November 1, 2019

RE: Proposal for a uniform 1 X 1 nm wind turbine layout for New England Offshore Wind

Mr. Michael Emerson, Director
Marine Transportation Systems (CG-5PW)
US Coast Guard, Stop 7501
Washington DC 20593-751

By email: Michael.D.Emerson@uscg.mil

Dear Mr. Emerson:

We, the five New England offshore wind leaseholders, propose a collaborative regional layout for wind turbines across our respective BOEM leases, and urge the Coast Guard, BOEM, and other regulators and stakeholders to support adoption of this 1 x 1 nautical mile (nm) uniform turbine layout with no additional designated transit corridors. For the purpose of this letter, the combined area encompassed by the seven leases is referred to as the New England Wind Energy Area (NE WEA). 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.

Enclosed please find a report prepared by W.F. Baird & Associates Ltd., a leading vessel and port safety consultant, which describes historic vessel transit patterns in the region and analyzes the 1x1nm layout using international vessel safety guidelines. Baird's analysis is based on AIS data between 2017 and 2018. The key findings include:

- Most traffic in the general region is transiting around, or along the outside edges, of the NE WEA;
- Most of the transiting vessels are fishing vessels, and they follow a wide range of transit paths through the NE WEA as they are coming from several different ports and heading to a variety of fishing grounds;
- Vessels up to 400' length can safely operate within the proposed 1x1 nm layout, and historic transit data shows vessels over this length tend to follow existing Traffic Separation Schemes already outside the NE WEA;
- Given the 1x1nm layout, there does not appear to be a need for designated transit corridors through the WEA.

We respectfully invite the Coast Guard to incorporate this proposal and the enclosed study in the ongoing Massachusetts and Rhode Island Port Access Route Study. Given the many advantages of the proposed 1x1 nm regional layout, the New England Leaseholders are proud to be working together to present a collaborative solution that we believe accommodates all ocean users in the region.

Advantages of a 1 x 1 nm uniform layout

There are four main advantages of the proposed 1x1nm uniform turbine layout:

- Navigation safety
- Responsive to fishermen's request for 1 nm turbine spacing and east-west rows
- Creates 231 transit corridors, in four cardinal directions
- Facilitates search and rescue operations

Navigation Safety

The Coast Guard has consistently expressed its desire that the potential wind energy facilities in then NE WEA preserve mariners' ability to transit from one end of the NE WEA to the other while maintaining a relatively steady course and speed. The Coast Guard was concerned that dissimilar array layouts may present a veritable obstacle course through which mariners must navigate. The solution jointly proposed here would address both Coast Guard issues and preserve navigation safety.

Responsive to requests from fishermen

Commercial fishermen working in the region have consistently advocated for turbines to be oriented in E-W rows, to accommodate long-standing practices designed to minimize conflict between fixed and mobile fishing gear. Considerable written and oral public comments have urged adoption of 1 nm spacing between turbines so as to better facilitate fishing operations among the turbines. Fishermen have also asked that turbine layouts be consistent across lease areas so as to avoid changing their operations as they pass from one lease area into the next.

Members of the Rhode Island Fisheries Advisories Board, the Massachusetts Fisheries Working Group, fisheries groups that serve as representatives to the Leaseholders, fishing fleet operators, and fish processing companies, as well as the National Marine Fisheries Service, have all expressed support for one or all of the following design elements: a uniform layout across the entire NE WEA, E-W rows, and at least 1 nm spacing being turbines. The 1x1nm turbine layout proposed here would provide each of these requested design elements, precisely as requested by the fishing industry.

Creates 231 transit corridors serving four cardinal directions

The proposed 1x1 nm turbine layout accommodates safe transiting through the region by creating 231 transit corridors in four cardinal directions. The existence of numerous corridors, in multiple directions, consistently across all lease areas, would be preferable to having a restricted number of designated transit lanes.

Because most of the vessel traffic in the NE WEA are fishing vessels, as noted in the Baird report, and fishing vessels utilize a wide variety of transit paths, having the ability to safely transit in any of four cardinal directions from any point within the NE WEA best accommodates the largest number of vessels operating in the area.

As shown in Figure 1, the uniform turbine layout would create 231 corridors of uniform width that cross from east-west (E-W), north-south (N-S), NW-SE, and SW-NE. These 231 corridors will be available for mariners no matter where they cross into the NE WEA. The corridor width in the E-W and N-S direction would be 1 nm. In the NW-SE and SW-NE directions the corridors would be 0.7 nm wide for the purpose of maintaining a constant heading, however the closest distance between any two turbines on either side of a vessel using a NW-SE or SW-NE corridor would be 1.4 nm

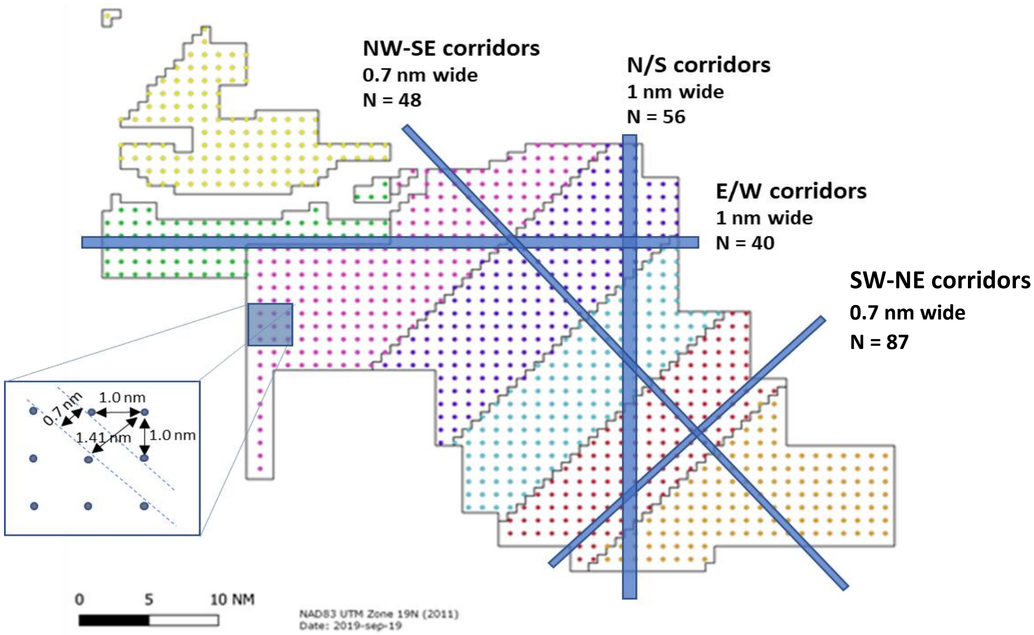

Figure 1: A full 1 X 1 nm E-W, N-S grid creates the equivalent of 231 transit lanes in four different key directions: E-W, NW-SE, N-S and SW-NE.

The AIS data that Baird analyzed, indicates that most of the vessels transiting the region currently choose to navigate outside of the NE WEA even when no turbine structures are present. And of those vessels transiting the NE WEA, many are just inside the edge of the NE WEA.

Of the vessels transiting the NE WEA, most are commercial fishing vessels. These vessels originate from several ports that are generally to the north and northwest of the NE WEA, heading to fishing grounds located generally to the southeast and south of the NE WEA. Consequently, a single transit corridor would still require many vessels to modify their traffic patterns, given the wide variety of origins and destinations to accommodate the wide variety of fishing vessel homeports and practices.

Baird's analysis demonstrates that for all but the very largest vessels transiting in the region — and for fishing vessels of all sizes— the wide spacing of 1 nm between turbines would allow for safe navigation among the turbines. This conclusion applies to vessels that might be passing or overtaking each other, and considers the need to make emergency turns, even with fishing gear deployed.

Facilitates search and rescue operations

Our proposal of a uniform grid turbine layout, with turbines no closer than 1 nm, would afford an even greater level of flexibility and safety for SAR operations, by both vessel and aircraft.

1 x 1 nm layout best accommodates all maritime stakeholders, allowing offshore wind to deliver its benefits to the U.S.

Given the many advantages of the proposed 1x1 nm turbine layout, the New England Leaseholders are proud to be working together to propose a collaborative solution to concerns that have been raised by stakeholders about the full-build out scenario of the NE WEA. We respectfully invite the Coast Guard to incorporate this proposal and the enclosed study in the Massachusetts and Rhode Island Port Access Routing Study. As detailed above, this proposed layout responds to input and requests from many stakeholders and creates an opportunity that we believe accommodates all ocean users. We appreciate your continued consideration for how to safely ensure continued coexistence of all ocean users in the region, including offshore wind.

Christer af Geijerstam, President
Equinor Wind US

Leon Olivier, Executive Vice President Enterprise Energy Strategy
Eversource Energy

John Hartnett, President
Mayflower Wind

Thomas Brostrøm, President
Orsted North America

Lars Thaaning Pedersen, CEO
Vineyard Wind LLC

CC: Walter Cruickshank, Director, Bureau of Ocean Energy Management

Enclosure: Baird Study "Vessel Navigation Through the Proposed Rhode Island/Massachusetts and Massachusetts Wind Energy Areas", October 31, 2019

Vessel Navigation Through the Proposed Rhode Island/Massachusetts and Massachusetts Wind Energy Areas

October 31 2019 | 13057.301.R1.RevD

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Vessel Navigation Through the Proposed Rhode Island/Massachusetts and Massachusetts Wind Energy Areas

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Revision	Date	Status	Comments	Prepared	Reviewed	Approved
A	06 Sep 2019	Draft	For client review	RDS	DT	RDS
B	24 Sep 2019	Draft		RDS	DT	RDS
C	07 Oct 2019	Draft		RDS	DT	RDS
D	31 Oct 2019	Draft		RDS	DT	RDS

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Acronyms

AIS	Automatic Identification System
AtoN	Aids to Navigation
BOEM	Bureau of Ocean Energy Management
COLREGS	International Regulations for Preventing Collisions at Sea
COP	Construction and Operations Plan
DWT	Deadweight Tonnage
EMF	Electromagnetic Field
ESP	Electrical Service Platform
Ft	feet
GPS	Global Positioning System
Hz	Hertz
IALA	International Association of Lighthouse Authorities
IPS	Intermediate Peripheral Structures
kts	Knots - vessel speed in nautical miles per hour
LOA	length overall
m	meter
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
MSL	Mean Sea Level
NM	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NTM	Notice to Mariners
PAtoN	Private Aids to Navigation
RACON	Radar Transponder
Ro-Ro	Roll-on roll-off vessel
SAR	Search and Rescue
SPS	Significant Peripheral Structure

TSS	Traffic separation scheme
USCG	US Coast Guard
VHF	Very High Frequency Radio
WEA	Wind Energy Area
WTG	Wind Turbine Generator

1. Introduction

In January 2019, Baird completed a Supplementary Analysis for Navigational Risk Assessment of the Vineyard Wind project. That study, documented in Baird (2019), focused on analysis of an Automated Identification System (AIS) data set of vessel traffic in the vicinity of the Vineyard Wind project covering the period from 2017 to 2018. The analyses and risk assessment completed by Baird were focused on the navigation risk during the operational phase of the Vineyard Wind project.

