



MAYFLOWER WIND

Appendix Y1. Obstruction Evaluation & Airspace Analysis

Document Revision

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Issue Date

February 2021



Mayflower Wind Offshore Wind Project

Mayflower Wind Energy LLC

Offshore Massachusetts

Obstruction Evaluation & Airspace Analysis

August 27, 2020



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Summary

Capitol Airspace conducted an obstruction evaluation and airspace analysis for the Mayflower Wind project off the coast of Massachusetts. The purpose for this analysis was to identify the potential for impacts on Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) operations as a result of 808 and 1,067-foot tall wind turbine generators (WTGs). These specific heights are being used in the evaluation as a minimum and maximum proposed WTG height in the Project Design Envelope (PDE). At the time of this analysis, WTG locations had not been identified. This analysis assessed height constraints overlying an approximately 199-square-mile study area (black outline, [Figure 1](#)) to aid in identifying optimal WTG locations.

The Bureau of Ocean Energy Management (BOEM) is responsible for regulating renewable energy activities on the outer continental shelf in accordance with 30 CFR Part 585. As part of the application process for leases, grants, and easements, BOEM may require the inclusion of an aeronautical study to determine the proposal's impact on airspace use and safety. If a project is determined to have an unacceptable impact on civil aviation or military activities, it could result in denial of the application.

14 CFR Part 77 applies to all structures within US territorial airspace. 14 CFR Part 77.9 requires that all structures exceeding 200 feet above ground level (AGL) be submitted to the FAA so that an aeronautical study can be conducted. The FAA's objective in conducting aeronautical studies is to ensure that proposed structures do not affect the safety of air navigation or the efficient utilization of navigable airspace by aircraft. The result of an aeronautical study is the issuance of a determination of 'hazard' or 'no hazard' that can be used by the proponent to obtain necessary local construction permits. It should be noted that the FAA has no control over land use in the United States and cannot enforce the findings of its studies.

The lowest obstacle clearance surfaces overlying the Mayflower Wind project range from 1,049 to 4,549 feet above mean sea level (AMSL) and are associated with minimum vectoring altitude sectors and minimum instrument flight rules (IFR) altitude sectors. Proposed structures that exceed these surfaces would require an increase to minimum vectoring altitudes and minimum IFR altitudes. If the FAA determines that either of these impacts would affect as few as one radar vectoring operation per week, it may result in FAA objections to proposed wind development.

At 1,067 feet tall, proposed WTGs in the northern section of the study area would exceed these surfaces and require an increase to minimum vectoring altitudes. If the FAA determines that this impact would affect as few as one radar vectoring operation per week, it may result in FAA objections to proposed wind development.

A warning area overlies the Mayflower Wind project and could result in military objections to proposed wind development.

This study did not consider electromagnetic interference on FAA communication or surveillance radar systems.

Capitol Airspace applies FAA defined rules and regulations applicable to obstacle evaluation, instrument procedures assessment and visual flight rules (VFR) operations to the best of its ability and with the intent to provide the most accurate representation of limiting airspace surfaces as possible. Capitol Airspace maintains datasets obtained from the FAA which are updated on a 28-day cycle. The results of this analysis are based on the most recent data available as of the date of this report. Limiting airspace surfaces depicted in this report are subject to change due to FAA rule changes and regular procedure amendments. Therefore, it is of the utmost importance to obtain FAA determinations of no hazard prior to making substantial financial investments in this project.



Methodology

Capitol Airspace studied the proposed project based on location information provided by Mayflower Wind Energy LLC. Using this information, Capitol Airspace generated graphical overlays to determine proximity to airports (**Figure 1**), published instrument procedures, enroute airways, FAA minimum vectoring altitude and minimum instrument flight rules (IFR) altitude charts, as well as military airspace and training routes.

Capitol Airspace evaluated all 14 CFR Part 77 imaginary surfaces, published instrument approach and departure procedures, visual flight rules operations, FAA minimum vectoring altitudes, minimum IFR altitudes, and enroute operations. All formulas, headings, altitudes, bearings and coordinates used during this study were derived from the following documents and data sources:

- 14 CFR Part 77 Safe, Efficient Use, and Preservation of the Navigable Airspace
- FAA Order 7400.2M Procedures for Handling Airspace Matters
- FAA Order 8260.3D United States Standard for Terminal Instrument Procedures
- FAA Order 8260.58A United States Standard for Performance Based Navigational (PBN) Instrument Procedure Design
- Technical Operations Evaluation Desk Guide for Obstruction Evaluation/Airport Airspace Analysis (1.5.1)
- United States Government Flight Information Publication, US Terminal Procedures
- National Airspace System Resource Aeronautical Data

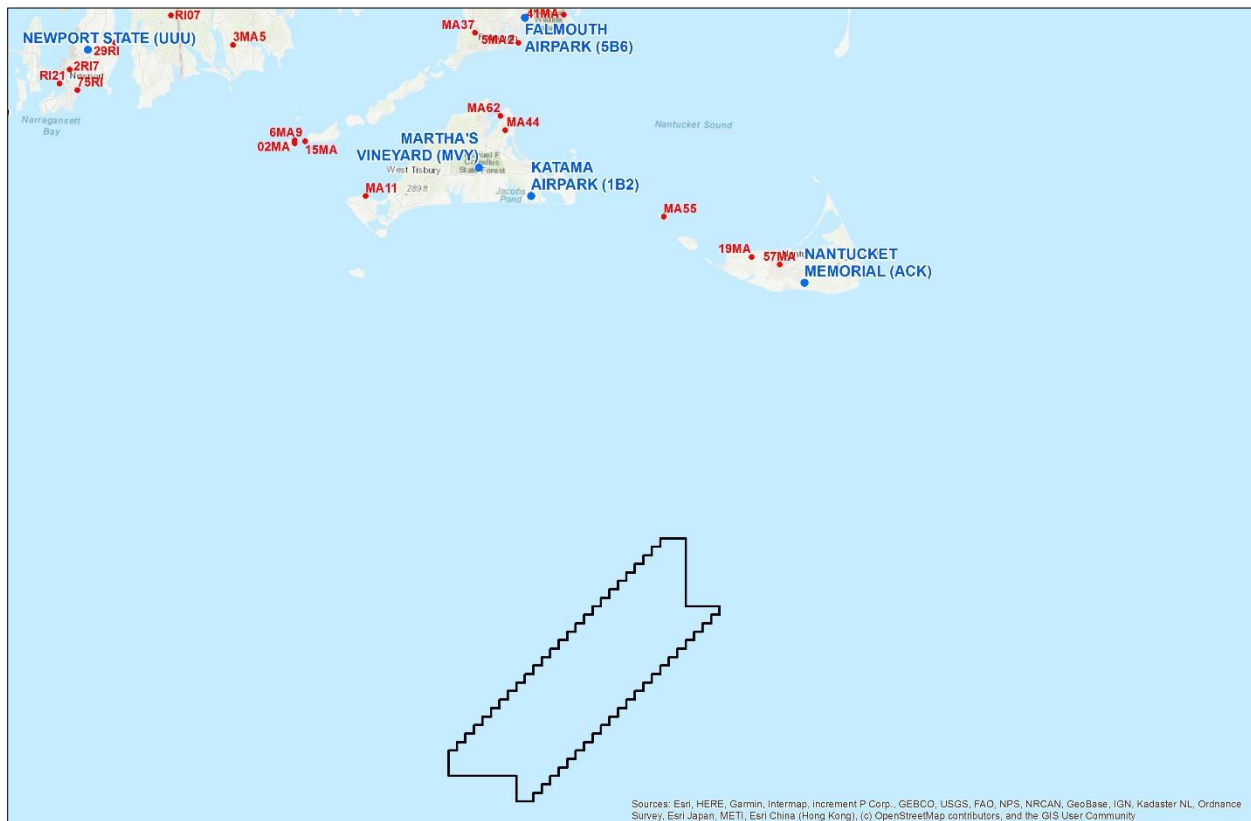


Figure 1: Public-use (blue) and private-use (red) airports in proximity to the Mayflower Wind project



Study Findings

Territorial Airspace

The FAA conducts aeronautical studies for structures proposed within any state, territory, or possession of the United States, within the District of Columbia, or within territorial waters¹ surrounding the United States.² Although an offshore wind project may be located outside of territorial waters, BOEM may require an aeronautical study as part of the application process.

