60 rescue helicopters. Enabling USCG helicopters to land on the ESPs could allow for more efficient responses to potential emergency situations within and outside the SWDA. The Proponent is also evaluating the use of cameras on WTGs and/or ESPs, which may aid in the detection of distressed mariners and enhance the USCG's ability to respond in emergency situations. In the event that a structure is allided by a vessel, the Proponent will conduct a structural inspection as quickly as possible and advise the USCG if the structure has become a hazard to navigation.

The WTG nacelle hatches for access will be designed to enable opening, access, entry and exit from both inside and outside. It will be possible to unsecure and open the nacelle roof hatch from the outside of the nacelle to facilitate emergency rescue from the nacelle top.

11.3. On-going Monitoring and Communications Mitigation

The Proponent employs a Marine Operations Liaison Officer who serves as the strategic maritime liaison between the Proponent's internal parties and all external maritime partners and stakeholders (e.g., USCG, US Navy, port authorities, state and local law enforcement, marine patrol, commercial operators, etc.). The Marine Operations Liaison Officer is also expected to be responsible for coordinating and issuing Offshore Wind Mariner Update Bulletins to notify maritime stakeholders of the Proponent's offshore activities. The Marine Operations Liaison Officer will also assist in coordination of vessel inspections for construction and on-going operations.

The Proponent will provide Offshore Wind Mariner Update Bulletins and coordinate with the USCG to issue NTMs advising other vessel operators of O&M activities. The Proponent's website will be regularly updated to provide information on the O&M activities occurring in the Offshore Development Area. The WTGs and ESPs will also be clearly identified on NOAA nautical charts.

Finally, the Proponent will continue to work with the USCG, BOEM, and other stakeholders to maintain safe navigation within the Offshore Development Area and to identify additional potential mitigation measures, as necessary.

11.4. Decommissioning Mitigations

Impacts associated with decommissioning activities will be adequately mitigated through the implementation of best management practices, where practicable. Avoidance, minimization, and mitigation measures are anticipated to be similar to those described above in Section 11.1.

11.5. Navigational Risk Change Analysis Summary

Section 5.b(4) of NVIC 01-19 notes that the NSRA should provide a "change analysis" in which the impacts of the proposed structures are compared to the baseline conditions. Appendix D provides tables in which the changes in risk associated with New England Wind during construction, operations, and decommissioning are summarized along with the proposed mitigations and the actions that may be taken to monitor the risks.

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Appendix A

WTG and ESP Coordinates

A.1 WTG and ESP Approximate Coordinates

Name	Position Type	Phase	Easting (m)	Northing (m)	Latitude (degrees)	Longitude (degrees)	Water Depth (m)
AL37	Vacant	Phase 2	375286	4555000	41° 8' 12.272" N	70° 29' 9.423" W	38.3
AT31	WTG/ESP	VW1 or Phase 1	364174	4542036	41° 1' 5.606" N	70° 36' 55.581" W	45.7
AT32	WTG/ESP	VW1 or Phase 1	366026	4542036	41° 1' 6.709" N	70° 35' 36.315" W	46.1
AT42	Vacant	Phase 2	384546	4542036	41° 1' 16.913" N	70° 22' 23.586" W	39.5
AU30	WTG/ESP	Phase 1	362322	4540184	41° 0' 4.452" N	70° 38' 13.36" W	46.8
AU31	WTG/ESP	Phase 1	364174	4540184	41° 0' 5.57" N	70° 36' 54.115" W	46.4
AU32	WTG/ESP	Phase 1	366026	4540184	41° 0' 6.673" N	70° 35' 34.868" W	48.8
AU33	WTG/ESP	VW1 or Phase 1	367878	4540184	41° 0' 7.761" N	70° 34' 15.62" W	45.6
AU34	WTG	VW1 or Phase 1	369730	4540184	41° 0' 8.834" N	70° 32' 56.371" W	48.8
AU35	WTG	VW1 or Phase 1	371582	4540184	41° 0' 9.891" N	70° 31' 37.121" W	48.3
AV28	WTG/ESP	Phase 1 or Phase 2	358618	4538332	40° 59' 2.136" N	70° 40' 50.322" W	48.5
AV29	WTG/ESP	Phase 1 or Phase 2	360470	4538332	40° 59' 3.284" N	70° 39' 31.099" W	47.8
AV30	WTG	Phase 1	362322	4538332	40° 59' 4.417" N	70° 38' 11.875" W	47.0
AV31	WTG/ESP	Phase 1	364174	4538332	40° 59' 5.534" N	70° 36' 52.649" W	47.8
AV32	WTG/ESP	Phase 1	366026	4538332	40° 59' 6.636" N	70° 35' 33.423" W	48.0
AV33	WTG	Phase 1	367878	4538332	40° 59' 7.724" N	70° 34' 14.195" W	47.7
AV34	WTG	Phase 1	369730	4538332	40° 59' 8.796" N	70° 32' 54.966" W	48.2
AV35	WTG	VW1 or Phase 1	371582	4538332	40° 59' 9.853" N	70° 31' 35.736" W	46.8
AV36	WTG	VW1 or Phase 1	373434	4538332	40° 59' 10.895" N	70° 30' 16.504" W	45.0
AW28	WTG/ESP	Phase 1 or Phase 2	358618	4536480	40° 58' 2.102" N	70° 40' 48.798" W	48.2
AW29	WTG/ESP	Phase 1 or Phase 2	360470	4536480	40° 58' 3.249" N	70° 39' 29.595" W	48.3
AW30	WTG	Phase 1	362322	4536480	40° 58' 4.381" N	70° 38' 10.391" W	48.9
AW31	WTG	Phase 1	364174	4536480	40° 58' 5.498" N	70° 36' 51.185" W	48.3
AW32	WTG/ESP	Phase 1	366026	4536480	40° 58' 6.6" N	70° 35' 31.979" W	47.3
AW33	WTG	Phase 1	367878	4536480	40° 58' 7.686" N	70° 34' 12.771" W	49.8
AW34	WTG	Phase 1	369730	4536480	40° 58' 8.758" N	70° 32' 53.562" W	49.5
AW35	WTG	Phase 1	371582	4536480	40° 58' 9.814" N	70° 31' 34.351" W	47.7
AW36	WTG	VW1 or Phase 1	373434	4536480	40° 58' 10.855" N	70° 30' 15.14" W	45.1
AW37	WTG	VW1 or Phase 1	375286	4536480	40° 58' 11.882" N	70° 28' 55.928" W	44.5
AX26	WTG/ESP	Phase 1 or Phase 2	354914	4534628	40° 56' 59.73" N	70° 43' 25.637" W	50.3
AX27	WTG/ESP	Phase 1 or Phase 2	356766	4534628	40° 57' 0.907" N	70° 42' 6.457" W	50.5
AX28	WTG/ESP	Phase 1 or Phase 2	358618	4534628	40° 57' 2.068" N	70° 40' 47.275" W	48.0
AX29	WTG/ESP	Phase 1 or Phase 2	360470	4534628	40° 57' 3.214" N	70° 39' 28.092" W	49.4
AX30	WTG/ESP	Phase 1 or Phase 2	362322	4534628	40° 57' 4.346" N	70° 38' 8.908" W	51.5

Name	Position Type	Phase	Easting (m)	Northing (m)	Latitude (degrees)	Longitude (degrees)	Water Depth (m)
AX31	WTG	Phase 1	364174	4534628	40° 57' 5.462" N	70° 36' 49.722" W	50.8
AX32	WTG/ESP	Phase 1	366026	4534628	40° 57' 6.563" N	70° 35' 30.536" W	51.6
AX33	WTG	Phase 1	367878	4534628	40° 57' 7.649" N	70° 34' 11.348" W	51.0
AX34	WTG	Phase 1	369730	4534628	40° 57' 8.72" N	70° 32' 52.159" W	50.0
AX35	WTG	Phase 1	371582	4534628	40° 57' 9.775" N	70° 31' 32.968" W	47.9
AX36	WTG	Phase 1	373434	4534628	40° 57' 10.816" N	70° 30' 13.777" W	45.3
AX37	WTG	VW1 or Phase 1	375286	4534628	40° 57' 11.842" N	70° 28' 54.584" W	46.1
AY26	WTG/ESP	Phase 2	354914	4532776	40° 55' 59.697" N	70° 43' 24.076" W	52.2
AY27	WTG/ESP	Phase 2	356766	4532776	40° 56' 0.873" N	70° 42' 4.916" W	52.7
AY28	WTG/ESP	Phase 1 or Phase 2	358618	4532776	40° 56' 2.033" N	70° 40' 45.754" W	51.2
AY29	WTG/ESP	Phase 1 or Phase 2	360470	4532776	40° 56' 3.179" N	70° 39' 26.591" W	51.5
AY30	WTG/ESP	Phase 1 or Phase 2	362322	4532776	40° 56' 4.31" N	70° 38' 7.426" W	51.9
AY31	WTG/ESP	Phase 1 or Phase 2	364174	4532776	40° 56' 5.425" N	70° 36' 48.261" W	51.4
AY32	WTG	Phase 1	366026	4532776	40° 56' 6.526" N	70° 35' 29.094" W	51.8
AY33	WTG	Phase 1	367878	4532776	40° 56' 7.611" N	70° 34' 9.926" W	49.3
AY34	WTG	Phase 1	369730	4532776	40° 56' 8.681" N	70° 32' 50.757" W	48.5
AY35	WTG	Phase 1	371582	4532776	40° 56' 9.736" N	70° 31' 31.586" W	47.7
AY36	WTG	Phase 1	373434	4532776	40° 56' 10.776" N	70° 30' 12.415" W	46.6
AZ24	WTG/ESP	Phase 2	351210	4530924	40° 54' 57.268" N	70° 46' 0.794" W	51.1
AZ25	WTG/ESP	Phase 2	353062	4530924	40° 54' 58.473" N	70° 44' 41.656" W	51.6
AZ26	WTG/ESP	Phase 2	354914	4530924	40° 54' 59.664" N	70° 43' 22.516" W	55.4
AZ27	WTG/ESP	Phase 2	356766	4530924	40° 55' 0.839" N	70° 42' 3.376" W	55.3
AZ28	WTG/ESP	Phase 2	358618	4530924	40° 55' 1.999" N	70° 40' 44.234" W	55.5
AZ29	WTG/ESP	Phase 1 or Phase 2	360470	4530924	40° 55' 3.144" N	70° 39' 25.091" W	52.6
AZ30	WTG/ESP	Phase 1 or Phase 2	362322	4530924	40° 55' 4.274" N	70° 38' 5.946" W	50.6
AZ31	WTG/ESP	Phase 1 or Phase 2	364174	4530924	40° 55' 5.389" N	70° 36' 46.8" W	52.1
AZ32	WTG	Phase 1	366026	4530924	40° 55' 6.488" N	70° 35' 27.653" W	51.4
AZ33	WTG	Phase 1	367878	4530924	40° 55' 7.573" N	70° 34' 8.505" W	50.4
AZ34	WTG	Phase 1	369730	4530924	40° 55' 8.643" N	70° 32' 49.356" W	49.8
AZ35	WTG	Phase 1	371582	4530924	40° 55' 9.697" N	70° 31' 30.205" W	49.1
BA24	WTG/ESP	Phase 2	351210	4529072	40° 53' 57.236" N	70° 45' 59.196" W	52.1
BA25	WTG/ESP	Phase 2	353062	4529072	40° 53' 58.44" N	70° 44' 40.077" W	51.9
BA26	WTG/ESP	Phase 2	354914	4529072	40° 53' 59.63" N	70° 43' 20.958" W	55.2
BA27	WTG/ESP	Phase 2	356766	4529072	40° 54' 0.805" N	70° 42' 1.837" W	56.0
BA28	WTG/ESP	Phase 2	358618	4529072	40° 54' 1.964" N	70° 40' 42.715" W	51.6
BA29	WTG/ESP	Phase 2	360470	4529072	40° 54' 3.108" N	70° 39' 23.592" W	50.6
BA30	WTG/ESP	Phase 1 or Phase 2	362322	4529072	40° 54' 4.238" N	70° 38' 4.467" W	51.4

Name	Position Type	Phase	Easting (m)	Northing (m)	Latitude (degrees)	Longitude (degrees)	Water Depth (m)
BA31	WTG/ESP	Phase 1 or Phase 2	364174	4529072	40° 54' 5.352" N	70° 36' 45.341" W	52.7
BA32	WTG/ESP	Phase 1 or Phase 2	366026	4529072	40° 54' 6.451" N	70° 35' 26.214" W	50.6
BA33	WTG	Phase 1	367878	4529072	40° 54' 7.535" N	70° 34' 7.086" W	51.0
BA34	WTG	Phase 1	369730	4529072	40° 54' 8.604" N	70° 32' 47.956" W	50.7
BA35	WTG	Phase 1	371560	4529072	40° 54' 9.645" N	70° 31' 29.766" W	50.6
BB23	WTG/ESP	Phase 2	349358	4527220	40° 52' 55.985" N	70° 47' 16.696" W	52.6
BB24	WTG/ESP	Phase 2	351210	4527220	40° 52' 57.204" N	70° 45' 57.599" W	53.7
BB25	WTG/ESP	Phase 2	353062	4527220	40° 52' 58.407" N	70° 44' 38.5" W	53.1
BB26	WTG/ESP	Phase 2	354914	4527220	40° 52' 59.596" N	70° 43' 19.401" W	54.6
BB27	WTG/ESP	Phase 2	356766	4527220	40° 53' 0.77" N	70° 42' 0.3" W	51.7
BB28	WTG/ESP	Phase 2	358618	4527220	40° 53' 1.929" N	70° 40' 41.198" W	51.5
BB29	WTG/ESP	Phase 2	360470	4527220	40° 53' 3.073" N	70° 39' 22.094" W	50.6
BB30	WTG/ESP	Phase 2	362322	4527220	40° 53' 4.201" N	70° 38' 2.989" W	50.5
BB31	WTG/ESP	Phase 1 or Phase 2	364174	4527220	40° 53' 5.315" N	70° 36' 43.883" W	51.3
BB32	WTG/ESP	Phase 1 or Phase 2	366026	4527220	40° 53' 6.413" N	70° 35' 24.776" W	54.0
BB33	WTG/ESP	Phase 1 or Phase 2	367878	4527220	40° 53' 7.497" N	70° 34' 5.668" W	53.2
BC22	WTG/ESP	Phase 2	347506	4525368	40° 51' 54.719" N	70° 48' 34.156" W	54.2
BC23	WTG/ESP	Phase 2	349358	4525368	40° 51' 55.953" N	70° 47' 15.08" W	53.3
BC24	WTG/ESP	Phase 2	351210	4525368	40° 51' 57.171" N	70° 45' 56.003" W	53.5
BC25	WTG/ESP	Phase 2	353062	4525368	40° 51' 58.374" N	70° 44' 36.925" W	53.4
BC26	WTG/ESP	Phase 2	354914	4525368	40° 51' 59.562" N	70° 43' 17.845" W	53.4
BC27	WTG/ESP	Phase 2	356766	4525368	40° 52' 0.736" N	70° 41' 58.764" W	52.0
BC28	WTG/ESP	Phase 2	358618	4525368	40° 52' 1.894" N	70° 40' 39.681" W	51.6
BC29	WTG/ESP	Phase 2	360470	4525368	40° 52' 3.037" N	70° 39' 20.598" W	52.8
BC30	WTG/ESP	Phase 2	362322	4525368	40° 52' 4.165" N	70° 38' 1.513" W	53.6
BC31	WTG/ESP	Phase 2	364174	4525368	40° 52' 5.278" N	70° 36' 42.427" W	53.8
BC32	WTG/ESP	Phase 1 or Phase 2	366026	4525368	40° 52' 6.375" N	70° 35' 23.339" W	55.3
BC33	WTG/ESP	Phase 1 or Phase 2	367878	4525368	40° 52' 7.458" N	70° 34' 4.251" W	55.0
BD21	WTG/ESP	Phase 2	345654	4523516	40° 50' 53.441" N	70° 49' 51.577" W	54.7
BD22	WTG/ESP	Phase 2	347506	4523516	40° 50' 54.688" N	70° 48' 32.522" W	54.0
BD23	WTG/ESP	Phase 2	349358	4523516	40° 50' 55.921" N	70° 47' 13.466" W	54.8
BD24	WTG/ESP	Phase 2	351210	4523516	40° 50' 57.138" N	70° 45' 54.409" W	55.6
BD25	WTG/ESP	Phase 2	353062	4523516	40° 50' 58.341" N	70° 44' 35.35" W	52.8
BD26	WTG/ESP	Phase 2	354914	4523516	40° 50' 59.528" N	70° 43' 16.29" W	52.3
BD27	WTG/ESP	Phase 2	356766	4523516	40° 51' 0.701" N	70° 41' 57.229" W	53.8
BD28	WTG/ESP	Phase 2	358618	4523516	40° 51' 1.858" N	70° 40' 38.166" W	55.0
BD29	WTG/ESP	Phase 2	360470	4523516	40° 51' 3.001" N	70° 39' 19.103" W	55.2

Name	Position Type	Phase	Easting (m)	Northing (m)	Latitude (degrees)	Longitude (degrees)	Water Depth (m)
BD30	WTG/ESP	Phase 2	362322	4523516	40° 51' 4.128" N	70° 38' 0.037" W	53.0
BD31	WTG/ESP	Phase 2	364174	4523516	40° 51' 5.24" N	70° 36' 40.971" W	52.0
BE25	WTG/ESP	Phase 2	353062	4521664	40° 49' 58.307" N	70° 44' 33.777" W	54.5
BE26	WTG/ESP	Phase 2	354914	4521664	40° 49' 59.494" N	70° 43' 14.737" W	56.5
BE27	WTG/ESP	Phase 2	356766	4521664	40° 50' 0.666" N	70° 41' 55.696" W	56.5
BE28	WTG/ESP	Phase 2	358618	4521664	40° 50' 1.823" N	70° 40' 36.653" W	55.8
BE29	WTG/ESP	Phase 2	360470	4521664	40° 50' 2.964" N	70° 39' 17.609" W	55.0
BE30	WTG/ESP	Phase 2	362322	4521664	40° 50' 4.091" N	70° 37' 58.563" W	54.0
BE31	WTG/ESP	Phase 2	364174	4521664	40° 50' 5.203" N	70° 36' 39.517" W	54.3
BF25	WTG/ESP	Phase 2	353062	4519812	40° 48' 58.274" N	70° 44' 32.205" W	57.9
BF26	WTG/ESP	Phase 2	354914	4519812	40° 48' 59.46" N	70° 43' 13.185" W	58.0
BF27	WTG/ESP	Phase 2	356766	4519812	40° 49' 0.631" N	70° 41' 54.163" W	57.3
BF28	WTG/ESP	Phase 2	358618	4519812	40° 49' 1.787" N	70° 40' 35.14" W	56.7
BF29	WTG/ESP	Phase 2	360470	4519812	40° 49' 2.928" N	70° 39' 16.116" W	55.9
BG25	WTG/ESP	Phase 2	353062	4517960	40° 47' 58.24" N	70° 44' 30.635" W	59.8
BG26	WTG/ESP	Phase 2	354914	4517960	40° 47' 59.425" N	70° 43' 11.634" W	58.3
BG27	WTG/ESP	Phase 2	356766	4517960	40° 48' 0.595" N	70° 41' 52.632" W	57.4
BG28	WTG/ESP	Phase 2	358618	4517960	40° 48' 1.751" N	70° 40' 33.629" W	56.7
BH25	WTG/ESP	Phase 2	353062	4516108	40° 46' 58.206" N	70° 44' 29.066" W	59.6
BH26	WTG/ESP	Phase 2	354914	4516108	40° 46' 59.39" N	70° 43' 10.085" W	59.3
BH27	WTG/ESP	Phase 2	356766	4516108	40° 47' 0.56" N	70° 41' 51.103" W	58.8
BJ25	WTG/ESP	Phase 2	353062	4514256	40° 45' 58.171" N	70° 44' 27.498" W	60.8
BJ26	WTG/ESP	Phase 2	354914	4514256	40° 45' 59.355" N	70° 43' 8.537" W	60.2
BK25	WTG/ESP	Phase 2	353062	4512404	40° 44' 58.137" N	70° 44' 25.932" W	61.5

Notes:

1) Grid coordinates referenced to UTM Zone 19 north in meters, NAD 1983 (2011) datum.
2) Water depths may be interpolated where WTG/ESP positions have not been surveyed yet.
3) Water depths are referenced to Mean Lower Low Water.

Appendix B

Navigational and Operational Risk Model (NORM)

B.1 Introduction

NORM is a model developed by Baird to assess and quantify navigational risk for both open-water and defined waterway conditions. NORM is capable of calculating navigational risk in both situations and is mainly geared towards quantifying the change in risk due to potential installations, or changes in waterway conditions. NORM is written in Python, and is a statistical based navigational risk model that uses a theoretical framework derived from well established literature as its base. NORM uses raw AIS traffic inputs, metocean conditions, and fixed structure information to calculate the risk of various accident scenarios. NORM can calculate the occurrence frequency of head-on collisions, overtaking collisions, crossing collisions, powered allisions and drifting allisions. These calculations can be performed for intra-class, inter-class, and overall traffic risk analyses.

