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PUCO Case Caption: IN the matter of the

Application of Republic Wind,  
LLC for a Certificate of Environmental  
Compatibility and Public Need for a  
Wind Powered Electric Generating Facility  
in Seneca and Sandusky Counties, Ohio

Staff Exhibit 2

**Date Submitted:**

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Technician *Ar* date processed *11/25/19*

BEFORE THE OHIO POWER SITING BOARD

- - -

In the Matter of the :  
Application of Republic :  
Wind, LLC for a Certificate :  
of Environmental :  
Compatibility and Public : Case No. 17-2295-EL-BGN  
Need for a Wind-Powered :  
Electric Generating :  
Facility in Seneca and :  
Sandusky Counties, Ohio. :

- - -

PROCEEDINGS

before Mr. Jay S. Agranoff and Ms. Anna Sanyal,  
Administrative Law Judges, at the Ohio Power Siting  
Board, 180 East Broad Street, Room 11-C, Columbus,  
Ohio, called at 9:00 a.m. on Tuesday, November 12,  
2019.

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VOLUME IV

- - -

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# Republic Wind Project

Apex Clean Energy

*Sandusky and Seneca Counties, Ohio*

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*Obstruction Evaluation & Airspace Analysis*

March 8, 2019



Capitol Airspace Group

[capitolairspace.com](http://capitolairspace.com)

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Staff Ex. 2



## Summary

Capitol Airspace conducted an obstruction evaluation and airspace analysis for the Republic wind project in Sandusky and Seneca Counties, Ohio. The purpose for this analysis was to identify obstacle clearance surfaces established by the Federal Aviation Administration (FAA) that could limit the placement of 591 and 660 foot above ground level (AGL) wind turbines. At the time of this analysis, 50 individual wind turbine locations (black points, **Figure 1**) had been identified. This analysis assessed height constraints overlying each location as well as an approximately 37 square mile study area (red outline, **Figure 1**) to aid in identifying optimal wind turbine locations.

14 CFR Part 77.9 requires that all structures exceeding 200 feet 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 have an effect on the safety of air navigation and the efficient utilization of navigable airspace by aircraft. The end 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.

Height constraints overlying the Republic wind project range from 1,110 to 1,400 feet above mean sea level (AMSL) and are associated with instrument departure and approach procedures. Proposed wind turbines that exceed these surfaces would require an increase to instrument departure procedure minimum climb gradients and instrument approach procedure minimum altitudes. If the FAA determines that these impacts would affect as few as one operation per week, it could result in determinations of hazard.

United States Geological Survey (USGS) elevation data indicates that these surfaces could limit 591 foot AGL wind turbines in the southern and southwestern sections of the study area, including 28 proposed locations. Additionally, these surfaces could also limit 660 foot AGL wind turbines throughout the majority of the study area, including 49 proposed locations. Visual flight rules (VFR) traffic pattern airspace could further limit wind development in the northern and northwestern sections of the study area.

Multiple military slow routes overlie the Republic wind project. Impact on these routes could result in military objections to proposed wind development.

Lastly, the Republic wind project is located within line of sight of multiple surveillance radar systems. Impact on surveillance radar systems can result in the issuance of determinations of hazard regardless of the lack of impact on the other surfaces described in this report.

This study did not consider electromagnetic interference on communications 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 56 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.*



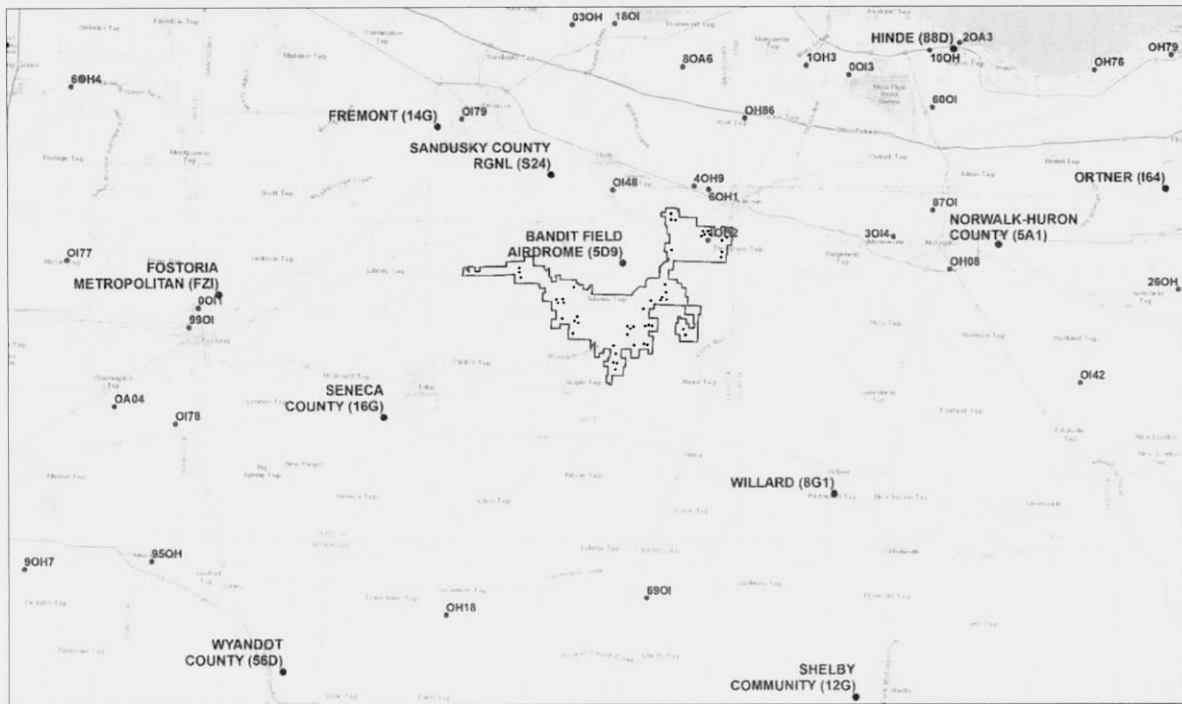


## Methodology

Capitol Airspace studied the proposed project based on location information provided by Apex Clean Energy. 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 military 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 Approach 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 Analysis Version 1.3.0
- 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 Republic wind project**