Since that time, guidance has been provided that a uniform wind turbine layout with an East-West orientation should be assumed over the entire Rhode Island/Massachusetts and Massachusetts Wind Energy Area (referred to herein as the WEA) as shown in Figure 1.1. The proposed layout has a 1 nautical mile (nm) wind turbine generator (WTG) spacing in both the East-West (E-W) and North-South (N-S) directions, providing corridors 1 nm wide in both the N-S and E-W orientations. This uniform layout also inherently creates 0.7 nm wide corridors on the diagonal in the Northwest-Southeast (NW-SE) and Southwest-Northeast (SW-NE) directions. As may be seen in Figure 1.1, these corridors exist across the entire WEA, not just through selected designated fairways.

This uniform WTG layout will allow vessels to transit through the turbines on a constant heading track along N-S, E-W, NW-SE and SW-NE corridors at all locations in the WEA.

This study has examined the potential impact of the proposed WTG layout on vessel navigation through the WEA. A first step was to conduct an analysis of historical vessel traffic using Automatic Identification System (AIS) data and the methods presented in Baird (2019). Subsequently an assessment of the influence of the WTG arrangement and transit corridors on vessel navigation was conducted using international design guidance.

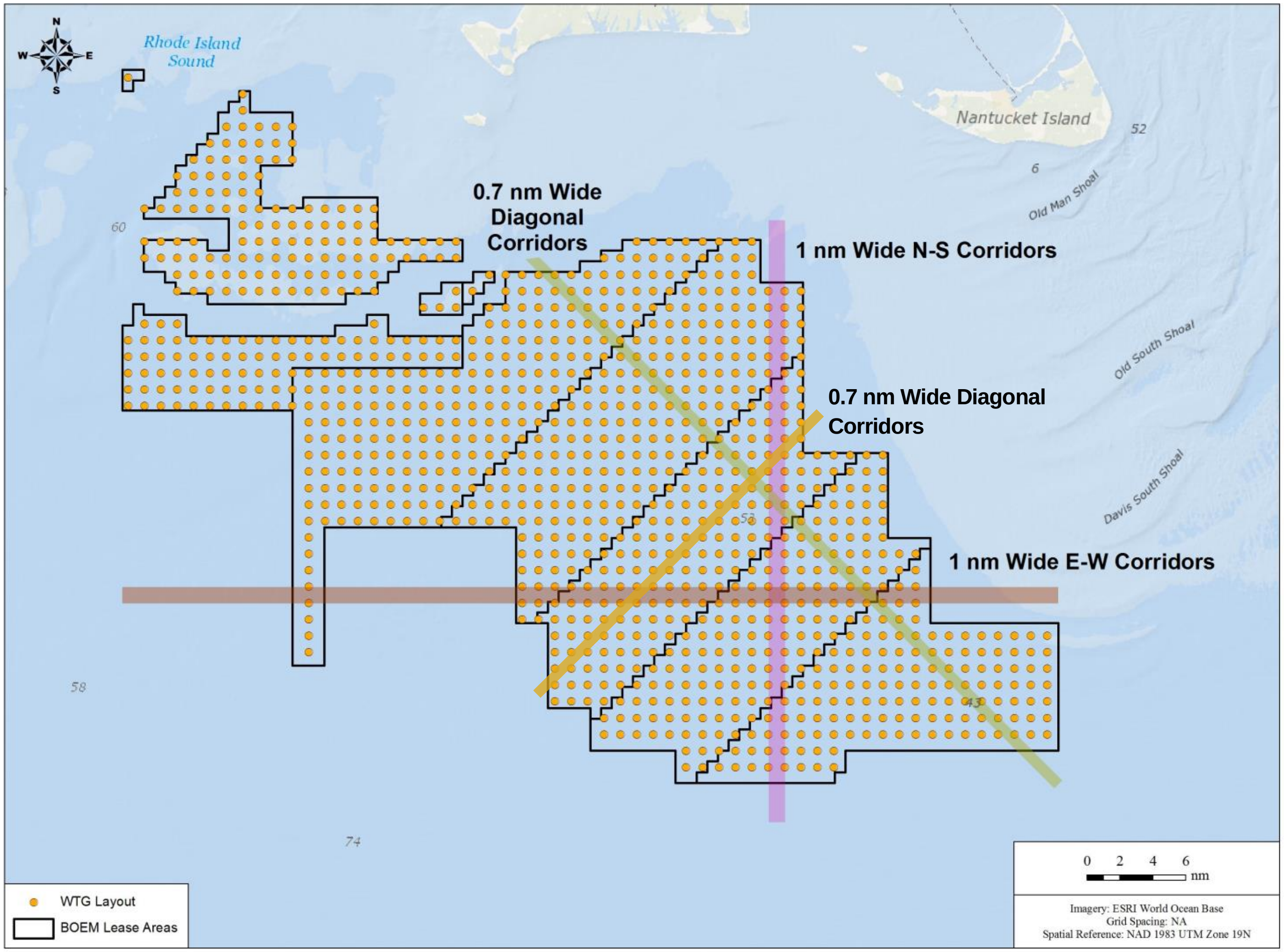

Figure 1.1: RI/MA and MA Wind Energy Areas (WEA) – Uniform Turbine Layout (1 nm E-W; 1 nm N-S; 0.7 nm NW-SE; 0.7 nm SW-NE spacing)

2. Summary of Historical Vessel Traffic

Historical vessel traffic patterns for the years 2017 and 2018 were examined using AIS data. All tracks for vessels transiting within the perimeter of the WEA were extracted from the AIS dataset. The analysis focused on the following vessel types as identified by their AIS reporting codes:

- Cargo;
- Tankers;
- Passenger;
- Military;
- Sailing and Pleasure vessels; and
- Fishing.

Table 2.1 presents a summary of the AIS vessel traffic through the WEA by vessel type. Fishing vessels are the dominant vessel type based on number of AIS data points (pings), unique transits identified in Baird's analysis, and unique vessels. Fishing vessels represent over 70% of the AIS data. The size of fishing vessels is typically 70 ft length overall (LOA) up to a maximum of 195 ft, while vessel beam is typically 25 ft, up to a maximum of 49 ft. Cargo and tanker vessels represent approximately 11% of vessel position data and those vessels typically exceed 600 ft LOA, with the largest vessels between 900 and 1000 ft. There are very few military vessels that transit the WEA (0.3% of total traffic) with only seven unique vessels per year on average. Note the "Other" category has been excluded from the statistics as it is comprised of survey vessels that were operating in the WEA (thus, not normal traffic) as well as vessels that were missing the AIS category data.

Table 2.1: Summary of AIS Vessel Traffic through WEA: 2017 and 2018.

Vessel Type	LOA (ft)		Beam (ft)		% AIS data points – All Data	Unique Vessels (per year)*		Unique Tracks (per year)*	
	Mode^	Max	Mode^	Max		Count	%	Count	%
Fishing	70	195	25	49	71.2%	348	38.7%	3,259	69.4%
Military	105	465	20	55	0.3%	7	0.8%	19	0.4%
Passenger	570	960	105	145	0.7%	16	1.8%	41	0.9%
Cargo	660	990	105	155	7.0%	94	10.4%	252	5.4%
Tanker	600	900	105	155	4.3%	59	6.6%	185	3.9%
Sailing and Recreational	45	300	15	80	16.5%	376	41.8%	941	20.0%
Not Included in Normal Vessel Traffic									
Other#	225	600	35	95	-	48	N/A	453	N/A

* Average of 2017 and 2018 data

Includes survey vessels which operated in the WEA in 2017 and 2018 as well as uncategorized vessels (incomplete AIS data)

^ Mode is the most common LOA or beam of the specified vessel type

2.1 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 Baird (2019), a comparison was made between the permitted fishing vessels and those equipped with AIS equipment for two of the larger fishing ports (New Bedford and Point Judith). It was concluded that AIS-equipped fishing vessels appear to represent a relatively large percentage (estimated at about 40% to 60%) of the fishing vessels operating in the area. And while the AIS data does not capture all the fishing vessel traffic which transits the WEA, 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.

2.2 Summary of Vessel Traffic Through the WEA

Figure 2.1 presents vessel track density plot for all AIS vessels (excluding research and survey vessels) which transited near and through the WEA between 2017 and 2018. The highest density of vessel traffic (shown in grey contours) transits outside the WEA. There are three designated Traffic Separation Schemes (TSS) adjacent to the WEA that can be readily identified by traffic density in the figure (using numbers shown on Figure 2.1):

1. The Narragansett Bay Traffic Lanes that run north-south to the west of the WEA.
2. The Buzzard Bay Traffic Lanes that run in a northeast-southwest orientation and are located northwest of the WEA.
3. The Nantucket-Ambrose Traffic Lanes located to the south of the WEA.

The following report sections (2.3 to 2.5) focus on the three groups of vessels that comprise much of the traffic in the area:

- Cargo, tanker and passenger vessels (grouped together due to size and vessel characteristics)
- Pleasure and sailing vessels
- Fishing vessels

The majority of the AIS vessel traffic through the WEA are fishing vessels (see Table 2.1, 69% of the vessel transits through WEA are fishing vessels) and it is therefore appropriate to focus on the characteristics of the fishing vessel traffic through the WEA and the potential navigation impacts to that group of vessels.