NORM consists of three main steps, as outlined in Figure B.1. These include an input step (where all relevant input data in collected), a pre-processing step (where the input data is processed into meaningful inputs for the risk calculations), and the actual risk calculation step.

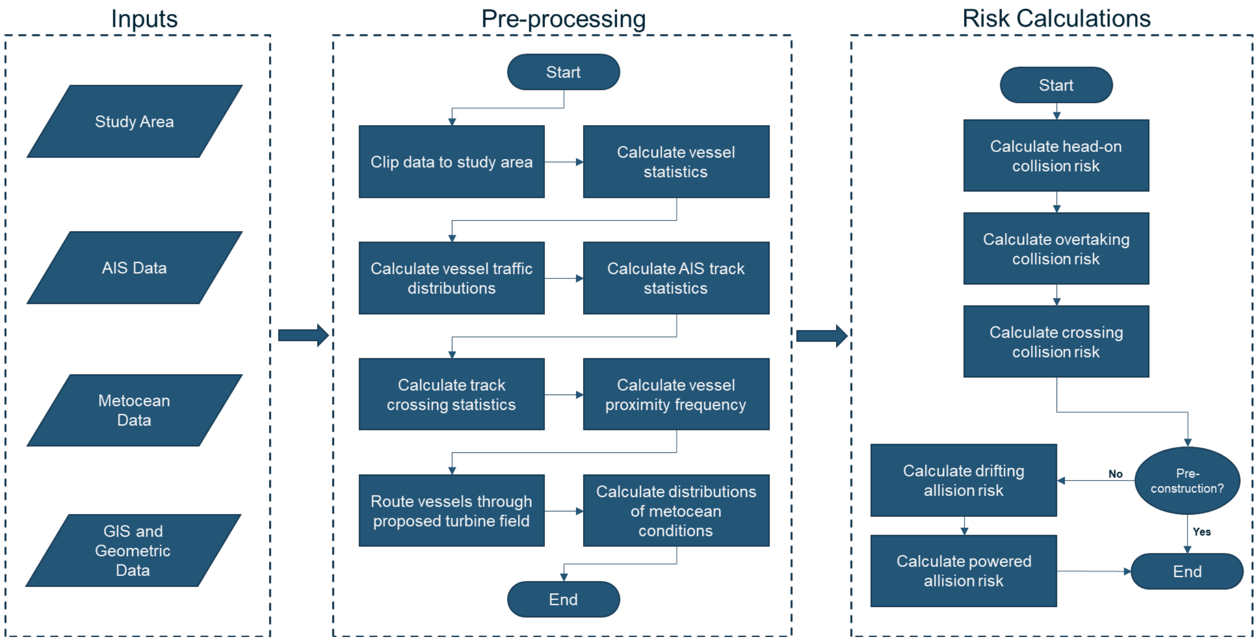


Figure B.1: Overview of NORM Modeling Procedure

B.1.1 Inputs

B.1.1.1 Study Area

The study area for the navigational risk assessment must be chosen carefully to only contain the traffic that may be appreciably affected by the project of interest. If too large an area is chosen, it may contain a considerable amount of traffic that may never actually experience any impacts due to an offshore installation resulting in an underestimation of the relative change in navigational risk. If too small an area is chosen, then the study may be focused on vessels that experience a larger impact and could result in an overestimation of the relative change in navigational risk. NORM analyzes the traffic patterns local to the area of interest and, with some manual user input, chooses an appropriate study area. This study area is then used to clip all AIS data (often retrieved for a larger area) to contain the analysis only to the study area.

B.1.1.2 AIS Data

NORM uses raw AIS data as inputs into the model, mainly for the pre-processing steps outlined in Section B.1.2. Multi-year datasets can be used by NORM to understand the distribution of vessel characteristics that are common to the study area and for determination of design vessel characteristics used in the risk calculations. This data is also used for various analyses to determine traffic characteristics such as heading distributions, crossing angle distributions, proximity frequencies, etc.

B.1.1.3 Metocean Data

Wind and/or current conditions local to the chosen study area are used as a model input for NORM. NORM considers long term historical or hindcast datasets to understand the conditions local to the chosen study area. The wind and current conditions are specifically used for the drifting allision risk calculations, whereby the direction and speed of the drifting vessel is directly correlated with the speed and direction of the winds acting on it as well as oceanographic and/or tidal current.

For North America, NORM has the ability to search multiple databases to identify datasets with information on visibility conditions in the chosen study area. Outside of North America visibility data may be manually input. Visibility is a critical component that affects mariner’s ability to safely travel, and is used by NORM to modify the various causation factors as outlined in Section B.1.3.1.

B.1.1.4 GIS and Geometric Inputs

NORM has the capability to incorporate arbitrarily shaped and positioned objects in the form of GIS shapefiles. These can be used to represent turbine locations, offshore oil rigs, or any other offshore installation, and their respective geometry. These inputs are mainly used to calculate collisions with fixed offshore objects, i.e., allisions. When using NORM to calculate navigational risk in the presence of a turbine field, the layout of the grid dictates the geometric characteristics of the corridors that can be safely transited, and relative positioning of turbines with respect to transiting vessels. NORM uses the GIS and geometric inputs to automatically determine the appropriate corridor geometry and assumed traffic distribution through these corridors in the presence of a turbine field or other fixed objects.

B.1.2 Pre-processing

NORM includes a pre-processing step, whereby all the raw inputs are processed to obtain meaningful relationships and inputs for the risk calculations. This includes pre-processing of the raw AIS data, metocean data, and GIS/geometric data. As part of this pre-processing step, NORM calculates the following:

1. Vessel characteristics and traffic statistics
    - Distribution of vessel LOA, beam, speed, annual/seasonal volume for each vessel class
2. Vessel traffic distributions
    - Spatial distribution of traffic concentration (see Figure B.2)
    - Spatial distribution of vessels with respect to one another in concentrated areas, done on an inter-class and intra-class basis (see Figure B.3)

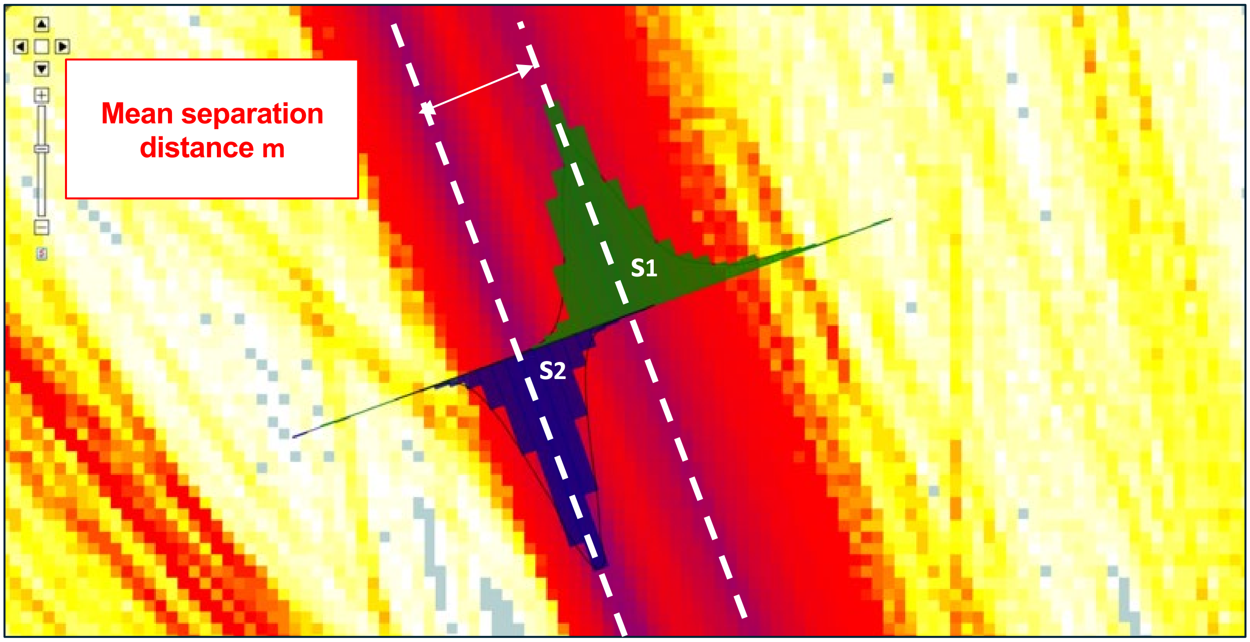


Figure B.2: Spatial Distribution of Traffic Concentration and Vessel Traffic Distribution

3. AIS track statistics
   - AIS ping data used to make AIS tracks
   - Individual tracks analyzed to get track length and heading distributions, done on an inter-class and intra-class basis (see Figure B.3)

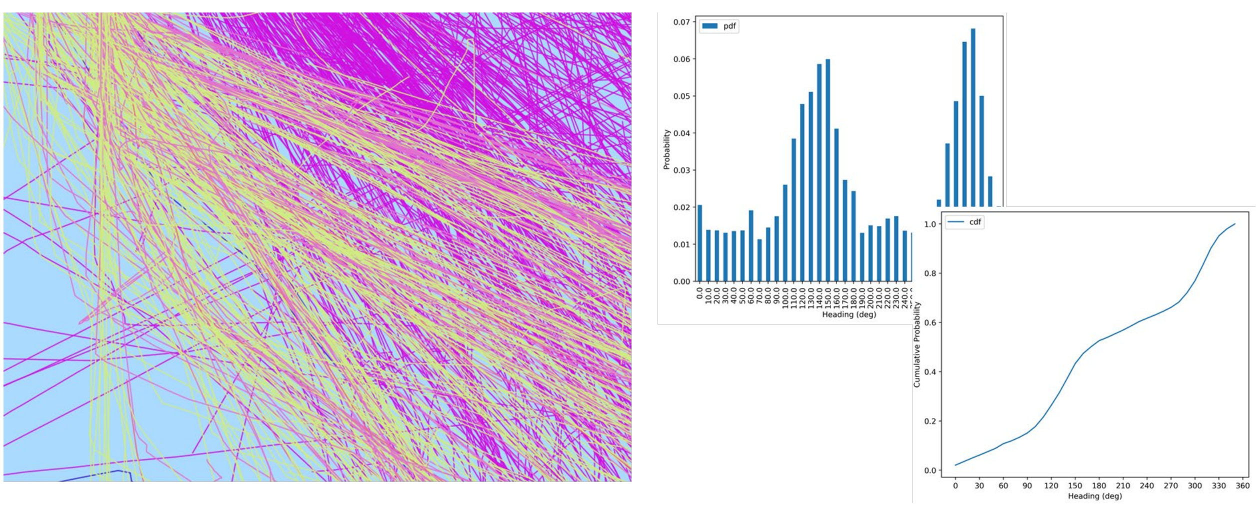


Figure B.3: AIS Tracks, and Track Length and Heading Distributions

4. Track crossing statistics
   - AIS tracks used to determine potential crossing locations and distribution of crossing angles, done on an inter-class and intra-class basis (see Figure B.4)

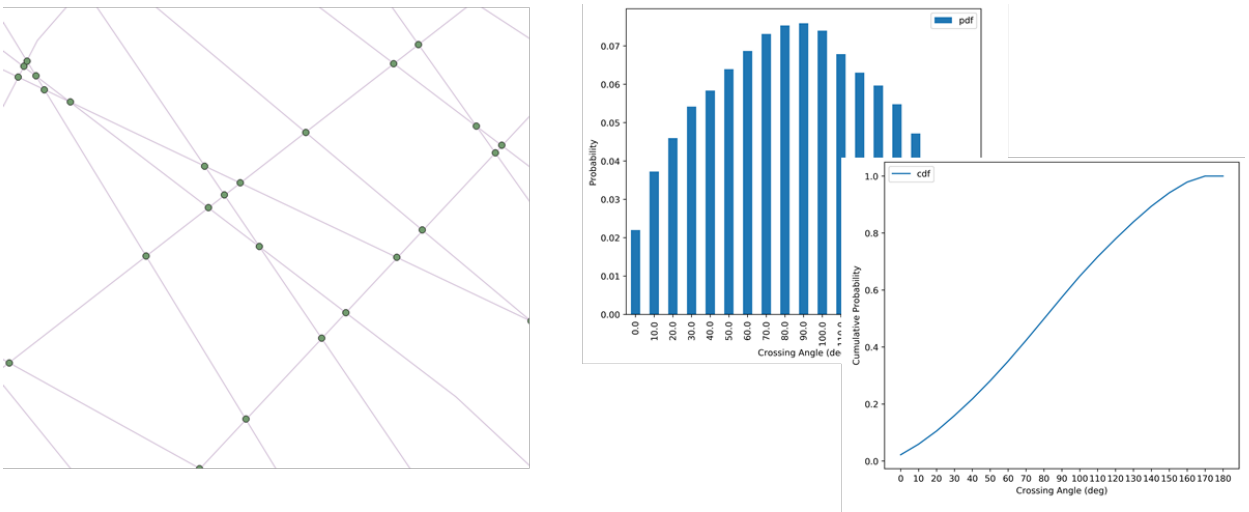


Figure B.4: AIS Tracks, and Track Intersection Angle Distribution

5. Vessel proximity frequencies
   - AIS tracks used to establish a relationship between vessel proximity and recurrence interval, done on an inter-class and intra-class basis
6. Route vessels through turbine field
   - NORM utilizes a simple algorithm (based on existing traffic patterns, turbine field footprint, and turbine placement) to route traffic down future corridors between turbine rows, establishing future traffic conditions within the turbine field used for risk calculations (see Figure B.5)

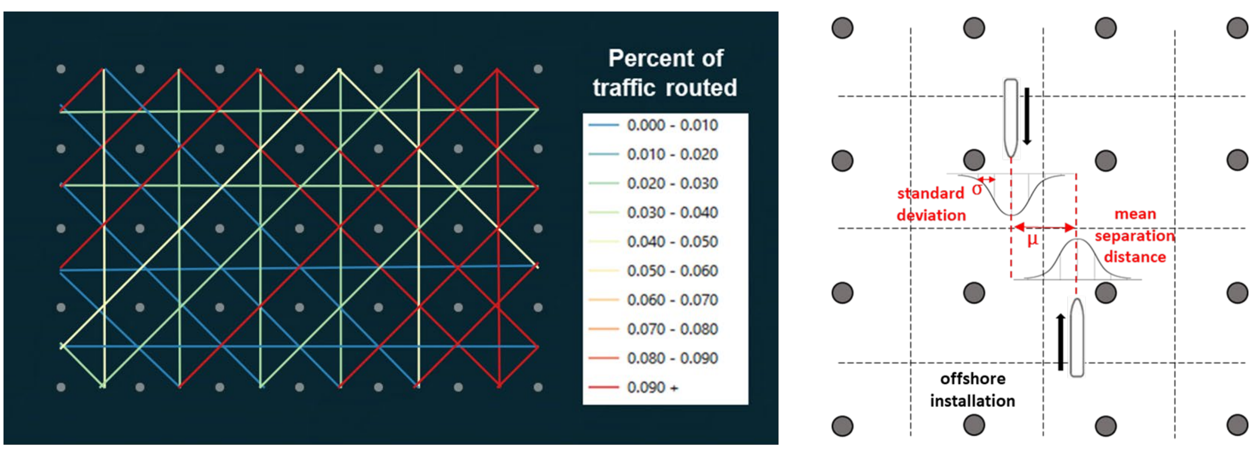


Figure B.5: Traffic routed through Turbine Field (left), Assumed Future Traffic (right)

B.1.3 Risk Calculations

NORM employs a widely adopted and accepted methodology for calculating navigational risk for various collision/allision scenarios that is described in the below equation:

$$N_a = P_a * n = P_g * P_c * n$$

Where N_a is the number of accidents occurring over a given time period (typically one year), P_a is the probability of an accident occurring, n is the number of vessels over a given time period, P_g is the geometric probability of an accident occurring, and P_c is the causation probability. The causation probability is the probability that a potential accident will in fact occur once on a potential collision/allision course.

The number of vessels considered (n) is obtained from AIS data. Methodology outlined in Zhang et al. (2019) is employed to calculate the geometric probability (P_g); this methodology stems from original work outlined in Pedersen (2010). NORM also employs causation factors (P_c) developed by Fuji and Mizuki (1998).

B.1.3.1 Causation Factors

Causation factors are defined as the probability that an accident will in fact occur, given that one (or more) vessel(s) is on a potential collision/allision course. It is the factor meant to capture human error in the collision or allision process, whereby it acts as a reduction factor for all the possible collisions/allisions that could occur under blind navigation conditions.

Causation factors have historically been computed using fault tree analysis, Bayesian networks, or derived from historical accident data. In general, they are dependent on human and vessel response, environmental conditions, use of navigational and communication equipment (i.e., AIS, VTS), etc. NORM utilizes the causation factors developed by Fuji and Mizuki (1998), rooted in historical observations. These causation factors have been widely applied in the industry, and have been used as default factors for navigational risk models as such IWRAP (IALA, n.d.); the causation factors are summarized in Table B.1.

Table B.1: Accident Causation Factors used in NORM

Accident Scenario	Causation Factor
Head-on Collision	0.5E-04
Overtaking Collision	1.1E-04
Crossing Collision	1.3E-04
Grounding	1.6E-04
Powered Allision	1.86E-04

Adverse visibility conditions in potential accident scenarios can reduce vessel reaction and response time and lead to increased navigational risk. According to Fujii and Mizuki (1998), the causation factors they generated were obtained from historical data where visibility was less than 1 km approximately 3% of the year. They also state that the causation probability (and thus navigational risk) is approximately inversely proportional to the visibility. Suggestions are then provided to scale the causation factors by a factor of two if the frequency of visibility less than 1 km is between 3% to 10%, and by a factor eight if it is between 10 to 30%. NORM makes this adjustment based on visibility conditions.

B.1.3.2 Collision Scenarios

Collisions are defined as the event of one vessel striking or contacting another vessel. NORM considers three different collision scenarios as part of the navigational risk assessment procedure: head-on, overtaking, and crossing. These collision scenarios are depicted in Figure B.6.

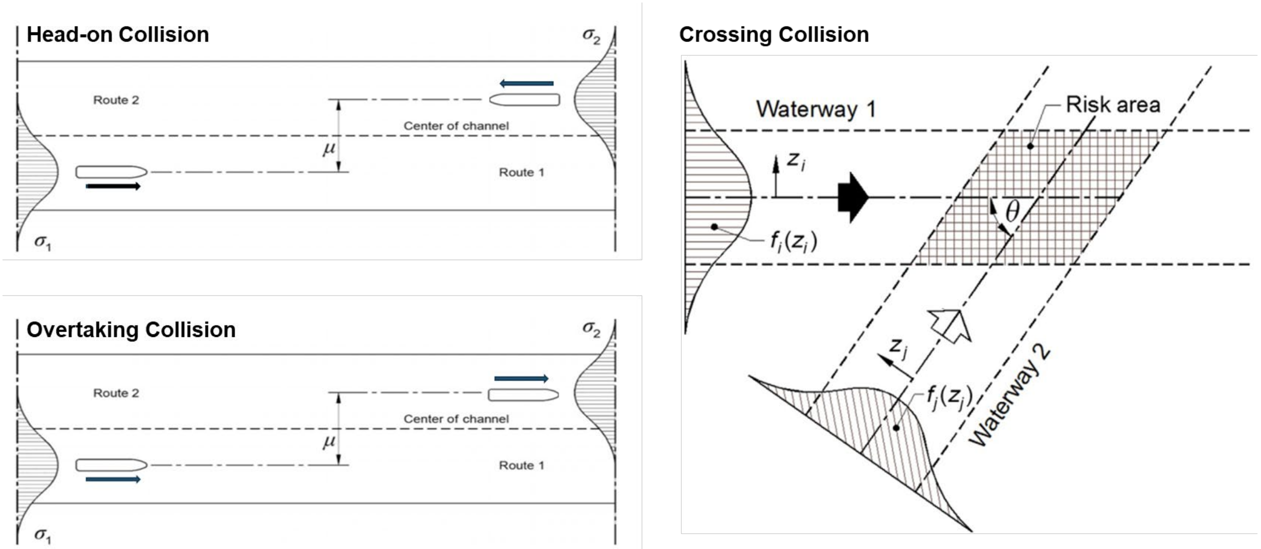


Figure B.6: Collision Scenarios considered by NORM (images adopted from Zhang et al., 2019)

Head-on collisions occur when vessels are approaching from parallel but opposite directions. Overtaking collisions are similar to head-on collisions, but occur when two vessels are travelling in the same direction at different speeds. Crossing collisions can occur when two vessel tracks intersect at a significantly non-parallel angle (assumed >10 degrees in the NORM model). NORM utilizes the applicable methodology (from Zhang et al. [2019]) to calculate the navigational risk for each of these scenarios, with outputs from the pre-processing step used as the inputs for the risk calculations. In particular, NORM utilizes the full distribution of vessel track headings, and the observed probabilities of vessels approaching head-on, overtaking or at a crossing angle within the study area.