The Mayflower Wind project is not located within territorial waters (purple, **Figure 2**). Therefore, the FAA does not have a mandate to conduct aeronautical studies for WTGs proposed within the defined study area. Regardless, BOEM may require consultation with the FAA as part of the application process, and providing an aeronautical study is useful to these consultations.

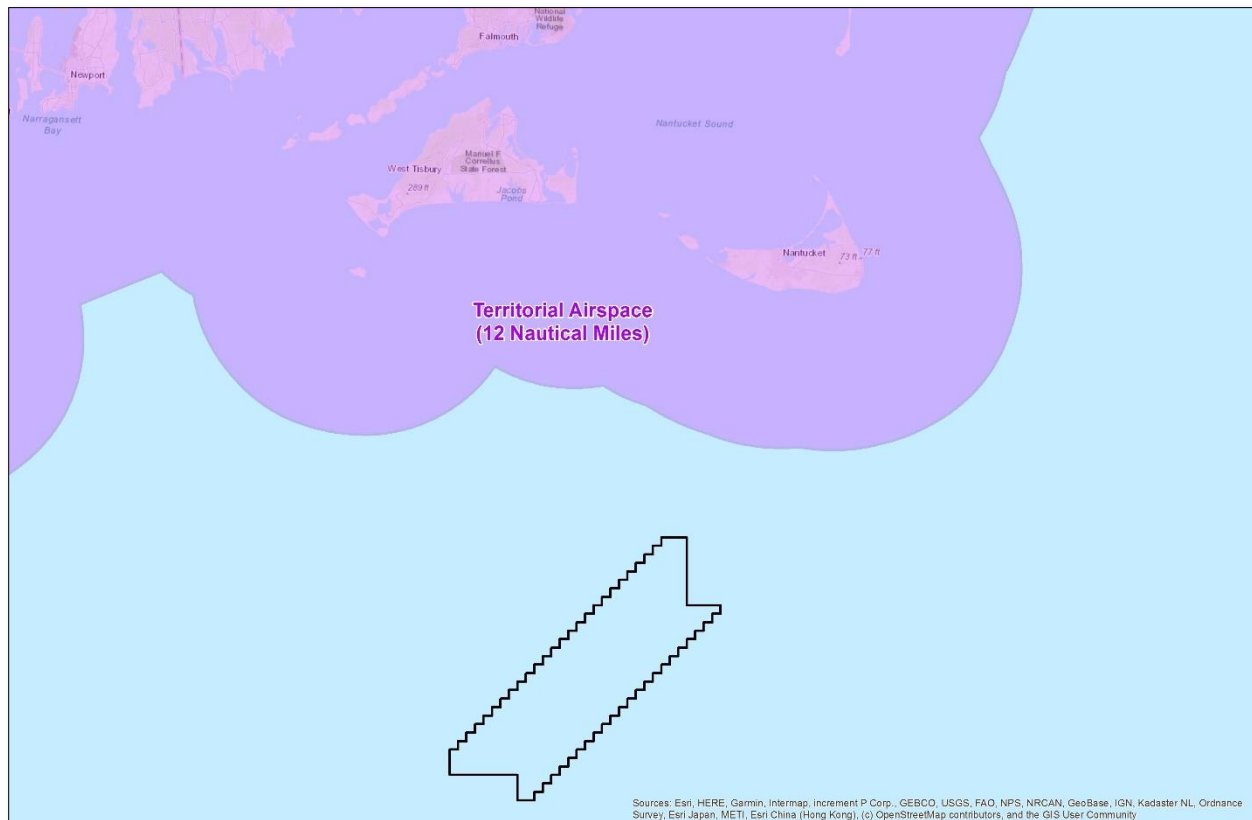


Figure 2: Territorial Airspace in proximity to the Mayflower Wind project

¹ The National Oceanic and Atmospheric Administration (NOAA) defines territorial waters as 12 nautical miles measured from the official U.S. baseline – a recognized low water line along the coast. NOAA publishes this boundary in a publicly available [Web Map Service](#).

² As described in FAA Order 7400.2M 5-1-4(a) "Scope."



14 CFR Part 77.17(a)(2) Obstruction Standard and 77.19/21/23 Imaginary Surfaces

The FAA uses level and sloping imaginary surfaces to determine if a proposed structure is an obstruction to air navigation. Structures that are identified as obstructions are then subject to a full aeronautical study and increased scrutiny. However, exceeding a Part 77 imaginary surface does not automatically result in the issuance of a determination of hazard. Proposed structures must have airspace impacts that constitute a substantial adverse effect in order to warrant the issuance of determinations of hazard.

Military and public-use airport 14 CFR Part 77.17(a)(2) and 77.19/21/23 imaginary surfaces do not overlie the Mayflower Wind project (e.g., [Figure 3](#)). However, at 808 and 1,067 feet tall, proposed WTGs will exceed 77.17(a)(1) – a height of 499 feet AGL at the site of the object – and would be identified as obstructions regardless of location if located within U.S. territorial airspace. However, the Mayflower wind project is not located within U.S. territorial airspace.

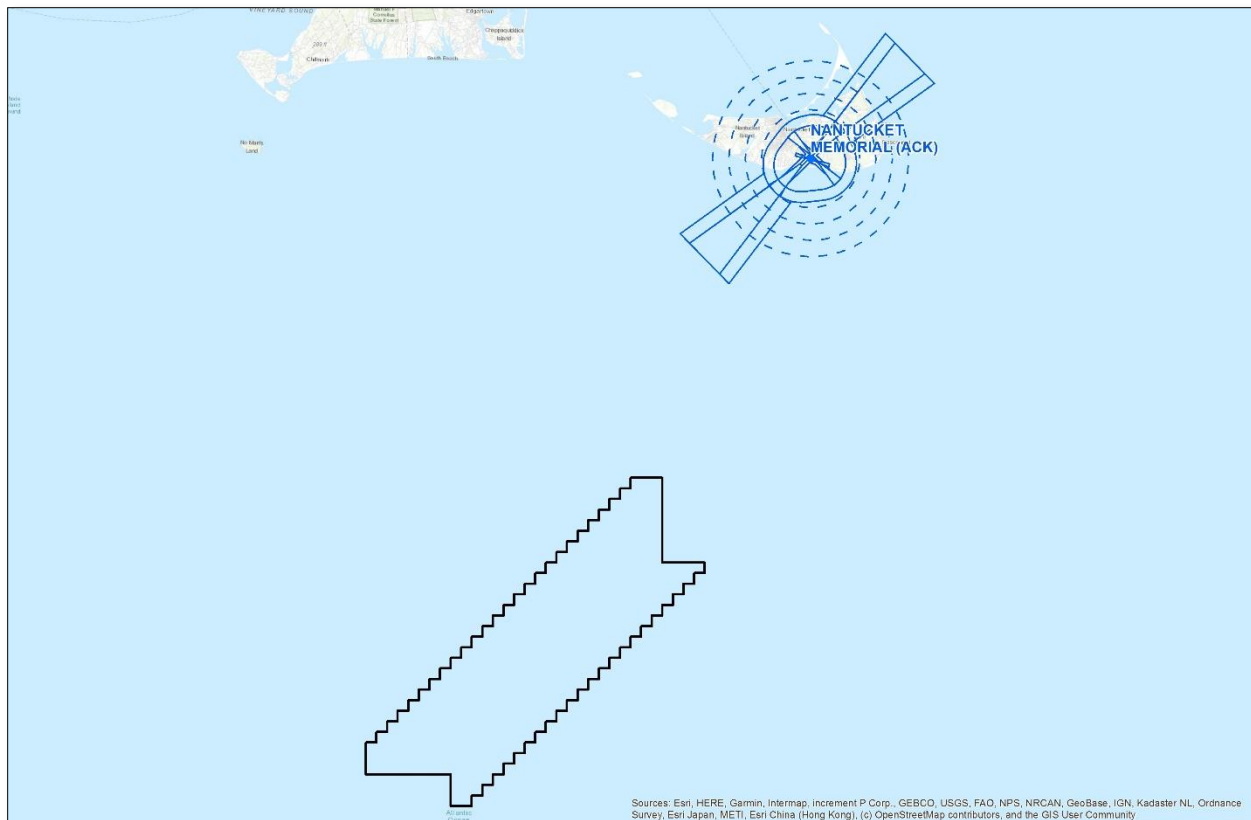


Figure 3: 77.17(a)(2) obstruction standard (dashed blue) and 77.19 imaginary surfaces (solid blue)



Visual Flight Rules (VFR) Traffic Pattern Airspace

VFR traffic pattern airspace is used by pilots operating during visual meteorological conditions (VMC). The airspace dimensions are based upon the category of aircraft which, in turn, is based upon the approach speed of the aircraft. 14 CFR Part 77.17(a)(2) and 77.19 (as applied to a *visual* runway) imaginary surfaces establish the obstacle clearance surface heights within VFR traffic pattern airspace.

