

## **Appendix D – Microwave Beam Path Analysis**



# Wind Power GeoPlanner™

## Microwave Study

OTP Langdon Wind



Prepared on Behalf of  
Atwell, LLC

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**COMSEARCH**  
A CommScope Company

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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:** OTP Langdon Wind

**County:** Cavalier

**State:** North Dakota

**Number of Turbines:** 27

**Blade Diameter:** 97 meters

**Hub Height:** 80 meters

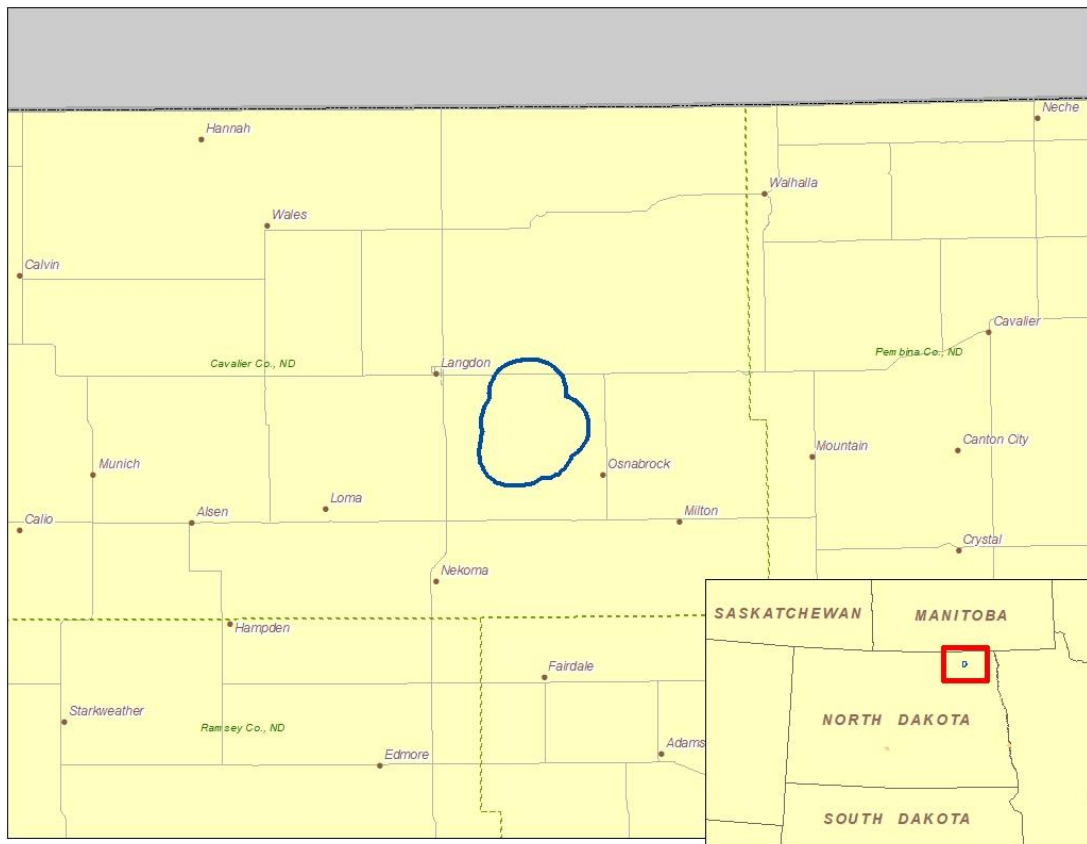


Figure 1: Area of Interest

### 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 GHz<sup>1</sup>. First, we determined all microwave paths that intersect the area of interest<sup>2</sup> and listed them in Table 1. These paths and the area of interest that encompasses the planned turbine locations are shown in Figure 2.

