

Wind Power GeoPlanner™

Microwave Study

Hoffman Falls



Prepared on Behalf of
Liberty Renewables Inc.

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1. Introduction

Microwave bands that may be affected by the installation of wind turbine facilities operate over a wide frequency range (900 MHz – 23 GHz). Comsearch has developed and maintains comprehensive technical databases containing information on licensed microwave networks throughout the United States. These systems are the telecommunication backbone of the country, providing long-distance and local telephone service, backhaul for cellular and personal communication service, data interconnects for mainframe computers and the Internet, network controls for utilities and railroads, and various video services. This report focuses on the potential impact of wind turbines on licensed, proposed and applied non-federal government microwave systems.

2. Project Overview

Project Information

Name: Hoffman Falls

County: Madison

State: New York

Number of Turbines: 24

Blade Diameter: 163 meters

Hub Height: 127.5 meters

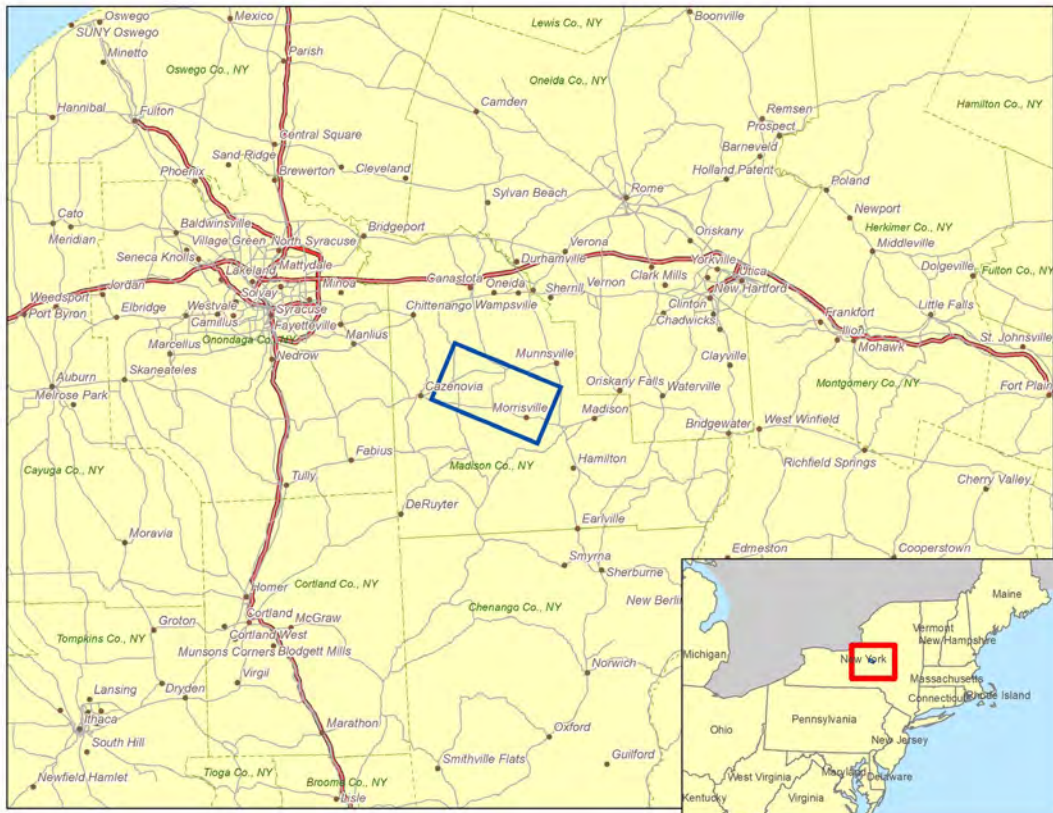


Figure 1: Area of Interest

3. Two-Dimensional Fresnel Zone Analysis

Methodology

Our obstruction analysis was performed using Comsearch’s proprietary microwave database, which contains all non-government licensed, proposed and applied paths from 0.9 - 23 GHz¹. First, we determined all microwave paths that intersect the area of interest² defined as a rectangular area with a minimum of a 2-mile buffer from all turbine locations and listed them in Table 1. These paths and the area of interest that encompasses the planned turbine locations with a minimum 2-mile buffer are shown in Figures 2, 3 and 4.

