

**Appendix F**  
**Wind Power GeoPlanner™ Microwave Study**  
**for the Meridian Wind Project**

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# Wind Power GeoPlanner™

## Microwave Study

### Triple H Wind Project



Prepared on Behalf of  
Infinity Renewables

March 25, 2016



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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:** Triple H Wind Project

**County:** Hyde and Hughes

**State:** South Dakota

**Number of Turbines:** TBD

**Blade Diameter:** 116 meters

**Hub Height:** 80 meters

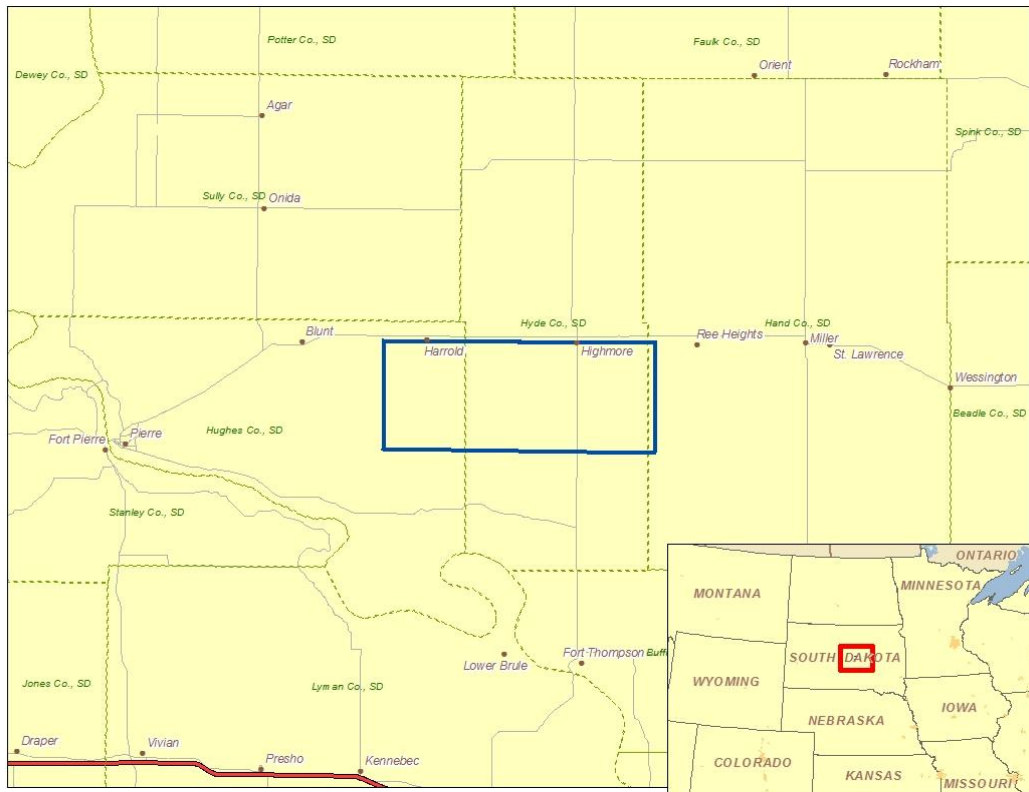


Figure 1: Area of Interest

### 3. 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.

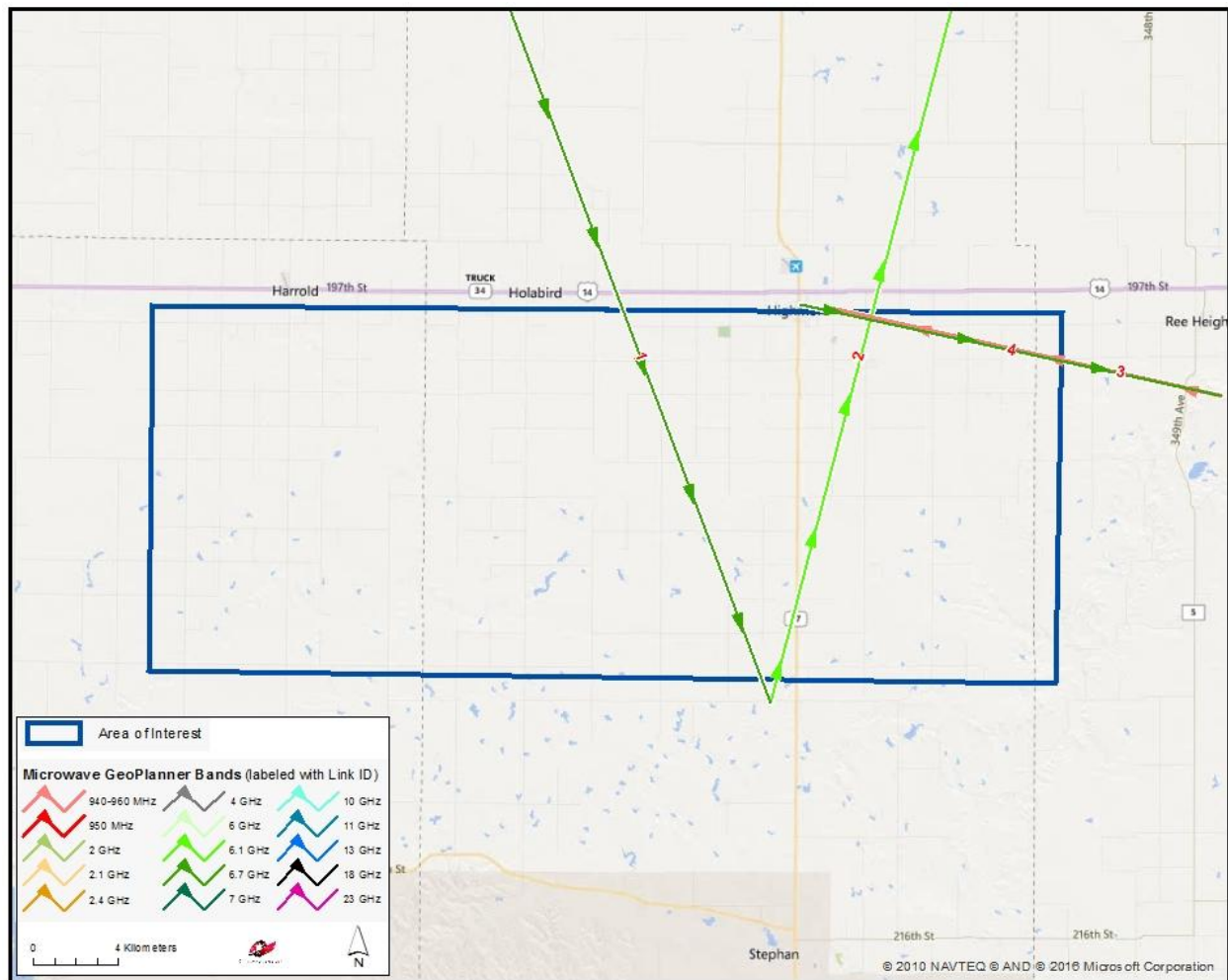


Figure 2: Microwave Paths that Intersect the Area of Interest