Navigational risk for each of the collision scenarios is highly dependent on the vessel characteristics, track characteristics and traffic distributions calculated during the pre-processing step. NORM has the capability to use the full range of vessel and track characteristics for risk calculations, or single statistical values i.e., mean/median vessel LOA, beam, speed, etc. Collision risk due to head-on, overtaking and crossing collisions is calculated by NORM for all inter-class and intra-class combinations, as well as overall traffic for all vessel classes.

As the methodology outlined in Zhang et al. (2019) is mainly geared towards defined navigational channels, for open-water conditions NORM considers the true level of interaction of vessels (through the frequency-proximity pre-processing analysis) as part of the calculation to overcome inherent limitations in the formulation for this type of application.

B.1.3.3 Allision Scenarios

Allisions are defined as the event of a vessel striking or contacting a fixed structure. NORM considers both powered and drifting allisions as part of the navigational risk assessment procedure. Powered allisions occur when there is still power to the vessel and operable steering, whereas drifting allisions occur after a vessel experiences either loss of propulsion or rudder failure, a combination of the two, or some other form of damage that renders the vessel inoperable. Both powered and drifting allisions are depicted in Figure B.7.

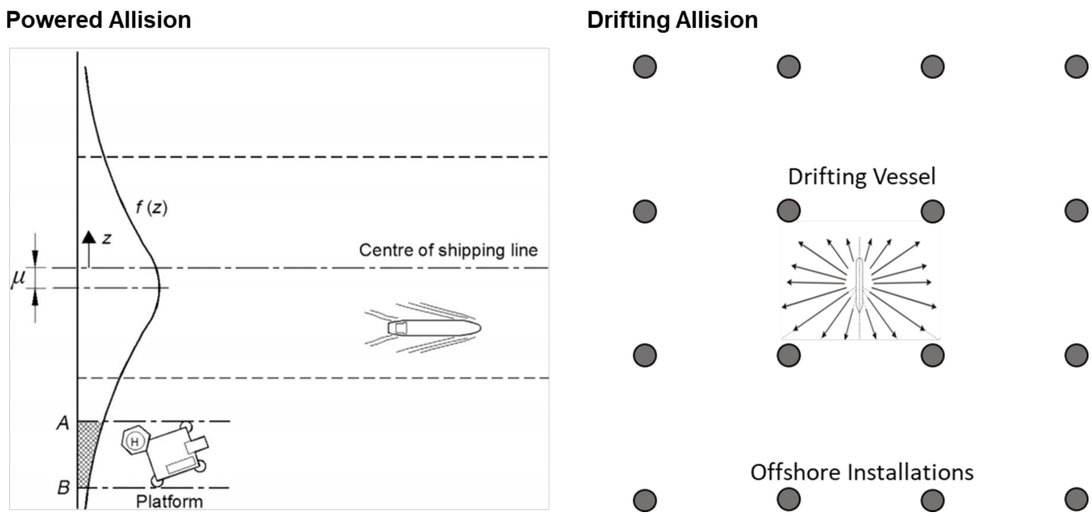


Figure B.7: Allision scenarios considered by NORM (Powered Allision image adopted from Zhang et al., 2019)

Powered allisions are similar to head-on collisions in that they generally depend on the same factors, but the second vessel, or fixed structure in this case, has a speed of zero and a fixed location. As such, a similar procedure to head-on collisions is followed for the calculation of powered allision risk, in that the outputs from the pre-processing step are used as inputs for the applicable methodology as outlined in Zhang et al. (2019). NORM augments this methodology slightly to make it account for multiple turbines along a given corridor between turbine rows (as opposed to a single fixed object).

For powered allision risk calculations within a turbine field, the amount of traffic going down a particular corridor is dependent on the results of the routing pre-processing step (see Figure B.5 left), while the traffic distributions are dependent on the geometric constraints of the turbines and their placement (GIS and geometric inputs, see Figure B.5 right).

Drifting collisions are much more random and difficult to quantify. NORM assumes rates of vessel breakdown that are commonly used in literature and other navigational risk models which are outlined in Zhang et al. (2019) and Rasmussen et al. (2012):

Table B.2: Rates of Vessel Breakdown used in NORM

Factor	Frequency (per vessel and hour)
Loss of propulsion	1.3E-04
Rudder failure	6.3E-05
Loss of propulsion and rudder failure	1.5E-05

Furthermore, a drift-repair function is assumed to model the probability that a vessel is still drifting at a certain time after breakdown. This drift-repair function is often modeled with a Weibull function with an assumed cut-off time. NORM assumes a 10-hour cut-off time. That is to say, it is assumed that after 10 hours, all vessels will have been repaired or rescued. This repair function is illustrated in Figure B.8:

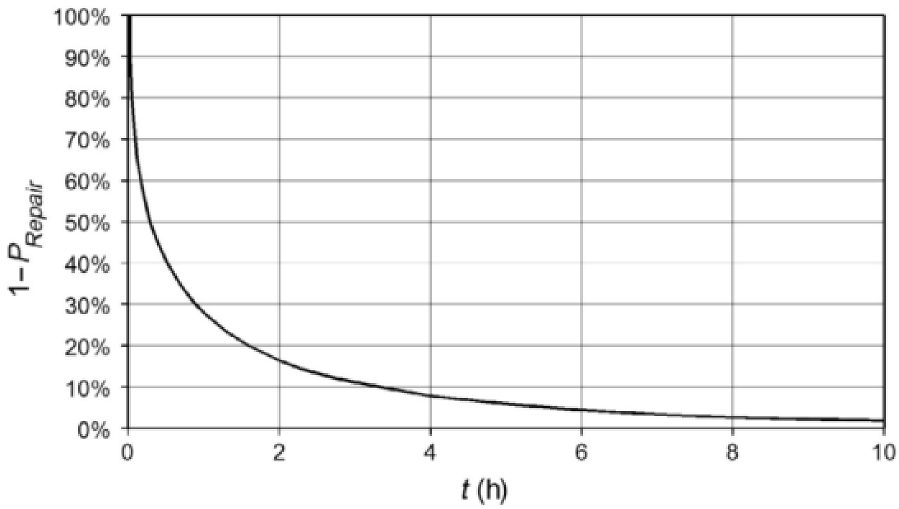


Figure B.8: Drift-repair function used in NORM (image adopted from Zhang et al., 2019)

For the purposes of drifting allision risk calculations, NORM assumes a drift speed of 1 knot (0.5 m/s) (literature suggests typical is 1–6 knots) with the same directional distribution as the local wind conditions. Alternately, NORM can use a drift velocity and directional distribution equal to local oceanographic and/or tidal currents. NORM then determines all of the turbines within the vessels potential drift radius and calculates drifting allision risk for each turbine individually based on an initial starting position, and sums them up. NORM's formulation for calculation drifting allision risk accounts for probability of vessel breakdown, probability of vessel drift-repair, turbine field placement, influence of metocean conditions on drift direction, and vessel characteristics.

Appendix C

VMS Data Maps and Polar Histograms

VMS Data Maps and Polar Histograms

This appendix provides a summary of VMS data maps and polar histograms. The map data were obtained from NOAA's National Marine Fisheries Service (NMFS) while the polar histograms were provided by BOEM (2021a) based on processing of VMS raw position reports.

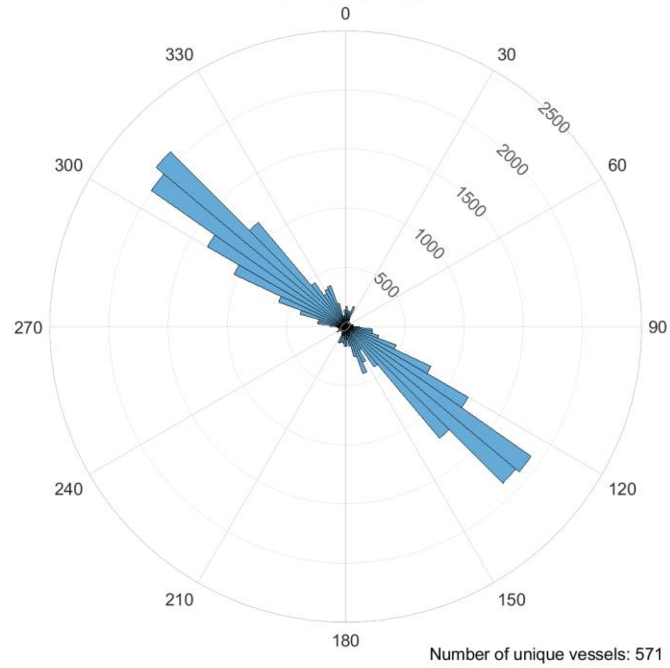
The VMS maps are shown by species and are based on the 2015-2016 fishing seasons (the most recent data that is publicly available).

The polar histograms provide summaries of average vessel course by species over the period 2014 to 2019 for Lease Areas OCS-A 0501 and OCS-A 0534 based on a 5-degree compass bin size. Histograms are not available in all cases. If there were less than three vessels over a spatial area then the raw position reports were removed.

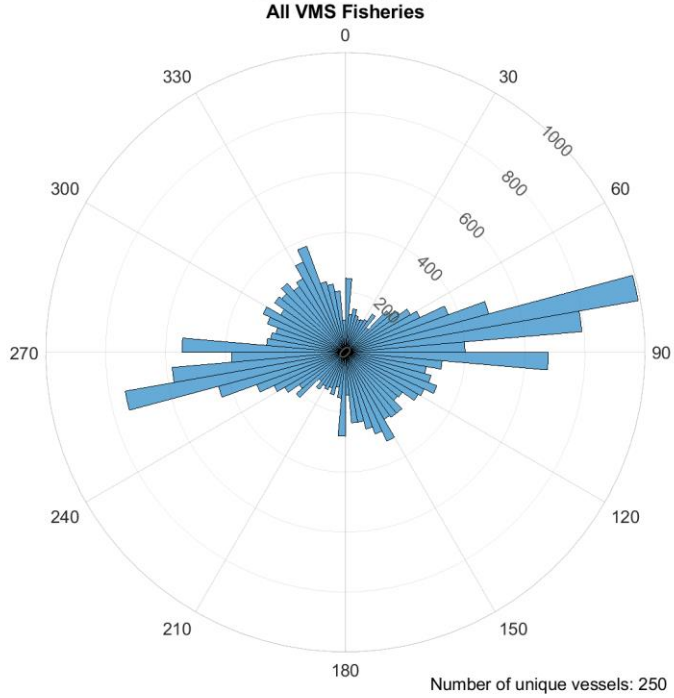
Vessel speed is used to distinguish vessels that are actually fishing as opposed to transiting. For most species, vessels sailing at less than 4 knots are considered fishing but for scallop fishing the vessel speed is assumed as 5 knots. In this Appendix, two maps and histograms are provided for each fish species providing fishing density or vessel course when either transiting or actively fishing.

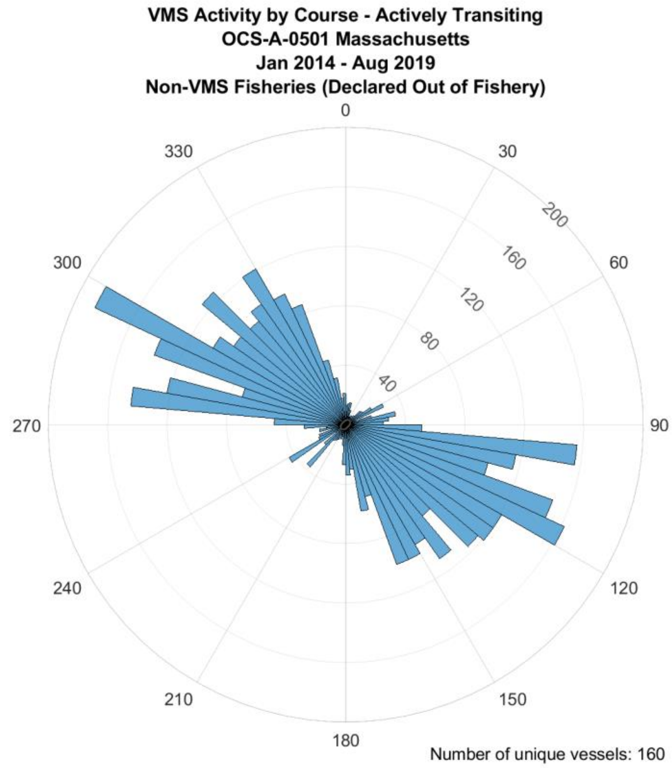
Polar histograms are also provided for all VMS fisheries (all species together) and also for non-VMS fisheries. The latter comprises vessels that are not participating in a VMS monitored fishery at the time of data transmission.

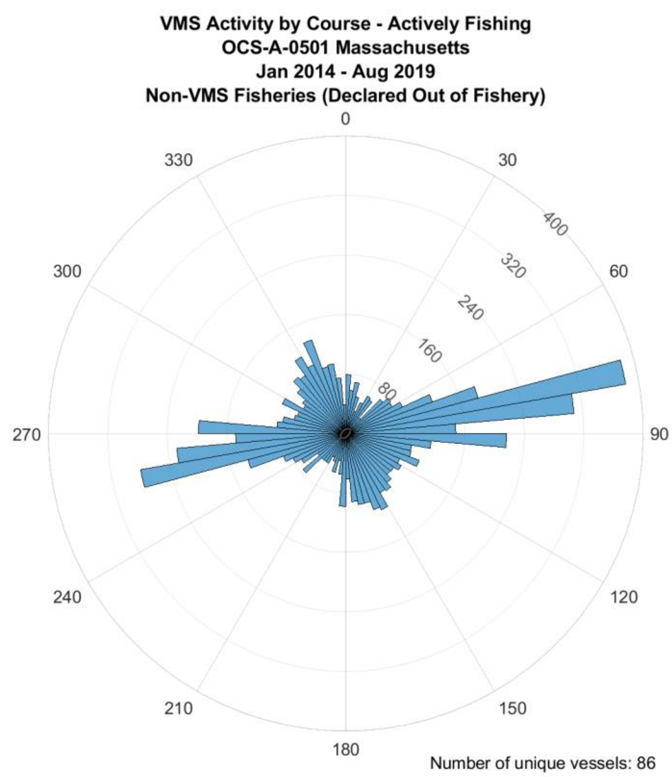
VMS Activity by Course - Actively Transiting
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
All VMS Fisheries

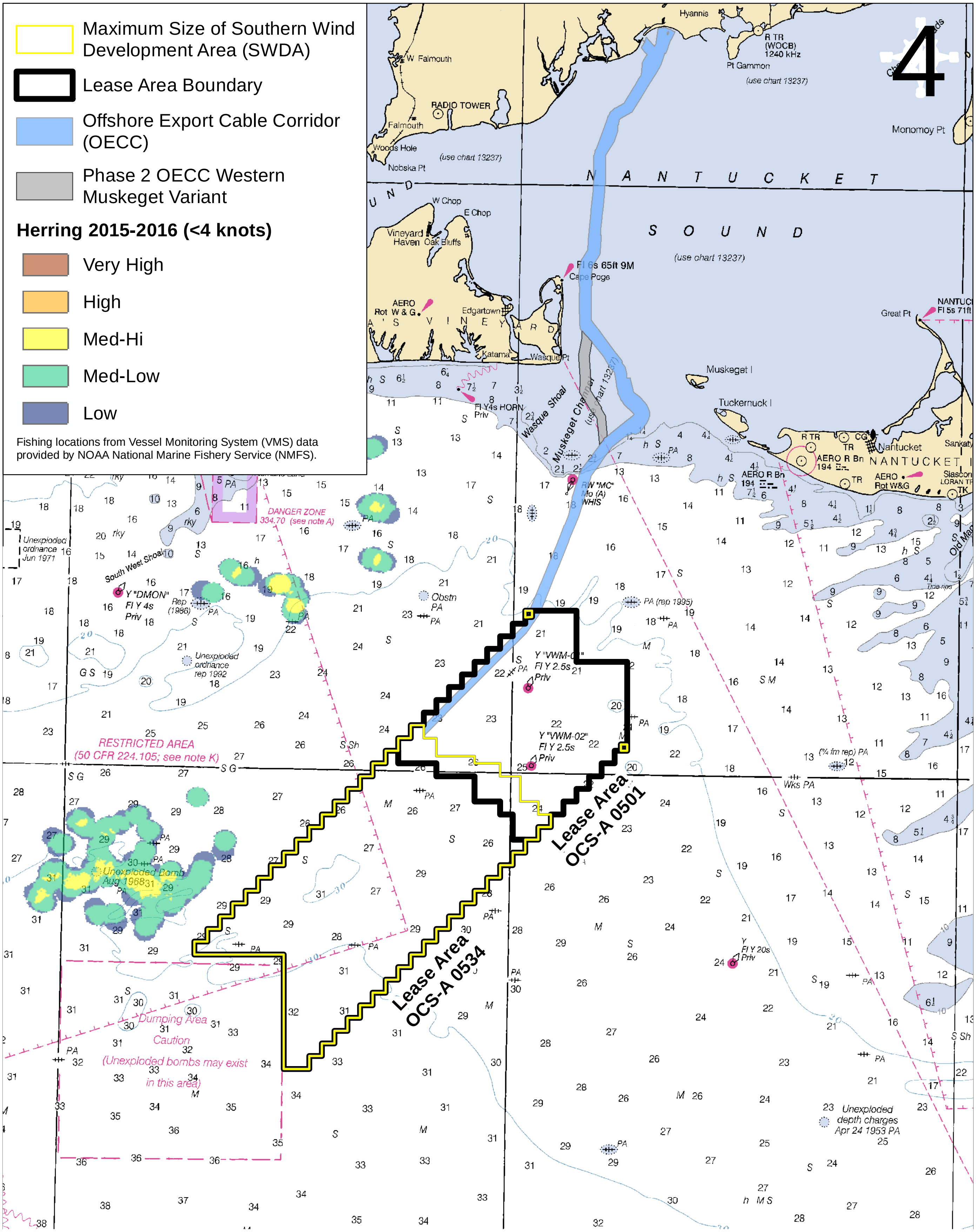


VMS Activity by Course - Actively Fishing
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
All VMS Fisheries




VMS Activity by Course - Actively Transiting
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Non-VMS Fisheries (Declared Out of Fishery)
0
30
60
90
120
150
180
210
240
270
300
330
40
80
120
160
200
Number of unique vessels: 160


VMS Activity by Course - Actively Fishing
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Non-VMS Fisheries (Declared Out of Fishery)
0
30
60
90
120
150
180
210
240
270
300
330
80
160
240
320
400
Number of unique vessels: 86



0 2 4 6 NM

0 6 12 18 km

VMS Commercial Fishing Density for Herring 2015-2016 (<4 knots)

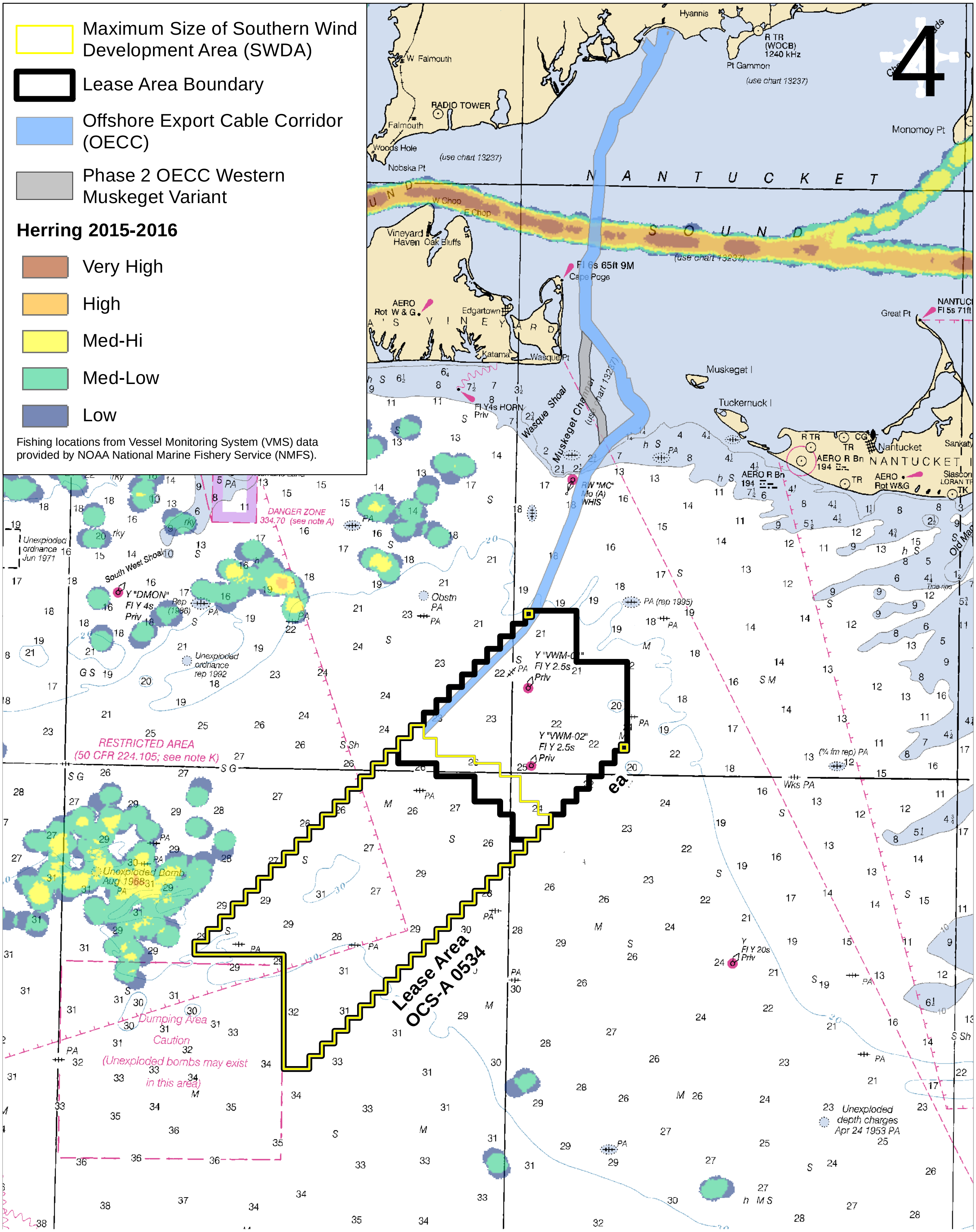
New England Wind

Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

Baird.