VFR traffic pattern airspace does not overlie the Mayflower Wind project (**Figure 4**). Therefore, 808 and 1,067-foot tall WTGs within the defined study area should not have an impact on VFR traffic pattern airspace.

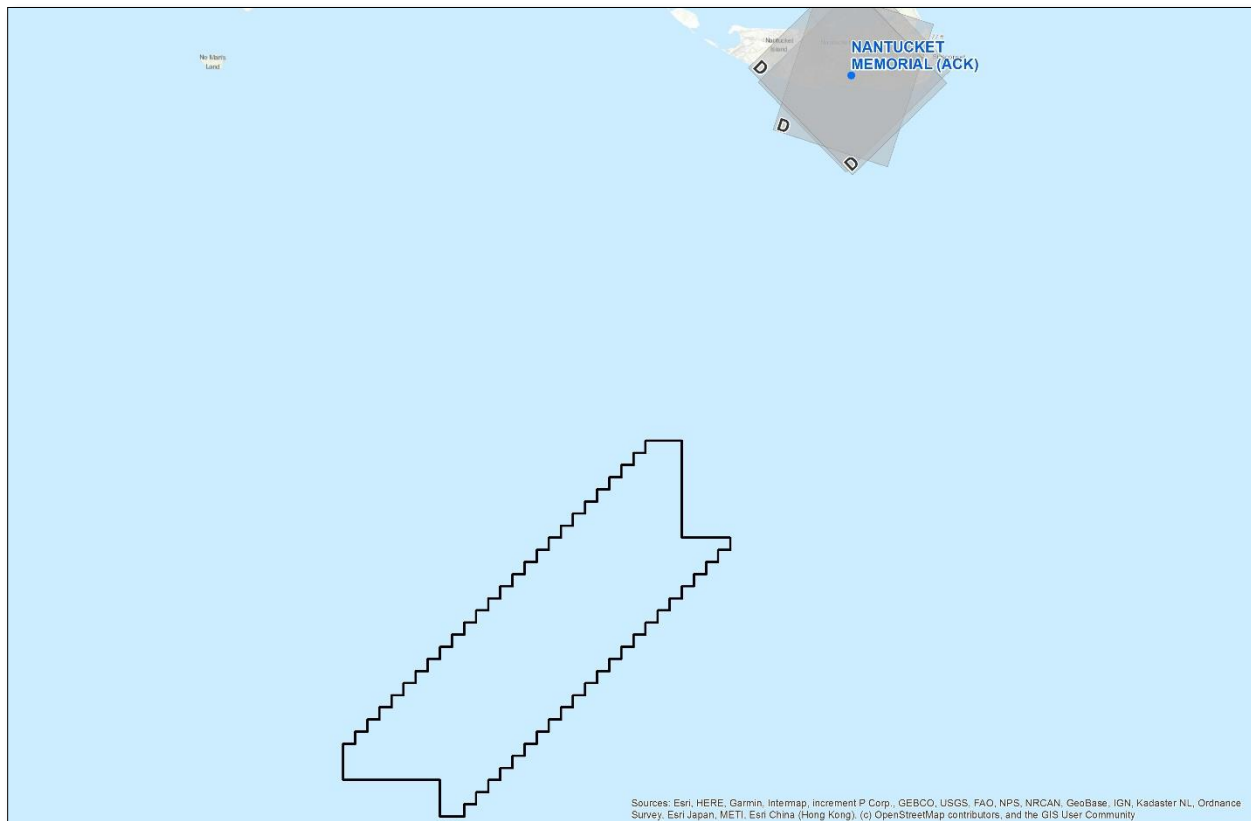


Figure 4: VFR traffic pattern airspace in proximity to the Mayflower Wind project



Visual Flight Rules (VFR) Routes

During periods of marginal VMC – low cloud ceilings and one statute mile visibility – pilots often operate below the floor of controlled airspace. Operating under these weather conditions requires pilots to remain within one statute mile of recognizable landmarks such as roads, rivers, and railroad tracks. The FAA protects for known and regularly used VFR routes by limiting structure heights within two statute miles of these routes to no greater than 14 CFR Part 77.17(a)(1) – a height of 499 feet AGL at the site of the object.

There is no dataset that identifies VFR routes or their utilization. However, the Mayflower Wind project is not located within two statute miles of landmarks that could be used as VFR routes (hatched orange, [Figure 5](#)). Therefore, wind development within the defined study area should not have an impact on VFR routes.

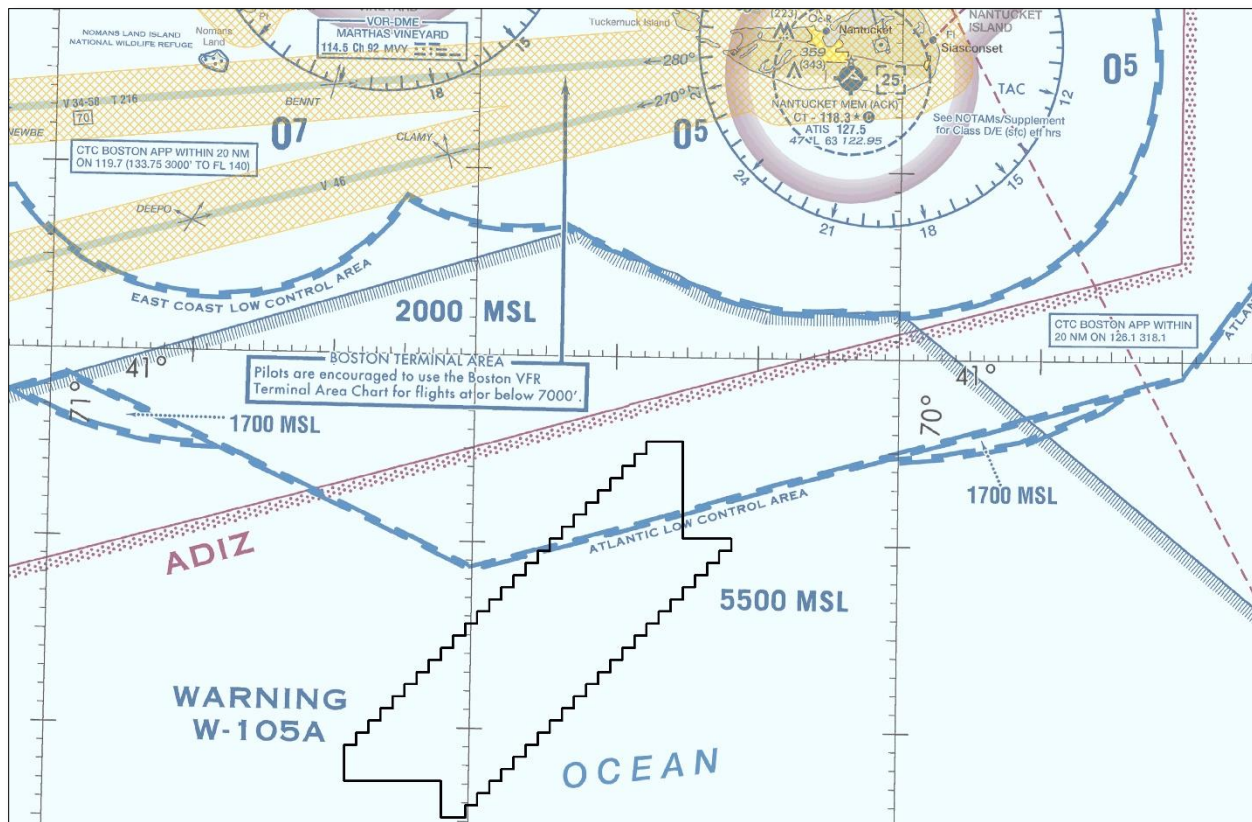


Figure 5: Potential VFR routes (orange hatched areas) in proximity to the Mayflower Wind project