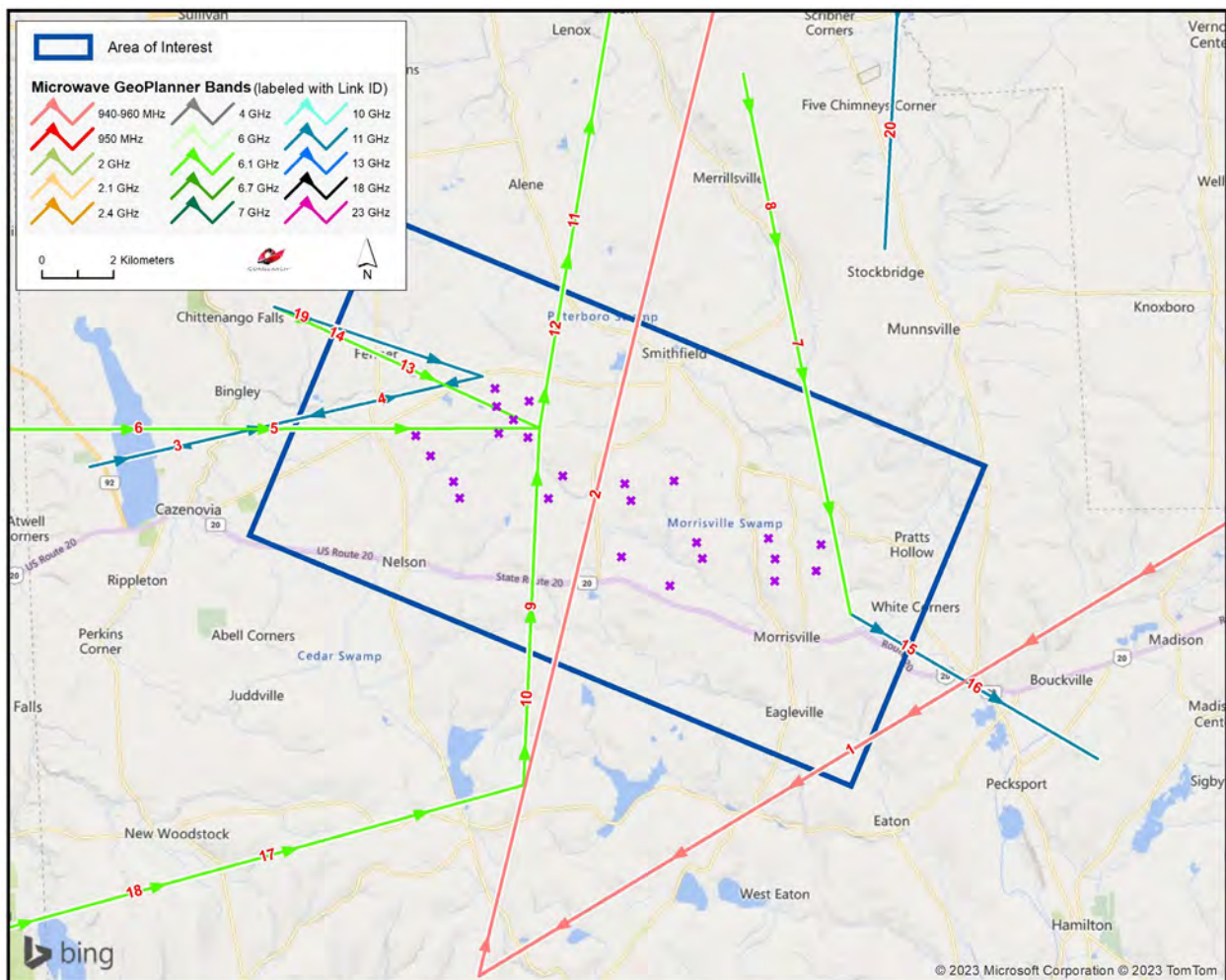


Figure 2: Microwave Paths that Intersect the Area of Interest

¹ Please note that this analysis does not include unlicensed microwave paths or federal government paths that are not registered with the FCC.

² We use FCC-licensed coordinates to determine which paths intersect the area of interest. It is possible that as-built coordinates may differ slightly from those on the FCC license.