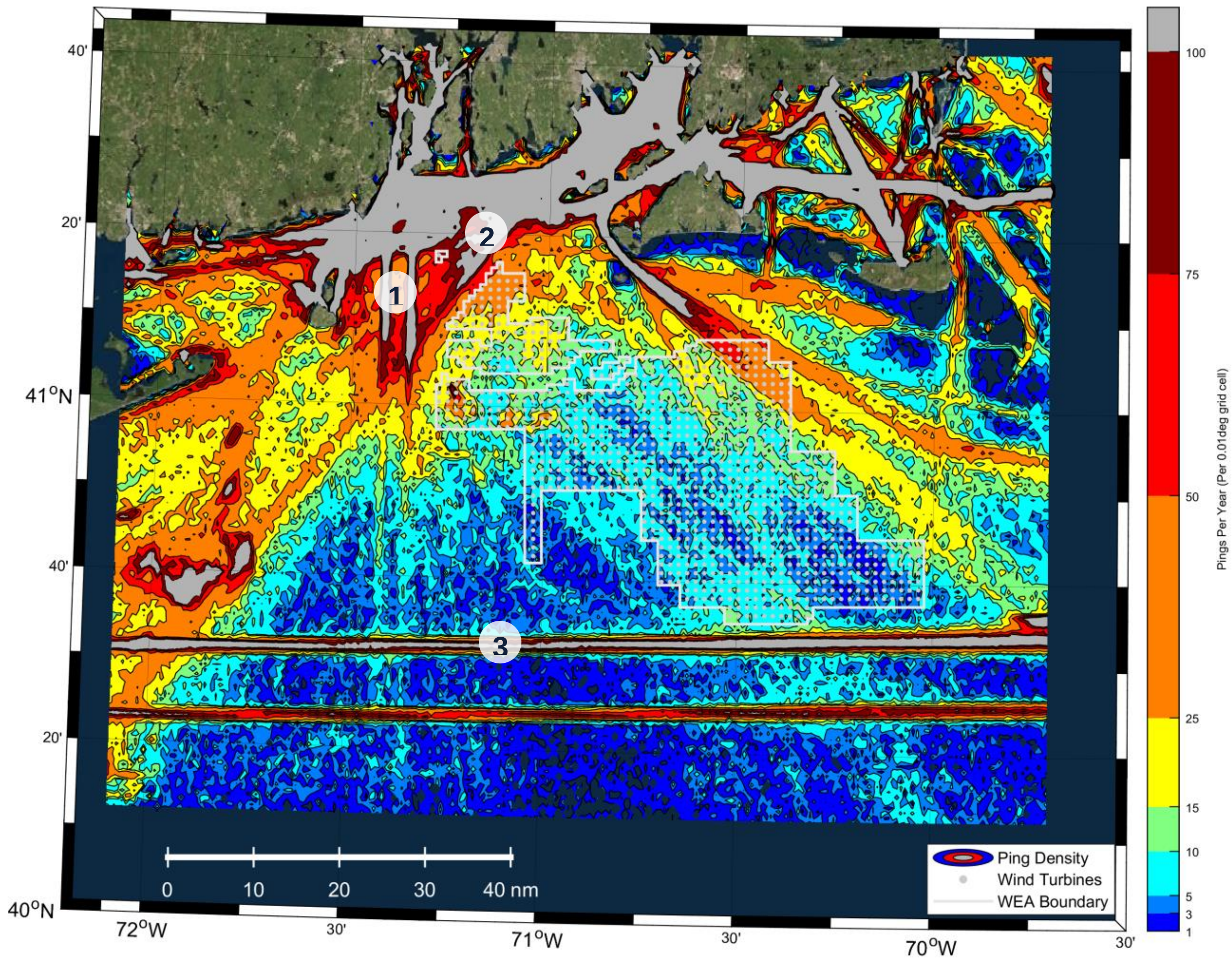

Figure 2.1: All AIS Vessel Traffic Through WEA Vessel Traffic Density: 2017 and 2018 (excluding survey and research vessels).
Note: Numbers indicate designated traffic lanes (TSS).

2.3 Cargo, Tanker and Passenger Vessel Traffic through the WEA

Figure 2.2 presents unique vessel tracks for passenger, cargo and tanker vessels. Based on Table 2.1, most of these vessels are 550 ft or longer (LOA) and they are typically transiting through the NW-SE axis of the WEA, or along the southwestern margins of the WEA. Vessel speeds through the WEA are relatively high, ranging from 8 to 16 knots. Many of these vessels are travelling to and from the Narragansett Bay Traffic Lanes and the Nantucket-Ambrose Traffic Lanes . The feasibility of those ships navigating through the WEA with a uniform turbine layout is discussed later in this report.

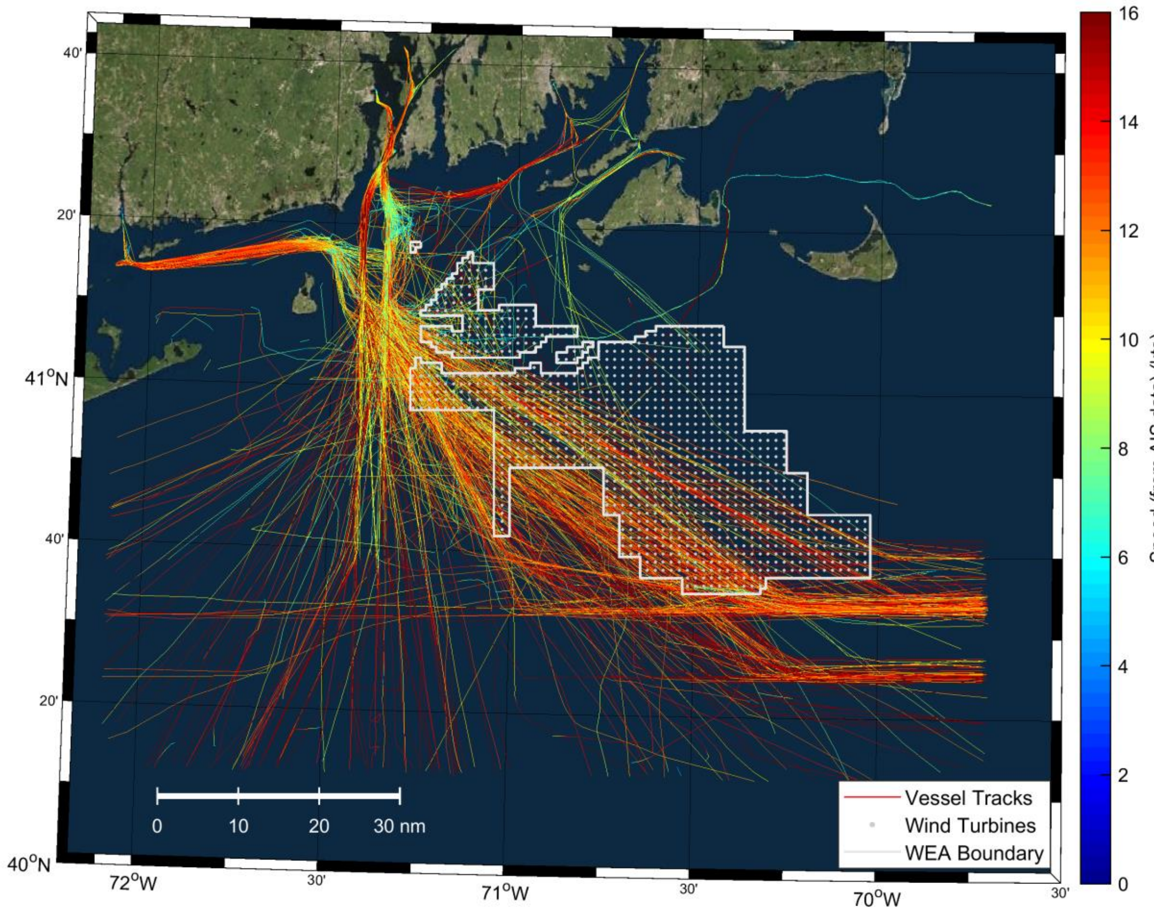

Figure 2.2: Cargo, Tanker and Passenger Vessel Tracks: 2017 and 2018

While a track plot, such as Figure 2.2, provides an indication of the range of historical vessel transits, it is difficult to evaluate the relative volume of vessel traffic as the tracks tend to overlie each other on the busier transit routes. To better understand the traffic volume, "vessel track density plots" were prepared that give an indication of the number of AIS data points ("pings") per specified area (0.01 degrees) annually. The greater the number of data points, the greater the traffic volume. Figure 2.3 presents such a vessel track density plot for cargo, tanker and passenger vessels which transit near and through the WEA. It may be noted in Figure 2.3 that many vessels transit around the WEA. For the vessels that do transit through the WEA the most common transit route is between points 1 and 2 indicated on Figure 2.2.

