Appendix 20-B
Microwave Study

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Bliss Wind Repowering Project

Wyoming County, New York

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1 Introduction

Microwave signals are utilized for point-to-point communications in a wide frequency range (900 megahertz [MHz] to 23 gigahertz [GHz]). These telecommunication systems provide 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. Obstructions such as wind turbines can potentially impact nearby radio communications, including microwave point-to-point systems. This report describes the potential impact of wind turbines at the Repowered Facility on licensed, proposed, and applied non-federal government microwave systems.

2 Project Overview

Facility Site Information
Name: Bliss Wind Repowering Project
Number of Turbines: Up to 34
County: Wyoming
Blade Diameter: 163 meters
State: New York
Hub Height: 120 meters

The microwave paths within 2 miles of the Facility Site (the Study Area) were reviewed from up-to-date Google Earth map services available on FCCInfo.com and Microwave.earth that pull data from the FCC Universal Licensing System (ULS) database and Micronet Communications 70/80/90 GHz registry. Twelve microwave paths were identified within 2 miles of the Facility Site. Table 1 presents the call sign, band, path length, and licensee for each microwave path.

Table 1 Summary of Microwave Paths within 2 Miles of the Facility Site

ID	Status	Callsign 1	Band	Path Length (km)	Licensee
1	Active	WRTK684	010995.00 MHz	8.341	T-Mobile License LLC
2	Active	WRTK686	011485.00 MHz	8.341	T-Mobile License LLC
3	Active	WQYP527	010795.00 MHz	18.595	Wyoming, County of
4	Active	WQYP534	011285.00 MHz	18.595	Wyoming, County of
5	Active	WQFD635	006785.00 MHz	20.414	New York, State of
6	Active	WQEZ457	010638.125 MHz	17.085	New York, State of
7	Active	WQFB474	010573.125 MHz	17.085	New York, State of
8	Active	WRCY737	010875.00 MHz	24.277	Saia Communications, Inc.
9	Active	WRCY737	010835.00 MHz	24.277	Saia Communications, Inc.
10	Active	WQXP778	011365.00 MHz	24.277	Saia Communications, Inc.
11	Active	WQYP527	010755.00 MHz	28.862	Wyoming, County of
12	Active	WRCU314	011245.00 MHz	28.862	Wyoming, County of

Key:
km = kilometers; MHz = megahertz

3 Two-Dimensional Fresnel Zone Analysis

3.1 Methodology

The following obstruction analysis was performed using the Federal Communications Commission (FCC) ULS database to query all microwave radio services from currently licensed and pending facilities within 50 kilometers (km) of the Facility Site. The microwave paths within 2 miles of the Facility Site (Study Area) were reviewed from up-to-date Google Earth map services available on FCCInfo.com and Microwave.earth, which pull data from the FCC ULS database and Micronet Communications 70/80/90 GHz registry. Table 2 lists the microwave paths that were found to intersect the Facility Site. Figure 1 shows these paths and the Facility Site, which encompasses the planned turbine locations. The Fresnel zones for the closest microwave paths to turbines were calculated and mapped to assess the potential impact from the turbines.