ID	Status	Callsign 1	Callsign 2	Band	Path Length (km)	Licensee
1	Licensed	WLT51	WLT49	940-960 MHz	42.05	New York, State of Div of State Police
2	Licensed	WQBX986	WQCB227	940-960 MHz	95.51	New York, State of
3	Licensed	WQGG694	WQGP490	11 GHz	11.26	Cellco Partnership - (W-NY)
4	Licensed	WQGP490	WQGG694	11 GHz	11.26	Cellco Partnership - (W-NY)
5, 6	Licensed	WQNH518	WQNH560	6.1 GHz	23.88	Madison, County Of
7, 8	Licensed	WQNH536	WQNH563	6.1 GHz	15.39	Madison, County Of
9, 10	Licensed	WQNH559	WQNH560	6.1 GHz	9.99	Madison, County Of
11, 12	Licensed	WQNH560	WQNH547	6.1 GHz	14.52	Madison, County Of
13, 14	Licensed	WQNH561	WQNH560	6.1 GHz	8.15	Madison, County Of
15, 16	Licensed	WQNH563	WQNH550	11 GHz	7.98	Madison, County Of
17, 18	Licensed	WQNH564	WQNH559	6.1 GHz	15.34	Madison, County Of
19	Licensed	WQZA455	WQZA456	11 GHz	6.14	Conterra Ultra Broadband, LLC
20	Licensed	WRXM629	WRXM630	11 GHz	11.39	T-Mobile License LLC

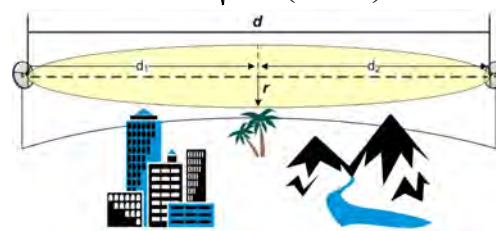
Table 1: Summary of Microwave Paths that Intersect the Area of Interest

*(See enclosed mw_geopl.xlsx for more information and
GP_dict_matrix_description.xls for detailed field descriptions)*

Verification of Coordinate Accuracy

It is possible that as-built coordinates may differ from those on the Federal Communications Commission (FCC) license. For this project, fifteen paths cross within close proximity of the proposed turbines and the tower locations for these paths will have a critical impact on the result. Therefore, we verified these locations using aerial photography. Some of the FCC licensed communication towers were found to be slightly off and were moved to their locations based on the aerial photos³.

Next, we calculated a Fresnel Zone for each path based on the following formula:

$$r \cong 17.3 \sqrt{\frac{n}{F_{GHz}} \left(\frac{d_1 d_2}{d_1 + d_2} \right)}$$


Where,

- r = Fresnel Zone radius at a specific point in the microwave path, meters
- n = Fresnel Zone number, 1
- F_{GHz} = Frequency of microwave system, GHz
- d₁ = Distance from antenna 1 to a specific point in the microwave path, kilometers
- d₂ = Distance from antenna 2 to a specific point in the microwave path, kilometers

In general, this is the area where the planned wind turbines should be avoided, if possible. Likewise, Comsearch recommends that an area directly in front of each microwave antenna should be avoided. This corresponds to the Consultation Zone which measures 1 kilometer along the main beam of the antenna and 24 ft (7.3 meters) wide. A depiction of the Fresnel Zones and Consultation Zones for each microwave path listed can be found in Figure 3, and is also included in the enclosed shapefiles^{4,5}.

³ See enclosed mw_geopl.shp (adjusted locations based on aerial photography/basis for report images and results) and mw_geopl_fcc.shp (locations solely based on FCC licensed information) for details.

⁴ The ESRI® shapefiles enclosed are in NAD 83 UTM Zone 18 projected coordinate system.

⁵ Comsearch makes no warranty as to the accuracy of the data included in this report beyond the date of the report. The data provided in this report is governed by Comsearch's data license notification and agreement located at http://www.comsearch.com/files/data_license.pdf.