## Study Findings

### 14 CFR Part 77 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.

14 CFR Part 77 imaginary surfaces (**Figure 2**) overlying the Republic wind project:

**Sandusky County Regional (S24)<sup>1</sup>**

77.17(a)(2): 1,014 to 1,298 feet AMSL

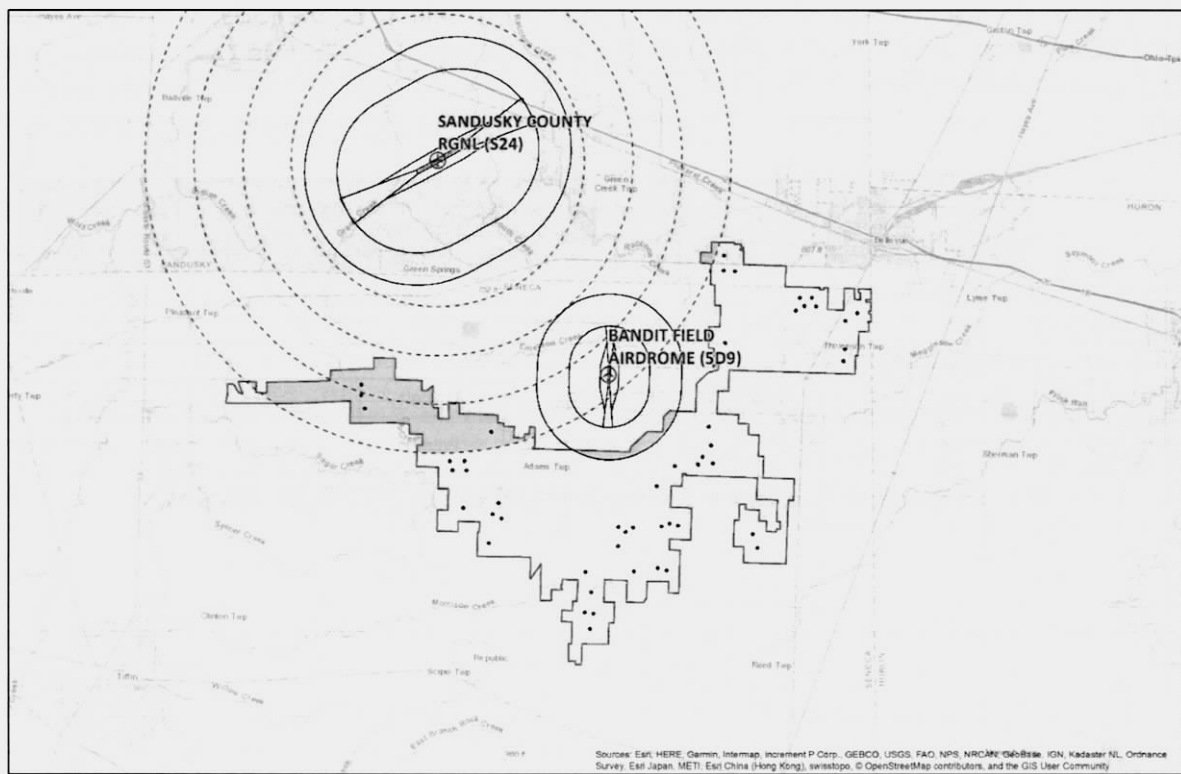
**Bandit Field Airdrome (5D9)**

77.19: 1,070 to 1,155 feet AMSL

At 591 and 660 feet AGL, proposed wind turbines in the northern section of the study area (orange areas, **Figure 2**), including four proposed locations, will exceed these surfaces and will be identified as obstructions. Additionally, at 591 and 660 feet AGL, all of the proposed wind turbines will exceed 77.17(a)(1) – a height of 499 feet AGL at the site of the object – and will be identified as obstructions regardless of location.

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<sup>1</sup> Sandusky County Regional (S24) plans to extend Runway 06/24 to the northeast. As a result, the 77.17(a)(2) imaginary surface could differ slightly from the surface based on the existing airport reference point (ARP).



**Figure 2: 77.17(a)(2) and 77.19 (black) imaginary surfaces overlying the Republic wind project**



### Visual Flight Rules (VFR) Traffic Pattern Airspace

VFR traffic pattern airspace is used by pilots operating during visual meteorological conditions. 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.

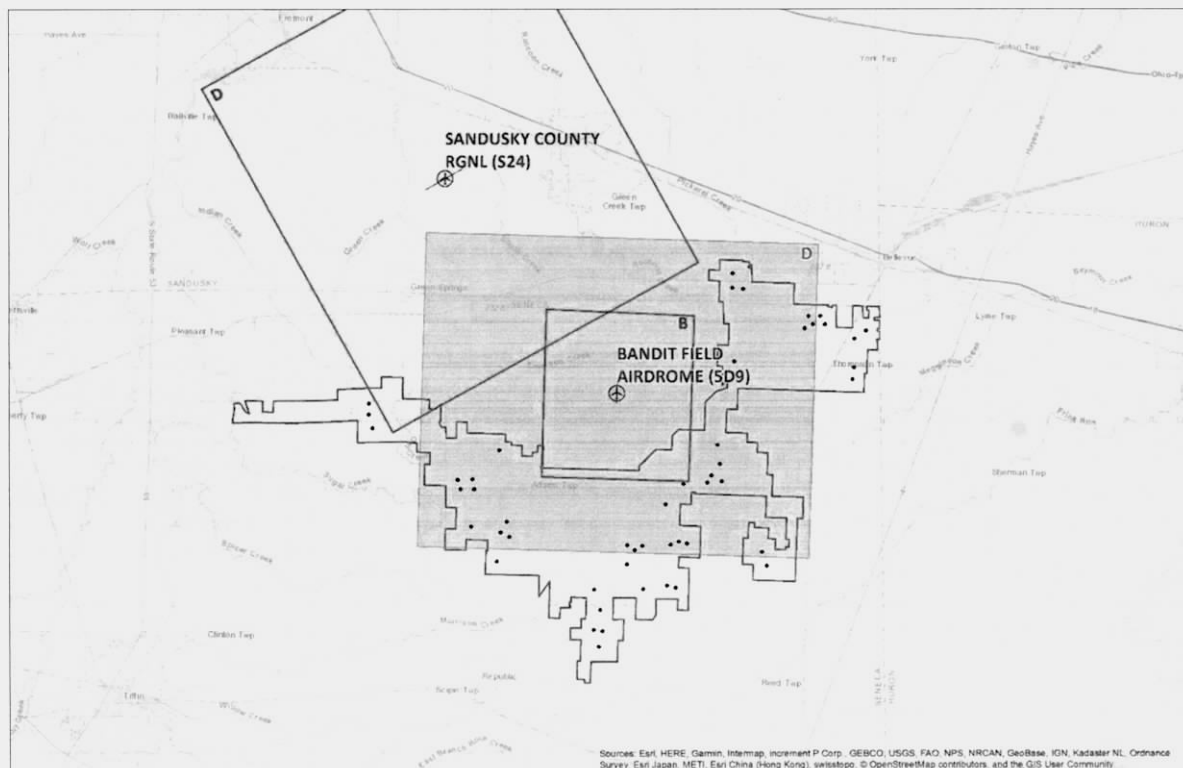
VFR traffic pattern airspace overlies the Republic wind project. While the FAA may initially protect for up to Category D VFR traffic pattern airspace (shaded gray, **Figure 3**), not all airports are likely to support a significant volume of Category D operations. As a result, the FAA will ultimately apply VFR traffic pattern airspace considering the airport's likely operations and runway characteristics (**Table 1 & Figure 3**).

The likely Sandusky County Regional Airport (S24) and Bandit Field Airdrome (5D9) VFR traffic pattern airspace (solid purple outline, **Figure 3**) overlies the Republic wind project. Due to the limiting height constraints associated with VFR traffic pattern airspace, 591 and 660 foot AGL wind turbines will not be feasible within its boundaries. However, none of the proposed wind turbines are located in these areas.

	Status	Dimensions (Feet)	Weight Bearing Capacity (Pounds)	Surface Type	Potential VFR Traffic Pattern Category	Likely VFR Traffic Pattern Category
Bandit Field Airdrome (5D9)						
Runway 18/36	Current	2,576 x 80	Not Published	Turf	-	B
Sandusky County Regional (S24) <sup>2</sup>						
Runway 06/24	Current	5,500 x 100	30,000 [single]	Asphalt	-	C
Runway 06/24	Proposed	7,000 (estimated length)	Unknown	Paved	-	D

**Table 1: Runway physical characteristics and likely VFR traffic pattern application**

<sup>2</sup> Sandusky County Regional (S24) plans to extend Runway 06/24 to the northeast. As a result, Capitol Airspace assessed VFR traffic pattern airspace for both the existing and planned runway locations.



**Figure 3: VFR traffic pattern airspace overlying the Republic wind project**



### Visual Flight Rules (VFR) Routes

During periods of marginal weather – 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.

The Republic wind project is located in proximity to transmission lines, highways, and railroads that may be used as a VFR routes (**Figure 4**). However, operational data describing the usage of VFR routes is not available. If the FAA determines that these potential routes are flown regularly, it could limit wind development in excess of 499 feet AGL and within two statute miles of these landmarks (hatched orange, **Figure 4**).