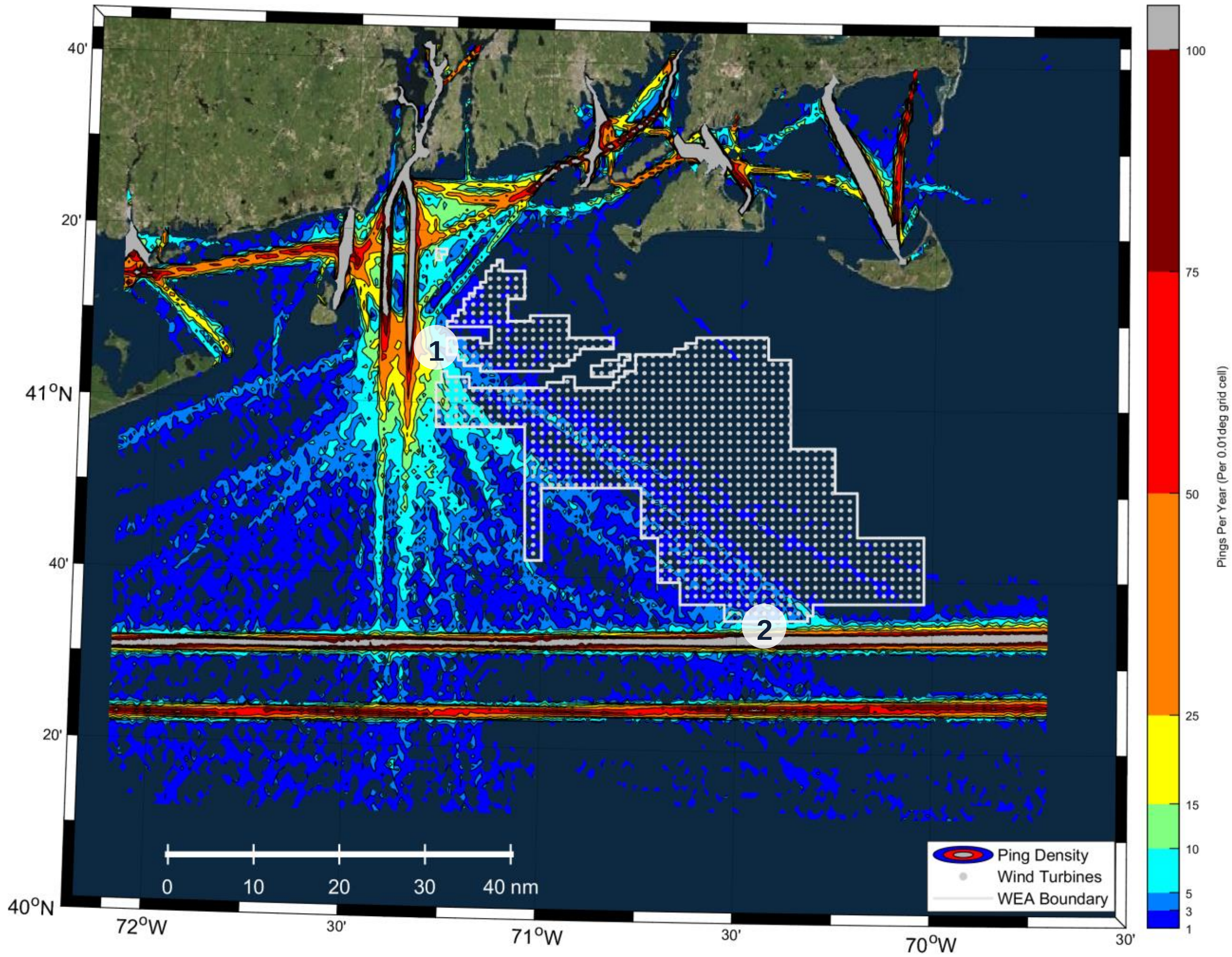

Figure 2.3: Cargo, Tanker and Passenger Vessel Traffic Density: 2017 and 2018

2.4 Pleasure and Sail Vessels

Pleasure and sail vessels represented 16% of the AIS vessel traffic navigation through and near the WEA. Figure 2.4 presents a plot of pleasure and sail vessel traffic for 2017 and 2018 which indicates a reasonable density of traffic through the WEA across a series of NW-SE transit routes. Vessel speeds through the WEA show considerable variability, typically ranging from 8 to 10 knots, but can be as slow as 6 knots or fast as 14 knots. Figure 2.5 presents a traffic density plot which highlights some of the preferred sailing routes. Based on vessel length, all of the vessels transiting through the WEA in 2017 and 2018 could also maneuver through the uniform turbine layout. However, certain very large sail craft do have mast heights that exceed the air draft limits of the turbines due to their blades, and operators of these vessels would need to aware of this limitation. Such vessels would need to be in close proximity to the turbine base for a turbine blade strike to be possible.

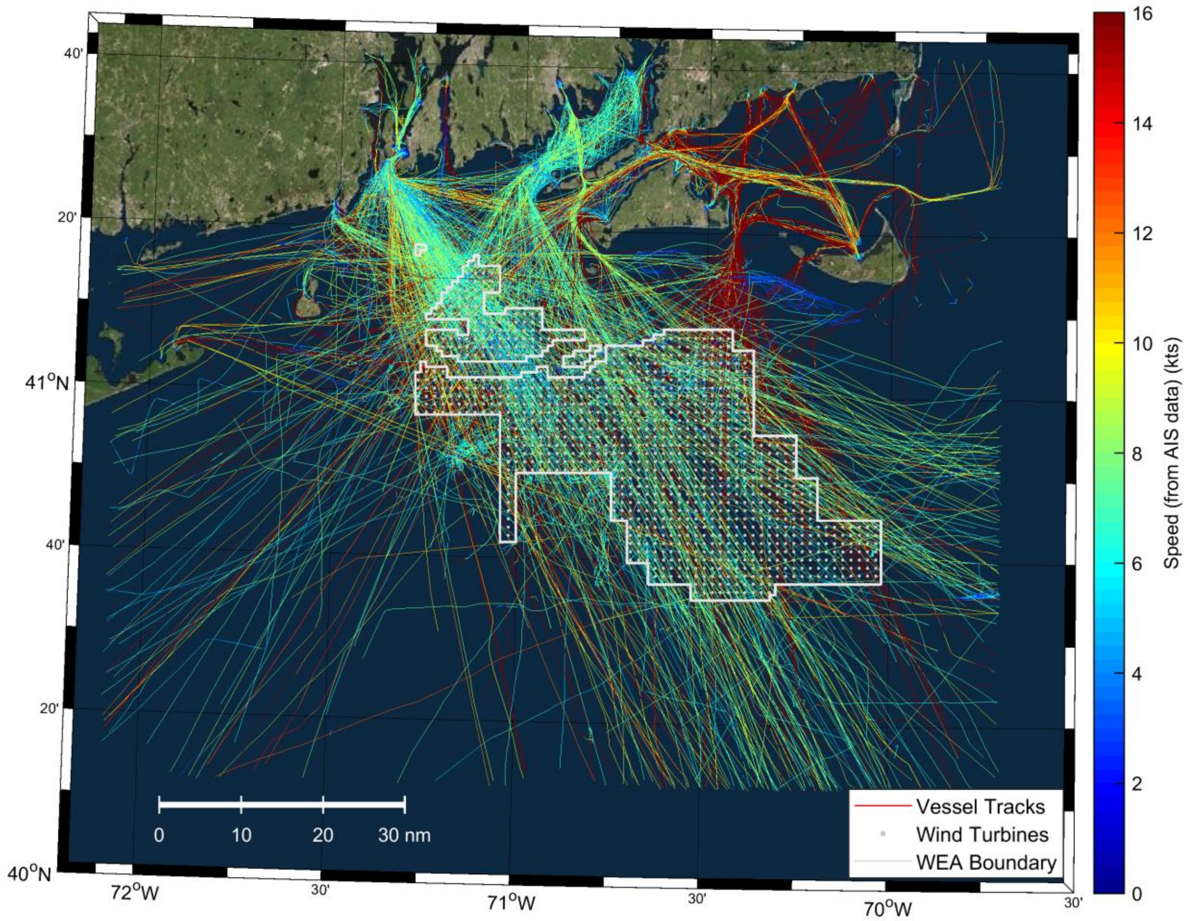

Figure 2.4: Pleasure and Sail Vessel Tracks: 2017 and 2018

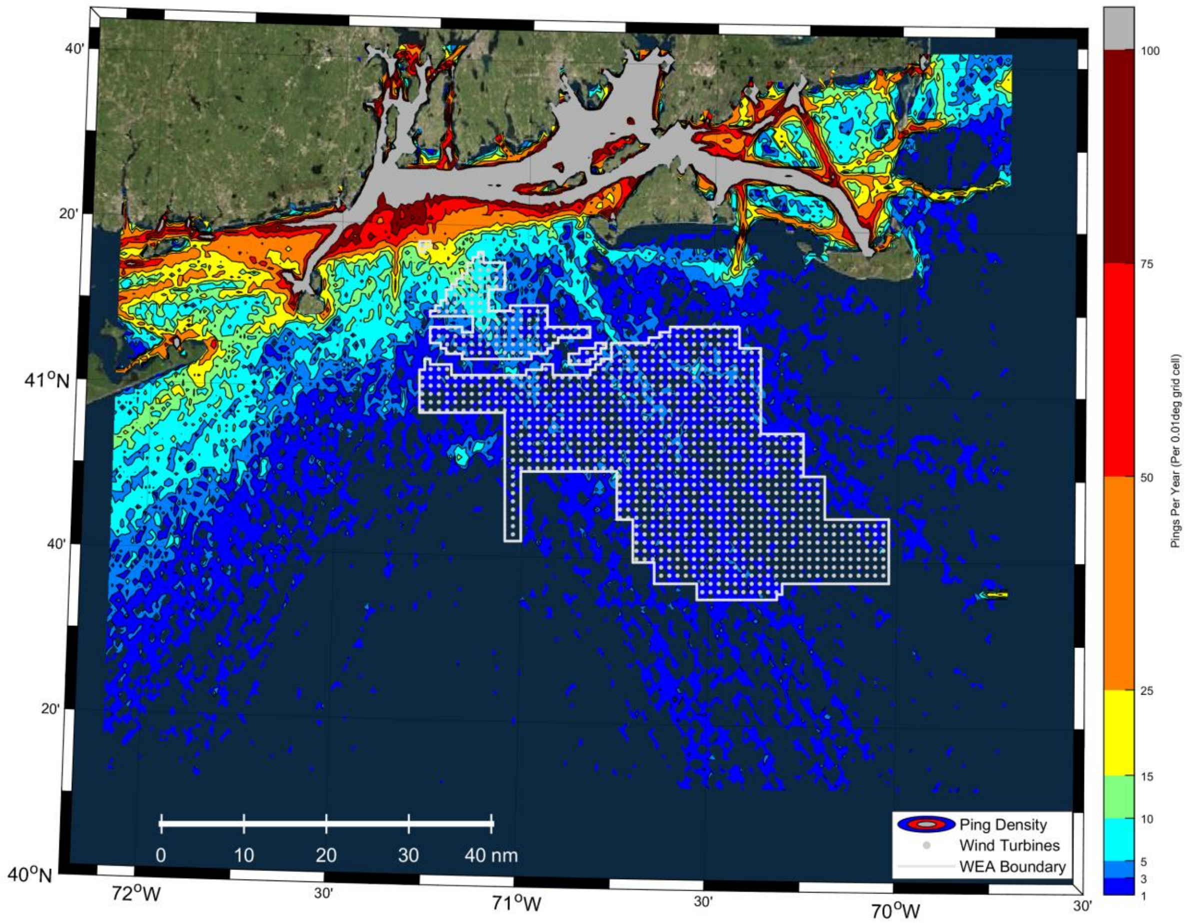

Figure 2.5: Pleasure and Sail Vessel Traffic Density: 2017 and 2018

2.5 Fishing Vessel Traffic through the WEA

The fishing vessel traffic was specifically analyzed based on unique track plots and track density through and around the WEA for the 2017 and 2018 data set, as shown in Figure 2.6 and Figure 2.7. Note that only fishing vessels travelling faster than 4 knots were considered; it was assumed that slower vessels were fishing (trawling) and not transiting. It may be seen in the figures that fishing vessels transit through the WEA with a wide range of track orientations depending on the port of origin and the intended fishing grounds. The typical transit speed of fishing vessels through the WEA is in the order of 6 to 8 knots.

