Wind Power GeoPlanner™

Government RADAR Systems Analysis

High Bridge Wind Farm

Prepared on Behalf of
Calpine Corporation

October 31, 2018

COMSEARCH
A CommScope Company

Table of Contents

1. Introduction - 2 -

2. Summary of Screening Results - 3 -

3. Analysis - 7 -

4. Conclusions - 8 -

5. Contact - 9 -

1. Introduction

Comsearch was contracted by Calpine Corporation to determine if there would be any significant degradation to the operational coverage of Government RADAR systems located near the proposed High Bridge Wind Energy Project in Chenango County, New York. Figure 1 shows the location of the High Bridge Wind Energy project area.

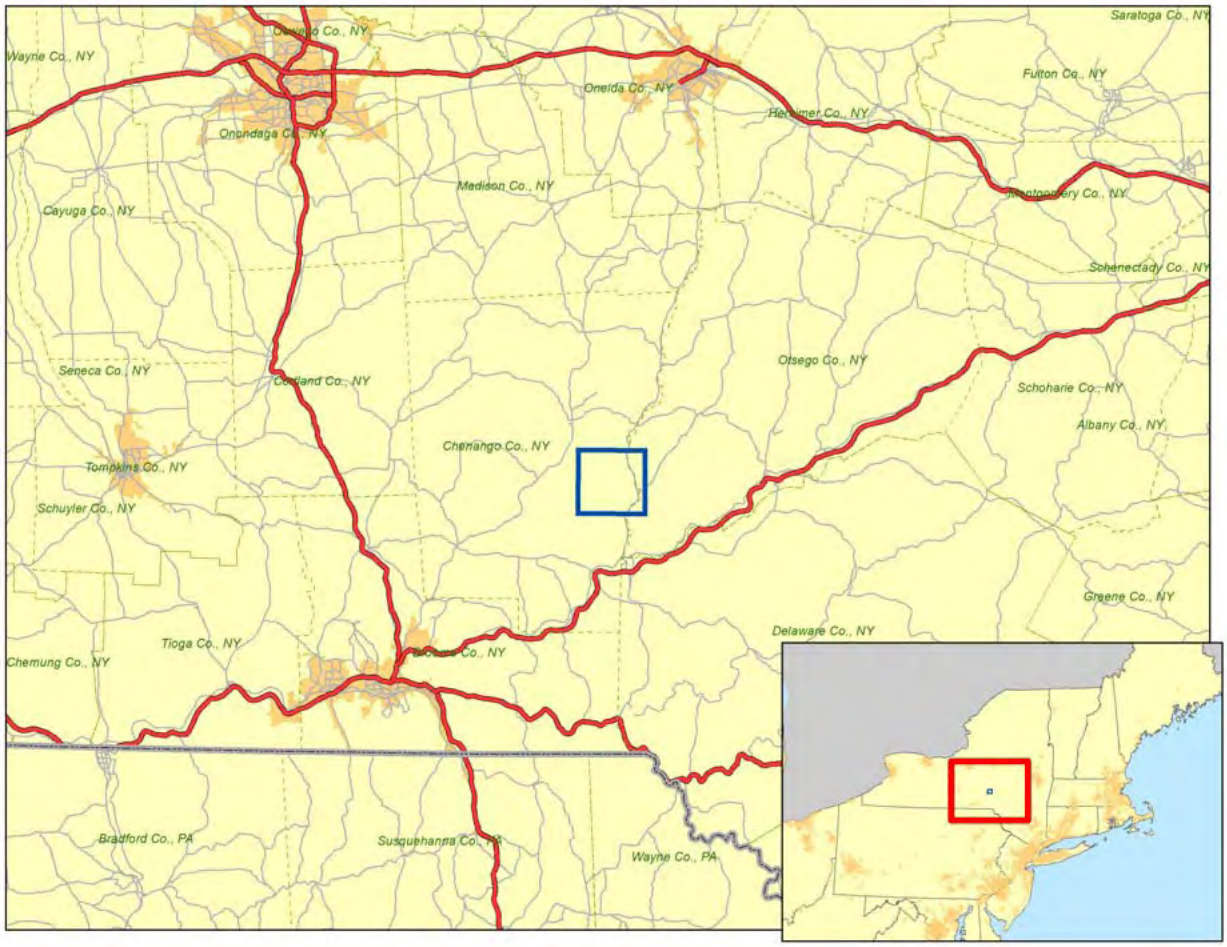

Figure 1: High Bridge Wind Energy Project Area

2. Summary of Screening Results

There are three types of radar systems that Comsearch examined as part of this analysis: Department of Defense (DoD) military systems, Federal Aviation Administration (FAA) long range radar systems, and National Weather Service (NWS) NEXRAD WSR-88D systems.