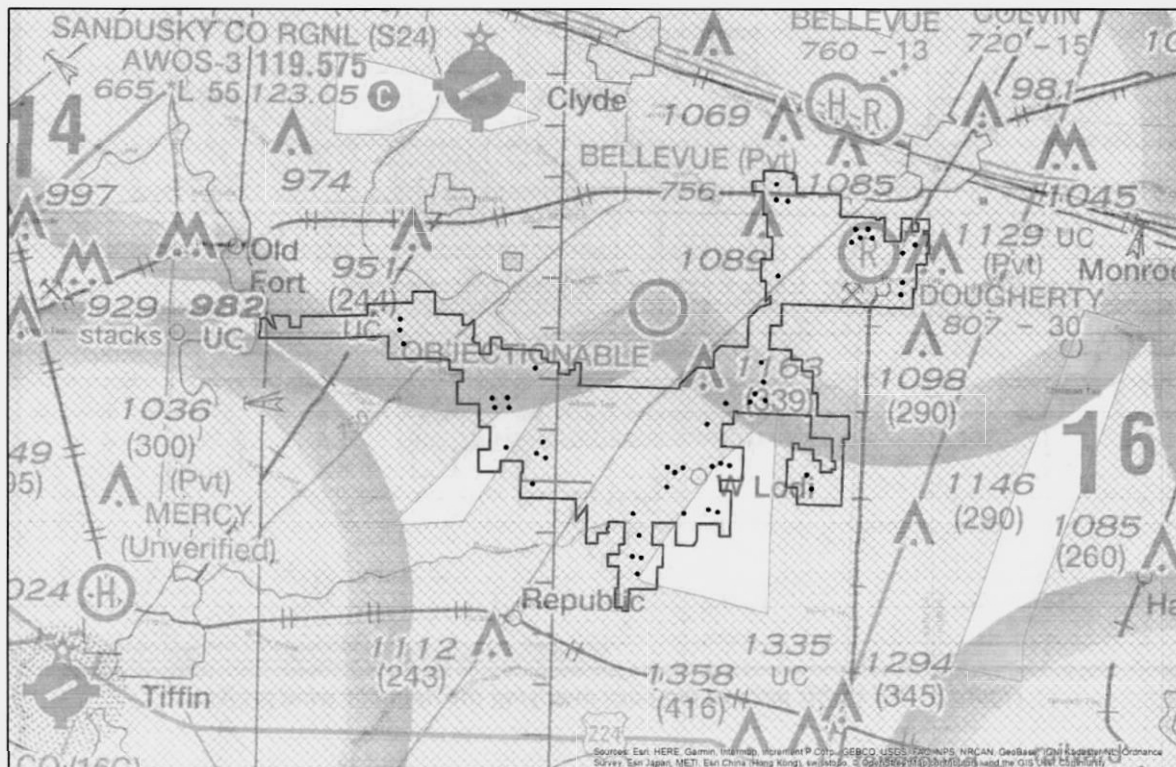


Figure 4: Potential VFR routes in proximity to the Republic wind project





## Instrument Departures

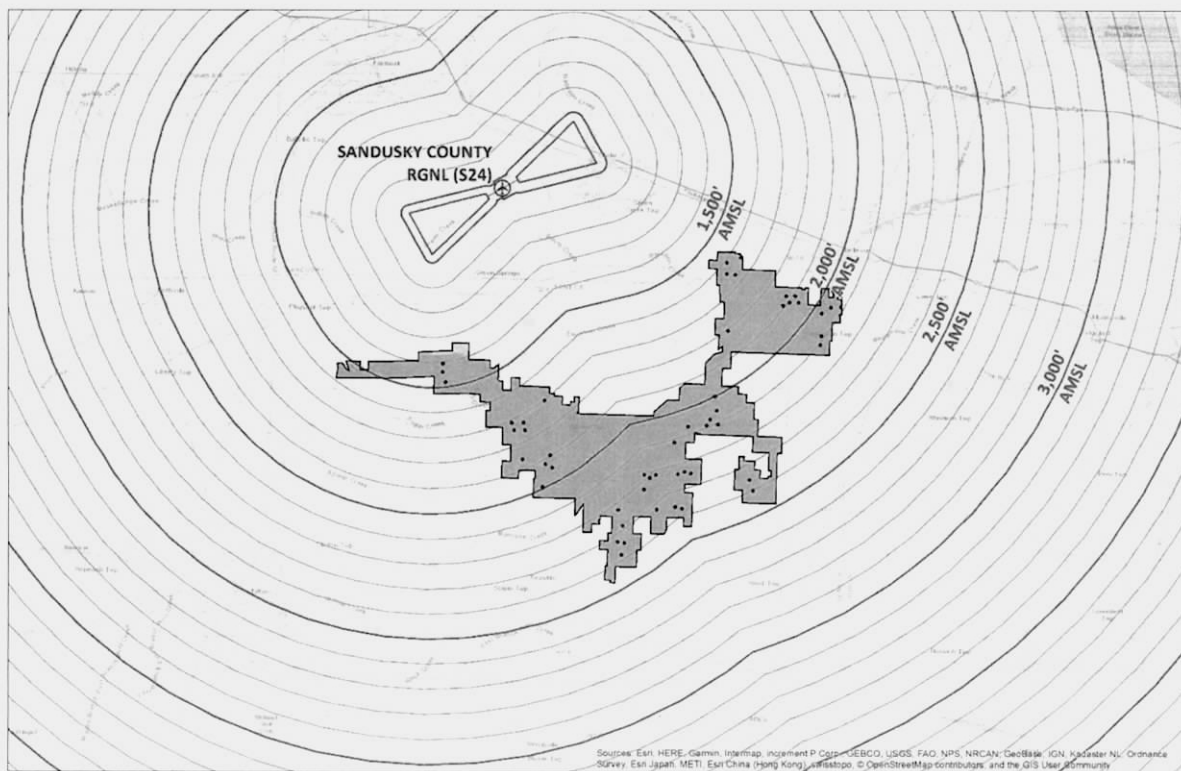
In order to ensure that aircraft departing during marginal weather conditions do not fly into terrain or obstacles, the FAA publishes instrument departure procedures that provide obstacle clearance to pilots as they transition between the terminal and enroute environments. These procedures contain specific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

### Sandusky County Regional (S24)

#### *Obstacle Departure Procedure*

Obstacle clearance surfaces (contours, **Figure 5**) range from 1,330 to 2,488 feet AMSL where they overlie the wind project and are some of the lowest height constraints overlying the northwestern section of the study area. USGS elevation data indicates that these surfaces could limit 660 foot AGL wind turbines along the northwestern edge of the study area (orange area, **Figure 5**). However, these surfaces should not limit 660 foot AGL wind turbines at any of the proposed locations.



**Figure 5: Sandusky County Regional Airport (S24) 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 a total of 38 published instrument approach procedures at 14 public-use airports in proximity to the Republic wind project:<sup>3</sup>

### **Shelby Community (12G)**

VOR-A Circling Approach

### **Fremont (14G)**

RNAV (GPS) Approach to Runway 09

### **Seneca County (16G)**

RNAV (GPS) Approach to Runway 06

RNAV (GPS) Approach to Runway 24

VOR Approach to Runway 06

NDB Approach to Runway 24

### **Port Bucyrus-Crawford County (17G)**

RNAV (GPS) Approach to Runway 04

RNAV (GPS) Approach to Runway 22

VOR Approach to Runway 22

### **Ashland County (3G4)**

RNAV (GPS) Approach to Runway 19

VOR-A Circling Approach

### **Sandusky County Regional (S24)**

RNAV (GPS) Approach to Runway 06

RNAV (GPS) Approach to Runway 24

### **Wyandot County (56D)**

VOR-A Circling Approach

### **Fostoria Metropolitan (FZI)**

RNAV (GPS) Approach to Runway 09

RNAV (GPS) Approach to Runway 27

VOR-A Circling Approach

### **Norwalk-Huron County (5A1)**

RNAV (GPS) Approach to Runway 28

### **Willard (8G1)**

VOR-A Circling Approach

### **Galion Municipal (GQQ)**

RNAV (GPS) Approach to Runway 05

RNAV (GPS) Approach to Runway 23

VOR Approach to Runway 23

### **Mansfield Lahm Regional (MFD)**

ILS or Localizer Approach to Runway 32

RNAV (GPS) Approach to Runway 05

RNAV (GPS) Approach to Runway 14

RNAV (GPS) Approach to Runway 23

RNAV (GPS) Approach to Runway 32

VOR Approach to Runway 14

VOR Approach to Runway 32

NDB Approach to Runway 32

### **Erie-Ottawa International (PCW)**

RNAV (GPS) Approach to Runway 09

RNAV (GPS) Approach to Runway 27

NDB Approach to Runway 28

### **Wood County (1G0)**

RNAV (GPS) Approach to Runway 10

RNAV (GPS) Approach to Runway 18

RNAV (GPS) Approach to Runway 28

RNAV (GPS) Approach to Runway 36

VOR Approach to Runway 18

Proposed structures that exceed instrument approach procedure obstacle clearance surfaces would require an increase to instrument approach procedure minimum altitudes. Increases to these altitudes, especially critical *decision altitudes (DA)* and *minimum descent altitudes (MDA)*, can directly impact the efficiency of an instrument approach procedure. 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.<sup>3</sup>

<sup>3</sup> Multiple private hospital heliports in proximity to the Republic wind project have special instrument approach procedures that may overlie the project. However, it is unlikely that the associated obstacle clearance surfaces would be lower than the other surfaces described in this report.