Map Published: 2021-11-16

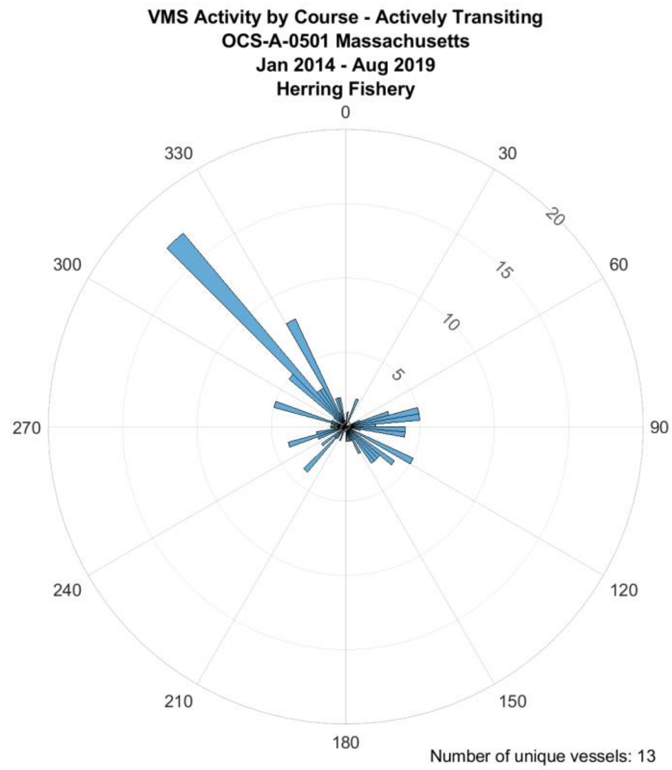
13057.501 VW501S - VMS Comm Fishing Density Herring 2015-2016 4knots Rev02.mxd

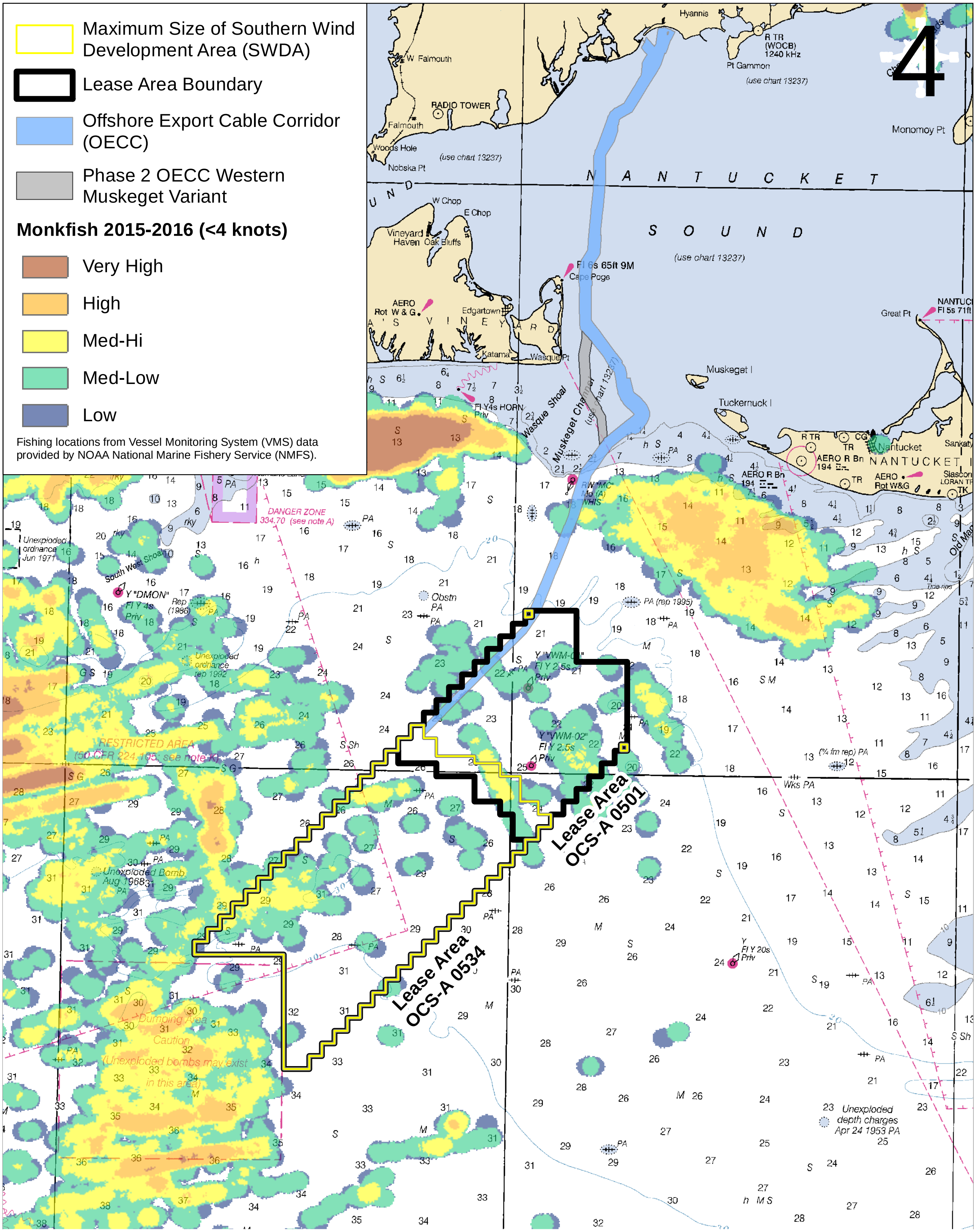


0 2 4 6 NM 0 6 12 18 km	**VMS Commercial Fishing Density for Herring 2015-2016** *New England Wind*	Imagery: Nautical Chart 13200, NOAA (Fathoms) Spatial Reference: NAD 1983 UTM Zone 19N Baird.

Map Published: 2021-11-16

13057.501 VW501S - VMS Comm Fishing Density Herring 2015-2016 Rev02.mxd


VMS Activity by Course - Actively Transiting
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Herring Fishery
0
30
60
90
120
150
180
210
240
270
300
330
5
10
15
20
Number of unique vessels: 13



VMS Commercial Fishing Density for Monkfish 2015-2016 (<4 knots)

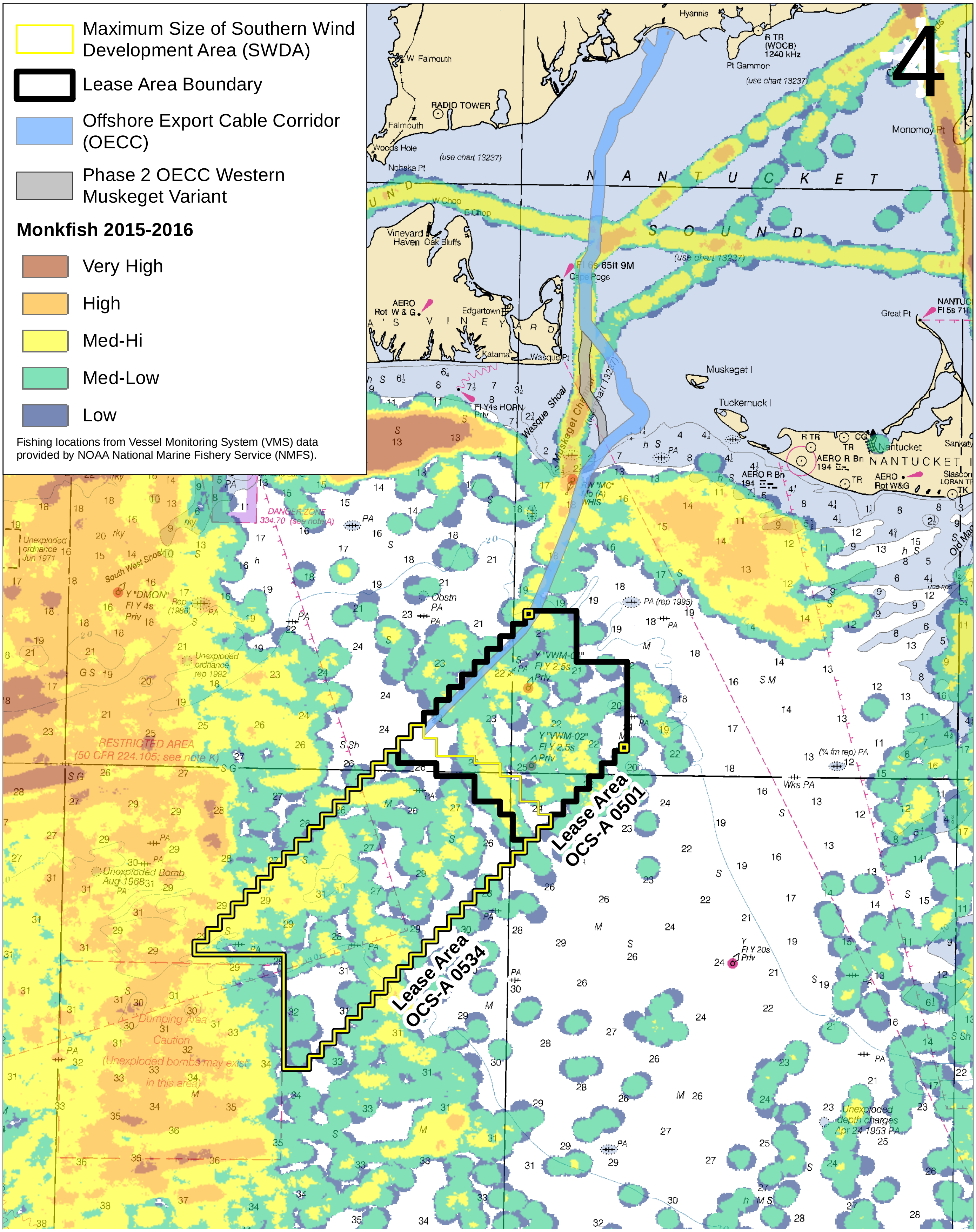
New England Wind

Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

Baird.

13057.501 VW501S - VMS Comm Fishing Density Monkfish 2015-2016 4knots Rev02.mxd

Map Published: 2021-11-16



0 2 4 6 NM

0 6 12 18 km

VMS Commercial Fishing Density for Monkfish 2015-2016

New England Wind

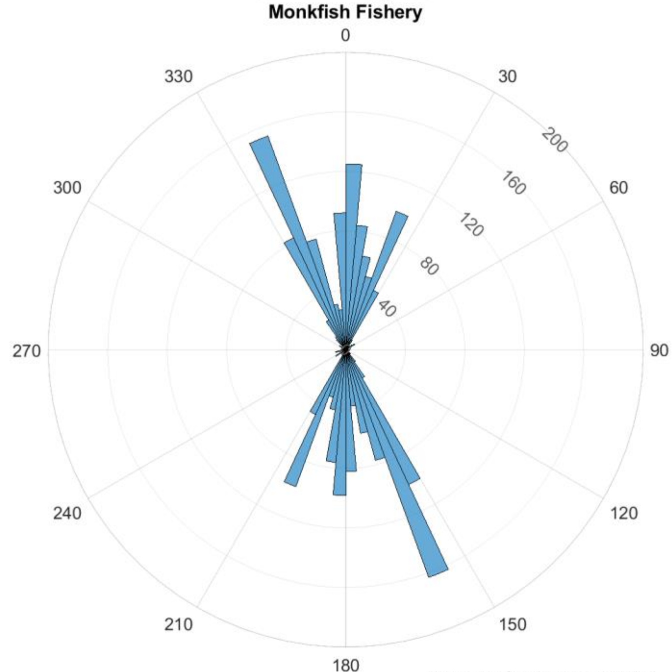
Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

Baird.

13057.501 VW501S - VMS Comm Fishing Density Monkfish 2015-2016 Rev02.mxd

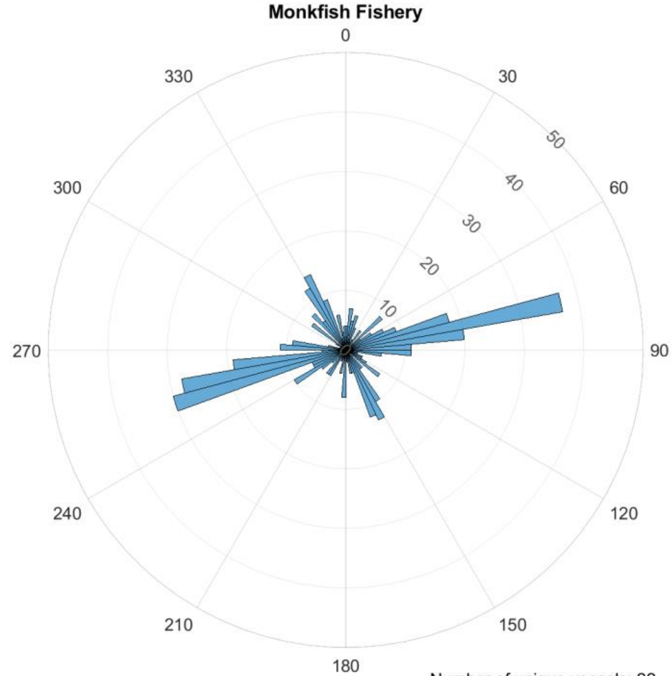
Map Published: 2021-11-16

VMS Activity by Course - Actively Transiting
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Monkfish Fishery

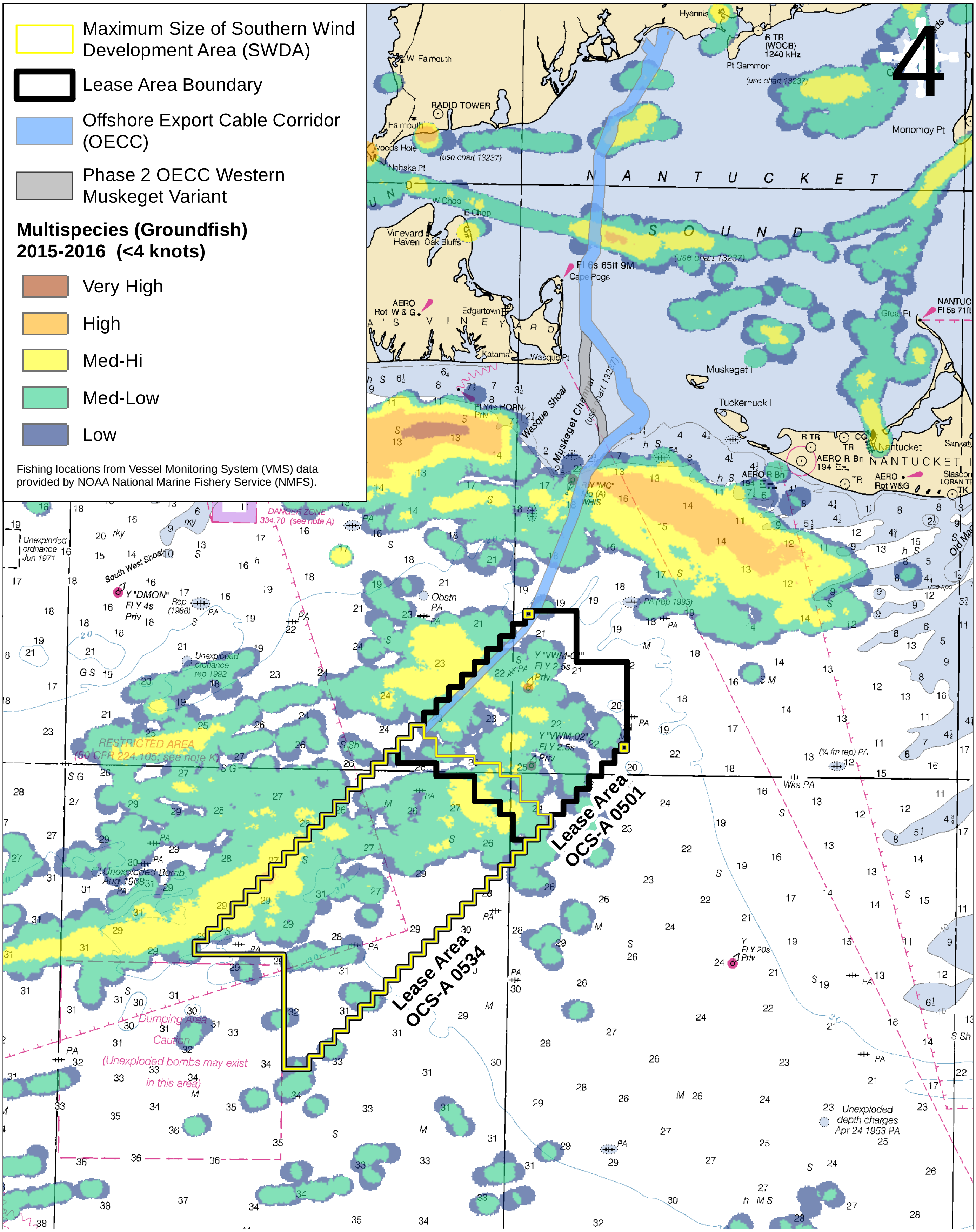


Number of unique vessels: 51

VMS Activity by Course - Actively Fishing
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Monkfish Fishery



Number of unique vessels: 22



0 2 4 6 NM

0 6 12 18 km

VMS Commercial Fishing Density for Multispecies (Groundfish) 2015-2016 (<4 knots)

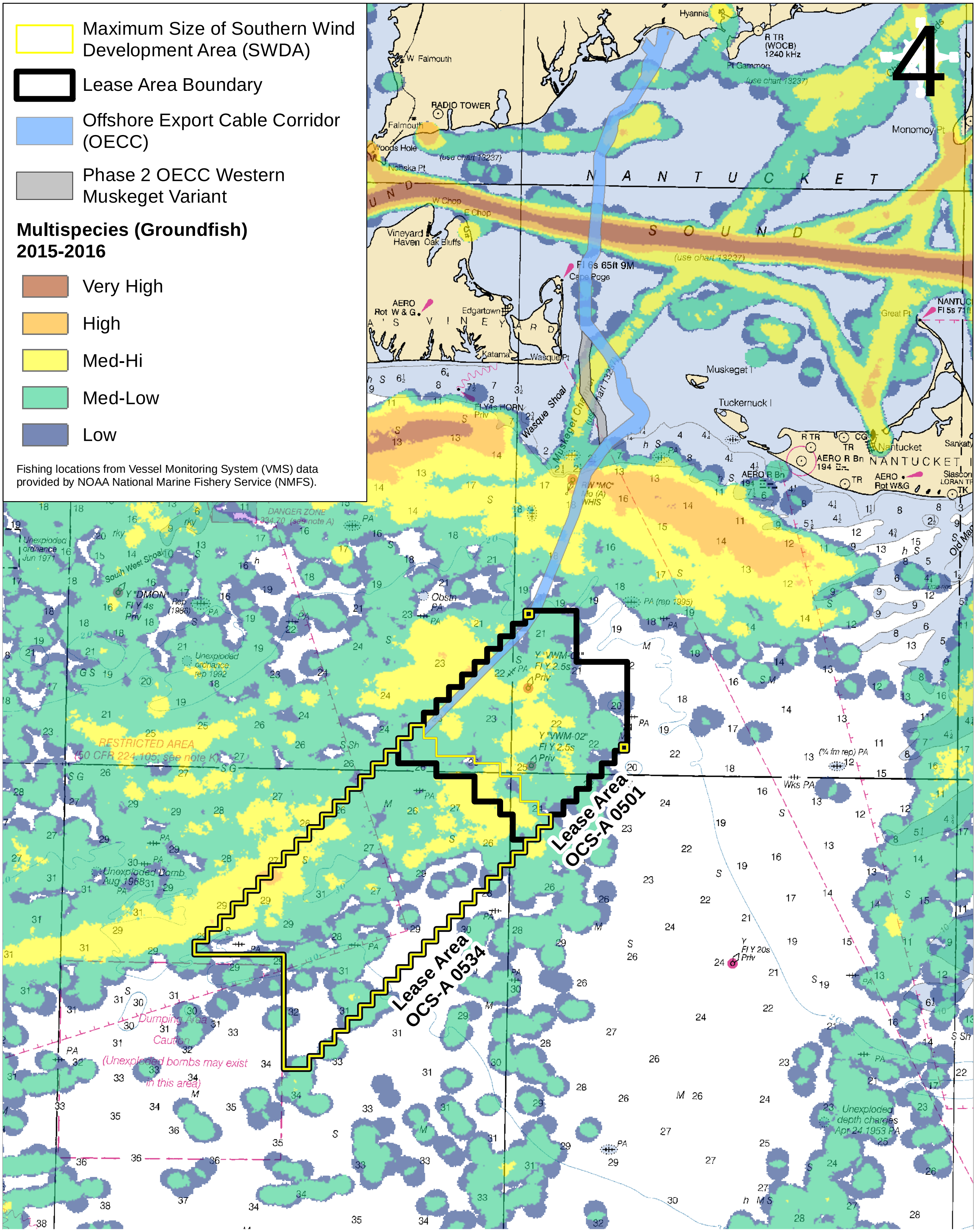
New England Wind

Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

Baird.