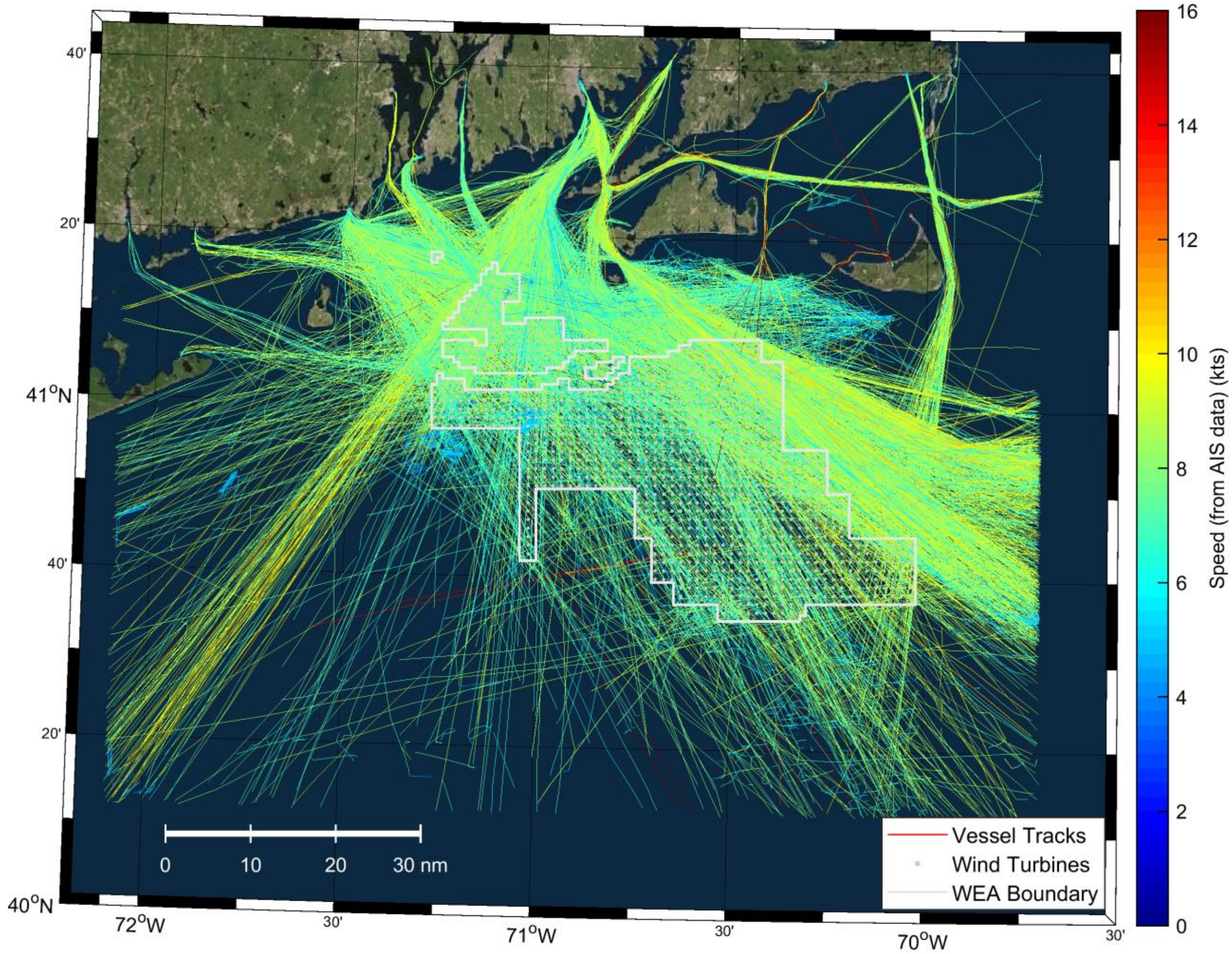

Figure 2.6: Fishing Vessel Traffic Tracks (>4 kts): 2017 and 2018

Figure 2.7 presents the fishing vessel traffic density through and surrounding the WEA. Overall, much of the fishing vessel traffic either skirts the WEA or intersects with perimeter areas of the WEA. The volume of traffic transiting through the middle of the WEA is limited.

Of the vessel traffic that did enter the WEA, the following observations were noted (using the numbers shown on Figure 2.7):

1. There is a concentration of fishing vessel traffic along a SW-NE corridor near the northwestern edge of the WEA.
2. Along the northeastern boundary of the WEA, there are two notable traffic corridors along a NW-SE corridor that intersects the northeastern boundary of the WEA.
3. Through the center of the WEA, there is a moderate density of traffic along a NNW-SSE corridor.

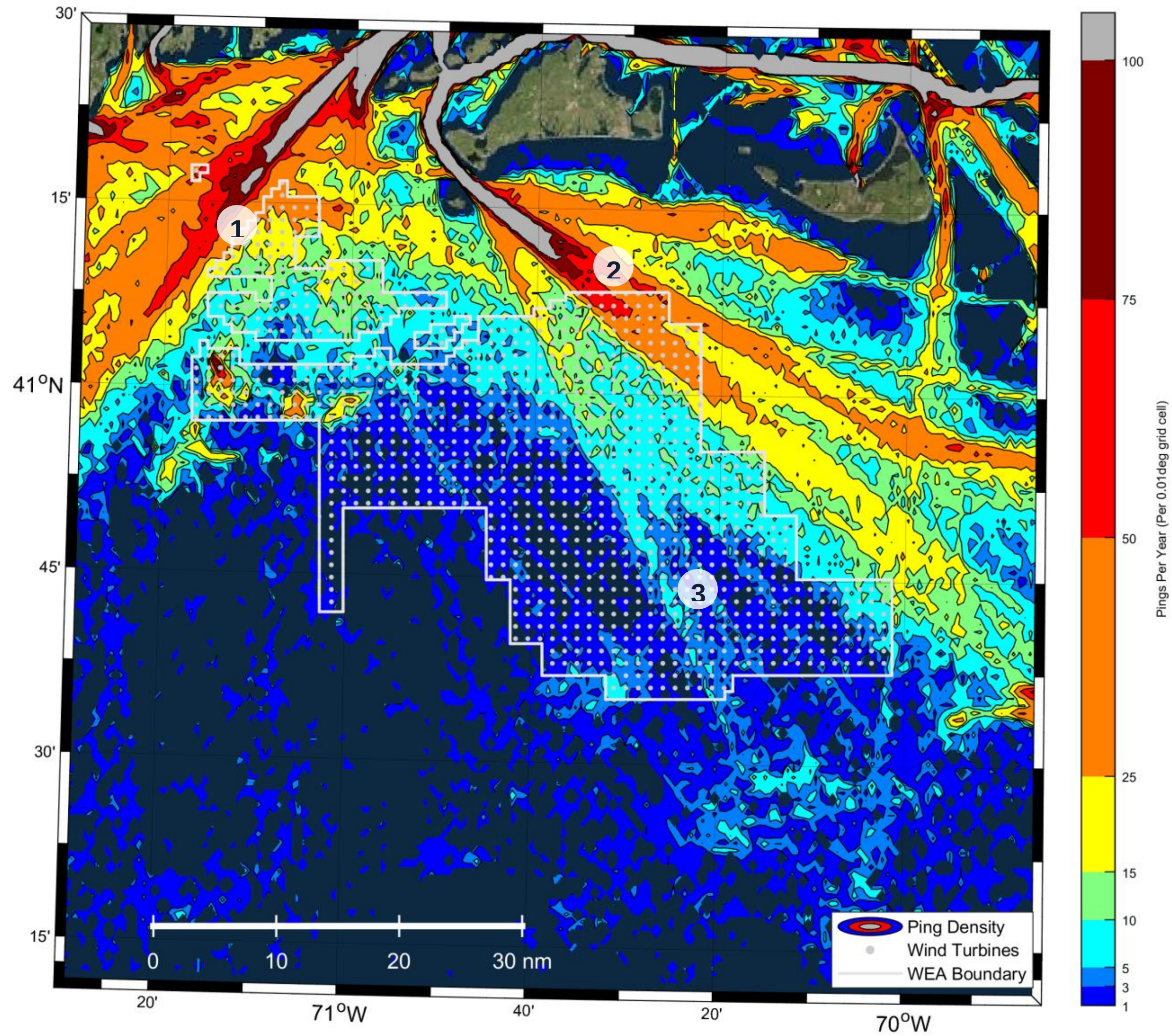

Figure 2.7: Fishing Vessel Traffic Density (> 4 kts): 2017 and 2018

Vineyard Wind has provided Baird with anecdotal information collected by the Vineyard Wind's fisheries liaison that links the Port of Origin and the fishing ground locations frequented by vessels from that port. Table 2.2 indicates the Port of Origin, Fishing Destination and Target Species that were provided to Baird. Based on the 2017 and 2018 AIS vessel traffic data, it has been noted whether the AIS data showed transits between the identified port and fishing destination.

Figure 2.8 is a conceptual schematic indicating the linkages between the destination fishing grounds for the fishing fleets at various ports of origin in the region based on Table 2.2. 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.

Table 2.2: Fishing Vessel Transits – Ports of Origin and Approximate Destinations

Port of Origin	Fishing Destination	Visible in AIS Data	Type of Catch
Chatham	Veatch Canyon, Atlantis Canyon	Yes	Monkfish
	The Dump	No	Monkfish
New Bedford	South of Nantucket / Martha's Vineyard	Yes	Squid
	Nantucket Lightship Closed Area	Yes	Scallop,
	Great South Channel / Georges	Yes	Scallop, groundfish
	Block Canyon	Yes	Monkfish
	The Dump	No	Monkfish, Lobster
	Munson Canyon	Yes	Whiting, squid
Westport	East side of Atlantis Canyon to the west	No	Lobster, monkfish
Sakonnet	West Atlantis Canyon	Yes	Monkfish
	Mid-way between Atlantis and Block Canyons	No	Monkfish, Lobster
Newport	Atlantis to Hydrographer Canyons	Yes	Lobster
Point Judith	South of Nantucket / Martha's Vineyard	Yes	Squid
	Nantucket Lightship Closed Area	Yes	Scallop
	Lydonia, Munson, Nygren Canyons	Yes	Squid, whiting
	South of the dump	No	Jonah crab (fall)
Montauk	South of Nantucket / Martha's Vineyard	Yes	Squid
	Nantucket Lightship Closed Area	No	Scallop
	Lydonia Canyon	No	Squid, whiting, butterfish
Stonington	South of Nantucket / Martha's Vineyard then to areas further south	Yes	Squid, whiting, butterfish