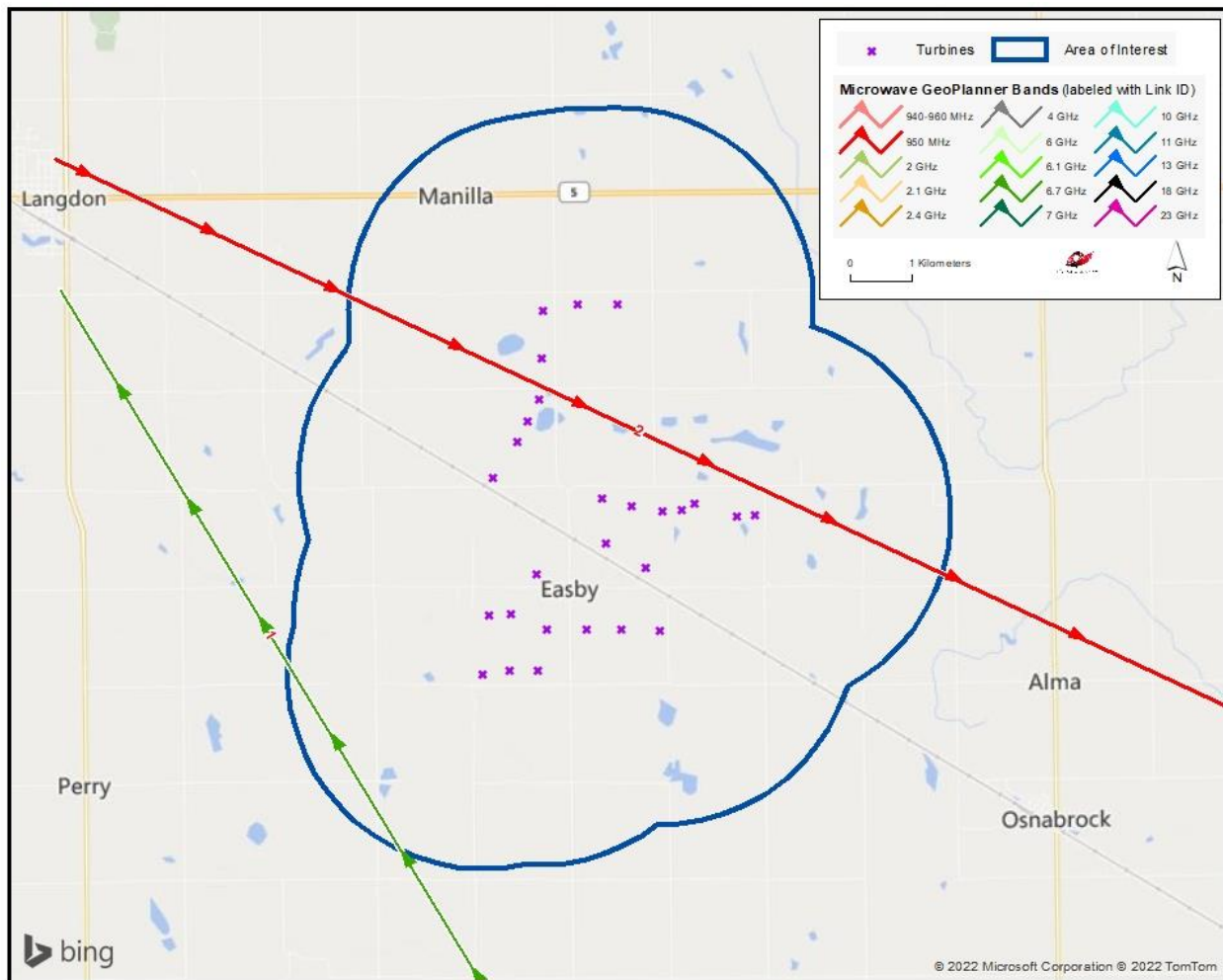


Figure 2: Microwave Paths that Intersect the Area of Interest

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

<sup>2</sup> 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	KZC46	KPN81	6.7 GHz	43.15	Minnkota Power Cooperative Inc.
2	Licensed	WQFA924	RXONLY	950 MHz	31.66	Simmons Broadcasting, Inc.