### Fostoria Metropolitan Airport (FZI)

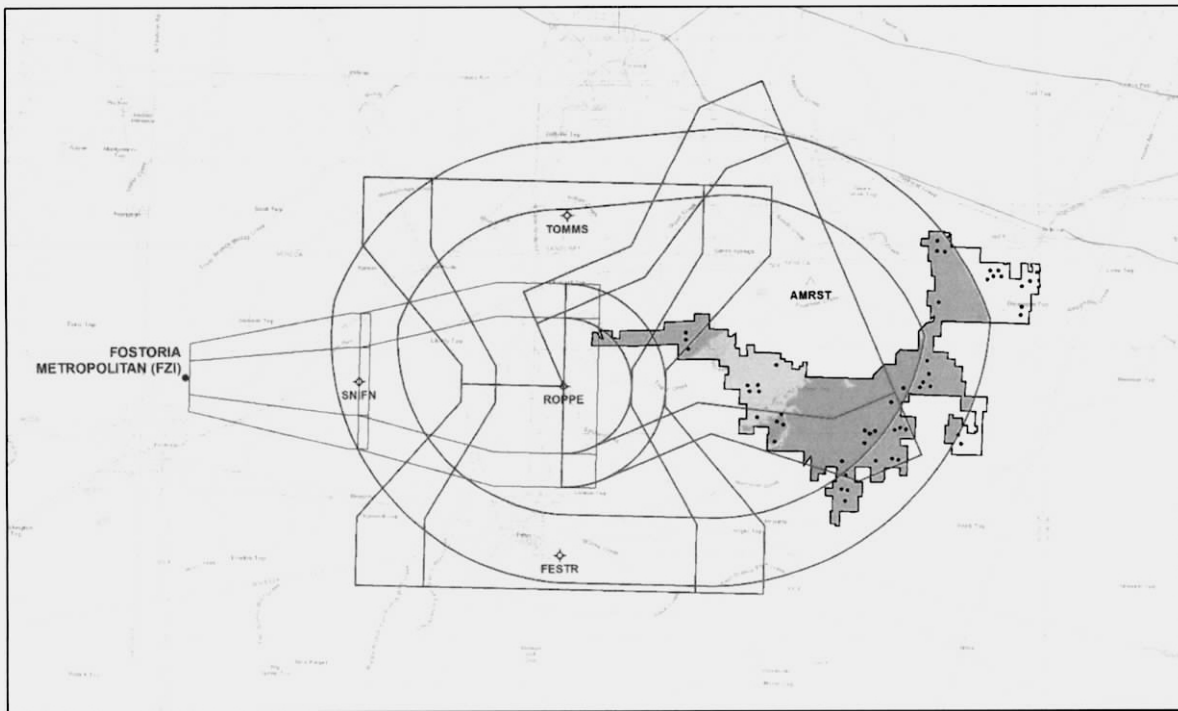
#### *RNAV (GPS) Approach to Runway 09*

The *ROPPE* missed approach holding pattern minimum holding altitude (MHA) is 2,400 feet AMSL. The primary area obstacle clearance surface is 1,400 feet AMSL and is one of the lowest height constraints overlying the western half of the study area.

#### *RNAV (GPS) Approach to Runway 27<sup>4</sup>*

The initial segment minimum altitude and *ROPPE* hold-in-lieu of procedure turn MHA are 2,400 feet AMSL. The primary area obstacle clearance surfaces (red outline, **Figure 6**) are 1,400 feet AMSL and are some of the lowest height constraints overlying the western half of the study area.

USGS elevation data indicates that these surfaces could limit 591 foot AGL wind turbines in the central section of the study area (red areas, **Figure 6**), including 10 proposed locations. Additionally, these surfaces could limit 660 foot AGL wind turbines in the western and central sections of the study area (red and orange areas, **Figure 6**), including 17 proposed locations. However, it is possible that the FAA would increase the *ROPPE* MHA as well as the RNAV (GPS) Approach to Runway 27 initial segment minimum altitudes in order to accommodate 591 and 660 foot AGL wind turbines. This mitigation option is available and is subject to FAA approval.



**Figure 6: Fostoria Metropolitan Airport (FZI) RNAV (GPS) Approach to Runway 27**

<sup>4</sup> The Fostoria Metropolitan Airport (FZI) RNAV (GPS) Approach to Runway 09 original publication date indicates that it was designed with legacy FAA Order 8260.48 instrument approach procedure design criteria. As a result, it is likely that the FAA will use legacy criteria to assess for impact on these approach procedures.



### Seneca County Airport (16G)

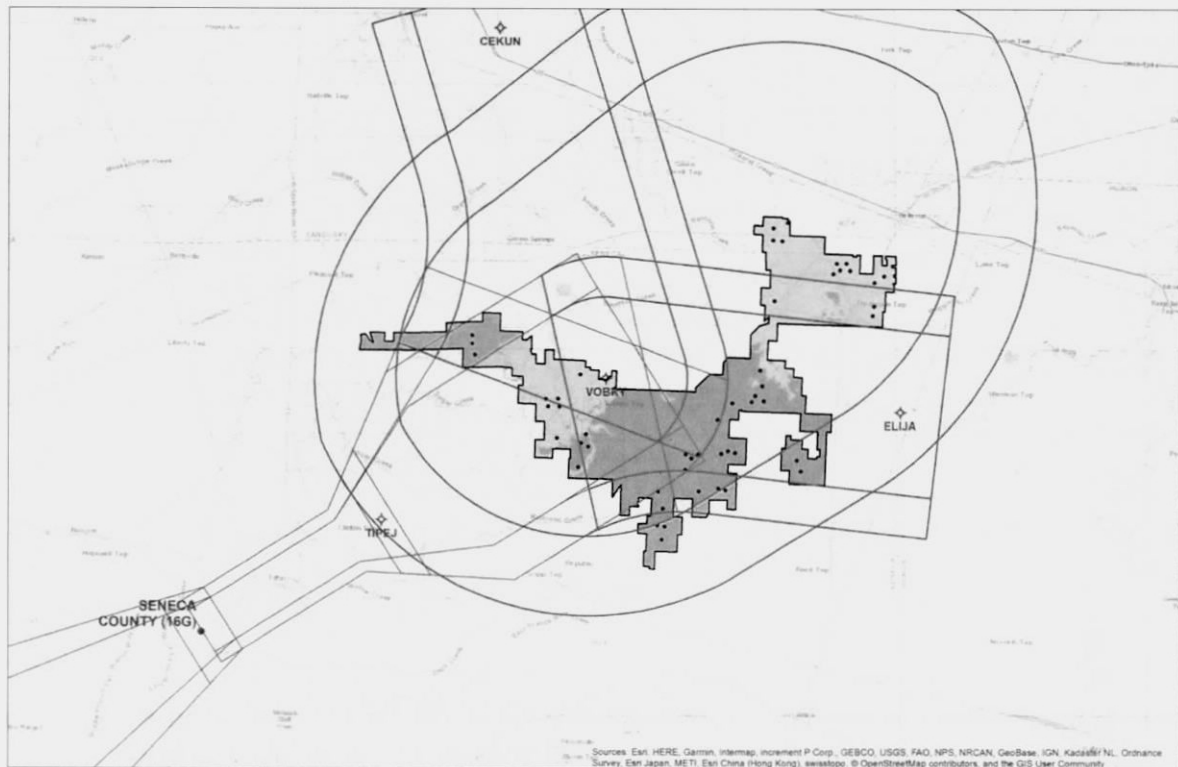
#### *RNAV (GPS) Approach to Runway 06*

The missed approach “climb-to” altitude and *VOBRY* missed approach holding pattern MHA are 2,400 feet AMSL. The primary area obstacle clearance surfaces are 1,400 feet AMSL and are some of the lowest height constraints overlying the majority of the study area.