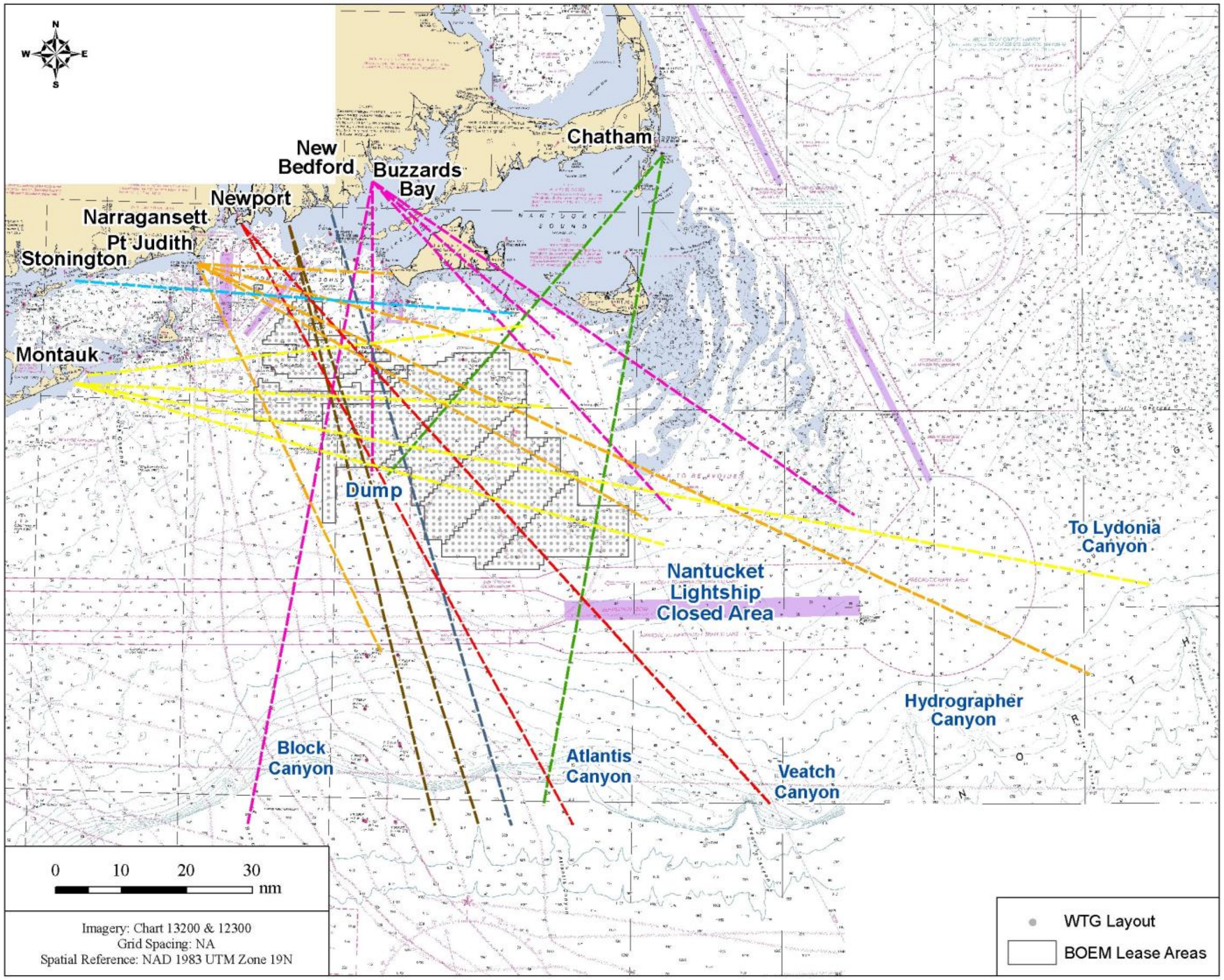

Figure 2.8: Key Fishing Ports Relative to Fishing Ground Locations

Many of the fishing grounds are located south of the WEA at the various canyons where there is a steep drop off in water depths. Other vessels target fishing within the Nantucket Lightship Closed Area, which is located east of, and overlapping with, the most easterly lease area (OCS-A 0522). Vessels from a variety of ports (New Bedford, Point Judith, Montauk, and Stonington) travel to squid trawling grounds located between Nantucket and Martha's Vineyard Islands and the WEA. Vessels from certain ports (Chatham, New Bedford) fish in an area called the "Dump", where unexploded ordnance is identified on hydrographic charts (no wind energy development is planned for this area).

A comparison of Figure 2.6, Figure 2.7 and Figure 2.8 indicates that:

- Vessels transiting to the canyons south of the leases have a wide range of destinations in the general fishing area and are coming from a number of different origination ports, and therefore are transiting over a wide range of tracks and do not follow any specific path.
- Fishing vessels from New Bedford and Buzzards Bay heading to the more easterly fishing grounds travel around the southern end of Martha's Vineyard then follow a southeasterly track along the northern edge of the WEA. Some of the vessels out of Point Judith follow similar tracks. A number of these vessel tracks cross the northeastern edge of the WEA.
- Figure 2.7 shows that a number of fishing vessels travel through the WEA along a NNW-SSE path, starting from the vicinity of Nomans Land Island, and headed towards Veatch Canyon region (Location 3).
- There are fishing grounds, such as the Dump and the Nantucket Lightship Closed Area, where no transits are evident in the AIS plots suggesting that those areas are fished by vessels that are not AIS-equipped.

3. Vessel Navigation Through the WEA

3.1 Navigation Calculations

The Supplementary Analysis for Navigational Risk Assessment of the Vineyard Wind project (Baird, 2019), reported on various analyses of vessel navigation conducted using the international design guidance given in PIANC (2014, 2018). These calculations have been repeated in this study for the WEA vessel traffic. The PIANC analyses are based on the maximum vessel lengths and beams given in Table 2.1.

For the purposes of the analyses, it was been assumed that a navigational lighting and marking plan similar to that proposed by Vineyard Wind (2019) for its current project proposal located in the northern portion of lease area OCS-A 0501 would be implemented over the entire WEA.

In terms of navigational safety when operating vessels within the WEA, there are three important considerations:

1. Sufficient width for two-way traffic (both directions) within a turbine field corridor when transiting or trawling in a straight line.
2. Ability to turn safely to avoid a vessel collision.
3. Ability to turn a trawler within a 1.0 nm corridor (it has been assumed that the trawlers will generally operate on an E-W alignment).

To address item 1 with respect to required channel width, calculations were carried out using the guidance provided by PIANC (2014). This document provides calculation procedures and recommendations for the design of vertical and horizontal dimensions of harbor approach channels of all types. The channel width calculation takes into consideration a range of factors, such as maneuverability of the vessel, the prevailing winds, the magnitude and direction of currents and waves, water depth and the bottom surface characteristics. The channel width is defined relative to the maximum vessel beam width, B.

Table 3.1 summarizes the results of the PIANC (2014) calculations. It was assumed that the transiting vessels (such as cargo or fishing) were of moderate maneuverability while a trawler with gear fully deployed is of poor maneuverability, which is the reason the beam factor differs for the two fishing vessel categories. A fishing trawler (also potentially transiting) of beam 35 feet with two outriggers each having a length of 70 feet was assumed as in Baird (2019). This gave an effective beam of 175 ft. For the purposes of this analysis, this effective beam was also assumed for transiting vessels (giving a conservative result).

Table 3.1: Minimum Two-Traffic Requirements for Vessels in a Straight Channel

	Transiting Cargo / Tanker Vessel	Transiting Fishing Vessels	Trawling
Required Channel Width, Beam Factor	10.8B	11.4B	11.0B
Assumed Maximum Vessel Beam	155 ft	175 ft*	175 ft*
Required Minimum Channel Width	1,674 ft (0.28 NM)	1,995 ft (0.33 NM)	1,925 ft (0.32 NM)

* Note: Effective vessel beam as described in the text above.

Table 3.1 provides the minimum required width for two-traffic in a straight channel for safe operations. As may be noted, the required widths are significantly less than the 0.7 nm width of the NW-SE and SW-NE corridors created by the 1 x 1 nm layout, as described in the introduction. Thus, it is safe for vessels to move within the turbine corridors without restrictions on speed and/or direction provided they are not larger than the assumed vessels. This would apply equally to both overtaking and passing vessels, and to fishing vessels with and without gear deployed. Moreover, these corridors widths are notional (not actual corridors with physical limits at the 0.7nm width), and the actual distance between any two turbines when navigating in these directions is 1.4 nm, see Figure 3.1.

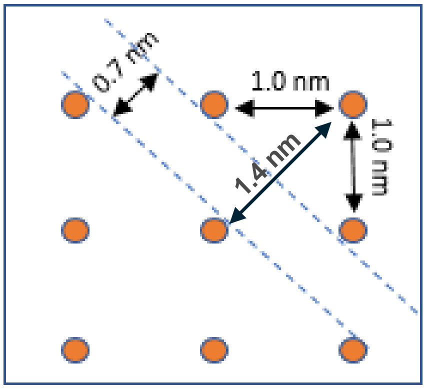

Figure 3.1: Distances Between Turbines When Considering a 0.7 nm Corridor

With respect to item 2 above, in an emergency situation such as an imminent collision, vessels may be required to execute a very rapid turn. Merchant vessels are designed to turn within a tactical turn diameter of 5 times the length of the vessel, while an allowance of 6 times vessel length (LOA) is often used for design purposes (PIANC, 2018). Based on this criterion and assuming a vessel travelling down the center of the minimum corridor width (0.7 nm), a vessel up to 350 to 400 feet LOA (length overall) can safely enter the WEA. Such a vessel executing a rapid turn in the 1 nm corridors would have additional buffer room on either side of the corridor.

The spacing required to turn a trawler between the turbine rows was examined in Baird (2019). It was estimated that a large trawler in this area can change headings by 180° within a lateral distance of 0.7 nm with gear fully deployed, well within the 1.0 nm spacing between turbines in the E-W rows. The required lateral distance would be much smaller if the gear were retrieved before turning then redeployed.

Overall, it was concluded that:

- The limiting constraint for vessel movements through the WEA based on PIANC (2018) will be vessel length. Based on collision avoidance criteria, it is recommended that vessels greater than 400 ft in length should transit around the WEA. In 2017 and 2018, there were no fishing vessels and approximately 27% of the non-fishing vessels with a length exceeding 400 ft.
- The minimum 0.7 nm nominal corridor width is sufficient for two-way transit of fishing or other vessels (up to 400 ft LOA) based on PIANC (2014, 2018) guidelines, allowing vessels to safely pass and overtake in opposite directions.
- The minimum 1.0 nm turbine separation is sufficient for all fishing activities including trawling, as even trawling vessels with gear fully deployed were estimated can change headings by 180° within a lateral distance of 0.7 nm.

It is important to recognize that the above analyses make the inherent assumption that the turbine corridors have a “hard” channel limit. That is, it is assumed that the vessel cannot cross the turbine row alignments that separate the corridors. In reality, the turbines are spaced 1 nm apart and there is room for the vessel to maneuver between the turbines.