Comsearch used the DoD RADAR screening tool to determine whether potential coverage issues were anticipated for the above systems. The geographical coordinates for four extreme points of the High Bridge Wind Energy project area were used as an input parameter for the screening tool as follows:

- Pt1 42:29:16.80 75:30:37.06
- Pt2 42:29:16.80 75:21:55.01
- Pt3 42:23:13.97 75:21:55.01
- Pt4 42:23:13.97 75:30:37.06

The results of the screening showed that there were no potential issues with the Department of Defense (DoD) military operations. Likewise, there were no predicted impacts to FAA long range radar and National Weather Service (NWS) NEXRAD WSR-88D systems. In support of these findings, three figures and statements were captured from the DoD screening tool and are presented below.

Figure 2 shows the screening results for the DoD military system which is basically a sectional aeronautical chart centered on the wind project area.

Figure 2: Screening Tool Diagram for DoD Military Systems

According to the DoD screening tool, there are no likely impacts to military airspace. The following contacts were provided for confirmation and documentation if required:

- David Brentzel (404) 562-4211
  USAF Regional Environmental Coordinator
- US Navy Representative, FAA Eastern Service Area (404) 305-6908
  USN Regional Environmental Coordinator
- LTC Jeffrey Martuscelli (404) 305-6915
  USA Regional Environmental Coordinator
- US Marine Corps Representative, FAA Eastern Service Area (404) 305-6907
  USMC Regional Environmental Coordinator

Formal project approval is granted as a result of the FAA review of the Form 7460-1 that is required for each individual wind turbine to be installed in the project. No issues are anticipated based on the preliminary screening tool results.

Figure 3 shows the screening results for the NEXRAD weather service systems. The screening tool map shows that the High Bridge Wind Energy project will be located in the green "Notify" area of the NEXRAD systems located around the project area. This designation signifies that some impact is possible for the surrounding radar systems, however consultation with NOAA is optional. Nevertheless, NOAA would still like to know about the wind farm project. All information regarding the wind project can be sent directly to NOAA at wind.energy.matters@noaa.gov.