Map Published: 2021-11-16

13057.501 VW501S - VMS Comm Fishing Density Multispecies 2015-2016 4knots Rev02.mxd



0 2 4 6 NM

0 6 12 18 km

VMS Commercial Fishing Density for Multispecies (Groundfish) 2015-2016

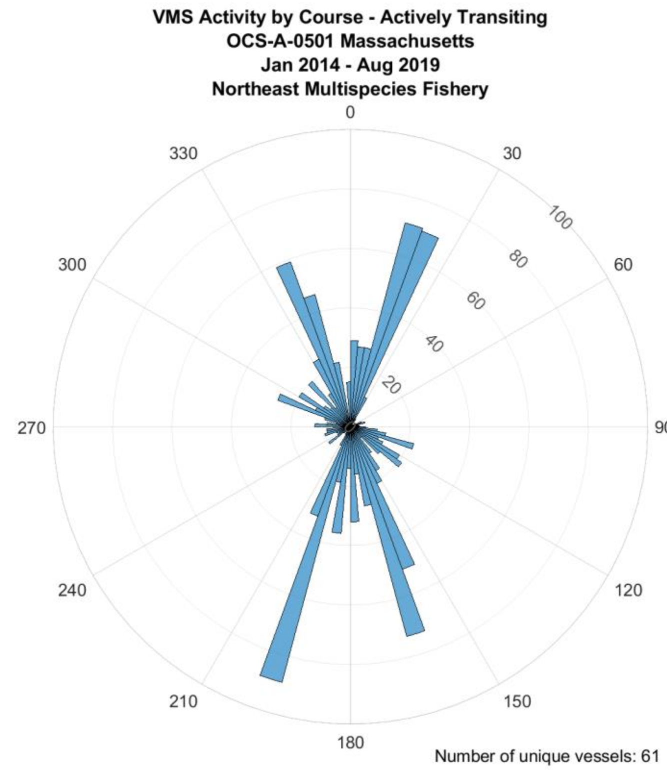
New England Wind

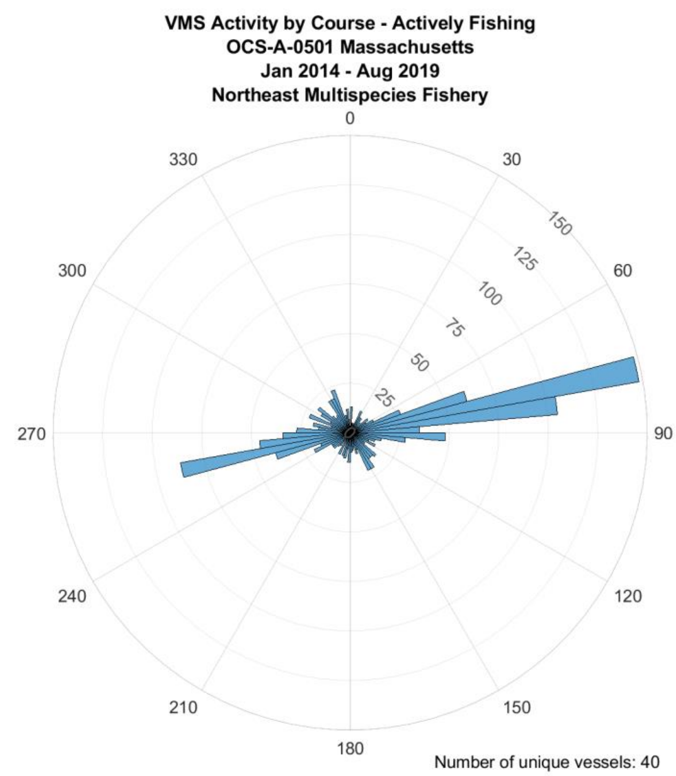
Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

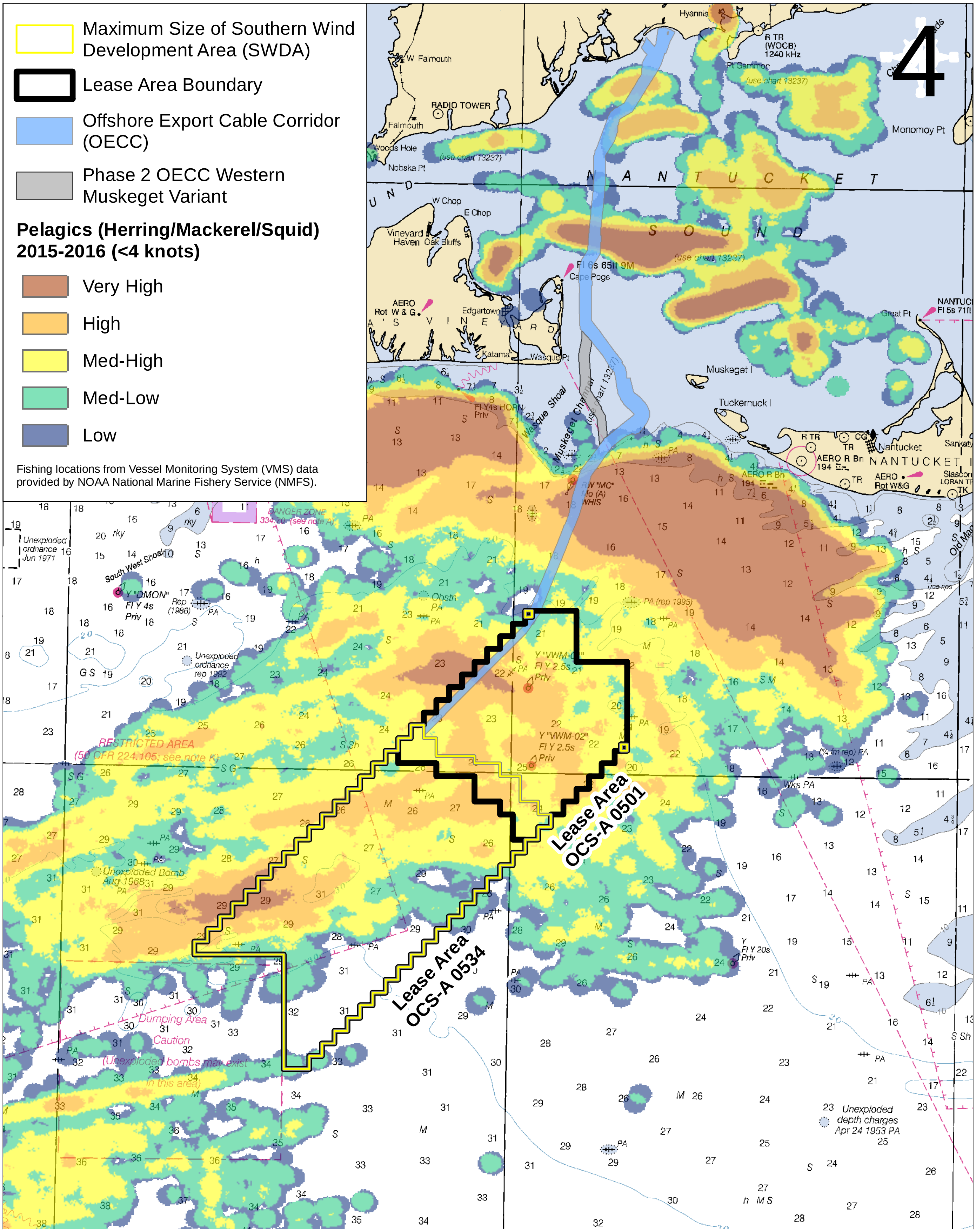
Baird.

13057.501 VW501S - VMS Comm Fishing Density Multispecies 2015-2016 Rev02.mxd

Map Published: 2021-11-16


VMS Activity by Course - Actively Transiting
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Northeast Multispecies Fishery
0
30
60
90
120
150
180
210
240
270
300
330
20
40
60
80
100
Number of unique vessels: 61


VMS Activity by Course - Actively Fishing
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Northeast Multispecies Fishery
0
30
60
90
120
150
180
210
240
270
300
330
25
50
75
100
125
150
Number of unique vessels: 40



0 2 4 6 NM

0 6 12 18 km

VMS Commercial Fishing Density for Pelagics (Herring/Mackerel/Squid) 2015-2016 (<4 knots)

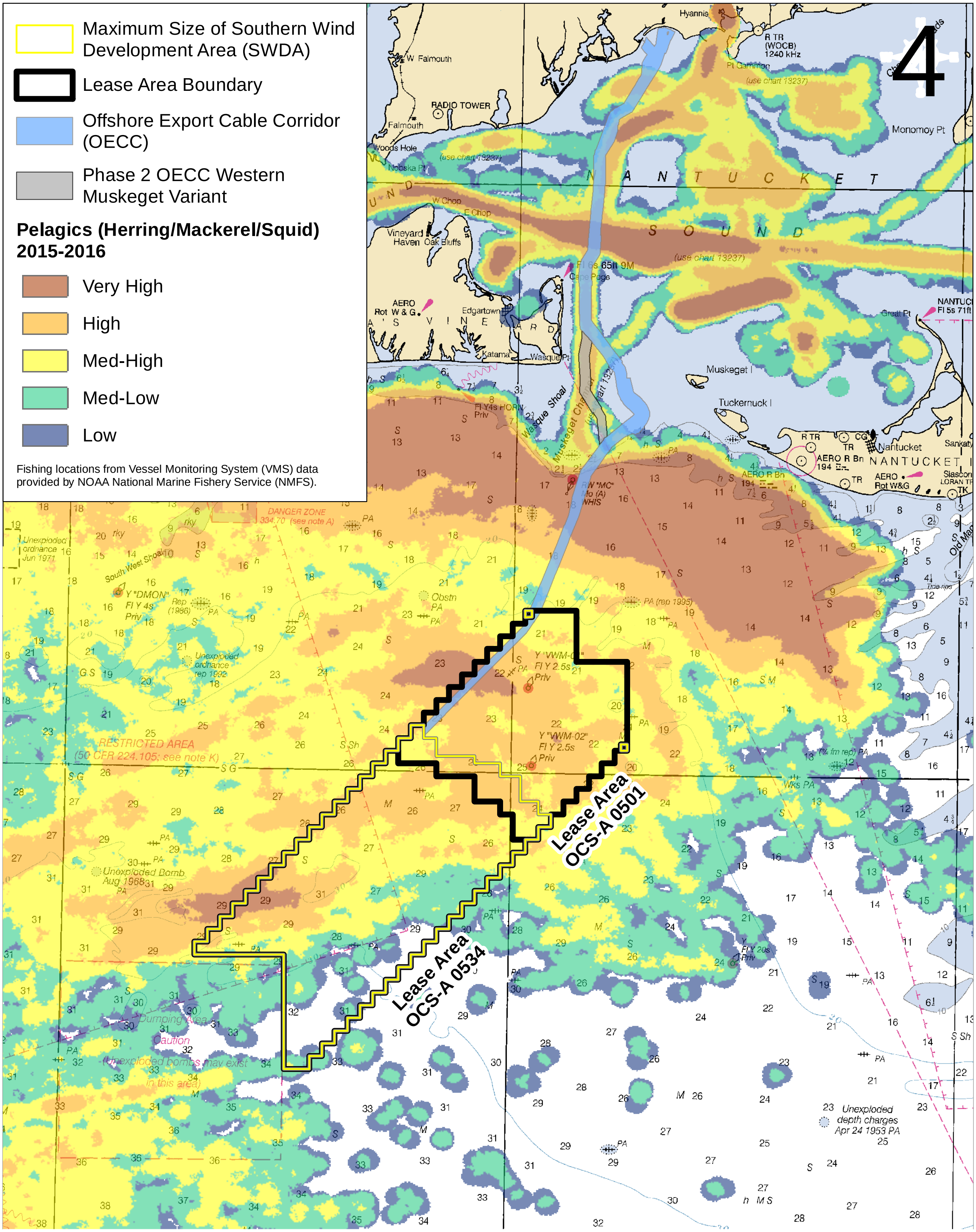
New England Wind

Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

Baird.

13057.501 VW501S - VMS Comm Fishing Density Pelagics 2015-2016 4knots Rev02.mxd

Map Published: 2021-11-16



0 2 4 6 NM
0 6 12 18 km

VMS Commercial Fishing Density for Pelagics (Herring/Mackerel/Squid) 2015-2016

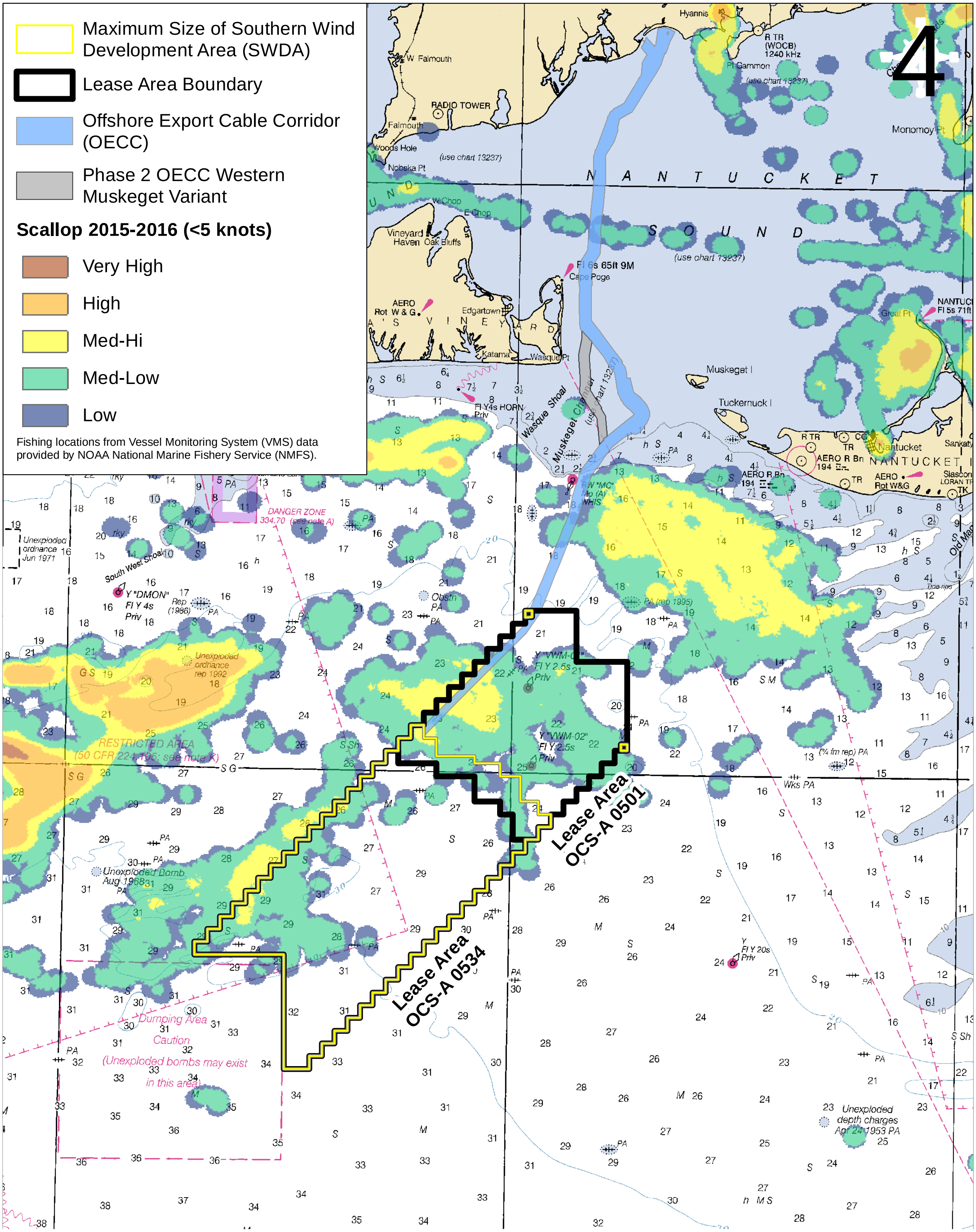
New England Wind

Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

Baird.

13057.501 VW501S - VMS Comm Fishing Density Pelagics 2015-2016 Rev02.mxd

Map Published: 2021-11-16



0 2 4 6 NM

0 6 12 18 km

VMS Commercial Fishing Density for Scallop 2015-2016 (<5 knots)

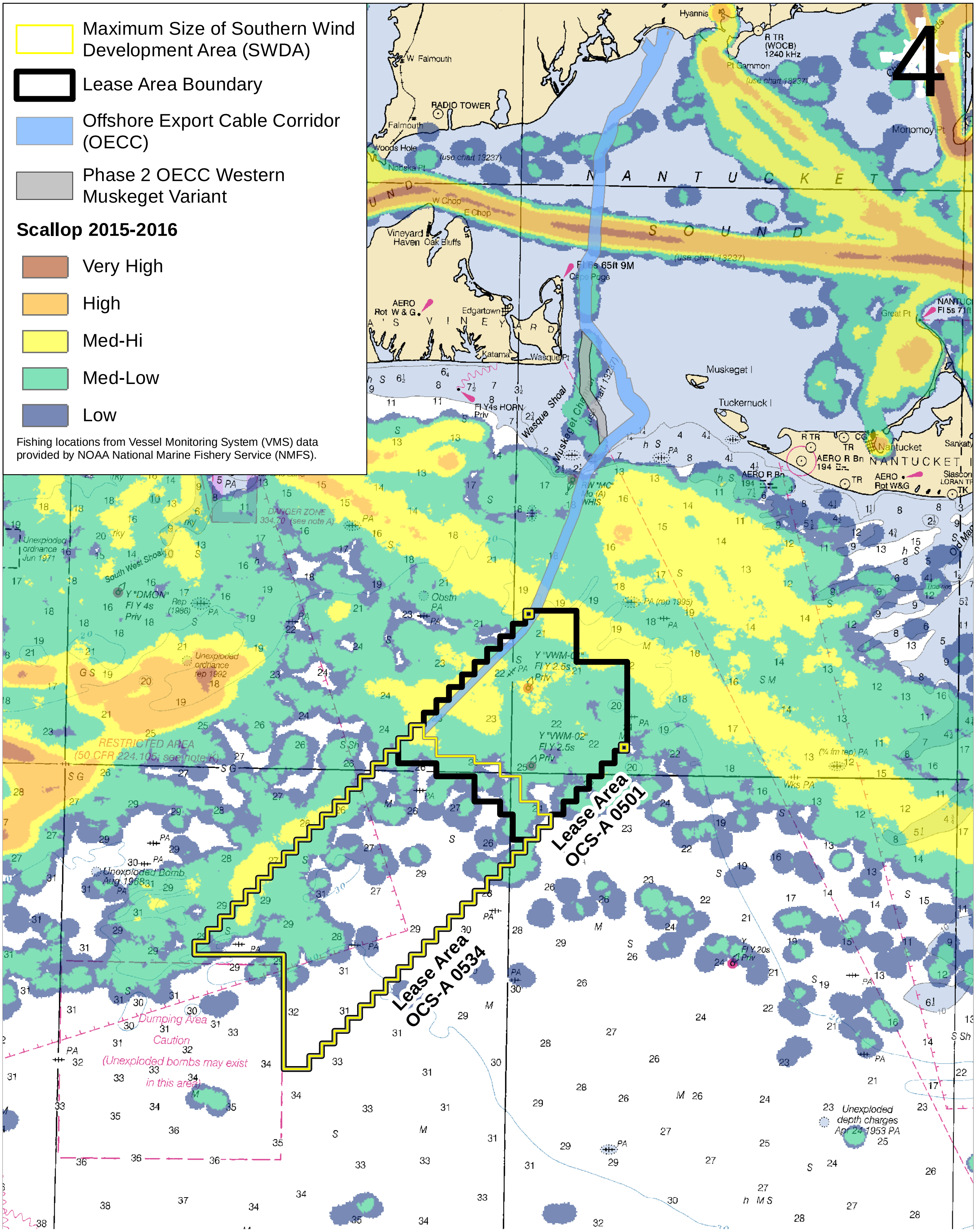
New England Wind

Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

Baird.