#### *RNAV (GPS) Approach to Runway 24*

The initial segment minimum altitude and *VOBRY* hold-in-lieu of procedure turn MHA are 2,400 feet AMSL. The primary area obstacle clearance surfaces (red outline, **Figure 7**) are 1,400 feet AMSL and are some of the lowest height constraints overlying the majority of the study area.

USGS elevation data indicates that these surfaces could limit 591 foot AGL wind turbines in the central section of the study area (red areas, **Figure 7**), including 23 proposed locations. Additionally, these surfaces could limit 660 foot AGL wind turbines throughout the majority of the study area (red and orange areas, **Figure 7**), including 43 proposed locations. However, it is possible that the FAA would increase the *VOBRY* MHA as well as the RNAV (GPS) Approach to Runway 24 initial segment minimum altitudes in order to accommodate 591 and 660 foot AGL wind turbines. This mitigation option is available and is subject to FAA approval.



**Figure 7: Seneca County Airport (16G) RNAV (GPS) Approach to Runway 24**



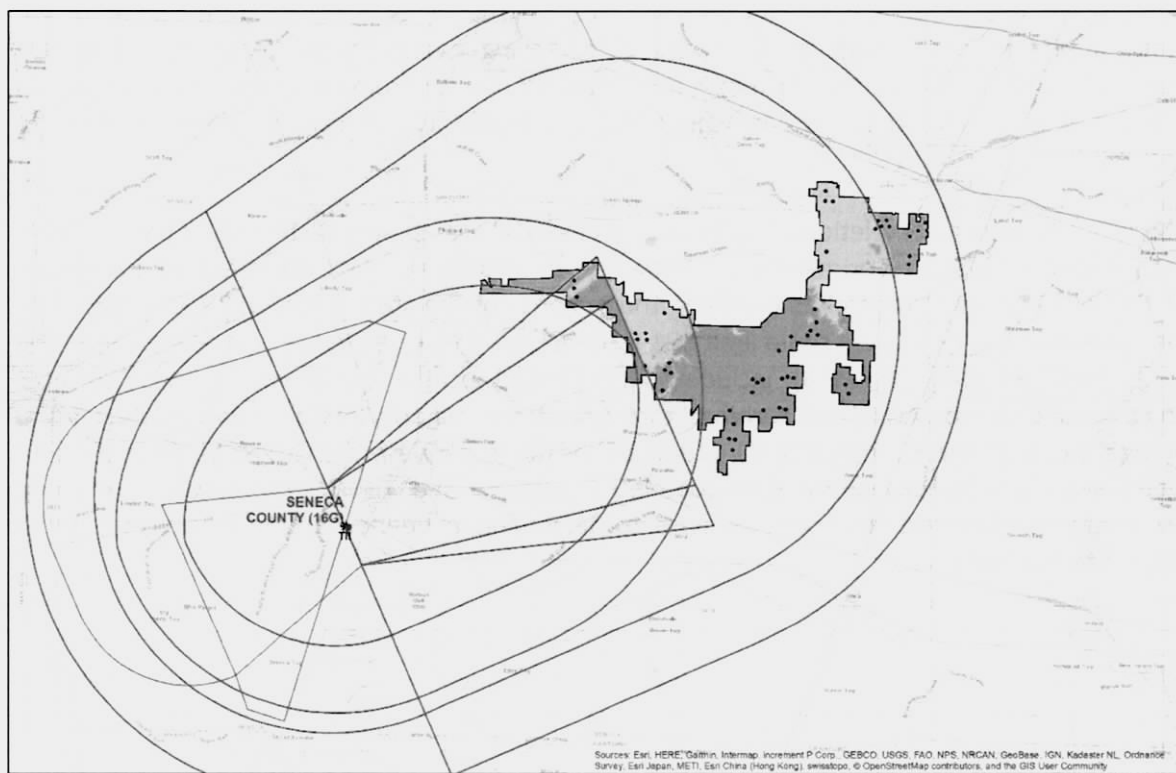
#### *VOR Approach to Runway 06*

The missed approach “climb to” minimum altitude is 2,400 feet AMSL. The primary area obstacle clearance surface is 1,400 feet AMSL and is one of the lowest height constraints overlying the western section of the study area. However, USGS elevation data indicates that this surface should not limit 591 or 660 foot AGL wind turbines within the defined study area.

#### *NDB Approach to Runway 24*

The final approach segment MDA is 1,460 feet AMSL. The obstacle clearance surfaces range from 1,110 to 1,460 feet AMSL and are the lowest height constraint overlying the western section of the study area. USGS elevation data indicates that these surfaces could limit 591 foot AGL wind turbines in this area (red area, **Figure 8**), including one proposed location (T3). Additionally, this surface could limit 660 foot AGL wind turbines in the western section of the study area (red and orange areas, **Figure 8**), including two proposed locations (T1 & T3). Increases to the MDA can directly impact the efficiency of an instrument approach procedure. As a result, it is possible that the FAA would use this impact as the basis for determinations of hazard.

The procedure turn completion altitude and *TIFFIN NDB* missed approach holding pattern MHA are 2,400 feet AMSL. The primary obstacle clearance surfaces are 1,400 feet AMSL and are some of the lowest height constraints overlying the majority of the study area. USGS elevation data indicates that these surfaces could limit 591 foot AGL wind turbines in the central section of the study area (red areas, **Figure 8**), including 28 proposed locations. Additionally, these surfaces could limit 660 foot AGL wind turbines throughout the majority of the study area (red and orange areas, **Figure 8**), including 41 proposed locations. However, it is possible that the FAA would increase the procedure turn completion altitude and *TIFFIN NDB* MHA in order to accommodate 591 and 660 foot AGL wind turbines. This mitigation option is available and is subject to FAA approval.



**Figure 8: Seneca County Airport (16G) NDB Approach to Runway 27**



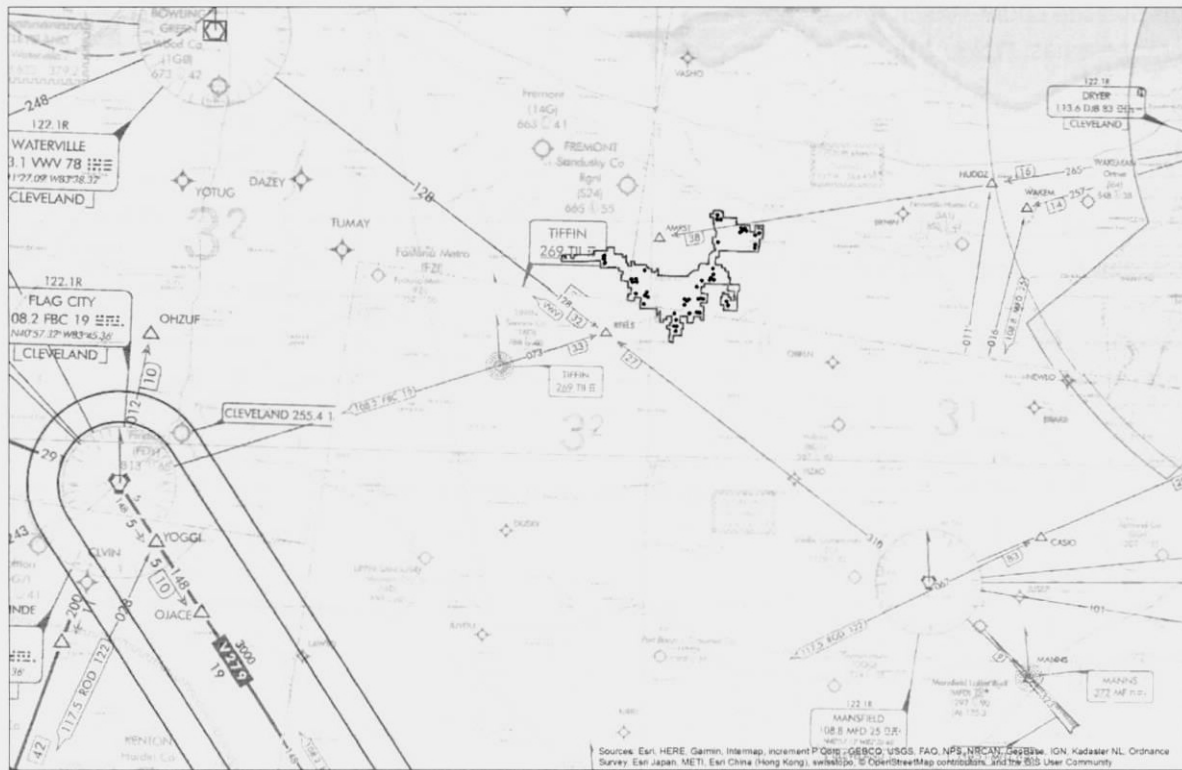


## Enroute Airways

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 of 1,000 feet of obstacle clearance 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 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.