Instrument Departures

In order to ensure that aircraft departing during marginal weather conditions do not fly into terrain or obstacles, the FAA publishes instrument departure procedures that provide obstacle clearance to pilots as they transition between the terminal and enroute environments. These procedures contain specific routing and minimum climb gradients to ensure clearance from terrain and obstacles.

Proposed structures that exceed instrument departure procedure obstacle clearance surfaces would require an increase to instrument departure procedure minimum climb gradients. If the FAA determines that this impact would affect as few as one operation per week, it could be used as the basis for determinations of hazard.

Instrument departure procedure obstacle clearance surfaces (e.g., [Figure 6](#)) are in excess of other, lower surfaces. Additionally, WTGs within the defined study area up to 1,067 feet tall should not have an impact on instrument departure procedures.

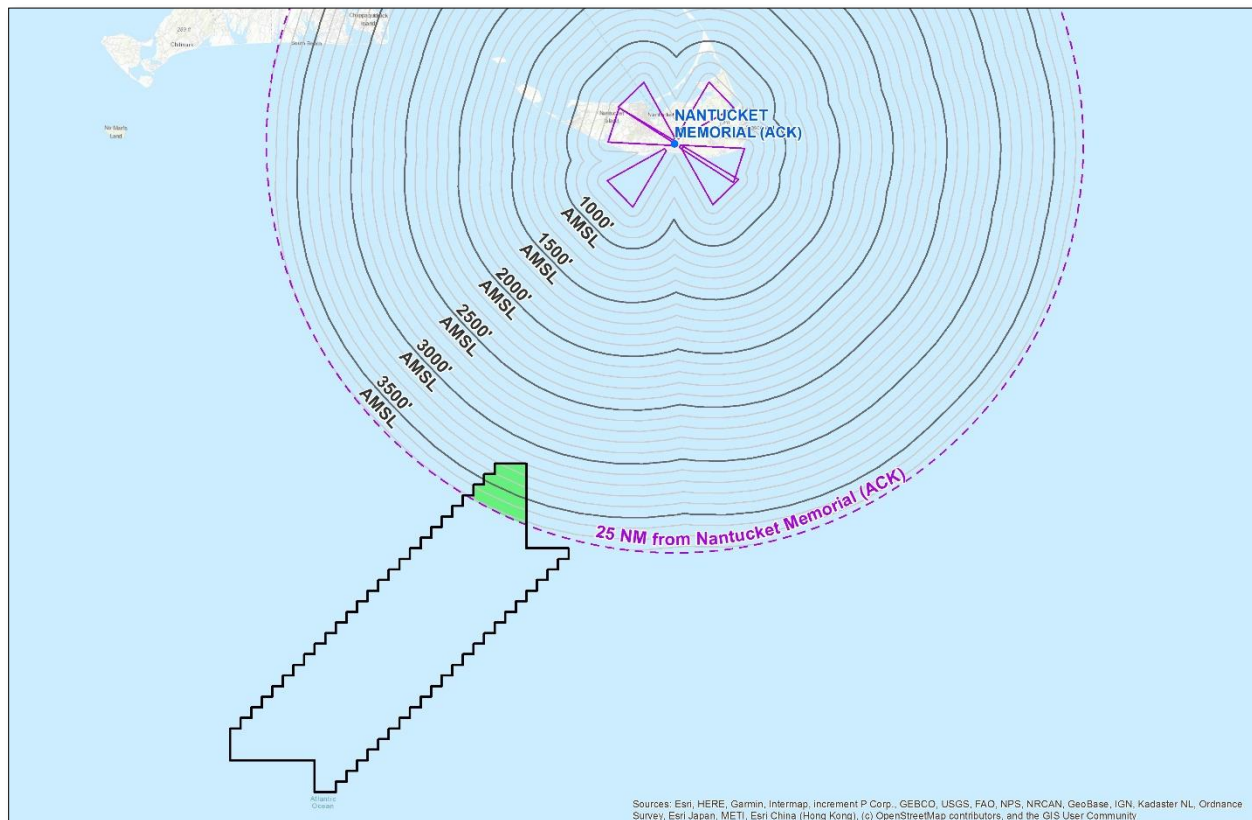


Figure 6: Nantucket Memorial (ACK) obstacle departure procedure assessment



Instrument Approaches

Pilots operating during periods of reduced visibility and low cloud ceilings rely on terrestrial and satellite based navigational aids (NAVAIDS) in order to navigate from one point to another and to locate runways. The FAA publishes instrument approach procedures that provide course guidance to on-board avionics that aid the pilot in locating the runway. Capitol Airspace assessed nine published instrument approach procedures at Nantucket Memorial (ACK):³

Nantucket Memorial (ACK)

ILS or Localizer Approach to Runway 06

ILS or Localizer Approach to Runway 24

RNAV (GPS) Approach to Runway 06

RNAV (GPS) Approach to Runway 15

RNAV (GPS) Approach to Runway 24

RNAV (GPS) Approach to Runway 33

VOR Approach to Runway 24

Great Point Visual Approach to Runway 24

Tuckernuck Visual Approach to Runway 06

Proposed structures that exceed instrument approach procedure obstacle clearance surfaces would require an increase to their minimum altitudes. Increases to these altitudes, especially critical *decision altitudes (DA)* and *minimum descent altitudes (MDA)*, can directly impact the efficiency of instrument approach procedures. If the FAA determines this impact would affect as few as one operation per week, it could be used as the basis for determinations of hazard.

³ Capitol Airspace assessed instrument approach procedures within 30 nautical miles (NM) of the study area. Although approach surfaces – including terminal arrival areas (TAA), feeder segments, and initial segments – from airports further than 30 NM may overlie the study area, the obstacle clearance surfaces present a lower risk to projects than the surfaces identified in this report. Therefore, height constraints associated with instrument approach surfaces for airports beyond 30 NM were not considered and are not included in the [Composite Map](#).



Nantucket Memorial (ACK)

Minimum Safe Altitudes⁴

The minimum safe altitudes (MSA) for all Nantucket Memorial (ACK) instrument approach procedures range from 1,500 to 1,700 feet AMSL. The obstacle clearance surfaces (i.e., hatched purple, **Figure 7**) range from 500 to 700 feet AMSL and would be the lowest height constraints overlying the northern section of the study area. At 808 and 1,067 feet tall, proposed WTGs will exceed these surfaces in this area. However, MSAs are for emergency use only and cannot be used as the basis for determinations of hazard.