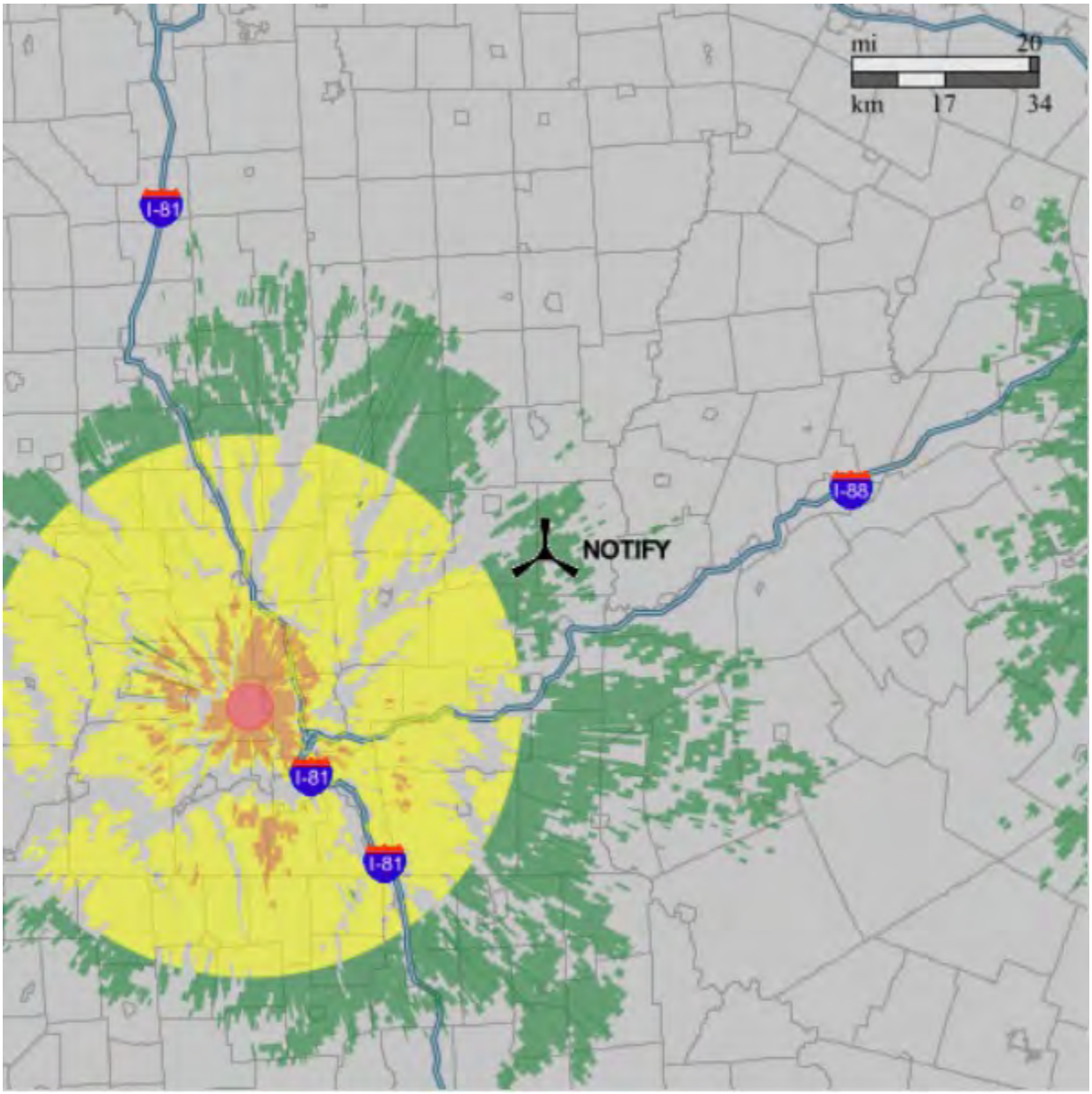

Figure 3: Screening Tool Diagram for Weather Service RADAR Coverage

Figure 4 shows the screening results for the FAA long range radar system. Based on the wind project location, no potential impact to Air Defense and Homeland Security radars is anticipated. Therefore, the screening tool returned the "Green" designation for the High Bridge Wind Energy Project. However, an aeronautical study is required. This study is performed by the FAA upon receipt of Form 7460-1 which must be submitted for each of the proposed wind turbines.