Enroute airway obstacle clearance surfaces do not overlie the Republic wind project (**Figure 9**) and should not limit 591 or 660 foot AGL wind turbines within the defined study area.



**Figure 9: Low altitude enroute chart L-28 with V279 obstacle evaluation areas (purple)**



### Minimum Vectoring/IFR Altitudes

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 of 1,000 feet of obstacle clearance 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 be used as the basis for determinations of hazard.

#### **Toledo (TOL) Terminal Radar Approach Control (TRACON)**

##### *2,400 foot AMSL Sector (FUSION 3)*

The MVA is 2,400 feet AMSL. The obstacle clearance surface (hatched purple, **Figure 10**) is 1,449 feet AMSL and is in excess of other lower surfaces. However, USGS elevation data indicates that this surface could still limit 660 foot AGL wind turbines in the western section of the study area (orange areas, **Figure 10**), including two proposed locations (*T4 & T10*).

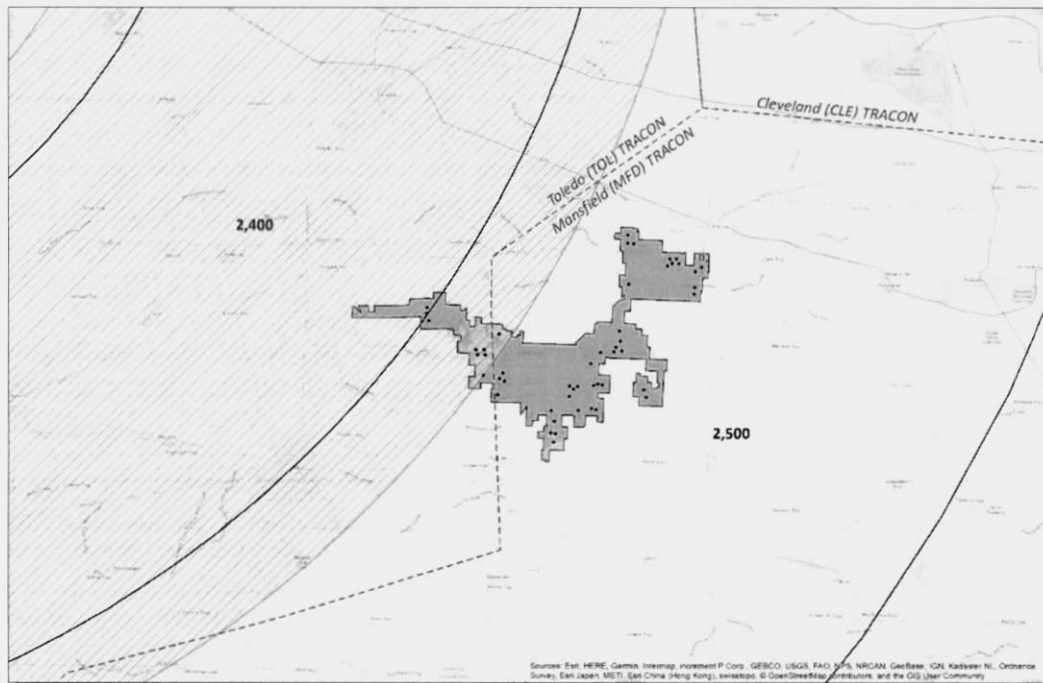
##### *2,500 foot AMSL Sector (FUSION 3)*

The MVA is 2,500 feet AMSL. The obstacle clearance surface is 1,549 feet AMSL and is in excess of other lower surfaces. However, USGS elevation data indicates that this surface could still limit 660 foot AGL wind turbines in the southern section of the study area (orange areas, **Figure 10**), including one proposed location (*T18*).

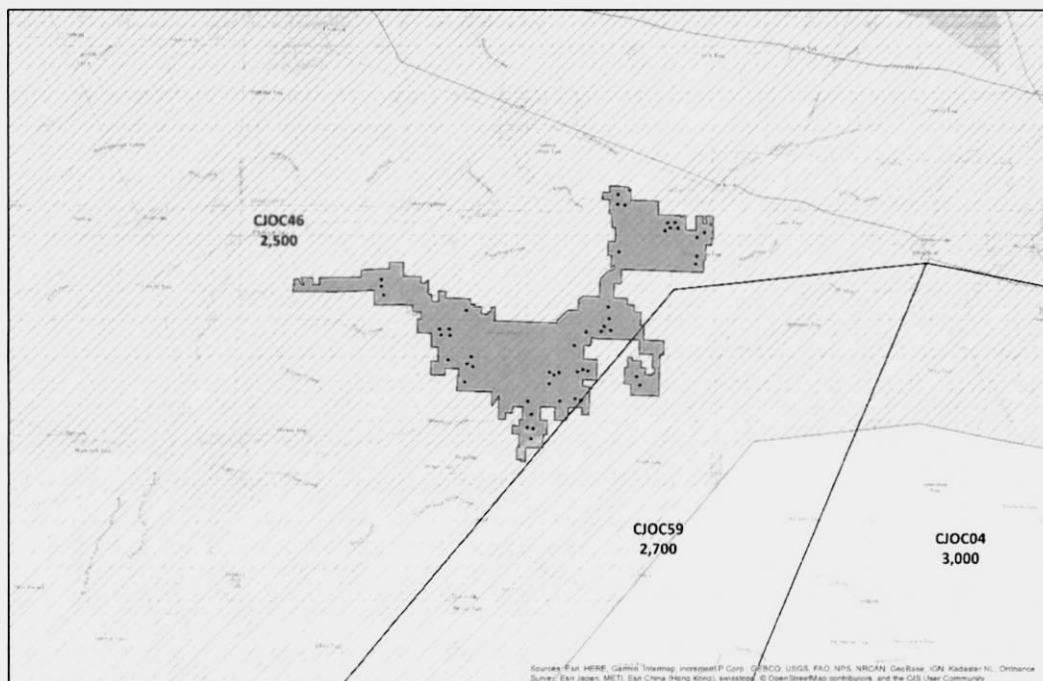
#### **Cleveland (ZOB) Air Route Traffic Control Center (ARTCC)**

##### *Sector CJO46*

The MIA is 2,500 feet AMSL. The associated obstacle clearance surface (hatched purple, **Figure 11**) is 1,549 feet AMSL and is in excess of other lower surfaces. However, USGS elevation data indicates that this surface could still limit 660 foot AGL wind turbines in the southern section of the study area (orange areas, **Figure 11**), including one proposed location (*T18*).