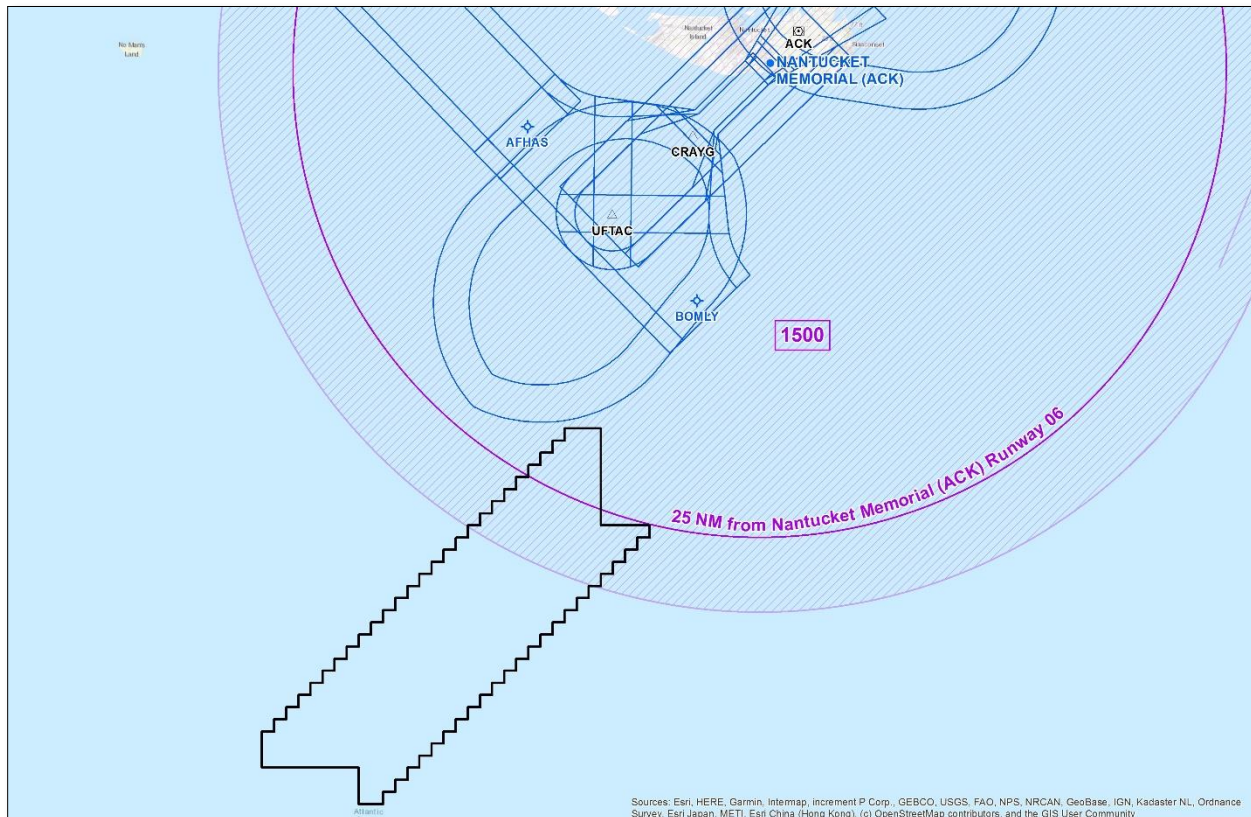


Figure 7: Nantucket Memorial (ACK) RNAV (GPS) Approach to Runway 06 (blue) with MSA obstacle evaluation area (hatched purple)

⁴ Multiple minimum safe altitudes (MSA) overlie the study area. However, in accordance with FAA Order 7400.2M Paragraph 6-3-9(e)(5), minimum safe altitudes (MSA) are for emergency use only and cannot be used as the basis for determinations of hazard. Therefore, height constraints associated with MSAs were not considered and are not included in the **Composite Map**.



Enroute Airways

Enroute airways provide pilots a means of navigation when flying from airport to airport and are defined by radials between VHF omni-directional ranges (VORs). The FAA publishes minimum altitudes for airways to ensure clearance from obstacles and terrain. The FAA requires that each airway have a minimum obstacle clearance of 1,000 feet in non-mountainous areas and normally 2,000 feet in mountainous areas.

Proposed structures that exceed enroute airway obstacle clearance surfaces would require an increase to their minimum obstruction clearance altitudes (MOCA) and/or minimum enroute altitudes (MEA). If the FAA determines that this impact would affect as few as one operation per week, it could be used as the basis for determinations of hazard.

Low altitude enroute airway obstacle clearance surfaces (e.g., **Figure 8**) do not overlie the Mayflower wind project. Therefore, 808 and 1,067-foot tall WTGs within the defined study area should not have an impact on enroute airways.

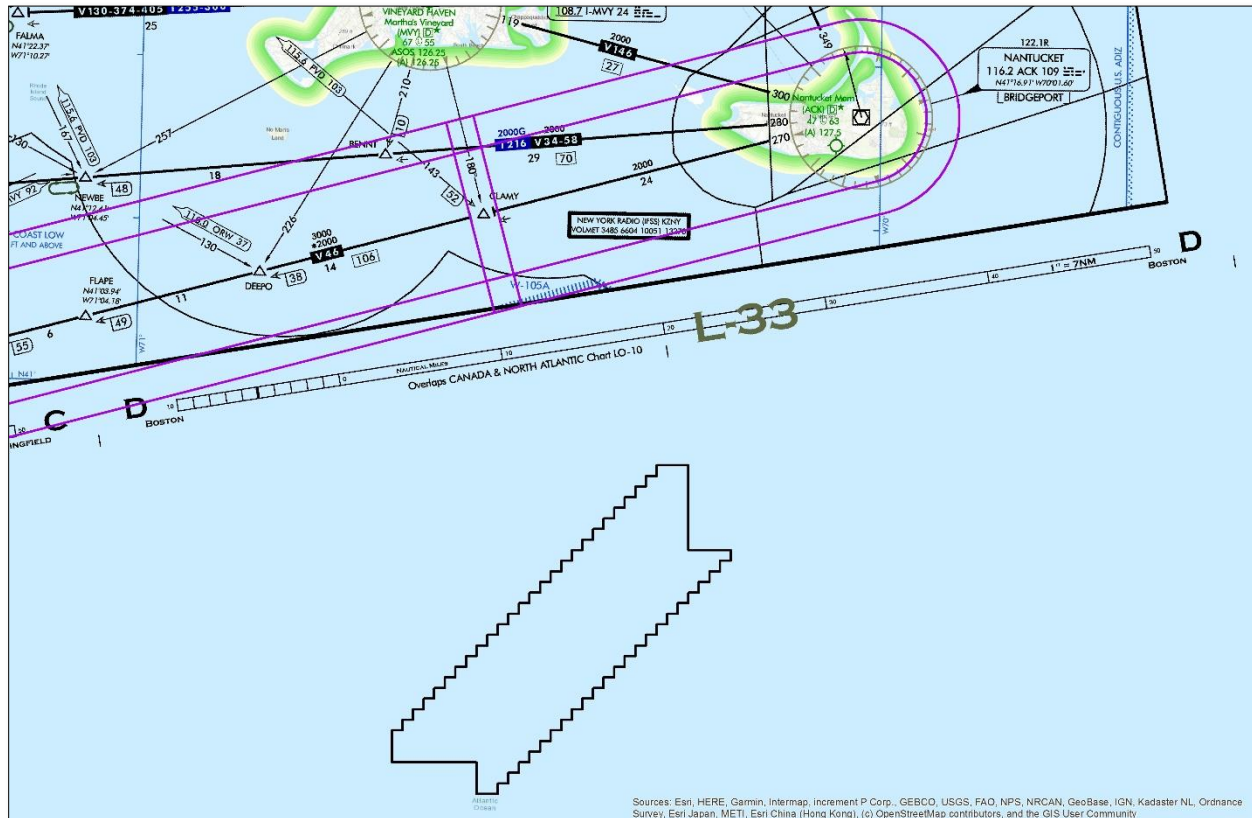


Figure 8: Low altitude enroute chart L-33 with V46 obstacle evaluation areas (purple)



Minimum Vectoring/IFR Altitudes⁵

The FAA publishes minimum vectoring altitude (MVA) and minimum instrument flight rules (IFR) altitude (MIA) charts that define sectors with the lowest altitudes at which air traffic controllers can issue radar vectors to aircraft based on obstacle clearance. The FAA requires that sectors have a minimum obstacle clearance of 1,000 feet in non-mountainous areas and normally 2,000 feet in mountainous areas.