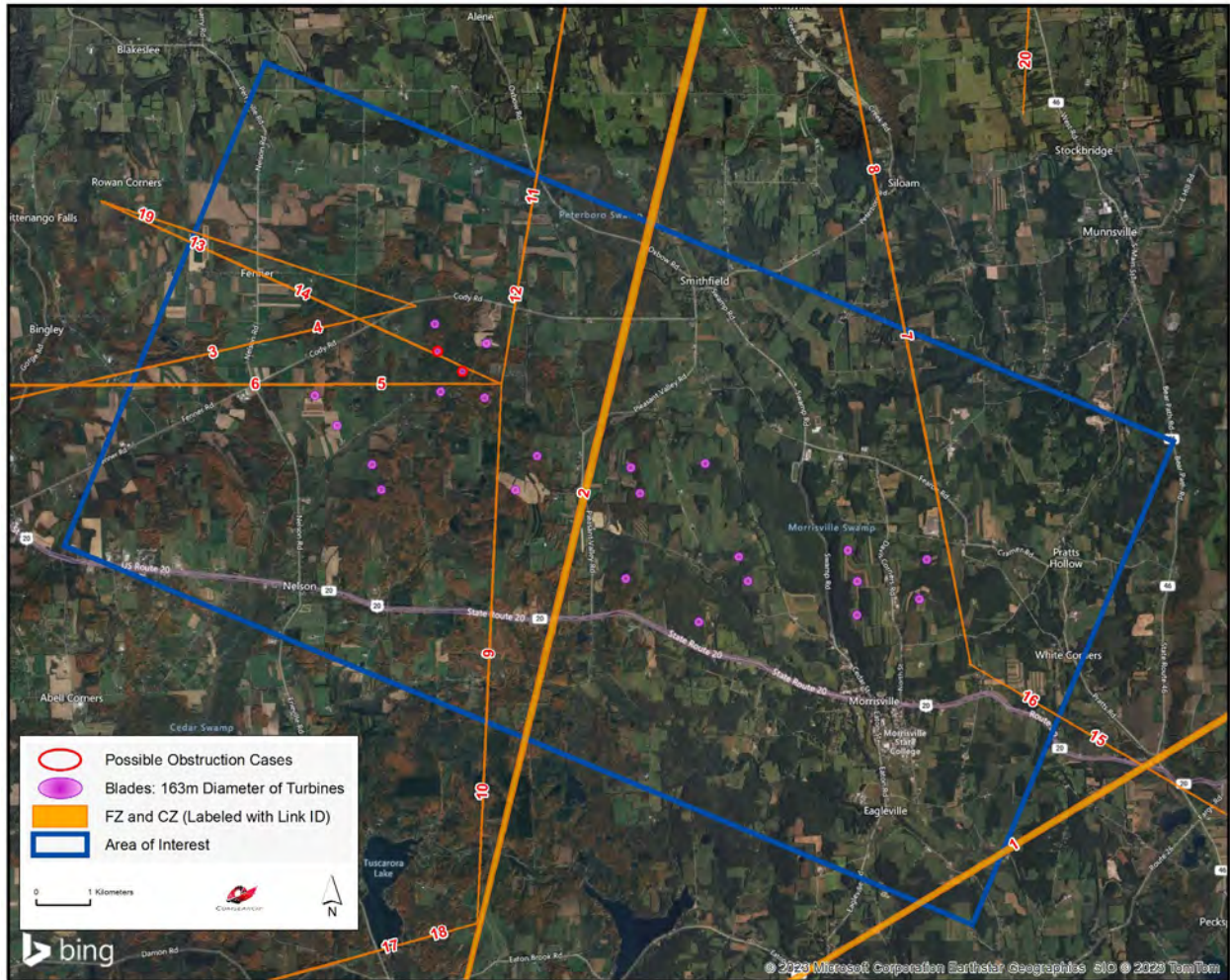


Figure 3: Fresnel Zones and Consultation Zones in the Area of Interest

Discussion of Potential Two Dimensional Obstructions

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines Intersecting the 2D Fresnel Zones
20	2	24	2

Table 2: Fresnel Zone Analysis Result

For this project, 24 turbines were considered in the analysis, each with a blade diameter of 163 meters and turbine hub height of 127.5 meters. Of those turbines, two were found to intersect the Fresnel Zones of two microwave paths. Figure 4 contains a detailed depiction of the potential obstruction scenarios and Table 3 contains a summary of the affected turbines. A cross sectional analysis was performed in Section 4 to determine the diagonal clearance value for these cases.