13057.501 VW501S - VMS Comm Fishing Density Scallop 2015-2016 5knots Rev02.mxd

Map Published: 2021-11-16



0 2 4 6 NM

0 6 12 18 km

VMS Commercial Fishing Density for Scallop 2015-2016

New England Wind

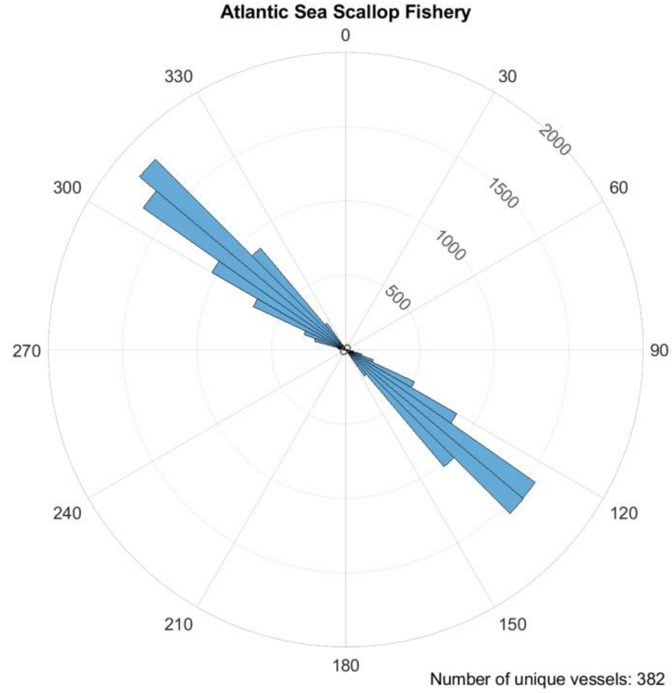
Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

Baird.

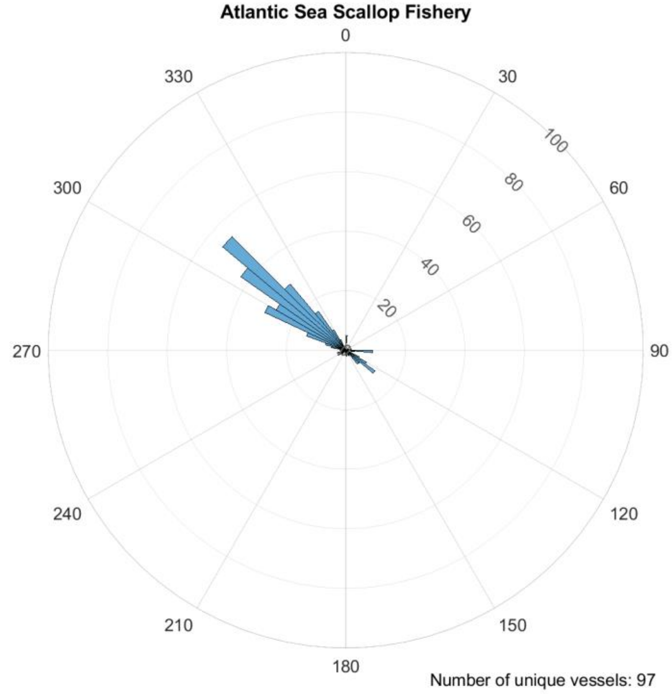
13057.501 VW501S - VMS Comm Fishing Density Scallop 2015-2016 Rev02.mxd

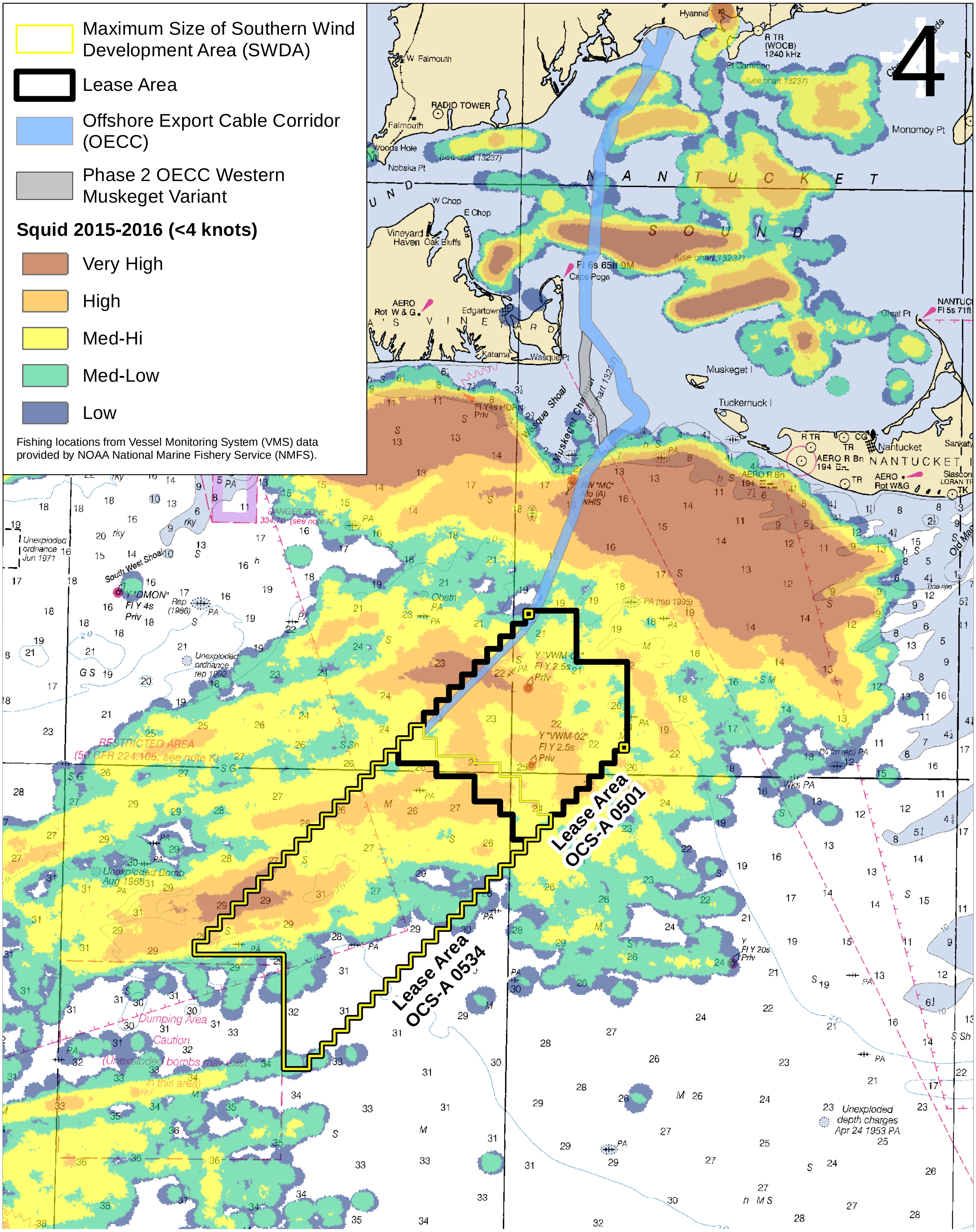
Map Published: 2021-11-16

VMS Activity by Course - Actively Transiting
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Atlantic Sea Scallop Fishery



VMS Activity by Course - Actively Fishing
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Atlantic Sea Scallop Fishery





0 2 4 6 NM

0 6 12 18 km

VMS Commercial Fishing Density for Squid 2015-2016 (<4 knots)

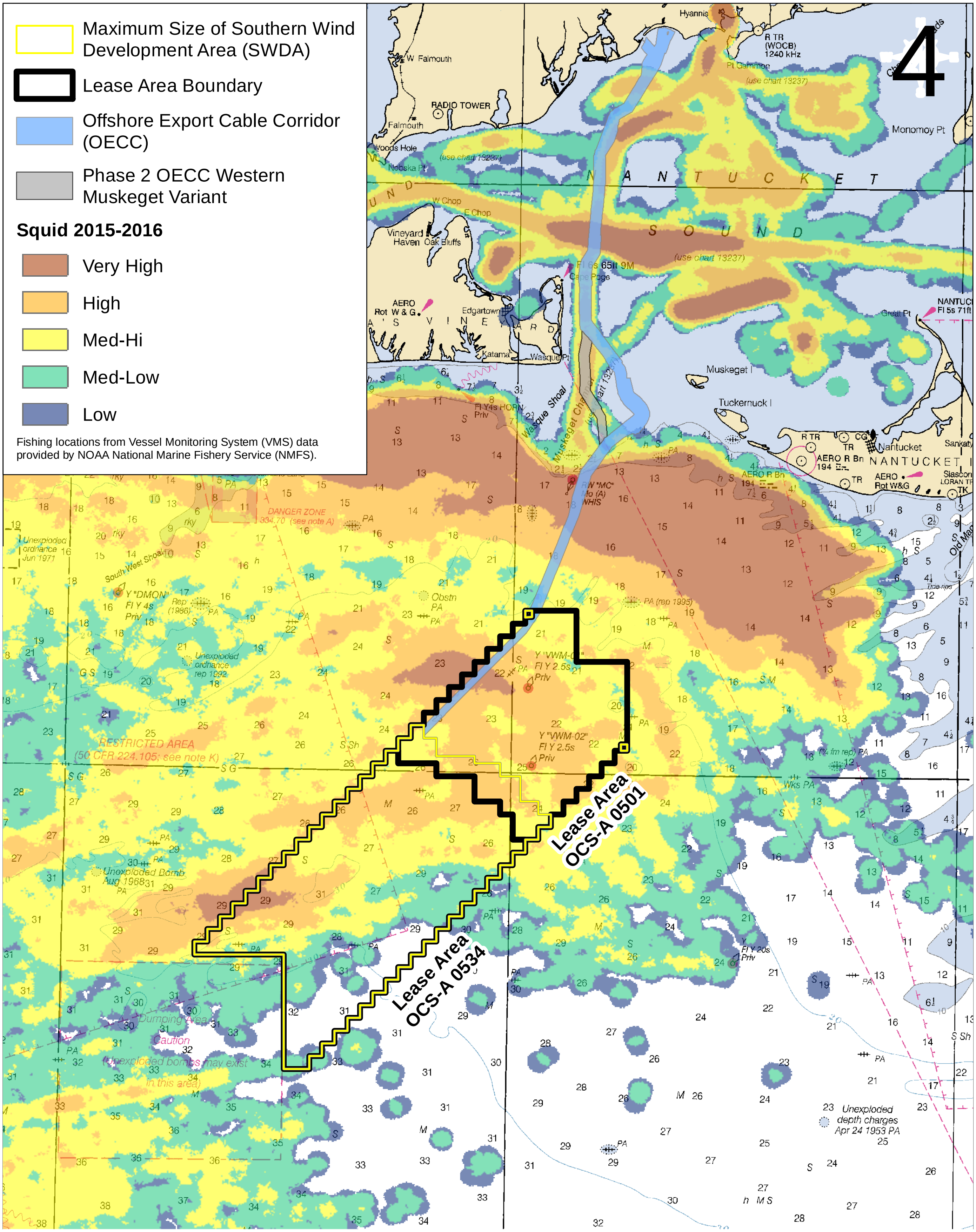
New England Wind

Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

Baird.

Map Published: 2021-11-16

13057.501 VW501S - VMS Comm Fishing Density Squid 2015-2016 4knots Rev02.mxd



VMS Commercial Fishing Density for Squid 2015-2016

New England Wind

Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

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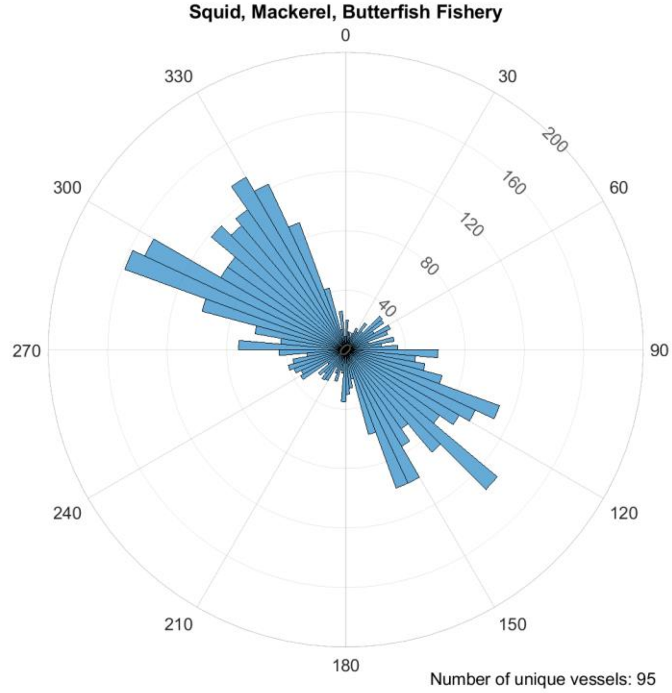
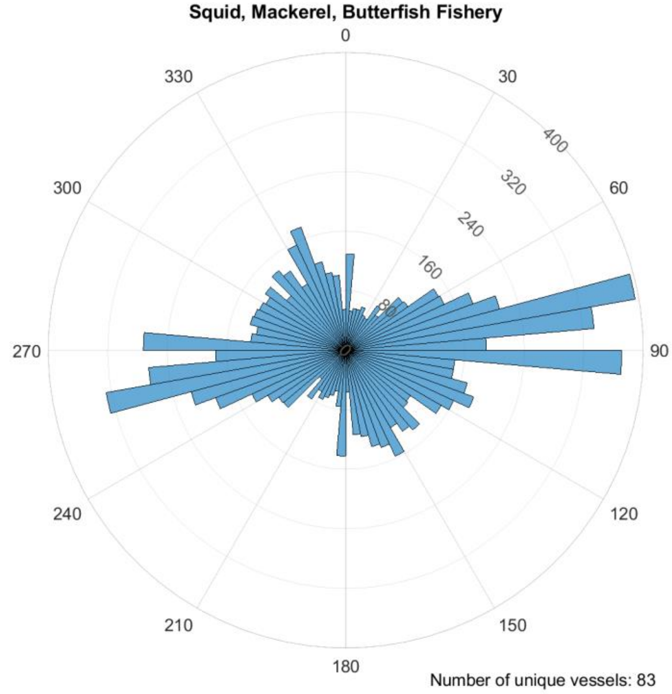
13057.501 VW501S - VMS Comm Fishing Density Squid 2015-2016 Rev02.mxd

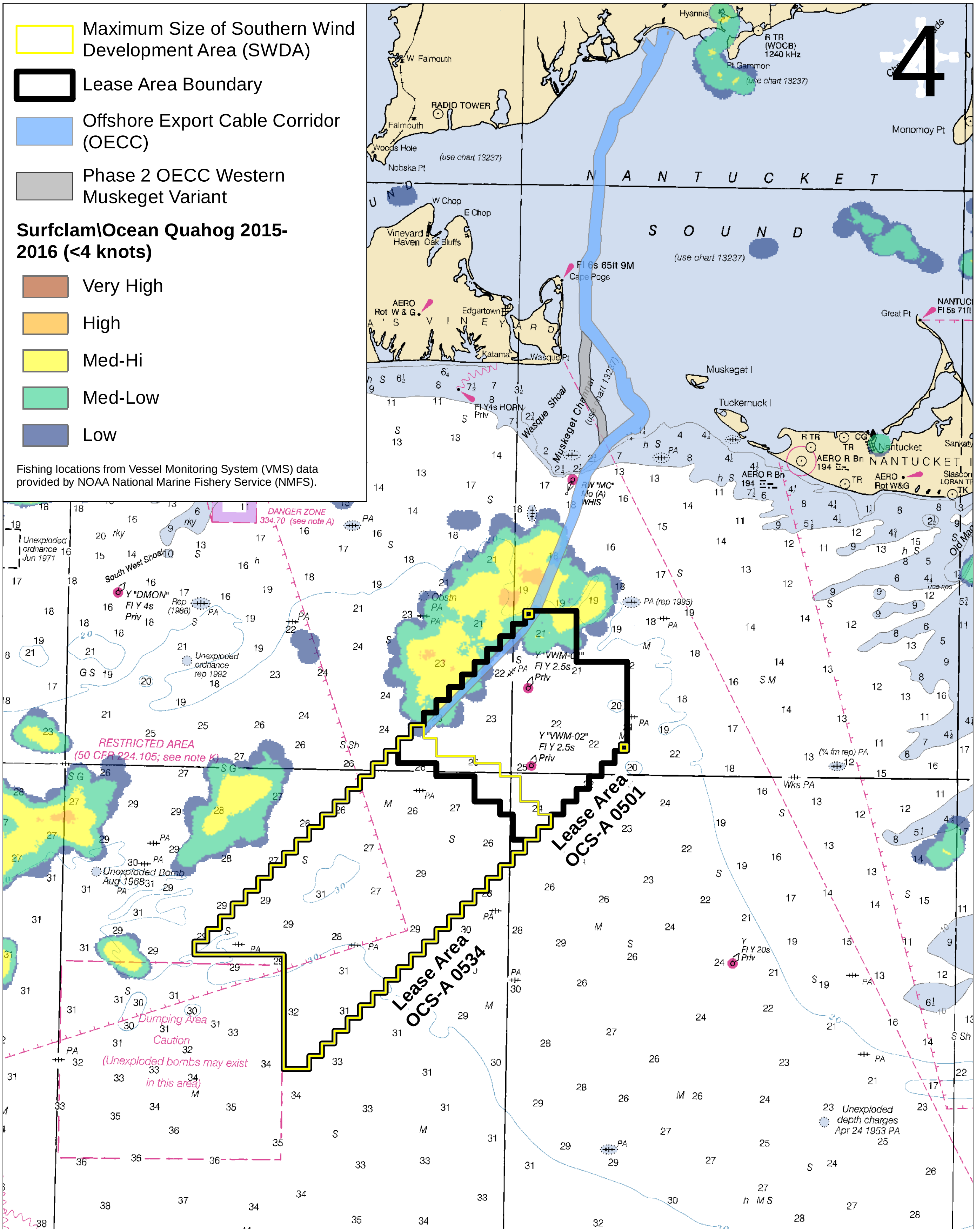
Map Published: 2021-11-16

VMS Activity by Course - Actively Transiting
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Squid, Mackerel, Butterfish Fishery



VMS Activity by Course - Actively Fishing
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Squid, Mackerel, Butterfish Fishery





0 2 4 6 NM
0 6 12 18 km

VMS Commercial Fishing Density for Surfclam Ocean Quahog 2015-2016 (<4 knots)