**Figure 10: Toledo (TOL) TRACON FUSION 3 MVA sectors (black) with 2,400 foot AMSL Sector obstacle evaluation area (hatched purple)**



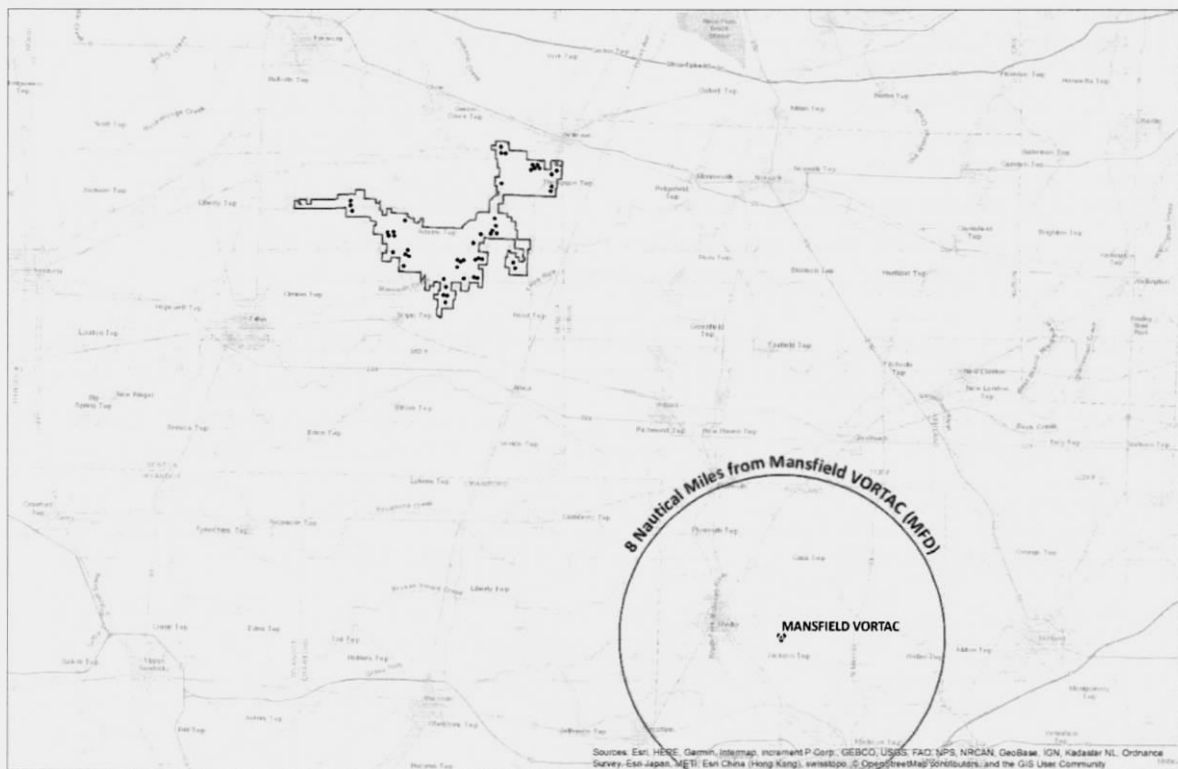
**Figure 11: Cleveland (ZOB) ARTCC MIA sectors (black) with Sector CJOC46 obstacle evaluation area (hatched purple)**



## Terminal and Enroute NAVAIDs

The FAA has established protection areas in order to identify proposed structures that may have a physical and/or electromagnetic effect on navigation facilities. The protection area dimensions vary based on the proposed structure type as well as the navigational facility type. Proposed structures within these protection areas may interfere with navigational facility 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 navigational facilities it could result in determinations of hazard.

NAVAID protection areas do not overlie the Republic wind project (**Figure 12**). As a result, it is unlikely that proposed wind turbines would have a physical or electromagnetic effect on Terminal or Enroute NAVAIDs.



**Figure 12: Mansfield VORTAC (MFD) screening surface**



## Military Airspace and Training Routes

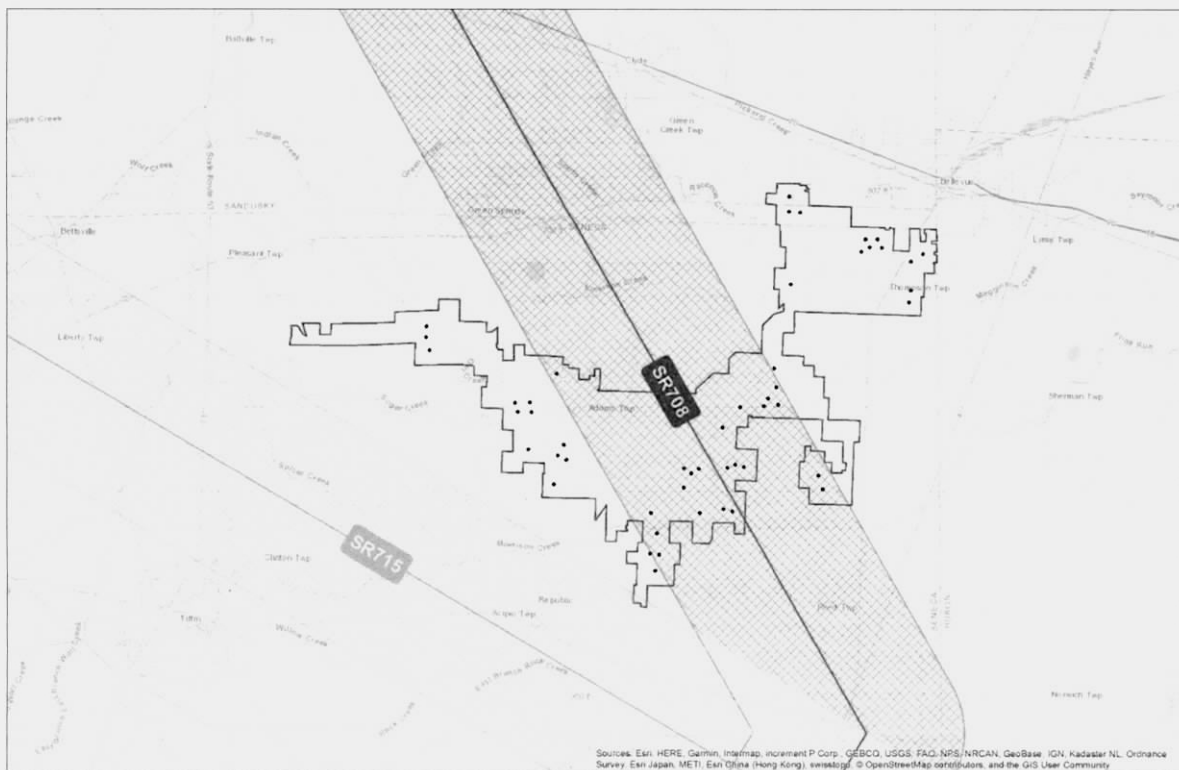
Since the FAA does not protect for military airspace or training routes, impact on their operations cannot result in a determination of hazard. However, the FAA will notify the military of proposed wind turbines located within these segments of airspace. If the planned development area is located on federal land, impact on military airspace or training routes may result in the denial of permits by the Bureau of Land Management.

Slow routes (SR) overlying the Republic wind project (**Figure 13**):

### Ohio Air National Guard (ANG)

Route/Airspace	Minimum Altitude
SR-708	500 feet AGL
SR-715	500 feet AGL

Due to the low altitudes associated with these routes, it is possible that wind development could have an impact on their operations. If the Ohio ANG use these routes regularly, it may result in military objections to proposed wind development.



**Figure 13: Military slow routes overlying the Republic wind project**



## Surveillance Radar Systems

Various radar systems support air traffic control operations as well as weather detection. Proposed wind turbines within radar line of sight (RLOS) are “visible” to radars and could create unwanted clutter resulting in false radar returns and decrease in radar sensitivity. If the FAA determines that these radar effects would impact air traffic control operations, the FAA may conduct further review to identify potential safety hazards and the associated risks to the National Airspace System. The additional analysis may extend the FAA’s timeline for review of proposed wind turbines and could ultimately result in determinations of hazard.

Radar System	Visible @ 591 AGL	Visible @ 660 AGL
<b>Mansfield</b> Airport Surveillance Radar Model-8 (ASR-8)	50	50
<b>Cleveland</b> ASR-9	0	0
<b>Columbus</b> ASR-9	0	0
<b>Romulus</b> ASR-9	0	0
<b>Toledo</b> ASR-9	28	49
<b>Akron/Canton</b> ASR-11	0	0
<b>Brecksville</b> Common Air Route Surveillance Radar (CARSR)	5	25
<b>Canton</b> CARSR	0	0
<b>Cleveland</b> Terminal Doppler Weather (TDWR)	1	6
<b>Cleveland</b> Weather Surveillance Radar Model 1988 Doppler (WSR-88D) <sup>5</sup>	0	0
<b>Detroit</b> WSR-88D <sup>5</sup>	0	0

*Table 2: Preliminary RLOS analysis results*

The preliminary RLOS analysis results indicate that 591 and 660 foot AGL wind turbines would be visible to the Mansfield ASR-8 (left, **Figure 14**), Toledo ASR-9 (right, **Figure 14**), Brecksville CARSR (left, **Figure 15**), and Cleveland TDWR (right, **Figure 15**). Wind turbines within RLOS could create unwanted primary returns (clutter) and dropped primary targets in the vicinity of proposed wind turbines. If the FAA determines that this impact would constitute a substantial adverse effect, it could be used as the basis for determinations of hazard regardless of the lack of impact on the other airspace surfaces described in this report.