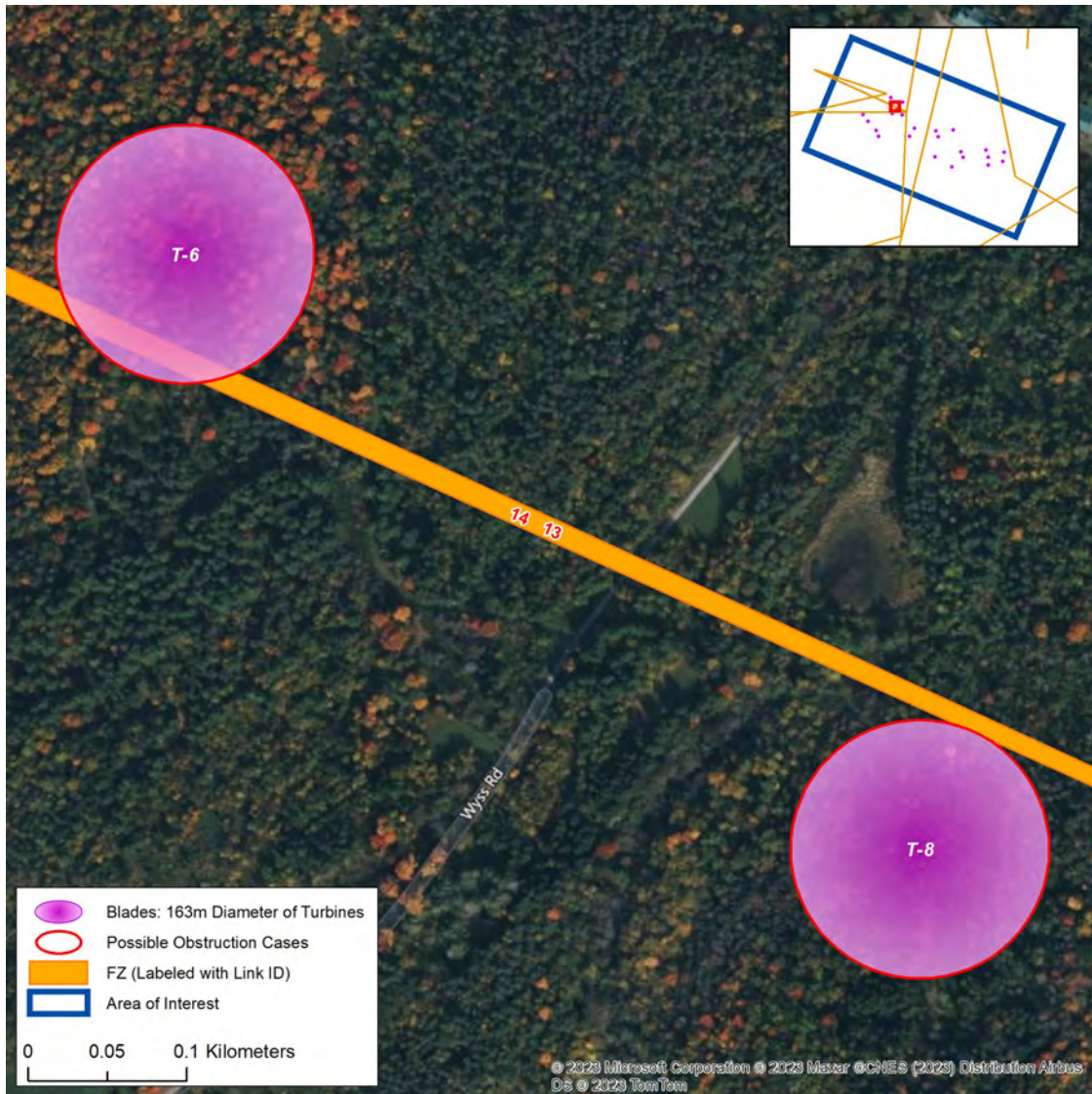


Figure 4: Potential Obstruction Cases

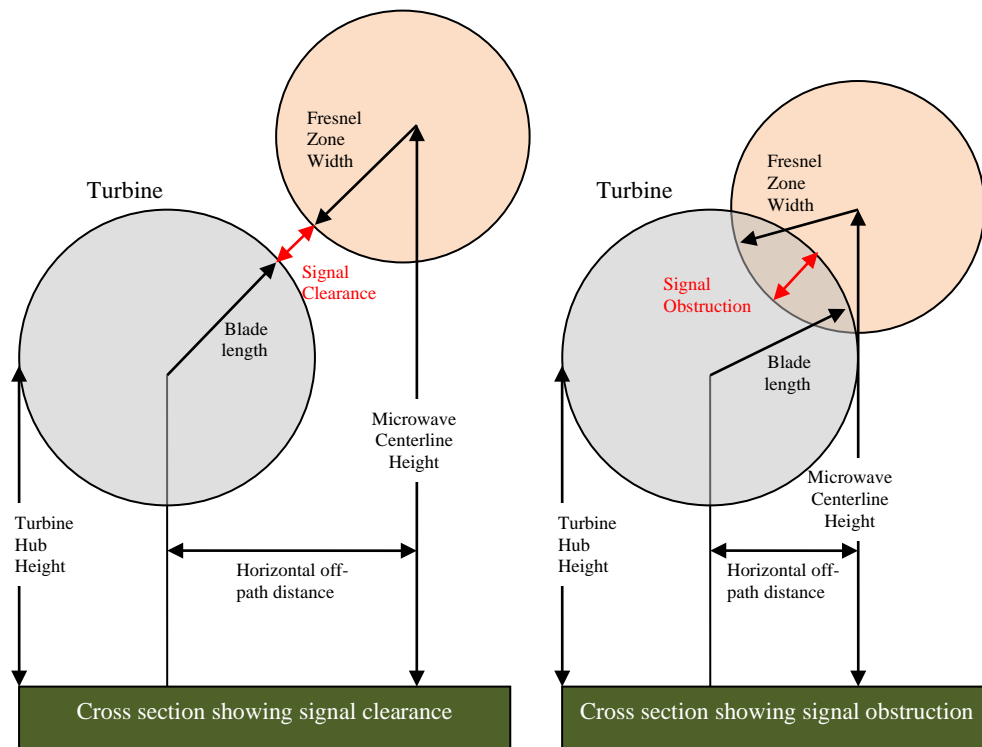
Turbine ID	Latitude (NAD83)	Longitude (NAD83)	Affected Microwave Path ID	Fresnel Zone Radius at Turbine Location (m)	Horizontal off-path Distance (m)	Distance along the path from site 1 (km)	Horizontal Clearance (m)
T-6	42.95652238	-75.74582183	13, 14	7.38	61.98	6.80	-26.90
T-8	42.95318275	-75.74010422	13,14	5.74	86.85	7.40	-0.38