3.2 Available Transit Corridors

As noted in Section 1, the proposed uniform layout across the WEA has a 1 nm WTG spacing in both the E-W and N-S directions. This uniform layout also inherently creates 0.7 nm wide corridors on the diagonal in the NW-SE and SW-NE directions. In the case of the diagonal corridors (NW-SE, SW-NE), the turbines are offset from each other in the direction of travel, such that the closest distance between two opposite turbines when navigating in the direction of the corridor is 1.4 nm.   Figure 3.2 provides an illustration of the E-W, N-S and diagonal SE-NW transit corridors provided by the uniform 1 nm x 1 nm turbine layout. Illustrations of the available transit corridors are provided in detail in the following:

- Figure 3.3: 40 E-W transit corridors;
- Figure 3.4: 56 N-S transit corridors; and
- Figure 3.5: 48 NW-SE transit corridors.

There are also 87 transit corridors in the SW-NE orientation although the AIS data showed that there is little vessel traffic that transits in this direction.

As may be noted in the AIS data plots shown in Section 2, much of the existing vessel traffic transits the WEA in a NW-SE orientation.

3.3 Designated Transit Corridors

The results of this analysis indicate that sufficient corridor width for vessel maneuvering can be maintained within the WEA without the need for dedicated transit lanes assuming the application of a uniform spacing across the entire WEA and a suggested limit of 400 ft vessel length. The proposed turbine arrangement would accommodate the wide range of ports, destinations, and routes and headings observed by fishing vessels. Additionally, there is a high degree of flexibility available to the US Coast Guard (USCG) to configure the transit corridors outlined in Figure 3.2 to Figure 3.5, should designated or specially corridors be deemed desirable. For example, in each direction, it would be possible to designate marked one-way transit corridors, with a potential separation corridor between opposite directions of transit.   Designating specific transit corridors will tend to concentrate the vessel traffic, potentially increasing the number of vessel interactions.

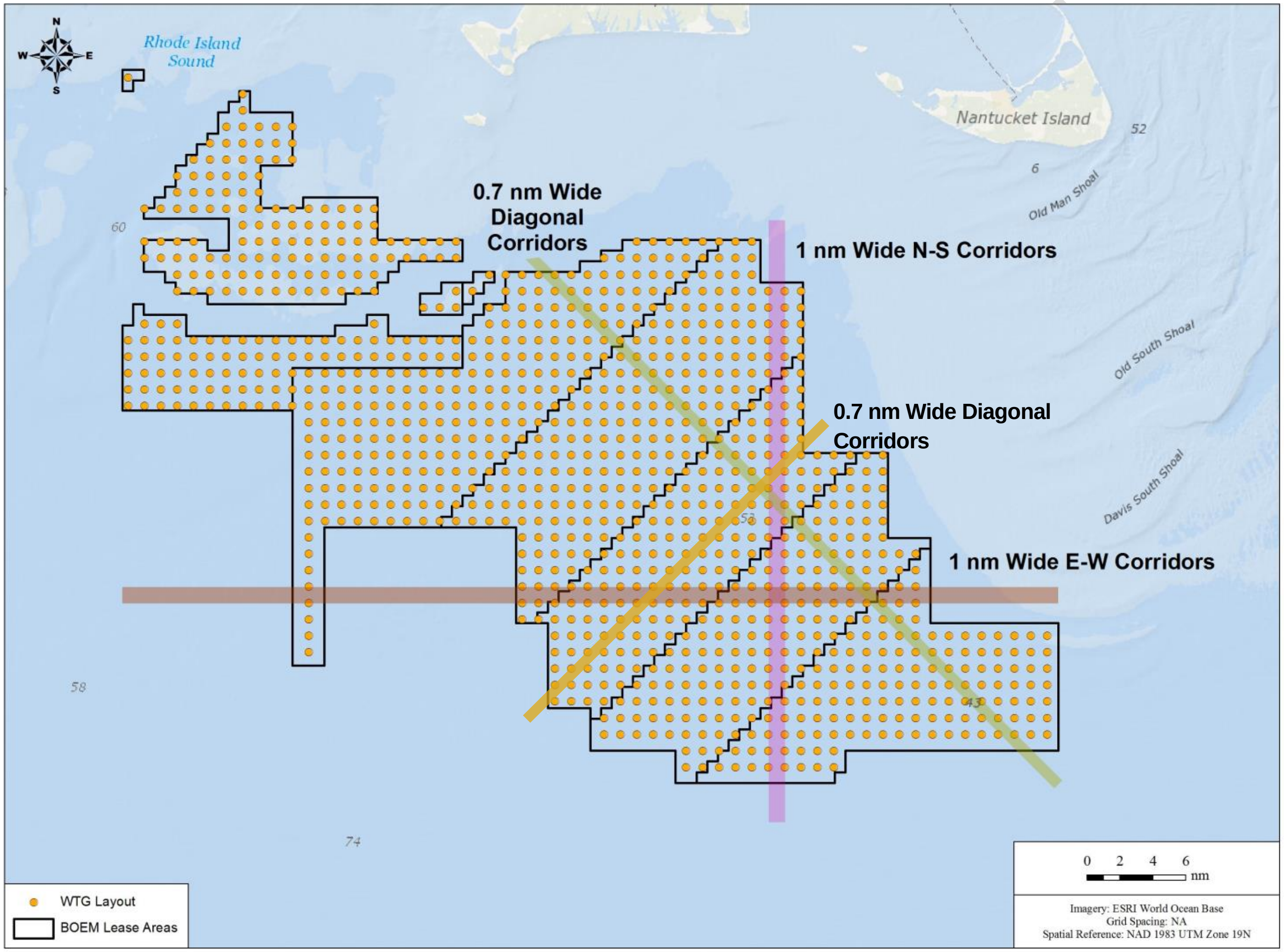

Figure 3.2: Overview of E-W, N-S, NW-SE and SW-NE Transit Corridors provided by 1 nm turbine layout.

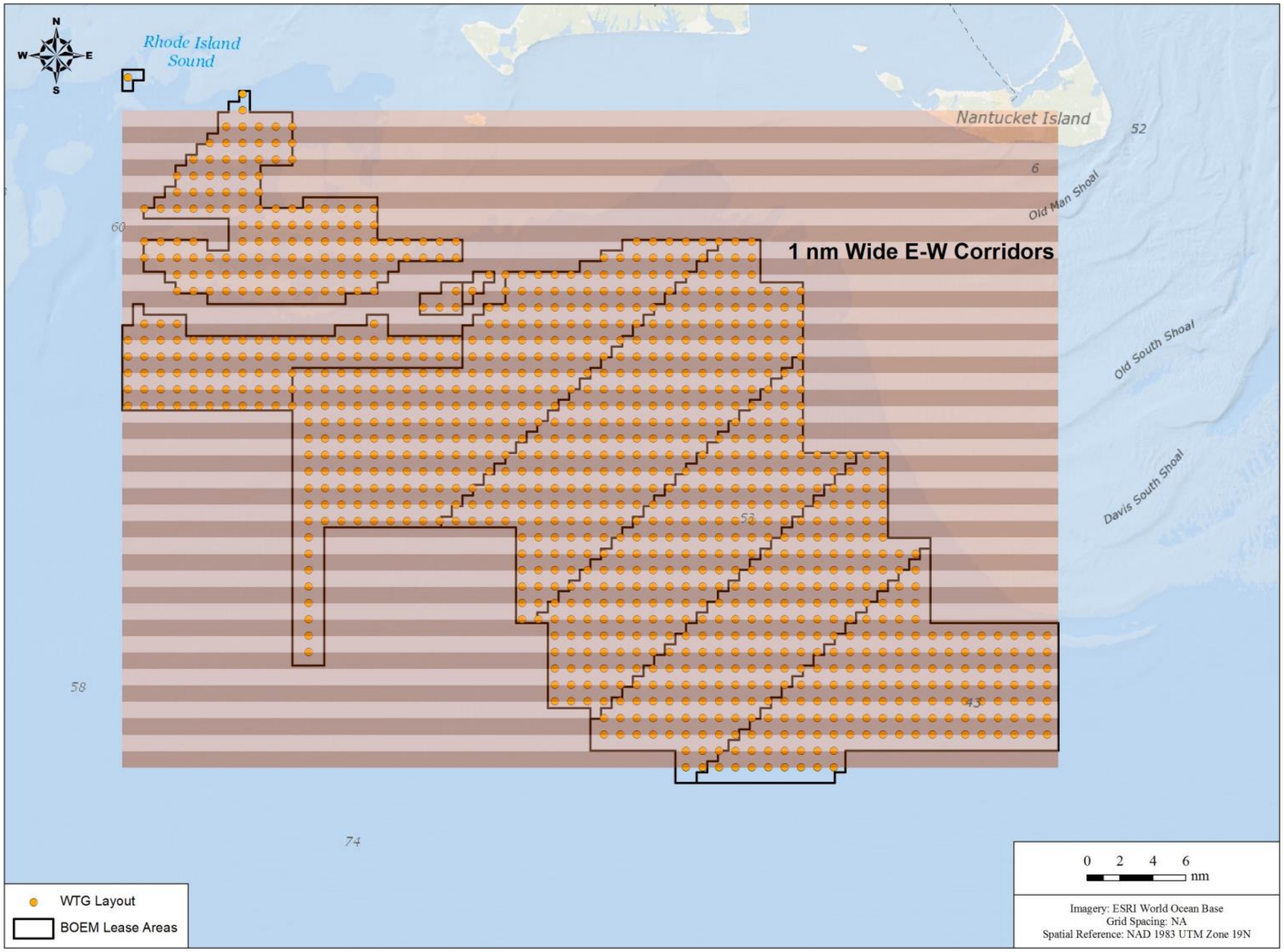

Figure 3.3: 40, 1 nm wide E-W Transit Corridors provided by 1x1 nm turbine layout.