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

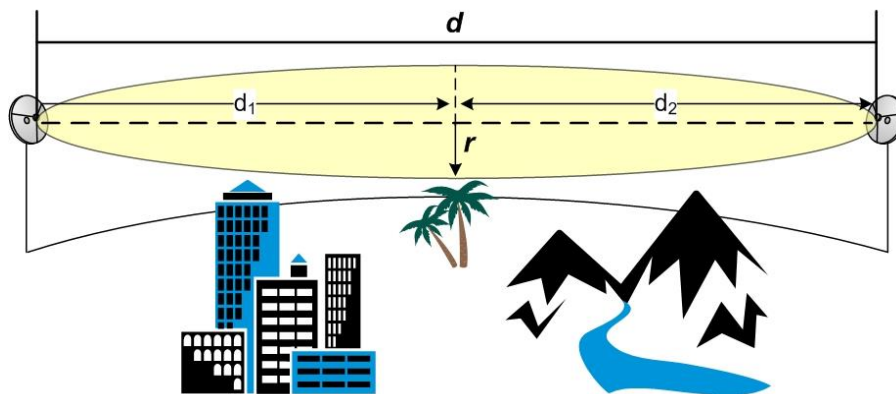
*(See enclosed mw\_geopl.xlsx for more information and GP\_dict\_matrix\_description.xls for detailed field descriptions)*

### Verification of Coordinate Accuracy

It is possible that as-built coordinates may differ from those on the FCC license. For this project, one path crosses within close proximity of the proposed turbines and the tower locations for this path will have a critical impact on the result. Therefore, we verified these locations using aerial photography. Some of the towers were found to be slightly off and were moved to their locations based on the aerial photos<sup>3</sup>.