<sup>5</sup> The project area falls within a green area established by the National Oceanic and Atmospheric Administration (NOAA) Radar Operations Center (ROC) screening tool. A green area, or “No Impact Zone”, indicates that impacts are not likely to WSR-88D operations.







## Conclusion

At 591 and 660 feet AGL, proposed wind turbines in the northern section of the study area will exceed 14 CFR Part 77.17(a)(2) and 77.19 imaginary surfaces (**Figure 2**) and will be identified as obstructions. Additionally, all of the proposed wind turbines will exceed 77.17(a)(1) – a height of 499 feet AGL at the site of the object – and will be identified as obstructions. However, heights in excess of these surfaces are feasible provided proposed wind turbines do not exceed FAA obstacle clearance surfaces.

The lowest obstacle clearance surfaces overlying the Republic wind project range from 1,110 to 1,400 feet AMSL (**Figure 16**) and are associated with Sandusky County Airport instrument departure procedures and multiple instrument approach procedures.

USGS elevation data indicates that multiple instrument approach procedure (**Figure 6, Figure 7, & Figure 8**) initial and missed approach segments could limit 591 foot AGL and 660 foot AGL wind turbines throughout the majority of the study area (red and orange areas, **Figure 17**), including up to 43 proposed locations. However, it is possible that the FAA would increase these altitudes in order to accommodate 591 and 660 foot AGL wind turbines. This mitigation option is available and is subject to FAA approval.

Sandusky County Regional Airport instrument departure procedures (**Figure 5**) could limit 660 foot AGL wind turbines along the northwestern edge of the study area (orange area, **Figure 17**). However, these surfaces should not limit 660 foot AGL wind turbines at any of the proposed locations. The Seneca County Airport NDB Approach to Runway 24 final approach segment (**Figure 8**) could limit 591 foot AGL and 660 foot AGL wind turbines in the western section of the study area (red and orange areas, **Figure 17**), including up to two proposed locations (*T1 & T3*). If the FAA determines that this impact would affect as few as one flight per week it could be used as the basis for determinations of hazard. Depending on the size of VFR traffic pattern airspace ultimately applied by the FAA, this segment of airspace could entirely limit wind development in the northern and northwestern sections of the study area (hatched orange and red, **Figure 16 & Figure 17**).

Additionally, Toledo (TOL) TRACON MVA sectors (**Figure 10**) and a Cleveland (ZOB) ARTCC MIA sector (**Figure 11**) could limit 660 foot AGL wind turbines in the western and southern sections of the study area, including three proposed locations (*T4, T10, & T18*).

Multiple military slow routes overlie the Republic wind project (**Figure 13**). Impact on these routes could result in military objections to proposed wind development.

Lastly, at 591 and 660 feet AGL, proposed wind turbines will be in line of sight of multiple surveillance radar systems (**Figure 14 & Figure 15**). Impact on surveillance radar systems could be used as the basis for determinations of hazard regardless of the lack of impact on the other airspace surfaces described in this report.

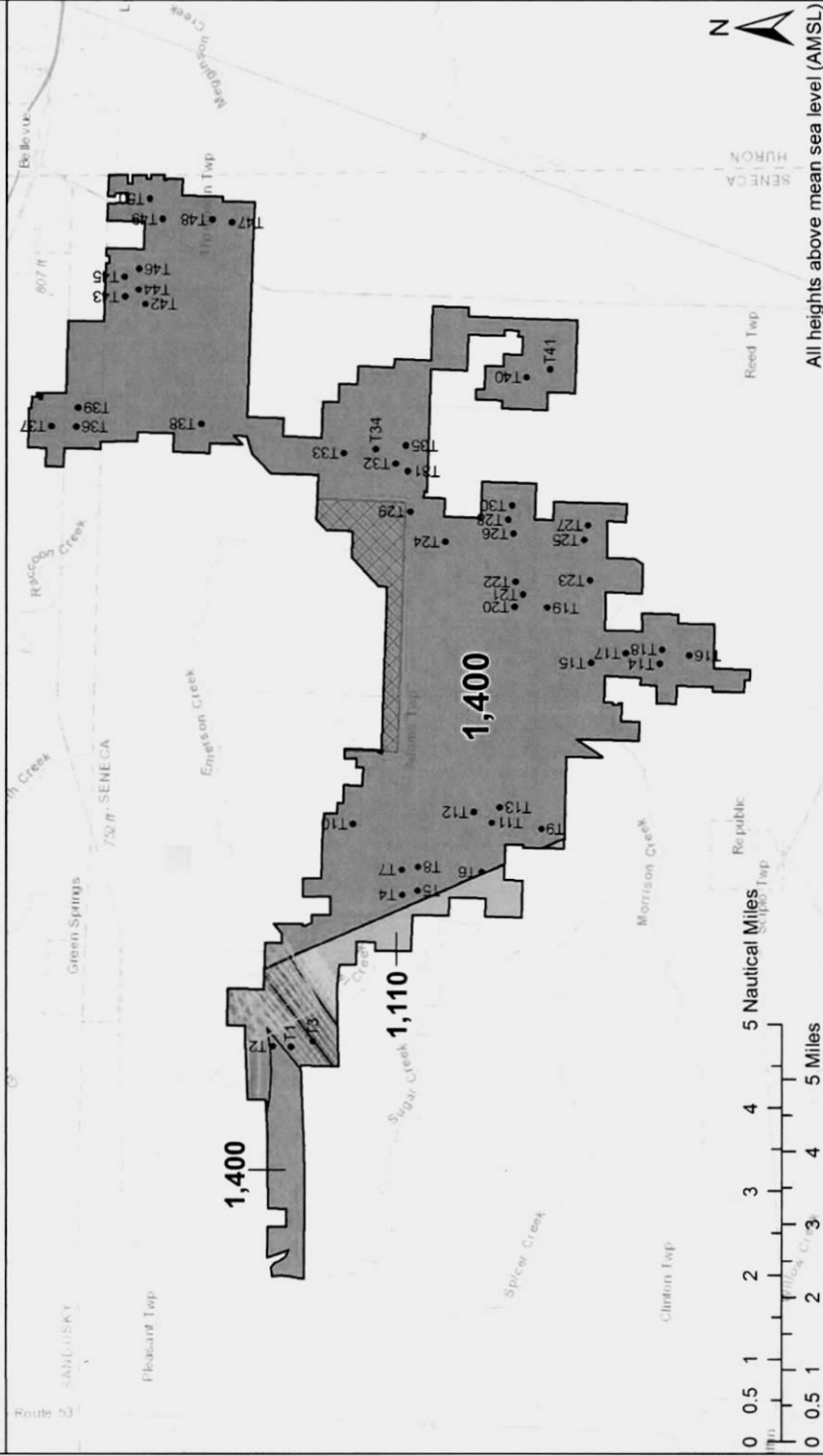
The AGL Clearance Map (**Figure 17**) is based on USGS National Elevation Dataset (NED) 1/3 Arc Second data which has a vertical accuracy of 1.89 meters root-mean-square error (RMSE). Therefore, the AGL Clearance Map should only be used for general planning purposes and not exact structure siting. In



order to avoid determinations of hazard, proposed wind turbine heights should adhere to the height constraints depicted in the Composite Map (**Figure 16**).

If you have any questions regarding the findings of this study, please contact **Rick Coles** or **Nick Lee** at (703) 256-2485.

Proposed structures that exceed 14 CFR Part 77.17(a)(1) - a height of 499 feet AGL at the site of the object - will be identified as obstructions regardless of location.



## Republic Wind Project

### Composite Height Constraint Map

Plot Date:  
7 March 2019  
by Nick Lee

Coordinate System:  
NAD 1983 UTM Zone 17N

Figure 16

Capital Airspace Group