New England Wind

Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

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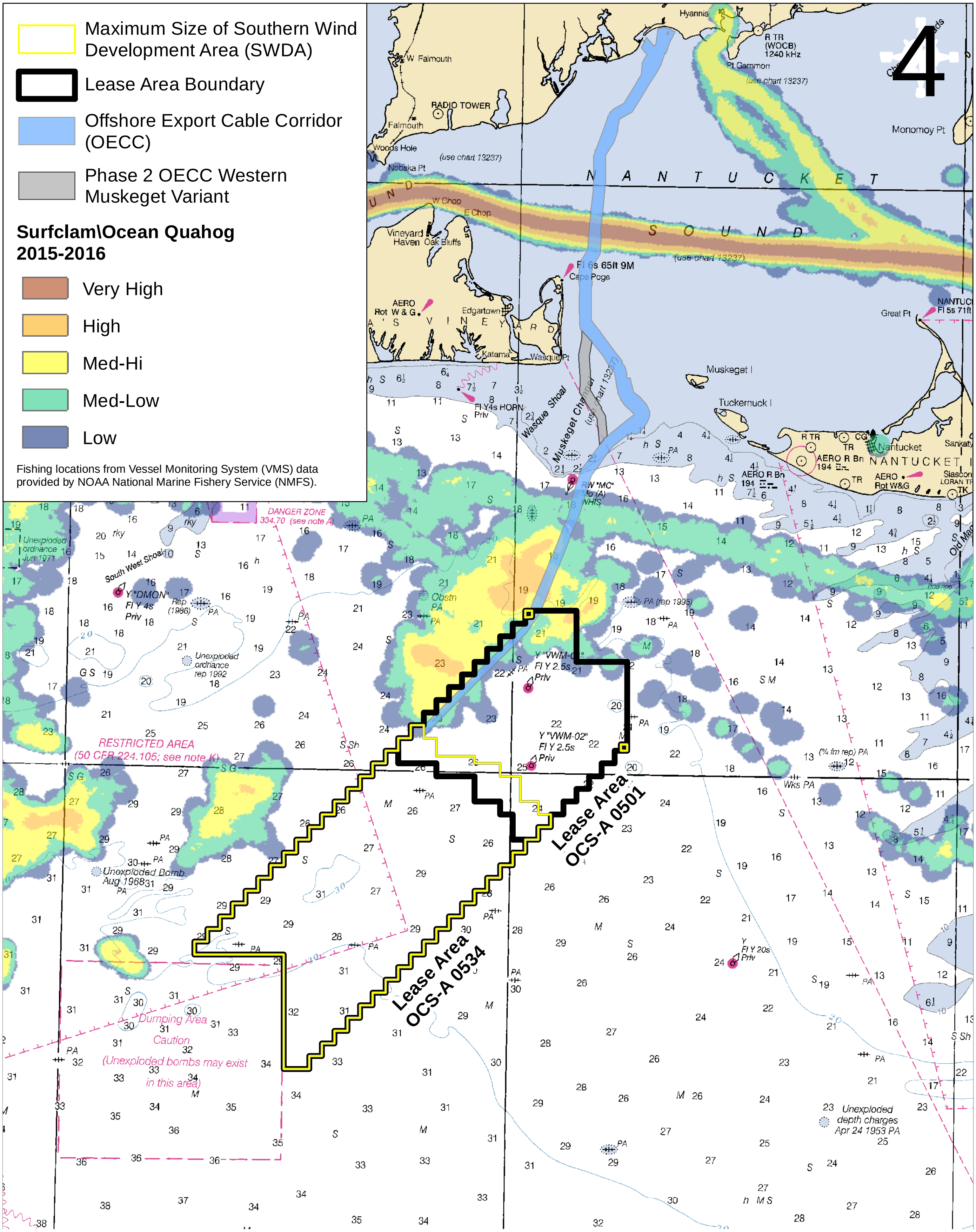
13057.501 VW501S - VMS Comm Fishing Density Surfclam Ocean Quahog 2015-2016 4knots Rev02.mxd

Map Published: 2021-11-16



0 2 4 6 NM

0 6 12 18 km

VMS Commercial Fishing Density for Surfclam Ocean Quahog 2015-2016

New England Wind

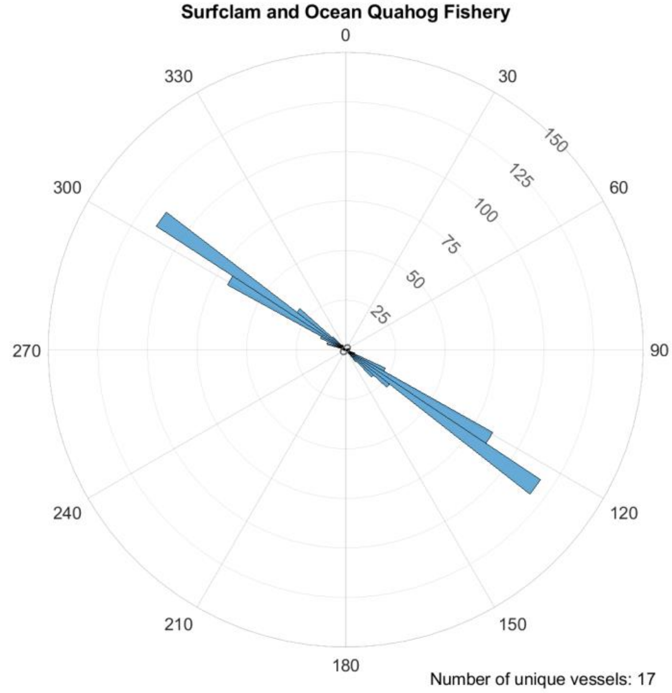
Imagery: Nautical Chart 13200, NOAA (Fathoms)
Spatial Reference: NAD 1983 UTM Zone 19N

Baird.

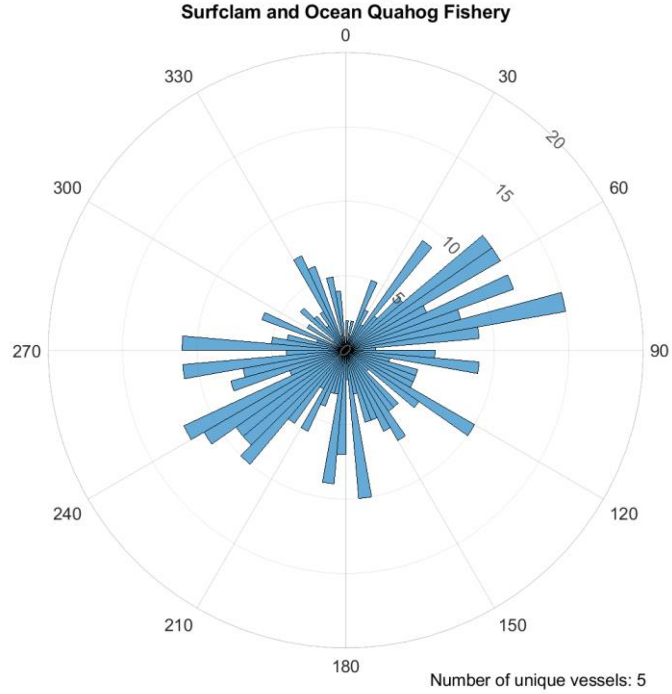
13057.501 VW501S - VMS Comm Fishing Density Surfclam Ocean Quahog 2015-2016 Rev02.mxd

Map Published: 2021-11-16

VMS Activity by Course - Actively Transiting
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Surfclam and Ocean Quahog Fishery



VMS Activity by Course - Actively Fishing
OCS-A-0501 Massachusetts
Jan 2014 - Aug 2019
Surfclam and Ocean Quahog Fishery



Appendix D

Change Analysis Summary

New England Wind Change Analysis
Construction, Installation and Decommissioning

Document ID: 13057.501_Change Analysis Tables

Rev No. 3

Date: 09 Dec 2021

Risk No	Description of Change	Brief Description of Consequence	Report Section Where Discussed	Mitigation	Monitoring Actions
1	Increased vessel traffic to and from supply ports due to construction vessels	• Increased probability for collision with existing vessels leading to potential injury, loss of life or marine spill • Vessel transit delays affecting port traffic	10.3, 11.1	• The Proponent to develop a marine communications procedure to engage stakeholders • Marine Coordinator operating from a Marine Coordination Center will manage all construction vessel logistics and implement communication protocols. Unnecessary simultaneous transits at the ports to be minimized • Issue regular Offshore Wind Mariner Update Bulletins to advise stakeholders of vessel movements • Coordinate with the USCG to issue NTMs advising other vessel operators of construction, installation, or decommissioning activities • Construction vessels to display navigational lights and day shapes	• Regular coordination with local pilots, port authorities, USCG, USACE and other stakeholders as appropriate
2	Increased vessel traffic in the SWDA, OECC and nearby waterways	• Increased probability for collision with existing vessels leading to potential injury, loss of life or marine spill	10.1-10.2, 11.1	• The Proponent to develop a marine communications procedure to engage stakeholders • Marine Coordinator operating from a Marine Coordination Center will manage all construction vessel logistics and implement communication protocols • Establish vessel traffic management plans with Port Authority, USCG, USACE and other key stakeholders • Issue regular Offshore Wind Mariner Update Bulletins to advise stakeholders of vessel movements • Coordinate with the USCG to issue NTMs advising other vessel operators of construction, installation, or decommissioning activities • Installed WTGs and ESPs to be become PATONs • Construction vessels to display navigational lights and day shapes	• Regular coordination with local pilots, port authorities, USCG, USACE and other stakeholders as appropriate
3	Potential interference with transiting vessels during cable laying operations	• Increased probability for collision with existing vessels leading to potential injury, loss of life or marine spill	10.2, 11.1	• Marine Coordinator operating from a Marine Coordination Center will manage all construction vessel logistics and implement communication protocols • Issue regular Offshore Wind Mariner Update Bulletins to advise stakeholders of cable laying activity • Coordinate with the USCG to issue NTMs advising other vessel operators of construction, installation, or decommissioning activities • Construction vessels to display navigational lights and day shapes • Establish temporary safety buffer zone around working areas	• Regular coordination with local pilots, port authorities, USCG, USACE and other stakeholders as appropriate • Maintain appropriate lookout on construction vessels
4	Presence of vessels in SWDA during construction and installation process	• Increased probability for collision leading to possible injury, loss of life or marine spill	10.1, 11.1	• Marine Coordinator operating from a Marine Coordination Center will manage all construction vessel logistics and implement communication protocols • Establish temporary safety buffer zone around working areas • Issue regular Offshore Wind Mariner Update Bulletins to advise stakeholders of safety buffer zone locations • Coordinate with the USCG to issue NTMs advising other vessel operators of construction, installation, or decommissioning activities • Construction vessels to display navigational lights and day shapes	• Regular coordination with local pilots, port authorities, USCG, USACE and other stakeholders as appropriate • Maintain appropriate lookout on construction vessels
5	Presence of installed and partially constructed turbines	• Increased probability for vessel allision leading to injury, loss of life or marine spill	10.1, 10.4-10.5, 11.1	• WTGs, including partially constructed WTGs, appropriately marked and lit • Installed WTGs and ESPs to be become PATONs • Establish temporary safety buffer zone around working areas • Coordinate with the USCG to issue NTMs advising other vessel operators of construction, installation, or decommissioning activities • The Proponent to regularly provide updates as to the locations of installed WTGs and ESPs to the USCG and NOAA for use in navigational charts	
6	Possible impact on marine radar systems	• Possible reduced ability to detect presence of other vessels when transiting within WTG field • Possible reduced ability to detect presence of other vessels when vessels emerge from transiting within WTG field	10.4, 11.1, 11.2	• BOEM is currently sponsoring a study by the National Academies of Sciences, Engineering, and Medicine to evaluate impacts of WTGs on marine vessel radar and identify potential mitigation measures; additional mitigation measures for potential radar impacts will be assessed following completion of this study • Communication with waterway users on potential effects of WTGs/ESPs on marine radar systems and means to mitigate these effects	
7	Potential interference with USCG SAR missions due to presence of installed or partially constructed WTGs	• Delayed response in SAR activity leading to potentially adverse outcomes for the vessel in distress	9.8, 10.5, 11.1	• Work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested New England Wind WTGs • Coordination with USCG when SAR activity identified including braking adjacent WTGs	• Test the USCG coordination plan
8	Increased marine radio traffic	• Communication delays that affect SAR response, vessel traffic coordination	11.1, 11.2	• The Proponent to develop a marine communications procedure to engage stakeholders • Marine Coordinator operating from a Marine Coordination Center will manage all construction vessel logistics and implement communication protocols	• Test the communications procedure on a regular basis

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New England Wind Change Analysis
Operations and Maintenance

Document ID: 13057.501_Change Analysis Tables

Rev No. 3

Date: 09 Dec 2021

Risk No	Description of Change	Brief Description of Consequence	Report Section Where Discussed	Mitigation	Monitoring Actions
1	Air draft restriction created by the WTGs	• Possible allision of a vessel with a turbine rotor	9.4, 11.2-11.3	• Provide locations and air draft heights of the WTGs and ESPs to the USCG and NOAA for identification on relevant navigational charts • USCG can advise NOAA of any other relevant notes or precautionary statements to be published on relevant navigational charts • Coordinate with the USCG to issue Notice to Mariners (NTMs) advising mariners of the air draft restriction within the SWDA	
2	Vessels required to transit through defined corridors or around the SWDA	• Increased transit time • Increased risk of collision or allision • Vessels may be in closer proximity due to corridor size	9.2-9.3, 11.2	• Provision of uniform turbine layout that provides transit corridors in four orientations • Coordinate layout with neighboring WTG layouts • Provision of relatively wide corridor spacings (1 NM E-W & N-S; 0.7 NM in NW-SE & SW-NE)	
3	Presence of new obstructions (WTGs and ESPs) in the waterway	• Possible allision with a WTG or ESP, possibly leading to damage, injury, loss of life and/or marine spill	9.3, 11.2-11.3	• WTGs appropriately marked and lit • WTGs and ESPs to be become PATONs • Provide locations and air draft heights of the WTGs and ESPs to the USCG and NOAA for identification on relevant navigational charts • Mariner Radio Activated Sound Signals (MRASS) and AIS transponders to aid mariners in avoiding WTGs and ESPs in low visibility conditions • Coordinate with the USCG to issue NTMs advising mariners of the air draft restriction within the SWDA • USCG can advise NOAA of any other relevant notes or precautionary statements to be published on relevant navigational charts	
4	Disruption of trawling activity due to presence of the WTGs/ESPs	• Increased transit time to/from fishing ground impacting fishery economics • Disruption and/or reorientation of trawling activity in the SWDA	9.2-9.3, 11.2	• Adoption of relatively wide (1 NM) corridors in north-south and east-west directions to facilitate both transiting and trawling	
5	Increased traffic to/from SWDA due to maintenance vessels	• Increased probability of collision, possibly leading to damage, injury, loss of life and/or marine spill	9.3, 11.2-11.3	• Marine Coordinator operating from a Marine Coordination Center will manage all maintenance vessel logistics and implement communication protocols. Unnecessary simultaneous transits at the ports to be minimized. • Maintenance vessels to display proper navigation lights and day shapes	• Regular coordination with local pilots, port authorities, USCG, USACE and other stakeholders as appropriate
6	Impact on aerial Search and Rescue missions	• Delayed response in SAR activity leading to potentially adverse outcomes for the vessel in distress	9.8, 11.2-11.3	• Operations Center(s) to be maintained and will coordinate with the USCG • Emergency shutdown (braking system) of WTGs • Adoption of relatively wide (1 NM) corridors in north-south and east-west directions to facilitate SAR	• Regular testing of braking system • USCG pilot awareness and training
7	Possible disruption of marine radar systems	• Ghosting and spurious clutter due to strong reflections from WTGs • Vessels lose sight of each other when within WTG field	9.5, 11.2-11.3	• Provide updates as to the locations of installed WTGs and ESPs to the USCG and NOAA for use in navigational charts • Participate in regional efforts to develop potential mitigation measures, which may include providing communications and training materials, investigation into the use of more advanced radar systems, and investigation into the use of AIS • WTGs/ESPs defined as PATONs • BOEM is currently sponsoring a study by the National Academies of Sciences, Engineering, and Medicine to evaluate impacts of WTGs on marine vessel radar and identify potential mitigation measures; additional mitigation measures for potential radar impacts will be assessed following completion of this study	• Regular coordination with fisheries and recreational stakeholders
8	Possible disruption DSC and radio direction finding	• Delayed response in SAR activity leading to potentially adverse outcomes for the vessel in distress	9.5, 11.2-11.3		• Monitor for reports of DSC or radio direction finding degradation
9	Increased conflict between fixed fishery and mobile fishery	• Impact on fishery economics	9.2, 11.2-11.3	• Adoption of relatively wide (1 NM) corridors in the north-south and east-west directions so that traditional fixed fisheries gear placement along east-west lines may continue	• Regular coordination with fisheries stakeholders
10	Collision risk by large vessels transiting south of SWDA	• Increased probability of collision, possibly leading to damage, injury, loss of life and/or marine spill	9.2, 9.3, 11.3		• Regular coordination with local pilots, port authorities, USCG, USACE and other stakeholders as appropriate
11	Potential interference with USCG SAR missions due to presence of installed WTGs	• Delayed response in SAR activity leading to potentially adverse outcomes for the vessel in distress	9.8, 11.2-11.3	• Work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested New England Wind WTGs • Coordination with USCG when SAR activity identified including braking adjacent WTGs	• Test the USCG coordination plan
12	Increased marine radio traffic	• Communication delays that affect SAR response, vessel traffic coordination	11.2-11.3	• The Proponent to develop a marine communications procedure to engage stakeholders	• Test the communications procedure on a regular basis

Appendix E

NVIC 01-19 Checklist

ISSUE	REPORT SECTION	NOTES
1. SITE AND INSTALLATION COORDINATE		
Has the developer ensured that coordinates and subsequent variations of site perimeters and individual structures are made available, upon request, to interested parties at all, relevant project stages?	**2.1** **App. A**	Figure 2.1 illustrates variations in the Southern Wind Development Area's (SWDA's) perimeter and locations of individual structures. Coordinates are provided in Appendix A.
Has the coordinate data been supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format? Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 datum.	**To be provided**	
2. TRAFFIC SURVEY		
Was the traffic survey conducted within 12 months of the NSRA?	**6.1**	Yes, the traffic survey was conducted through 31 Dec. 2019 and the NSRA was initially submitted in September 2020.
Does the survey include all vessel types?	**6.3**	Yes, Table 6.2 presents vessel traffic data by vessel type.
Is the time period of the survey at least 28 days duration?	**6.1**	Yes, 48 months of data were used.
Does the survey include consultation with recreational vessel organizations?	**8**	Yes, the Proponent engages with stakeholders on all of its projects, including New England Wind. The USCG also carried out consultations as part of MARIPARS.
Does the survey include consultation with fishing vessel organizations?	**8 & 8.1**	Yes, the Proponent engages with stakeholders on all of its projects, including New England Wind. The USCG also carried out consultations with relevant stakeholders as part of MARIPARS.
Does the survey include consultation with pilot organizations?	**N/A**	Pilot transfer stations are well shoreward of the SWDA and not anticipated to be affected.
Does the survey include consultation with commercial vessel organizations?	**8**	Yes, the Proponent engages with stakeholders on all of its projects, including New England Wind. The USCG also carried out consultations with relevant stakeholders as part of MARIPARS.
Does the survey include consultation with port authorities?	**8**	Yes, consultation with port authorities has and will continue to occur for all of the Proponent's projects, including New England Wind. The USCG also carried out consultations as part of MARIPARS.
Does the survey include proposed structure location relative to areas used by any type of vessel?	**6**	Section 6 contains data on traffic relative to SWDA. Figure 6.3 shows all traffic and subsequent figures show traffic by vessel type.
Does the survey include numbers, types, sizes and other characteristics of vessels presently using such areas?	**6**	Section 6 provides details on total numbers of vessels/tracks by type and time period (see

ISSUE	REPORT SECTION	NOTES
		Tables 6.2 and 6.3). Sections 6.4 and 6.5 provide a breakdown by vessel type, including size statistics by vessel type.
Does the survey include types of cargo carried by vessels presently using such areas?	**6.4**	Section 6.4 and subsections provide details on commercial traffic and types of cargo carried (passengers, liquid bulk, dry bulk / cargo, military, and towing).
Does the survey identify non-transit uses of the areas (for example, fishing, day cruising of leisure craft, racing, marine regattas and parades, aggregate mining)?	**9.2.2**	No non-transit areas are designated. However, it is assumed that non-fishing commercial traffic will choose to re-route around the SWDA.
Does the survey include whether these areas contain transit routes used by coastal or deep-draft vessels, ferry routes, and fishing vessel routes?	**6.4**	Yes, vessel transit routes within and near the SWDA are described in Section 6.4, Also Figure 6.27 shows transit route density for all vessels.
Does the survey include alignment and proximity of the site relative to adjacent shipping routes	**5 & 6.4.8**	Section 5 identifies major designated shipping routes and describes their proximity and alignment relative to the SWDA. Section 6.4.8 includes Figure 6.27, which shows the SWDA's proximity to major fairways by transit route density.
Does the survey include whether the nearby area contains prescribed or recommended routing measures or precautionary areas?	**5**	Nearby routing measures are discussed in Section 5, but no additional routing measures are proposed. The Proponent is not aware of any USCG planned precautionary areas.
Does the survey include whether the site lies on or near a prescribed or conventionally accepted separation zone between two opposing routes or traffic separation scheme?	**5 & 5.1**	Yes. Figure 5.1 illustrates traffic separation schemes near the Offshore Development Area.
Does the survey include the proximity of the site to anchorage grounds or areas, safe haven, port approaches, and pilot boarding or landing areas?	**5 & 5.1**	Yes. Figure 5.1 illustrates navigation features near the Offshore Development Area.
Does the survey include the feasibility of allowing vessels to anchor within the vicinity of the structure field?	**9.10**	Yes.
Does the survey include the proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds?	**6.4.7**	Section 6.4.7 provides details on fishing vessel routes to and from fishing grounds as well as fishing activities within the SWDA. Appendix C provides VMS maps showing commercial fishing density in proximity to the Offshore Development Area.
Does the survey include whether the site lies within the limits of jurisdiction of a port and/or navigation authority?	**N/A**	The site does not lie within the jurisdiction of a port and/or navigation authority.
Does the survey include the proximity of the site to offshore firing/bombing ranges and areas used for any marine or airborne military purposes?	**5.3**	Yes.