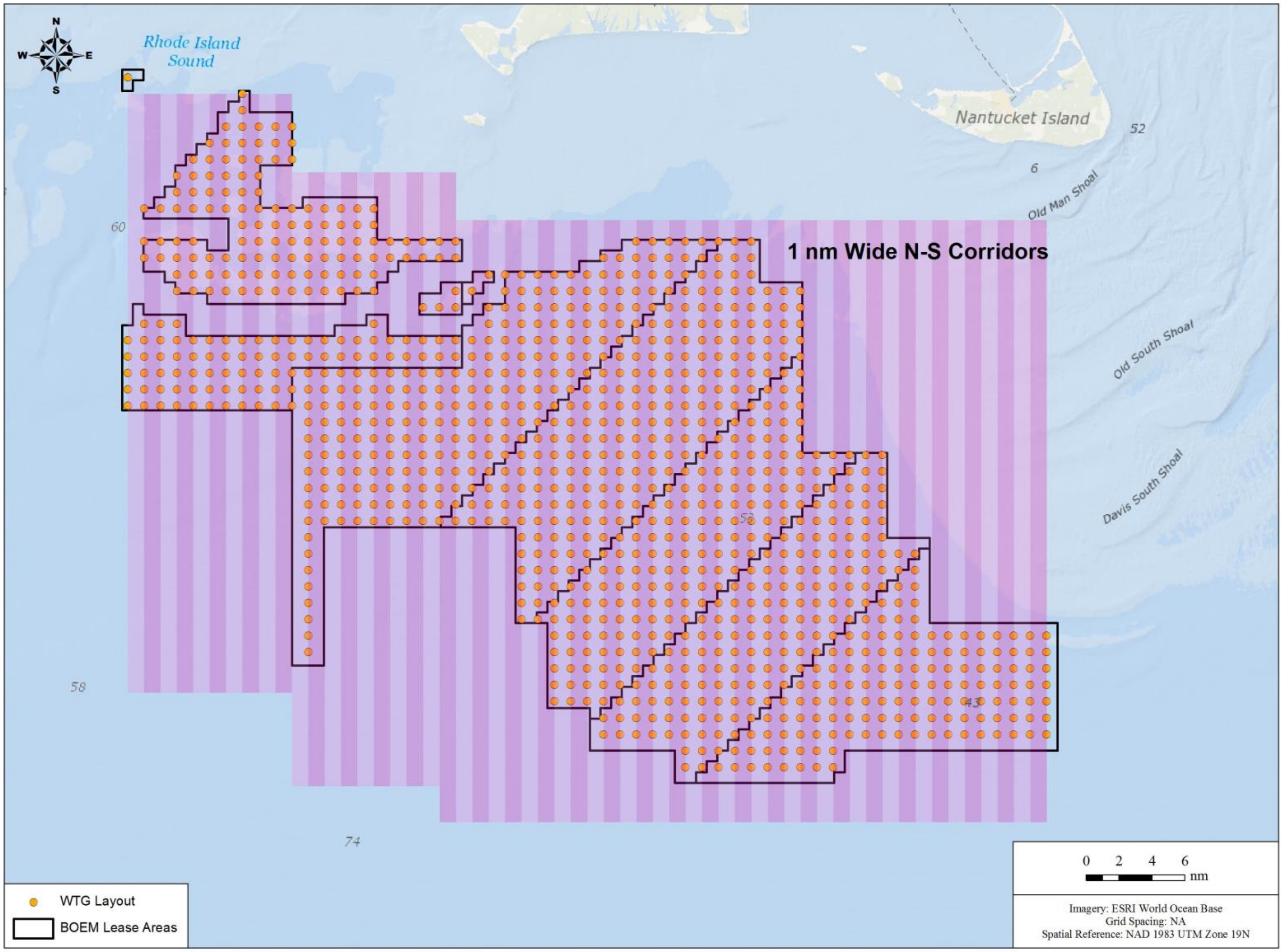

Figure 3.4: 56, 1 nm wide N-S Transit Corridors provided by 1x1 nm turbine layout.

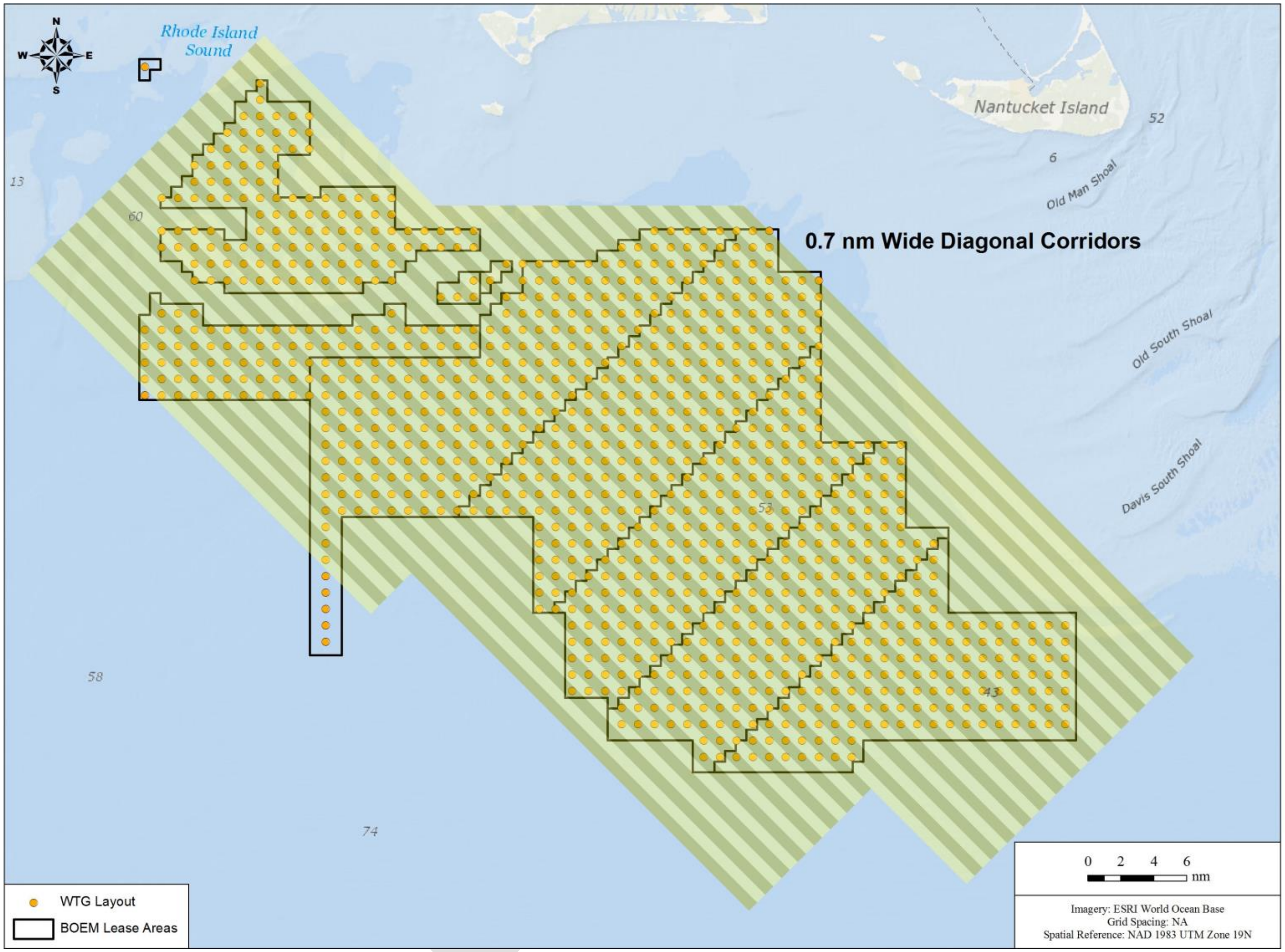

Figure 3.5: 48, 0.7 nm wide SE-NW Diagonal Transit Corridors provided by 1x1 nm turbine layout.

4. Vessel Traffic Around the WEA

Given the turbine layout assumed for this analysis, it is expected that vessels greater than 400 ft LOA or that exceed the air draft limits of the turbine blades will transit around the WEA. This would include many of cargo, tanker, and larger passenger vessels but not fishing vessels (as all observed had a length of less than 400 ft). For the cargo, tanker and passenger vessels identified in Figure 2.2 and Figure 2.3, which presently transit the southwestern margin of the WEA (see between Points 1 and 2 on Figure 2.3), it is expected that to skirt the western edge of the WEA will add approximately 10 nm to the transit distance. Based on average speed through the WEA, the additional transit time for vessels is estimated as the following:

- Passenger vessels: 40 minutes;
- Tanker vessels: 60 minutes; and
- Cargo vessels: 70 minutes.

Given the size, purpose, and transit track of these vessels, many of these larger commercial vessels may be making lengthy trips to or from points well beyond the general region of the WEA. For these vessels, the additional transit time to go around the WEA may be a small part of the overall trip duration. Passenger, tanker and cargo vessels represent approximately 10.2% of the vessel traffic transiting the WEA. As noted in Section 2.2, there are existing TSS that could accommodate the transit of those vessels around the WEA. Much of this traffic is transiting to/from the Narragansett Bay and Nantucket-Ambrose TSS.

Fishing vessels will be able to transit through the WEA (see Section 3.0) and also have the option to transit around the WEA. Figure 2.6 indicates that a significant portion of the AIS fishing vessels are transiting to the west of the WEA, and to the north or near the northern-eastern boundary of the WEA. Those fishing vessels that choose to transit around the WEA are expected to have no or small impacts, of 30 minutes at most, in transit times by avoiding the WEA.

5. Conclusions and Recommendations

A summary of the conclusions and recommendations with respect to vessel navigation through the WEA is as follows:

- There does not appear to be a need for designated transit corridors through the WEA if a uniform turbine layout with 1 nm corridors E-W and N-S and 0.7 nm corridors NW-SE and SW-NE is adopted. This layout would accommodate the wide range of ports, destinations, and routes observed by fishing vessels, which makes up most of the traffic going through the WEA, as well as the majority of observed vessel tracks through the WEA, thereby by accommodating the wide range of reported fishing practices in the region. This arrangement would effectively create 40 corridors in the E-W direction; 56, N-S; 48, NW-SE; and 87 SW-NE.
- If the USCG identifies the need to have designated transit corridors, then certain of the available corridors within the uniform turbine layout could be designated as one-way transit corridors. For example, in each direction, it would be possible to designate one-way transit corridors, with a potential separation corridor between opposite directions of transit.
- Based on considerations of collision avoidance, it is recommended that vessels exceeding 400 feet should transit around the WEA. Vessels of this size were observed to be tanker, cargo, passenger or military vessels. Transiting around the WEA may also provide a suitable option for much of the existing fishing vessel traffic, since the majority of fishing vessel traffic skirts the northwest and northeast boundaries of the WEA and results in little (less than 30 minutes) or no increase in transit times for these vessels.
- It was assumed in the analysis that the navigational lighting and marking plan for the entire WEA will be similar to that proposed by Vineyard Wind for its current project proposal (Vineyard Wind, 2019).

6. References

Baird (2019). Vineyard Wind - Supplementary Analysis for Navigational Risk Assessment. Prepared for Epsilon Associates Inc. Ref: 13057.201.R2.Rev0. January 23, 2019.

PIANC (2014). Harbour Approach Channels Design Guidelines. Report No. 121 – 2014.

PIANC (2018). Interaction Between Offshore Wind Farms and Maritime Navigation. MarCom WG Report No. 161 – 2018. March.

Vineyard Wind (2019). Vineyard Wind LLC - Lighting and Marking Requirements. Rev 4, 8 May 2019.