Proposed structures that exceed MVA/MIA sector obstacle clearance surfaces would require an increase to the altitudes usable by air traffic control for vectoring aircraft. If the FAA determines that this impact would affect as few as one operation per week, it could result in determinations of hazard.

Boston Consolidated (A90) Terminal Radar Approach Control (TRACON) MVA sectors, Boston (ZBW) Air Route Traffic Control Center (ARTCC) MIA sectors, and New York (ZNY) ARTCC MIA sectors overlie the Mayflower Wind project. The obstacle clearance surfaces range from 1,049 to 4,849 feet AMSL and are the lowest height constraints overlying the entire study area (*Table 1, Figure 9, & Figure 10*). At 1,067 feet tall, proposed WTGs in the northern section of the study area (orange area, *Figure 9*) will exceed the Boston Consolidated (A90) TRACON MVA Sector U and require an increase to its MVA. If the FAA determines that this impact would affect as few as one operation per week, it could result in FAA objections to proposed wind development. However, WTGs up to 1,049 feet tall within the defined study area should not have an impact on these sectors (green and orange areas, *Figure 9 & Figure 10*).

Table 1: MVA/MIA sector analysis results

Facility	Chart	Sector	MVA/MIA (AMSL Feet)	OCS (AMSL Feet)	Limiting at 808' tall	Limiting at 1,067' tall
A90 TRACON	A90_MVA_FUS3_2020 (<i>Figure 9</i>)	U	2000	1049	No	Yes
		T	5500	4549	No	No
	A90_MVA_FUS5_2019	HH	2300	1349	No	No
		EE	5800	4849	No	No
ZBW ARTCC	ZBW_TAV_2020 (<i>Figure 10</i>)	bBOS04	2300	1349	No	No
		bBOS06	5800	4849	No	No
ZNY ARTCC	ZNY_TAV_2019 (<i>Figure 10</i>)	NNNY25	5800	4849	No	No

⁵ The FAA updates MVA and MIA charts on an as-needed basis. However, the most recent charts available to Capitol Airspace are dated May 14, 2020, indicating that the FAA is not currently updating publicly available charts. It is possible the FAA has internally released updated charts that are not yet publicly available. These updated charts could result in height constraints that differ from those depicted in this report.

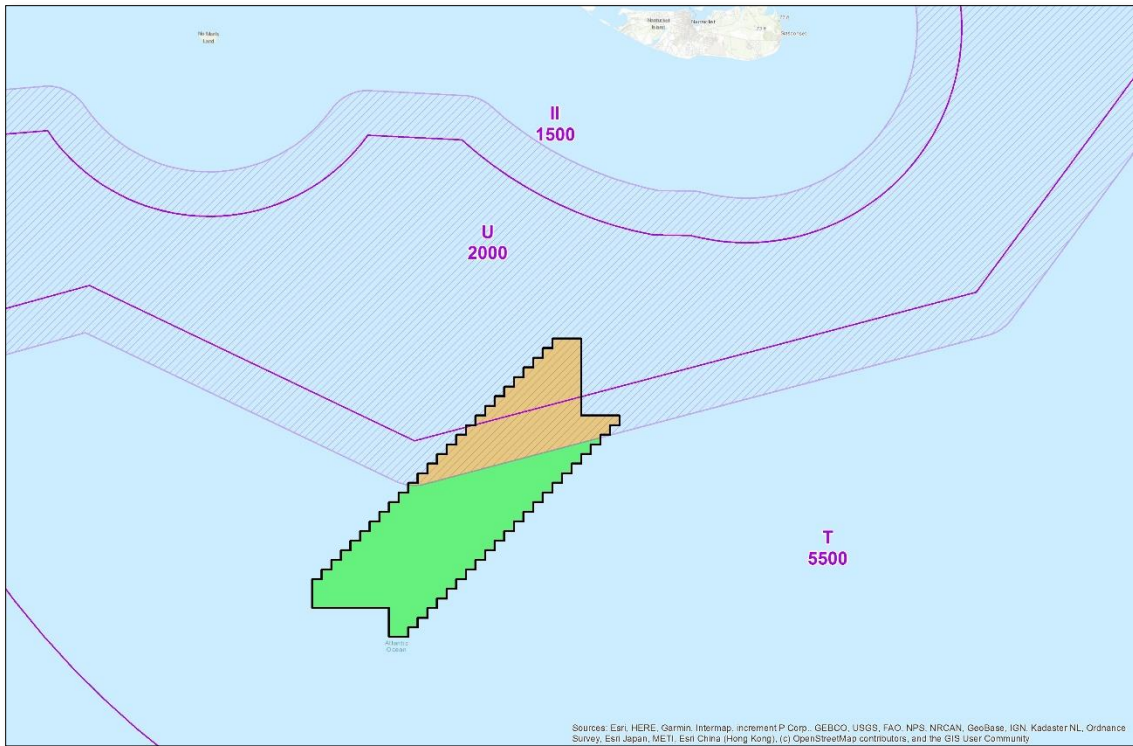


Figure 9: Boston Consolidated (A90) TRACON FUSION 3 MVA sectors (purple) and Sector U obstacle evaluation area (hatched purple)

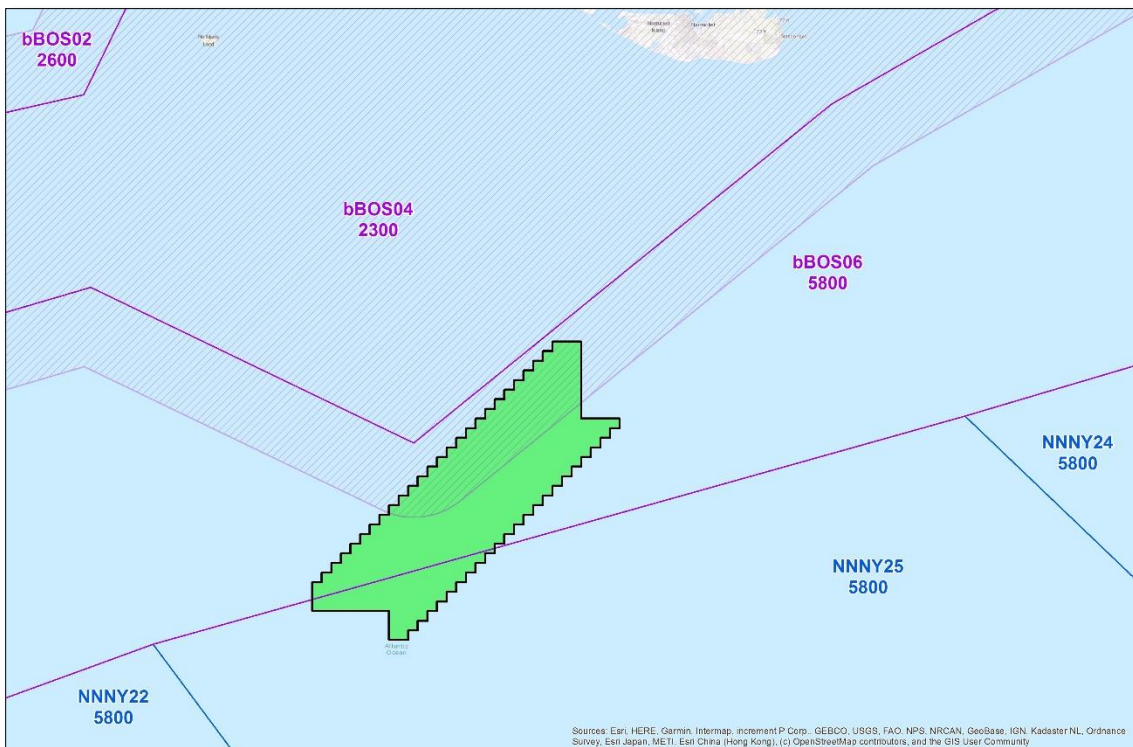


Figure 10: New York (ZNY) (blue) and Boston (ZBW) (purple) ARTCC MIA sectors with Sector bBOS04 obstacle evaluation area (hatched purple)



Terminal and Enroute Navigational Aids

The FAA has established protection areas in order to identify proposed structures that may have a physical and/or electromagnetic effect on navigational aids (NAVAIDs). The protection area dimensions vary based on the proposed structure type as well as the NAVAID type. Proposed structures within these areas may interfere with NAVAID services and will require further review by FAA Technical Operations. If further review determines that proposed structures would have a significant physical and/or electromagnetic effect on NAVAIDs, it could result in determinations of hazard.