Table 3: Turbines that Intersect Fresnel Zones

4. Cross Sectional Analysis

Our Fresnel Zone analysis in the previous section identified two potential obstruction cases involving two identical paths that needed to be further examined from a cross sectional perspective. The cases that will be analyzed in this section can be found in Table 3.

Our cross sectional analysis calculates the precise height and width of 100% of the first Fresnel Zone at the turbine location based on the antenna heights of the two link endpoints and the earth curvature bulge at the specific turbine location. The horizontal off-path distance was calculated in the previous section and the turbine hub height and blade length were provided by the client. The cross sectional analysis uses these values to calculate the clearance between the blades and the microwave Fresnel Zone as shown in the two diagrams below.



The results of the cross-sectional calculations can be seen in Table 4. It shows positive clearance values indicating clearance of the Fresnel Zones.

Microwave Path ID	Fresnel Zone Radius at Turbine Location (m)	Microwave Centerline Height at Turbine Location (m)	Turbine ID	Hub Height (m)	Blade Length (m)	Cross Sectional Clearance (m)
13, 14	7.38	34.06	T-6	127.5	81.5	23.24
13, 14	5.74	47.38	T-8	127.5	81.5	30.93

Table 4: Cross Sectional Analysis Results

5. Conclusion

Our study identified twenty microwave paths within and near the Hoffman Falls project area. The Fresnel Zones for these microwave paths were calculated and mapped. A total of 24 turbines were considered in the analysis, each with a blade diameter of 163 meters and a hub height of 127.5 meters. Of those turbines, none were found to have potential obstruction with the microwave systems in the area.

6. Contact

For questions or information regarding the Microwave Study, please contact:

Contact person: David Meyer
 Title: Senior Manager
 Company: Comsearch
 Address: 21515 Ridgetop Circle, Suite 300, Sterling, VA 20166
 Telephone: 703-726-5656
 Fax: 703-726-5595
 Email: David.Meyer@CommScope.com
 Web site: www.comsearch.com

Appendix: Turbine Locations

Turb Num	Latitude	Longitude
T-1	42.94894415	-75.77356225
T-2	42.94422243	-75.76848036
T-3	42.93752131	-75.76045037
T-4	42.93336402	-75.75827731
T-5	42.96102930	-75.74646614
T-6	42.95652238	-75.74582183
T-7	42.94978847	-75.74504600
T-8	42.95318275	-75.74010422
T-9	42.95788401	-75.73475623
T-10	42.94881586	-75.73505618
T-11	42.93349483	-75.72787267
T-12	42.93920200	-75.72302163
T-13	42.91892302	-75.70267709
T-14	42.93750224	-75.70159895
T-15	42.93313503	-75.69960987
T-16	42.91178953	-75.68604863
T-17	42.92270680	-75.67706764
T-18	42.91867204	-75.67496275
T-19	42.92391954	-75.65235773
T-20	42.91315819	-75.65018031
T-21	42.91877984	-75.65014773
T-22	42.91587113	-75.63607791
T-23	42.92248977	-75.63445939
T-24	42.93817544	-75.68487555