Figure 1: Microwave Paths within 2 Miles of the Facility Site

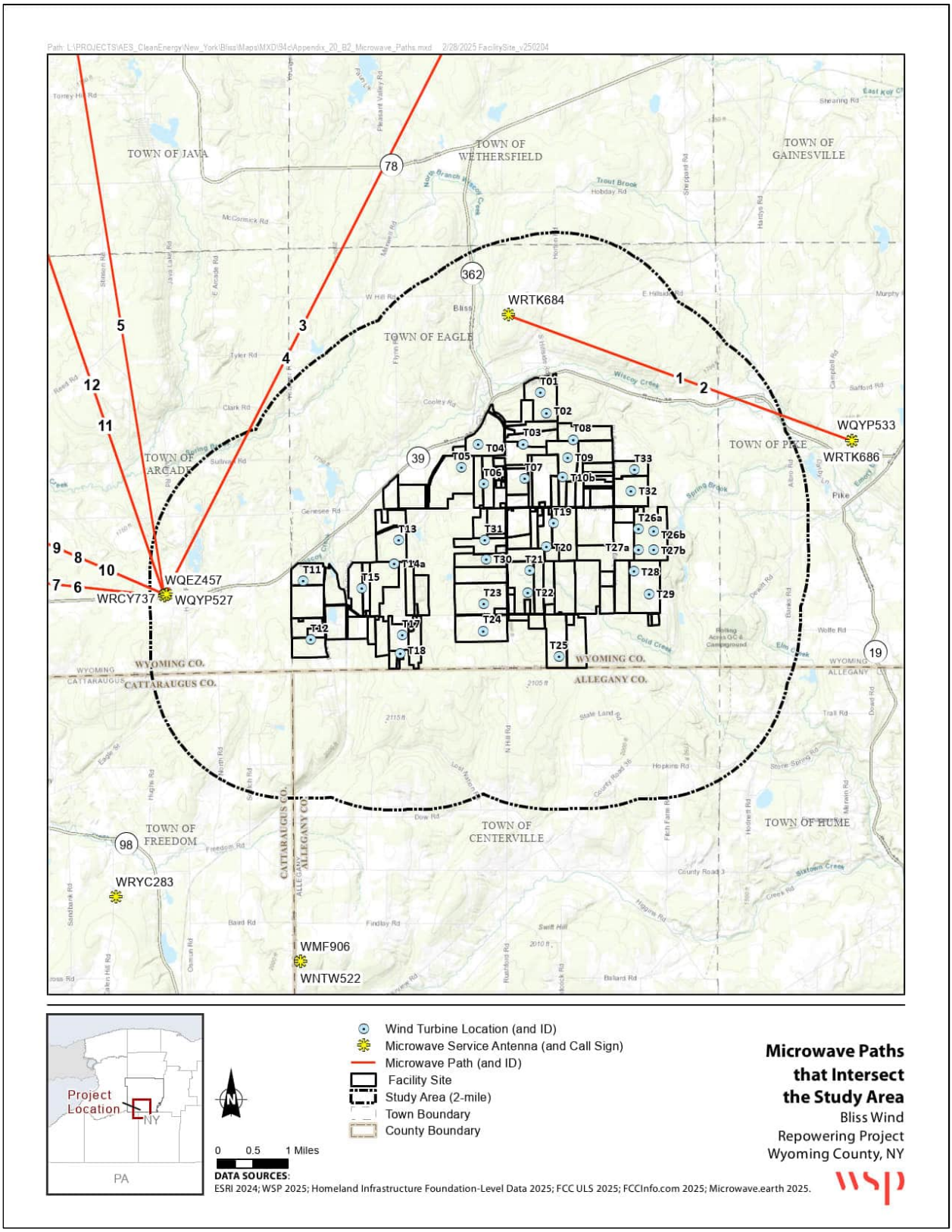


Table 2: Summary of Microwave Paths That Intersect the Study Area

Affected Microwave Path ID	Turbine ID	Fresnel Zone Width (Radius) at Turbine Location (m)	Horizontal off-path Distance from Proposed Turbine Hub (m)	Distance along the Path from Site 1 (km)	Rotor Diameter (m)	Signal Clearance (m)
1	T01	5.47	1403	1.3	163.0	1316.0
2	T01	5.35	1403	7.0	163.0	1316.2
3	T11	6.88	2670	1.9	163.0	2581.6
4	T11	6.73	2670	16.7	163.0	2581.8

Key:

km = kilometers

m = meters

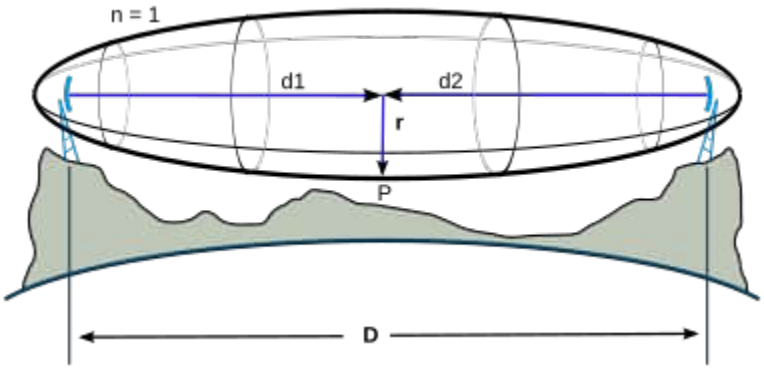
3.2 Microwave Path Review

The microwave paths that intersect the Study Area were reviewed, and the path IDs with the closest proximity to the turbines were identified (path IDs 1, 2, 3, and 4). Since the proximity of these paths have a critical result on the calculations, the transmitting and receiving antennas for these paths were verified using aerial photography and compared to the as-built coordinates provided to the FCC. After verification, the coordinates for the microwave service antennas were found to be located correctly, as shown on the aerial photography reference.

3.3 Fresnel Zone Calculation

The Fresnel zone is a long ellipsoidal-shaped area in space around the line of sight between a transmitter and receiver antenna. The Fresnel zone consists of multiple zones, and the size depends on the distance between the transmitter, receiver, and operating frequency. A Fresnel zone was calculated for the four closest paths to the Repowered Facility turbine locations using 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

d_1 = Distance from antenna 1 to a specific point in the microwave path (km)

d_2 = Distance from antenna 2 to a specific point in the microwave path (km)

A total of 34 turbines were considered in the analysis, each with a blade diameter of 163 meters (518.04 feet) and a hub height of 120 meters (547.9 feet). Of those turbines, none were found to have potential obstruction with the microwave systems in the area. The results of the Fresnel zone analysis are presented in Table 3.