NAVAID protection areas do not overlie the Mayflower Wind project ([Figure 11](#)). As a result, it is unlikely that proposed WTGs would have a physical or electromagnetic effect on terminal or enroute NAVAIDs.

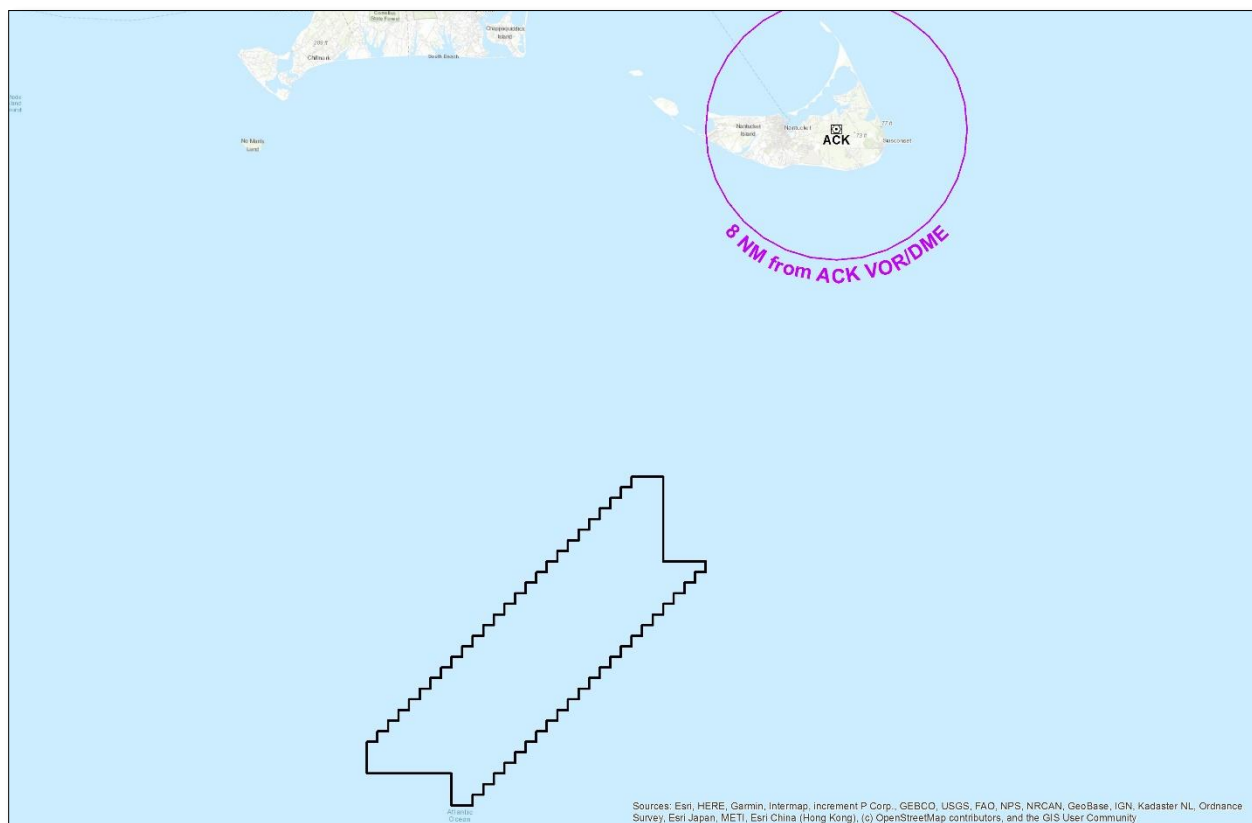


Figure 11: Nantucket (ACK) VOR/DME protection area and the Mayflower Wind project



Military Airspace and Training Routes

Although the FAA does not consider impact on military airspace or training routes, they will notify the military of proposed structures within these segments of airspace. Impact on these segments of airspace can result in military objections to the proposed development. If the planned development area is on federal land, impact on military airspace or training routes may result in the denial of permits by the Bureau of Land Management.

Warning areas (W) overlying the Mayflower Wind project (**Figure 12**):

U.S. Navy, Fleet Area Control and Surveillance Facility, Virginia Capes (FACSFAC VACAPES)

<i>Route/Airspace</i>	<i>Minimum Altitude</i>
W-105A	Surface

Due to the low altitude associated with this airspace, wind development could have an impact on its operations. If FACSFAC VACAPES or other nearby units use this airspace regularly, they may object to proposed wind development within the airspaces' boundaries. Under the provisions of the 2018 National Defense Authorization Act (NDAA), the Military Aviation and Installation Assurance Siting Clearinghouse (Clearinghouse) may issue a Notice of Presumed Risk to National Security (NPR) letter to initiate mitigation discussions. These discussions are facilitated through the Clearinghouse and with the affected bases or organizations with operational interests. Per the legislative directive, NPR letters are provided to the Governor of the State(s). The Clearinghouse typically attempts to notify developers shortly before the issuance of an NPR letter.



Figure 12: Military airspace overlying the Mayflower Wind project



Conclusion

At 808 and 1,067 feet AGL, proposed WTGs will exceed 77.17(a)(1) – a height of 499 feet AGL at the site of the object – and would be identified as obstructions within U.S. territorial airspace. However, exceeding these surfaces does not automatically indicate that a structure would have a substantial adverse effect on aviation operations. Proposed structures must have an impact on a significant volume of VFR or IFR operations in order to constitute a substantial adverse effect.