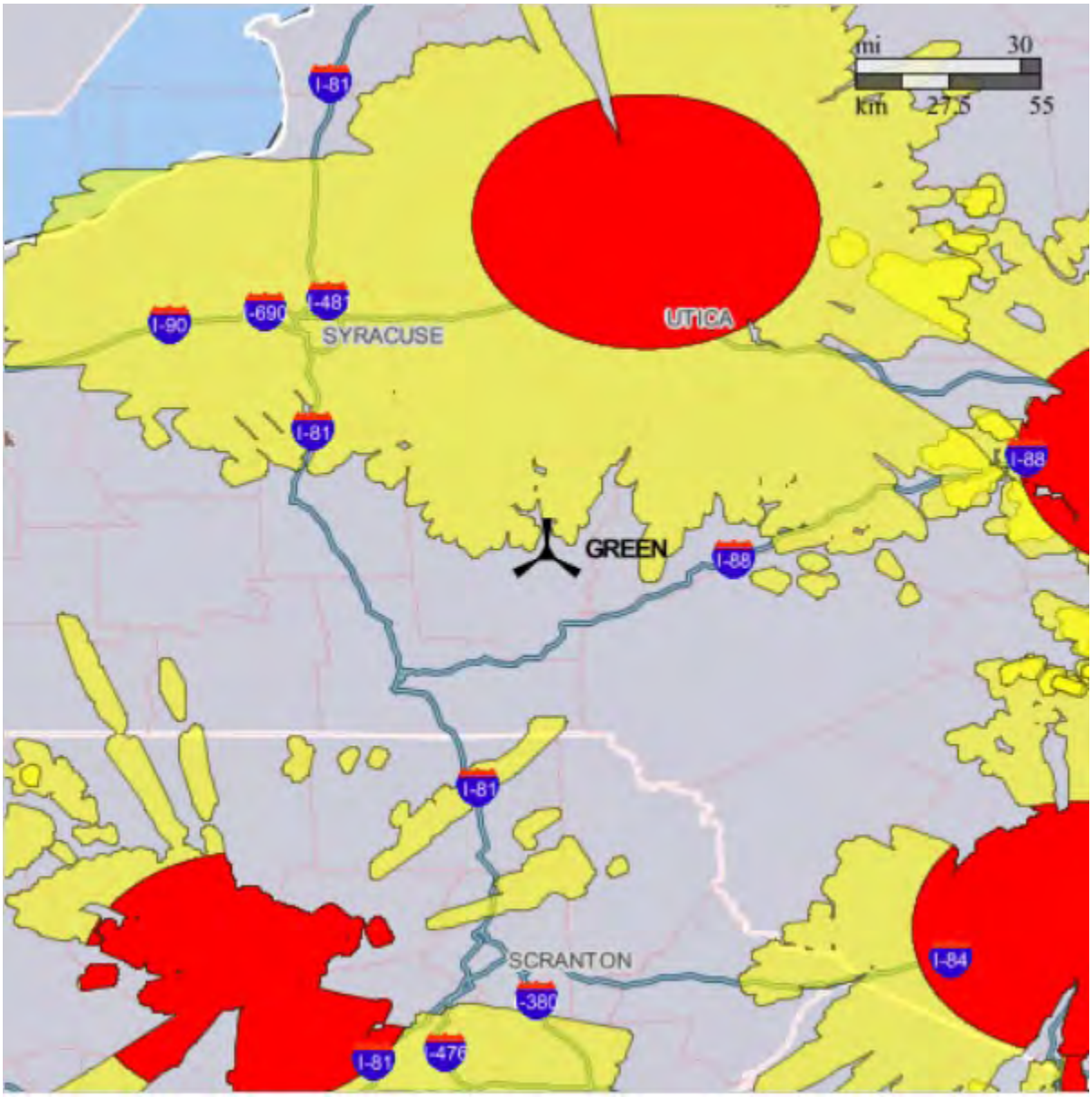

Figure 4: Screening Tool Diagram for FAA Long Range Radar Coverage

3. Analysis

To determine the potential impact of the proposed wind turbines on the FAA radar systems around the High Bridge wind energy project, the line-of-sight (LOS) distance between a given radar and wind turbine is calculated. If the physical separation distance between a radar and wind turbine is within the LOS distance, then the wind turbine would have the potential to obstruct coverage and produce false targets for that particular radar. Otherwise, the wind turbine would be located over the horizon and beyond line-of-sight. The separation distance between a radar and wind turbine is based on their geographical coordinates, whereas the LOS distance is determined based on the sum of the horizon distances associated with a particular radar antenna and wind turbine.

The distance to the horizon for a radar antenna is a function of its height and is given by:

$$D_1 = (2*H_R)^{½} \qquad \text{(Equation 1)}$$

Where:

- D_1 = Distance from radar to horizon in miles
- H_R = Height of radar antenna above sea level in feet

Likewise, the distance to the horizon for a wind turbine is a function of the maximum height reached by the tip of the rotating blade and is given by:

$$D_2 = (2*H_{WT})^{½} \qquad \text{(Equation 2)}$$

$$H_{WT} = (H_h + R/2) \qquad \text{(Equation 3)}$$

Where:

- D_2 = Distance from wind turbine to horizon in miles
- H_{WT} = Max height of wind turbine blade tip above sea level in feet
- H_h= Hub height in feet
- R = Rotor diameter in feet

The LOS distance, in miles, is simply the sum of horizon distances as follows:

$$D_{LOS} = (D_1 + D_2) \qquad \text{(Equation 4)}$$

From Equation 2 and Equation 3, the horizon distance for each wind turbine is determined. If the geographical coordinates and heights for each FAA radar is provided, then their corresponding horizon distance as well as LOS distance can be calculated using Equation 1 and Equation 4, respectively.

4. Conclusions

Potential issues involving military operations in the same area as the Antrim Winds Energy Project were examined. Based on the DoD screening tool, no issues were identified.

According to the same screening tool, some impact to the Weather Service's NEXRAD Radar Systems is possible. While consultation with NOAA is optional, they do request that information about the wind project is forwarded to them. They can be informed through the NTIA notification process or by sending information regarding the wind project directly to NOAA at wind.energy.matters@noaa.gov.

The FAA will be informed of the wind project through the submission of the FAA Form 7460-1 that will be required for each of the proposed wind turbines. The FAA will then perform an aeronautical study and may respond to one or more of the form submissions with a finding that an individual wind turbine is a presumed hazard to aviation because of its obstruction of radar signal or degradation to the radar operation.

Potentially, there are three reasons that the FAA may object to the installation of wind turbines in the at-risk area depicted in Figure 4: (1) the wind turbines may create shadow zones which may prevent target detection, (2) there may be target loss because of clutter return (reflections from the wind turbines), and (3) the creation of false targets due to the reflections from the wind turbines.

In order to receive approval for a wind turbine that is declared as a presumed hazard to aviation operations, it is possible to show using the technical approach in Section 3 that the wind turbine would not be a hazard. Otherwise, the hazard finding could be mitigated by modifying the wind turbine dimensions and/or changing its location.

5. Contact

For questions or information regarding the Government RADAR System Analysis report, please contact:

Contact person:	David Meyer
Title:	Senior Manager
Company:	Comsearch
Address:	19700 Janelia Farm Blvd., Ashburn, VA 20147
Telephone:	703-726-5656
Fax:	703-726-5595
Email:	dmeyer@comsearch.com
Web site:	www.comsearch.com