Table 3: Fresnel Zone Analysis Result

Microwave Path ID	Fresnel Zone Width (Radius) at Turbine Location (m)	Microwave Centerline Height Above Ground at Turbine Location (m)	Turbine ID	Hub Height (m)	Blade Length (diameter) (m)	Cross Sectional Signal Clearance (m)
1	5.47	19	T01	120.0	163.0	1325.1
2	5.35	21	T01	120.0	163.0	1325.0
3	6.88	20	T11	120.0	163.0	2590.4
4	6.73	20	T11	120.0	163.0	2590.4

Key:
m = meters

3.4 Conclusion

Although 60 percent clearance of the first Fresnel zone is usually sufficient to guarantee undisturbed performance of a microwave link, in the case of wind turbines, the recommendation is to keep the first Fresnel zone 100 percent clear as calculated using the above formula. It is recommended that wind turbine and blade radius avoid contact with the first Fresnel zone to ensure uninterrupted signal in the microwave communications. Figure 2 depicts Fresnel zones in the Study Area, and Figures 3 and 4 depict the Fresnel zones for the four closest microwave paths to turbines T01 and T11. The Fresnel zones are also included in the enclosed shapefiles.[1] The results of this analysis show that no turbines were found to have potential obstruction of the microwave systems in the area.

[1] The Esri shapefiles enclosed are in NAD_1983_StatePlane_New_York_East_FIPS_3101_Feet projected coordinate system.