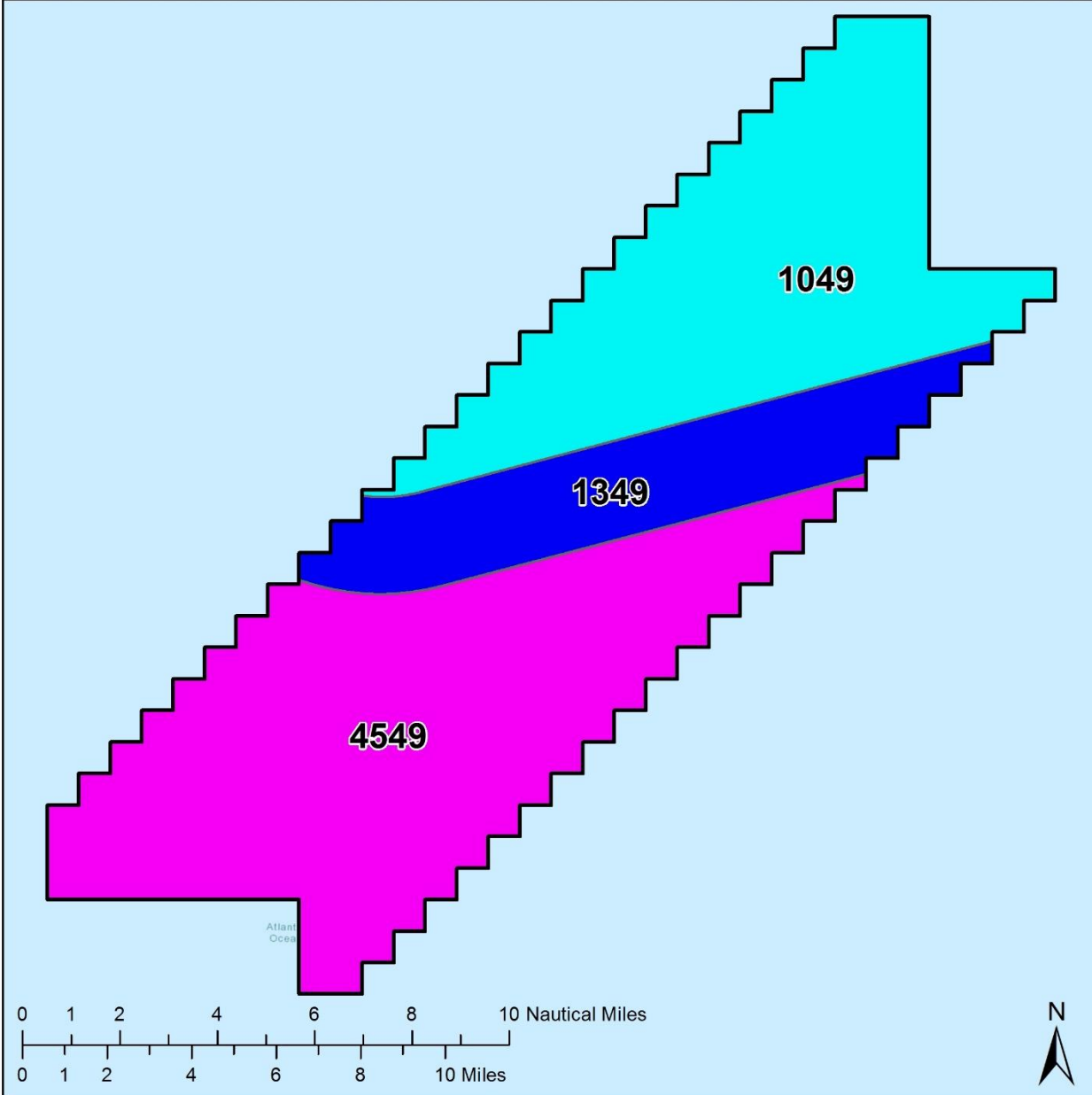
The lowest obstacle clearance surfaces overlying the Mayflower Wind project range from 1,049 to 4,549 feet AMSL (**Figure 13**) and are associated with multiple Boston Consolidated (A90) TRACON MVA sectors and Boston (ZBW) ARTCC MIA Sector bBOS04 (**Table 1, Figure 9, & Figure 10**). At 1,067 feet tall, proposed WTGs in the northern section of the study area (orange area, **Figure 14**) will exceed Boston Consolidated (A90) TRACON MVA Sector U and require an increase to its MVA. If the FAA determines that this impact would affect as few as one operation per week, it could result in FAA objections to proposed wind development. However, WTGs up to 1,049 feet tall within the defined study area should not have an impact on these sectors (green and orange areas, **Figure 14**).




Warning Area W-105A overlies the Mayflower Wind project (**Figure 12**). Impact on this airspace could result in military objections to proposed wind development. In May 2020, Mayflower Wind submitted an Informal Review request to the DoD Siting Clearinghouse for early consultation and has begun engagements with the DoD.


If you have any questions regarding the findings of this study, please contact **Dan Underwood** or **Wesley Williamson** at (703) 256-2485.



This map is a result of an obstruction evaluation and airspace analysis completed by Capitol Airspace Group on August 27, 2020

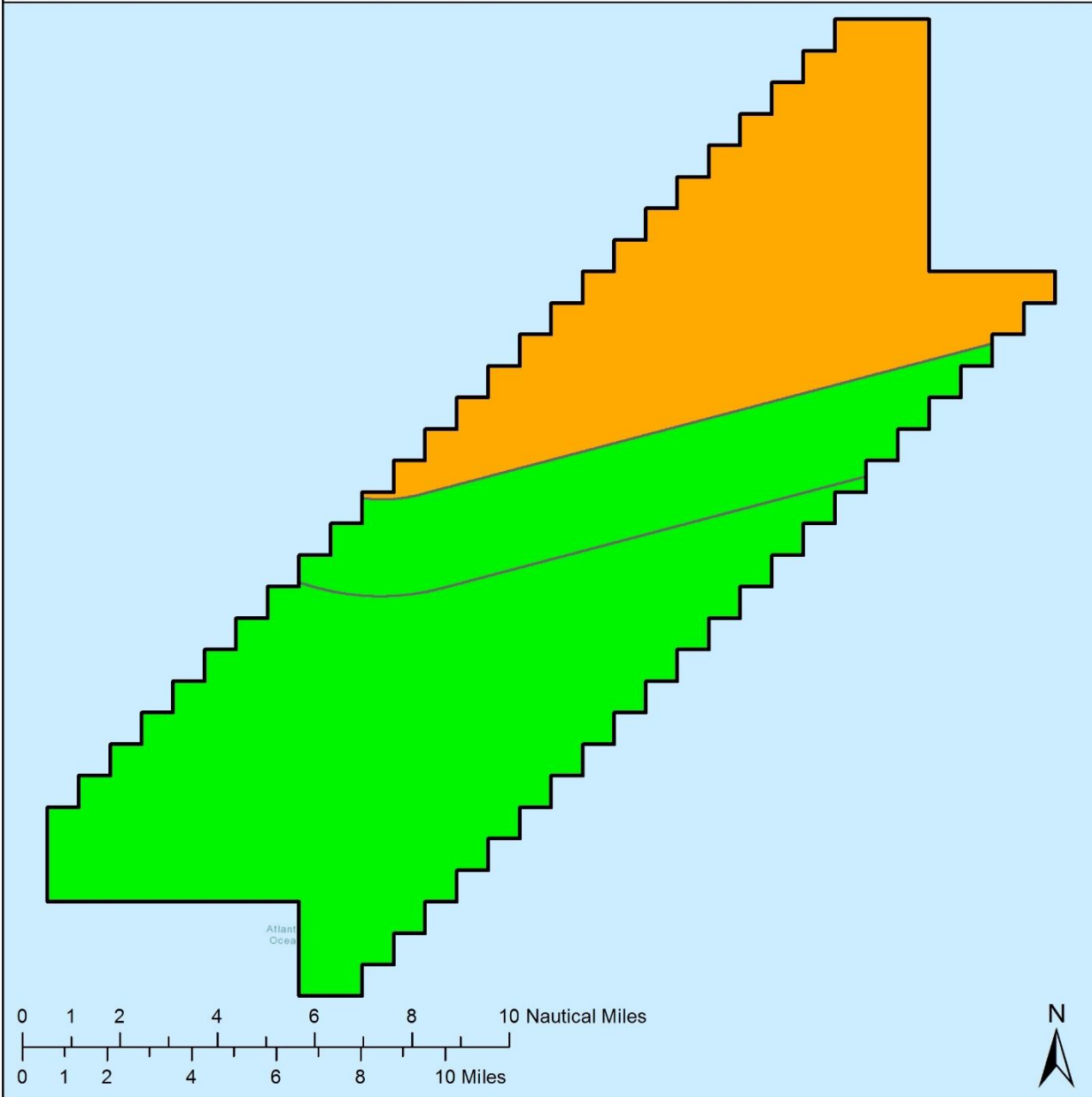





Obstacle Clearance Surface	
Height - AMSL Feet	
	1,049
	1,349
	4,549
All heights above mean sea level (AMSL)	
The lowest obstacle clearance surfaces overlying the project are associated with multiple Boston Consolidated (A90) TRACON MVA sectors and Boston (ZBW) ARTCC MIA sectors.	


Mayflower Wind Project Composite Height Constraint Map	
Report Date: August 27, 2020	Figure 13
Coordinate System: NAD 1983 UTM Zone 19N	 Capitol Airspace Group
Wesley Williamson	



This map is a result of an obstruction evaluation and airspace analysis completed by Capitol Airspace Group on August 27, 2020



Clearance	
	Limits 808' and 1,067' AMSL WTG
	Limits 1,067' AMSL WTG
	Does not limit 808' or 1,067' AMSL WTG
All heights above mean sea level (AMSL)	
The lowest obstacle clearance surfaces overlying the project are associated with multiple Boston Consolidated (A90) TRACON MVA sectors and Boston (ZBW) ARTCC MIA sectors.	

Mayflower Wind Project Above Mean Sea Level (AMSL) Clearance Map	
Report Date: August 27, 2020	Figure 14
Coordinate System: NAD 1983 UTM Zone 19N Wesley Williamson	 Capitol Airspace Group