ISSUE	REPORT SECTION	NOTES
Does the survey include the proximity of the site to existing or proposed offshore OREi/gas platform or marine aggregate mining?	**5.3**	Yes.
Does the survey include the proximity of the site to existing or proposed structure developments?	**5.3**	Yes.
Does the survey includes the proximity of the site relative to any designated areas for the disposal of dredging material or ocean disposal site?	**9.12**	Yes.
Does the survey include the proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon?	**5.2 & 5.3**	Section 5.2 addresses aids-to-navigation (ATONS) and private ATONS (PATONS) Section 5.3 addresses VMRS.
Does the survey include a researched opinion using computer simulation techniques with respect to the displacement of traffic, mixing of vessel types that were previously segregated; changes in traffic density and resultant change in vessels encounters; and, in particular, the creation of 'choke points' in areas of high traffic density?	**9 & 9.3.3 App. B**	Section 9 presents the development of and results from the NORM model, which is used to evaluate changes in traffic patterns and potential impacts in term of traffic density and collision/allision hazards. Section 9.3.3, in particular, provides details on the model's results. Appendix B provides details of the NORM model.
Does the survey include whether the site lies in or near areas that will be affected by variations in traffic patterns as a result of changes to vessel emission requirements?	**9.13**	Yes.
Does the survey include seasonal variations in traffic?	**6.3**	Table 6.3 provides seasonal and year-to-year variation in traffic.
3. OFFSHORE ABOVE WATER STRUCTURE		
Does the NSRA denote whether any features of the offshore above water structure, including auxiliary platforms outside the main generator site and cabling to the shore, could pose any type of difficulty or danger to vessels underway, performing normal operations, or anchoring? Such dangers would include clearances of wind turbine blades above the sea surface, the burial depth of cabling, and lateral movement of floating wind turbines.	**9.3 9.4& 9.10**	Section 9.3 addresses hazards from above water structures. Section 9.4 addresses air draft restriction. Section 9.10 addresses cable burial depth.
Does the NSRA denote whether minimum safe (air) clearances between sea level conditions at Mean Higher High Water (MHHW) and wind turbine rotors are suitable for the vessels types identified in the traffic survey? Depths, clearances, and similar features of other structure types which might affect navigation safety and other Coast Guard missions should be determined on a case by case basis.	**9.4**	The minimum tip clearance in Figure 9.10 is referenced to MLLW not MHHW, but the text identifies the relationship between these values.

ISSUE	REPORT SECTION	NOTES
Does the **NSRA** denote whether any feature of the installation could impede emergency rescue services, including the use of lifeboats, helicopters and emergency towing vessels (ETVs)?	**9.8**	New England Wind's offshore facilities have been designed with US Coast Guard Search and Rescue (SAR) requirements in mind and based upon the recommendations in MARIPARS.
Does the NSRA denote how rotor blade rotation and power transmission, etc., will be controlled by the designated services when this is required in an emergency?	**11.2.5**	Yes.
Does the **NSRA** denote whether any noise or vibrations generated by a structure above and below the water column would impact navigation safety or affect other Coast Guard missions?	**9.6.1**	Yes.
Does the NSRA denote the ability of a structure to withstand collision damage by vessels without toppling for a range of vessel types, speeds, and sizes?	**9.3.3.4**	Yes.
4. OFFSHORE UNDER WATER STRUCTURE		
Does the NSRA denote whether minimum safe clearance over underwater devices has been determined for the deepest draft of vessels that could transit the area?	**9.3.1.1**	Water depths at the SWDA far exceed the drafts of vessels operating in the area (by approximately 5-10 times vessel drafts).
Has the developer demonstrated an evidence-based, case- by-case approach which will include dynamic draft modeling in relation to charted water depth to ascertain the safe clearance over a device?	**N/A**	Water depths at the SWDA far exceed the drafts of vessels operating in the area and even dynamic draft effects would not lead to issues with safe clearance.
To establish a minimum clearance depth over devices, has the developer identified from the traffic survey the deepest draft of observed traffic? This will then require modeling to assess impacts of all external dynamic influences giving a calculated figure for dynamic draft. A 30% factor of safety for under keel clearance (UKC) should then be applied to the dynamic draft, giving an overall calculated safe clearance depth to be used in calculations.	**N/A**	Water depths at the SWDA far exceed the drafts of vessels operating in the area (by approximately 5-10 times vessel drafts).
NOTE: The Charted Depth reduced by safe clearance depth gives a maximum height above seabed available from which turbine design height including any design clearance requirements can be established.		
5. ASSESSMENT OF ACCESS TO AND NAVIGATION WITHIN, OR CLOSE TO, A STRUCTURE. Has the developer determined the extent to which navigation would be feasible within the structure site itself by assessing whether:		

ISSUE	REPORT SECTION	NOTES
Navigation within the site would be safe? • By all vessels or • By specified vessel types, operations and/or sizes? • In all directions or areas; or • In specified directions or areas? • In specified tidal, weather or other conditions; and • At any time, day or night?	**9.2 & 9.3.3.3**	Limits on vessel size and air draft are addressed. All particular scenarios (i.e. all directions, all vessels, any time, etc.) were not explicitly stated in the NSRA.
Navigation in and/or near the site should be • Prohibited by specified vessel types, operations and/or sizes; • 'Prohibited in respect to specific activities; • Prohibited in all areas or directions; • Prohibited in specified areas or directions; • Prohibited in specified tidal or weather conditions; • Prohibited during certain times of the day or night; or • Recommended to be avoided?	**N/A**	No prohibitions are proposed except temporary safety buffer zones immediately around installation vessels during construction and periodic maintenance activities (see Section 10). If in-water maintenance activities are required during O&M, there could be temporary safety buffer zones established around work areas in limited areas of the SWDA or along the OECC. Larger commercial vessels were assumed to choose to re-route around the SWDA (see Section 9.2.2)
Does the **NSRA** contain enough information for the Coast Guard to determine whether or not exclusion from the site could cause navigation, safety, or transiting problems for vessels operating in the area?	**9.2 & 9.3.3**	Vessels voluntarily re-routing around the SWDA are addressed but no exclusion is proposed except temporary safety buffer zones immediately around installation vessels during construction and periodic maintenance activities (see Section 10).
6. THE EFFECT OF TIDES, TIDAL STREAMS, AND CURRENTS. Does the NSRA contain enough information for the Coast Guard to determine whether or not:		
Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed structure is situated at various states of the tide, that is, whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa?	**9.3.1.1**	Not applicable, water depths at the SWDA far exceed the drafts of vessels operating in the area (by approximately 5-10 times vessel drafts).
Current maritime traffic flows and operations in the general area are affected by existing currents in the area in which the proposed structure is situated?	4.5	Currents are not a major navigation factor, as compared to wind driven drift, in the immediate vicinity of the SWDA.
The set and rate of the tidal stream, at any state of the tide, would have a significant effect on vessels in the area of the structure site?	**9.3.2.6**	Currents are not a major navigation factor, as compared to wind driven drift, in the immediate vicinity of the SWDA.
Current directions/velocities might aggravate or mitigate the likelihood of allision with the structure?	**9.3.2.6**	Currents are not a major navigation factor, as compared to wind driven drift, in the immediate vicinity of the SWDA.
The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its	**4.5**	Values are provided in compass directions only, and not relative to the axis of the site.

ISSUE	REPORT SECTION	NOTES
effect?		
The set is across the major axis of the layout at any time, and, if so, at what rate?	**4.5**	Values are provided in compass directions only, and not relative to the axis of the site.
In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream or currents?	**9.3.2.6**	Currents are not a major navigation factor, as compared to wind driven drift, in the immediate vicinity of the SWDA.
Structures themselves could cause changes in the set and rate of the tidal stream or direction and rate of the currents?	**4.5**	Given the wide spacing (1 NM [1.85 km]) of the WTGs/ESPs, the relatively deep waters at the SWDA, and the relatively small in-water profile of the WTG/ESP foundations, it is not expected that the structures will cause changes in the set and rate of the tidal stream or ocean currents.
Structures in the tidal stream could produce siltation, deposition of sediment or scouring, any other suction or discharge aspects, which could affect navigable water depths in the structure area or adjacent to the area?	**4.9**	Given the wide spacing (1 NM [1.85 km]) of the WTGs/ESPs, the relatively deep waters at the SWDA, and the relatively small in-water profile of the WTG/ESP foundations, it is not expected that the structures will induce any significant effect on siltation or sedimentation patterns that would influence navigable water depths.
Structures would cause danger and/or severely affect the air column, water column, seabed and sub-seabed in the general vicinity of the structure?	**4.9 & 4.10**	Given the wide spacing (1 NM [1.85 km]) of the WTGs/ESPs, the relatively deep waters at the SWDA, and the relatively small in-water profile of the WTG/ESP foundations, it is not expected that the structures will induce any significant effect on siltation or sedimentation patterns that would influence navigable water depths. Scour potential will be addressed during the design process and scour protection may be placed around the WTG and ESP foundations, if needed.
7. **WEATHER.** Does the NSRA contain a sufficient analysis of expected weather conditions, water depths and sea states that might aggravate or mitigate the likelihood of allision with the structure, so that Coast Guard can properly assess the applicant's determinations of whether:		
The site, in all weather conditions, could present difficulties or dangers to vessels, which might pass in close proximity to the structure?	**4**	Wind, waves, currents, ice, visibility (fog), and tides are addressed.
The structures could create problems in the area for vessels under sail, such as wind masking, turbulence, or sheer?	9.11	This is addressed.
In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred above?	**9.3.2.6**	This is addressed.

ISSUE	REPORT SECTION	NOTES
Depending on the location of the structure and the presence of cold weather, sea ice and/or icing of the structure may cause problems? A thorough analysis of how the presence of the structure would mitigate or exacerbate icing?	**4.6**	This is addressed.
An analysis of the likelihood that ice may form on the structure, especially those types that have rotating blades such as a Wind Turbine Generator (WTG), should be conducted by the applicant, and should include an analysis of the ability of the structure to withstand anticipated ice accumulation on the structures, and potential for ice to be thrown from the blades, and the likely consequences of that happening and possible actions to mitigate that occurrence?	**4.6**	This is addressed.
8. CONFIGURATION AND COLLISION AVOIDANCE		
The Coast Guard will provide Search and Rescue (SAR) services in and around OREis in US waters. Layout designs should allow for safe transit by SAR helicopters operating at low altitude in bad weather, and those vessels (including rescue craft) that decide to transit through them. Has the developer conducted additional site specific assessments, if necessary, to build on any previous assessments to assess the proposed locations of individual turbine devices, substations, platforms and any other structure within OREi such as a wind farm or tidal/wave array? Any assessment should include the potential impacts the site may have on navigation and SAR activities. Liaison with the USCG is encouraged as early as possible following this assessment which should aim to show that risks to vessels and/or SAR helicopters are minimized and include proposed mitigation measures.	**9.8 & 10.5**	The NSRA relied, in part, on the MARIPARS assessment given the USCG's expertise in SAR.
Each OREi layout design will be assessed on a case-by- case basis.	**N/A**	This is addressed.
Risk assessments should build on any earlier work conducted as part of the NSRA and the mitigations identified as part of that process. Where possible, an original assessment should be referenced to confirm where information or the assessment remains the same or can be further refined due to the later stages of project development. Risk assessments should present information to enable the USCG to adequately understand how the risks associated with the proposed layout have been reduced to As Low As Reasonably Practicable (ALARP).	**9.3**	A quantitative risk assessment has been carried out. In addition, the allowable widths of corridors have been estimated based on technical guidance.

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Packed boundaries will be considered on a case-by-case basis as part of the risk assessment process. For opposite boundaries of adjacent sites due consideration should be given to the requirement for lines of orientation which allow a continuous passage of vessels and/or SAR helicopters through both sites. Where there are packed boundaries this will affect layout decisions for any possible future adjacent sites. The definition of 'adjacent' will be assessed on a case-by-case basis.	**N/A**	Packed boundaries do not occur as a uniform WTG layout has been assumed by developers across all adjacent leases in the MA WEA and RI/MA WEA.
9. VISUAL NAVIGATION. Does the NSRA contain an assessment of the extent to which:		
Structures could block or hinder the view of other vessels underway on any route?	**9.7**	This is addressed.
Structures could block or hinder the view of the coastline or of any other navigational feature such as aids to navigation, landmarks, promontories?	**9.7**	This is addressed.
Structures and locations could limit the ability of vessels to maneuver in order to avoid collisions?	**9.2**	This is addressed.
10. COMMUNICATIONS, RADAR AND POSITIONING SYSTEMS. Does the NSRA provide researched opinion of a generic and, where appropriate, site specific nature concerning whether or not:		
Structures could produce interference such as shadowing, reflections or phase changes, with marine positioning, navigation, or communications, including Automatic Identification Systems **(AIS),** whether ship borne, ashore, or fitted to any of the proposed structures?	**9.5**	This is addressed.
Structures could produce radar reflections, blind spots, shadow areas or other adverse effects in the following interrelationships: • Vessel to vessel; • Vessel to shore; • Vessel Traffic Service radar to vessel; • Radio Beacons (RACONS) to/from vessel; and • Aircraft and Air Traffic Control?	**9.5**	This is addressed.
Structures, in general, would comply with current recommendations concerning electromagnetic interference?	**9.5.4**	This is addressed.
Structures might produce acoustic noise or noise absorption or reflections which could mask or interfere with prescribed sound signals from other vessels or aids to navigation?	**9.6.1**	This is addressed.
Structures, generators, and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems?	**9.5.4**	This is addressed.
The power and noise generated by structures above or below the water would create physical risks that would affect the health of vessel crews?	**9.6.1**	This is addressed.

<table>
<tr><th>ISSUE</th><th>REPORT SECTION</th><th>NOTES</th></tr>
<tr><td colspan="3">11. RISK OF COLLISION, ALLISION, OR GROUNDING. Does the NSRA, based on the data collected per paragraph 2 above, provide an evaluation that was conducted to determine the risk of collision between vessels, risk of allisions with structures, or grounding because of the establishment of a structure, including, but not limited to</td></tr>
<tr><td>• Likely frequency of collision (vessel to vessel);
• Likely consequences of collision ("What if' analysis);
• Likely location of collision;
• Likely type of collision;
• Likely vessel type involved in collision;
• Likely frequency of allision (vessel to structure)
• Likely consequences of allision ("What if' analysis);
• Likely location of allision;
• Likely vessel type involved in allision;
• Likely frequency of grounding;
• Likely consequences of grounding ("What if' analysis);
• Likely location of grounding; and
• Likely vessel type involved in grounding?</td><td>9.3.3</td><td>Quantitative risk modeling was carried out.</td></tr>
<tr><td colspan="3">12. EMERGENCY RESPONSE CONSIDERATIONS. In order to determine the impact on Coast Guard and other emergency responder missions, has the developer conducted assessments on the Search and Rescue and the Marine Environmental Protection emergency response missions?</td></tr>
<tr><td>Marine Environmental Protection/Response:
• How many marine environmental/pollution response cases has the USCG conducted in the proposed structure region over the last ten years?
• What type of pollution cases were they?
• What type and how many assets responded?
• How many additional pollution cases are projected due to allisions with the structures?</td><td>7.2 & 9.9</td><td>Section 7.2 addresses historic events, none of which occurred within the SWDA.
Section 9.9 describes potential impacts from New England Wind on MER</td></tr>
<tr><td colspan="3">13. FACILITY CHARACTERISTICS. In addition to addressing the risk factors detailed above, does the developer's NSRA include a description of the following characteristics related to the proposed structure:</td></tr>
<tr><td>Marine Navigational Marking?</td><td>11.2.1</td><td>This is addressed.</td></tr>
<tr><td>How the overall site would be marked by day and by night, taking into account that there may be an ongoing requirement for marking on completion of decommissioning, depending on individual circumstances?</td><td>11.2.1</td><td>New England Wind's structures will be marked and lit in accordance with USCG, BOEM, FAA guidance in effect at the time each Phase of New England Wind is being constructed and operated. Current plans for marking and lighting are based on USCG's offshore structure PATON marking guidance contained in District 1 LNM 44/20.</td></tr>
<tr><td>How individual structures on the perimeter of and within the site, both above and below the sea surface, would be marked by day and by night?</td><td>11.2.1</td><td>New England Wind's structures will be marked and lit in accordance with USCG, BOEM, FAA guidance in effect at the time each Phase of New England Wind is being constructed and operated. Current plans for marking and lighting are based on USCG's offshore structure PATON marking guidance contained in District 1 LNM 44/20.</td></tr>
</table>

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If the site would be marked by one or more Radar Beacons (RACONS) or, an Automatic Identification System (AIS) transceiver, or both and if so, the AIS data it would transmit?	**11.2.4**	This is addressed.
If the site would be fitted with a sound signal, the characteristics of the sound signal, and where the signal or signals would be sited?	**11.2.1**	This is addressed.
If the structure(s) are to be fitted with aviation marks, how would they be screened from mariners or potential confusion with other navigational marks and lights be resolved?	**11.2.2**	This is addressed.
Whether the proposed site and/or its individual generators would comply in general with markings for such structures, as required by the Coast Guard?	**11.2.1**	This is addressed.
Whether its plans to maintain its aids to navigation are such that the Coast Guard's availability standards are met at all times. Separate detailed guidance to meet any unique characteristics of a particular structure proposal should be addressed by the respective District Waterways Management Branch?	**11.2.1**	This is addressed.
The procedures that need to be put in place to respond to and correct discrepancies to the aids to navigation, within the timeframes specified by the Coast Guard?	**11.2.1**	This is addressed.
How the marking of the structure will impact existing Federal aids to navigation in the vicinity of the structure?	**9.7**	Minimal impacts on existing Federal aids to navigation are anticipated.
14. DESIGN REQUIREMENTS. Is the structure designed and constructed to satisfy the following recommended design requirements for emergency shut-down in the event of a search and rescue, pollution response, or salvage operation in or around a structure?		

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All above surface structure individual structures should be marked with clearly visible unique identification characters (for example, alpha-numeric labels such as "Al," "B2."). The identification characters should each be illuminated by a low-intensity light visible from a vessel, or be coated with a phosphorescent material, thus enabling the structure to be detected at a suitable distance to avoid a collision with it. The size of the identification characters in combination with the lighting or phosphorescence should be such that, under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer, and at a distance of at least 150 yards from the structure. It is recommended that, if lighted, the lighting for this purpose be hooded or baffled so as to avoid unnecessary light pollution or confusion with navigation aids. (Precise dimensions to be determined by the height of lights and necessary range of visibility of the identification numbers).	**11.2.1 & App. A**	Section 11.2.1 describes markings and Appendix A provides geographic coordinates and associated alphanumeric identifiers for each structure. The unique alphanumeric identifiers on each WTG tower and/or foundation are still being determined in coordination with the Bureau of Ocean Energy Management and the Unites States Coast Guard. The Proponent will update the identifiers once the labeling scheme is finalized.
All generators and transmission systems should be equipped with control mechanisms that can be operated from an operations center of the installation.	**11.2.5**	This is addressed.
Throughout the design process, appropriate assessments and methods for safe shutdown should be established and agreed to through consultation with the Coast Guard and other emergency support services.	**11.2.5**	This is addressed.
The control mechanisms should allow the operations center personnel to fix and maintain the position of the WTG blades, nacelles and other appropriate moving parts as determined by the applicable Coast Guard command center. Enclosed spaces such as nacelle hatches in which personnel are working should be capable of being opened from the outside. This would allow rescuers (for example, helicopter winch-man) to gain access if occupants are unable to assist or when sea-borne approach is not possible.	**11.2.5**	Nacelle hatches for access will be designed to enable opening, access, entry and exit from both inside and outside. It will be possible to unsecure and open the nacelle roof hatch from the outside of the nacelle to facilitate emergency rescue from the nacelle top.
15. OPERATIONAL REQUIREMENTS. Will the operations be continuously monitored by the facility's owners or operators, ostensibly in an operations center? Does the NSRA identify recommended minimum requirements for an operations center such as:		
The operations center should be manned 24 hours a day?	**11.2.5**	Yes.
The operations center personnel should have a chart indicating the Global Positioning System (GPS) position and unique identification numbers of each of the structure?	**App. A**	This is addressed.
All applicable Coast Guard command centers (District and Sector) will be advised of the contact telephone number of the operations center?	**11.2.5**	Yes.

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All applicable Coast Guard command centers will have a chart indicating the position and unique identification number of each of the structures?	**App. A**	Yes.
16. OPERATIONAL PROCEDURES. Does the NSRA provide for the following operational procedures?		
Upon receiving a distress call or other emergency alert from a vessel that is concerned about a possible allision with a structure or is already close to or within the installation, the Coast Guard Search and Rescue Mission Coordinator (SMC) will establish the position of the vessel and the identification numbers of any structures visible to the vessel. The position of the vessel and identification numbers of the structures will be passed immediately to the operations center by the SMC.	**N/A**	This is describing USCG's actions.
The operations center should immediately initiate the shut-down procedure for those structures as requested by the SMC, and maintain the structure in the appropriate shut-down position, again as requested by the SMC, until receiving notification from the SMC that it is safe to restart the structure.	**11.2.5**	This is addressed.
Communication and shutdown procedures should be tested satisfactorily at least twice each year.	**11.2.5**	This is addressed.
After an allision, the applicant should submit documentation that verifies the structural integrity of the structure	**11.2.5**	This is addressed.