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

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

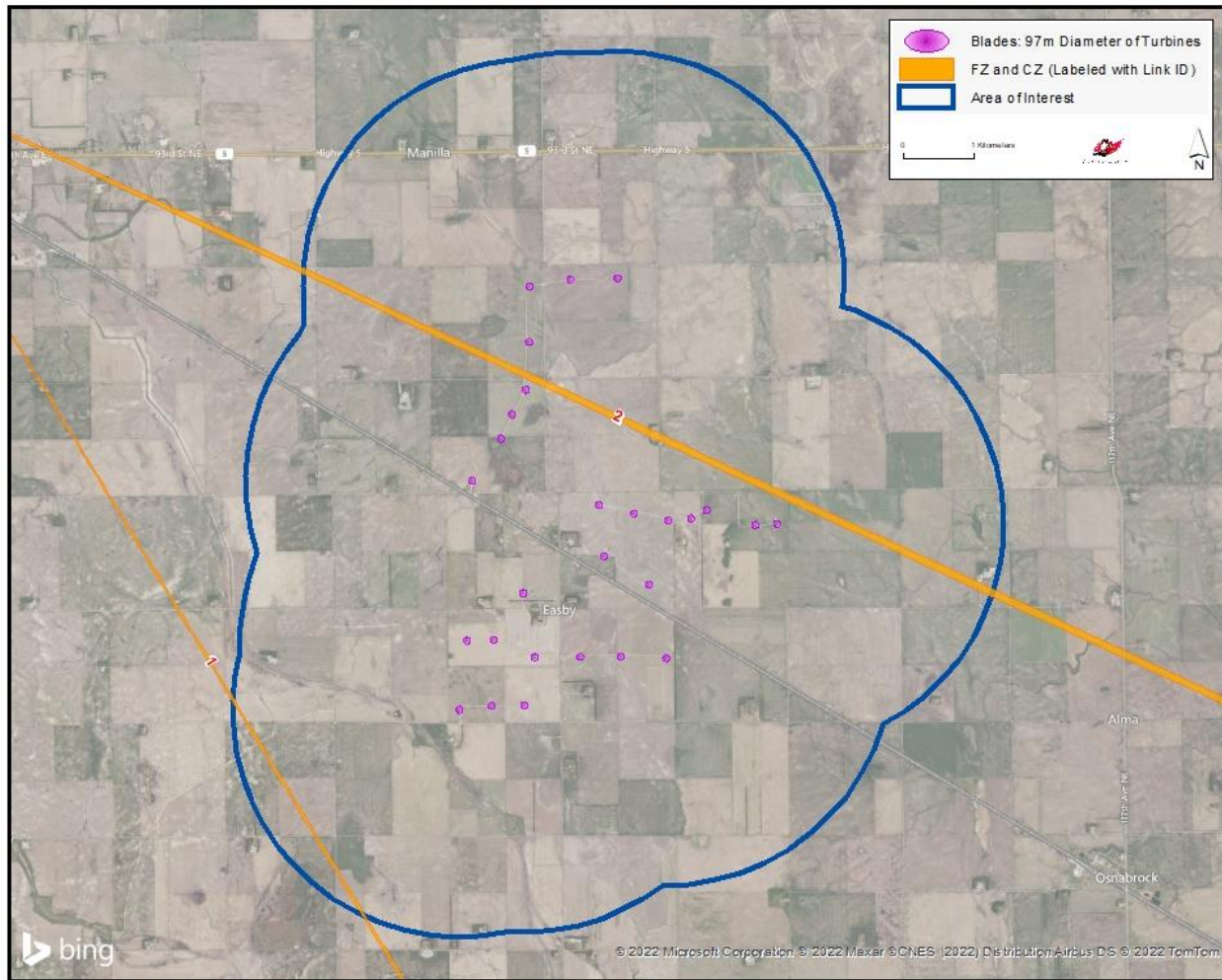


Where,

- r = Fresnel Zone radius at a specific point in the microwave path, meters
- n = Fresnel Zone number, 1
- F<sub>GHz</sub> = Frequency of microwave system, GHz
- d<sub>1</sub> = Distance from antenna 1 to a specific point in the microwave path, kilometers
- d<sub>2</sub> = Distance from antenna 2 to a specific point in the microwave path, kilometers

<sup>3</sup> 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.

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<sup>4,5</sup>.



*Figure 3: Microwave Paths with Fresnel Zones*

<sup>4</sup> The ESRI® shapefiles enclosed are in NAD 83 UTM Zone 14 projected coordinate system.

<sup>5</sup> 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](http://www.comsearch.com/files/data_license.pdf).

## 4. Conclusion

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines intersecting the Fresnel Zones
2	0	27	0

*Table 2: Fresnel Zone Analysis Result*

Our study identified two microwave paths intersecting the OTP Langdon Wind area of interest. The Fresnel and Consultation Zones for these microwave paths were calculated and mapped in order to assess the potential impact from the turbines. A total of 27 turbines were considered in the analysis, each with a blade diameter of 97 meters and a hub height of 80 meters. Of those turbines, none were found to have potential obstruction with the microwave systems in the area.

## 5. Contact

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

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 Web site: [www.comsearch.com](http://www.comsearch.com)

## Appendix: Turbine Locations

<b>Turbine</b>	<b>Latitude</b>	<b>Longitude</b>
1	48.696801	-98.258196
2	48.714100	-98.232104
3	48.715001	-98.238802
4	48.730900	-98.259402
5	48.699005	-98.271204
6	48.714299	-98.227801
7	48.715302	-98.224802
8	48.704998	-98.260302
9	48.737000	-98.258700
10	48.724701	-98.264300
11	48.705899	-98.236002
12	48.716099	-98.245501
13	48.744999	-98.241503
14	48.690701	-98.266596
15	48.713398	-98.215403
16	48.699101	-98.266100
17	48.713501	-98.211199
18	48.744900	-98.250597
19	48.719399	-98.269900
20	48.727799	-98.262103
21	48.744099	-98.258502
22	48.696801	-98.249400
23	48.690701	-98.260302
24	48.690201	-98.272799
25	48.709599	-98.244700
26	48.696499	-98.232798
27	48.696801	-98.241602