Figure 2: Fresnel Zones in the Study Area

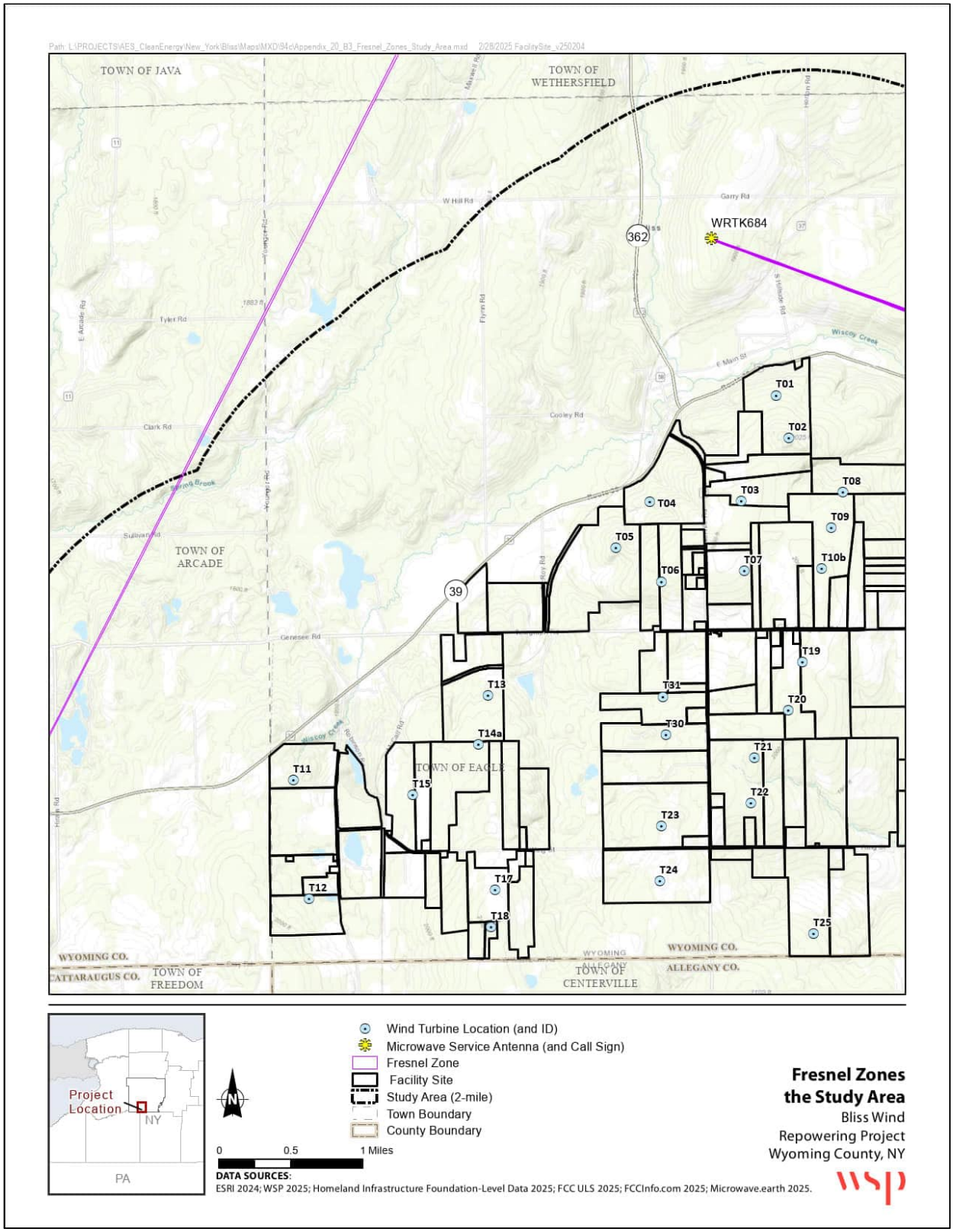


Figure 3: Fresnel Zone near Turbine T01

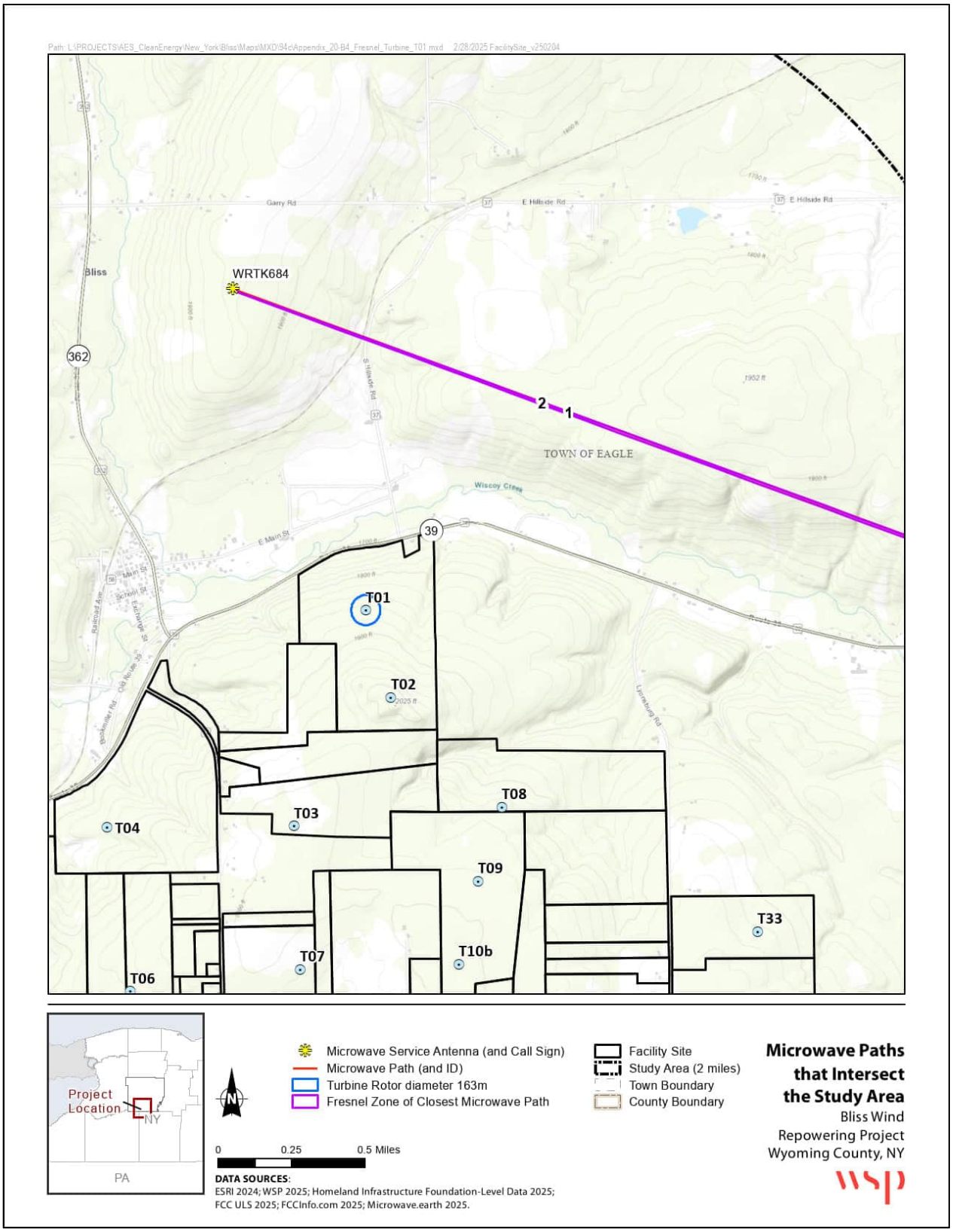


Figure 4: Fresnel Zone Near Turbine T11