<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.

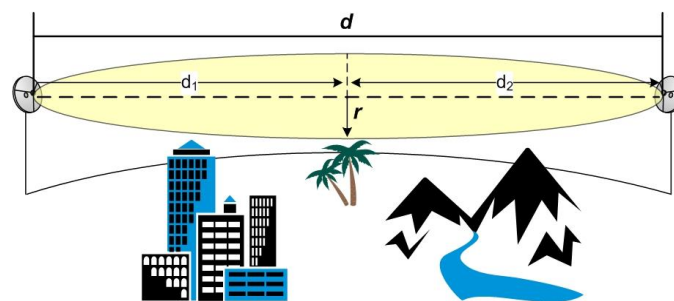
<sup>2</sup> We use FCC-licensed coordinates to determine which paths intersect the area of interest. It is possible that as-built coordinates may differ slightly from those on the FCC license.

ID	Status	Callsign 1	Callsign 2	Band	Path Length (km)	Licensee
1	Licensed	WBD224	WBD225	6.7 GHz	77.00	Basin Electric Power Cooperative
2	Licensed	WBD225	WQRB909	6.1 GHz	59.49	Basin Electric Power Cooperative
3	Licensed	WQKM509	WQNE257	940-960 MHz	18.84	NorthWestern Corporation
4	Licensed	WQUQ655	WQKM509	6.7 GHz	20.35	NorthWestern Corporation

**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)

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

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


Where,

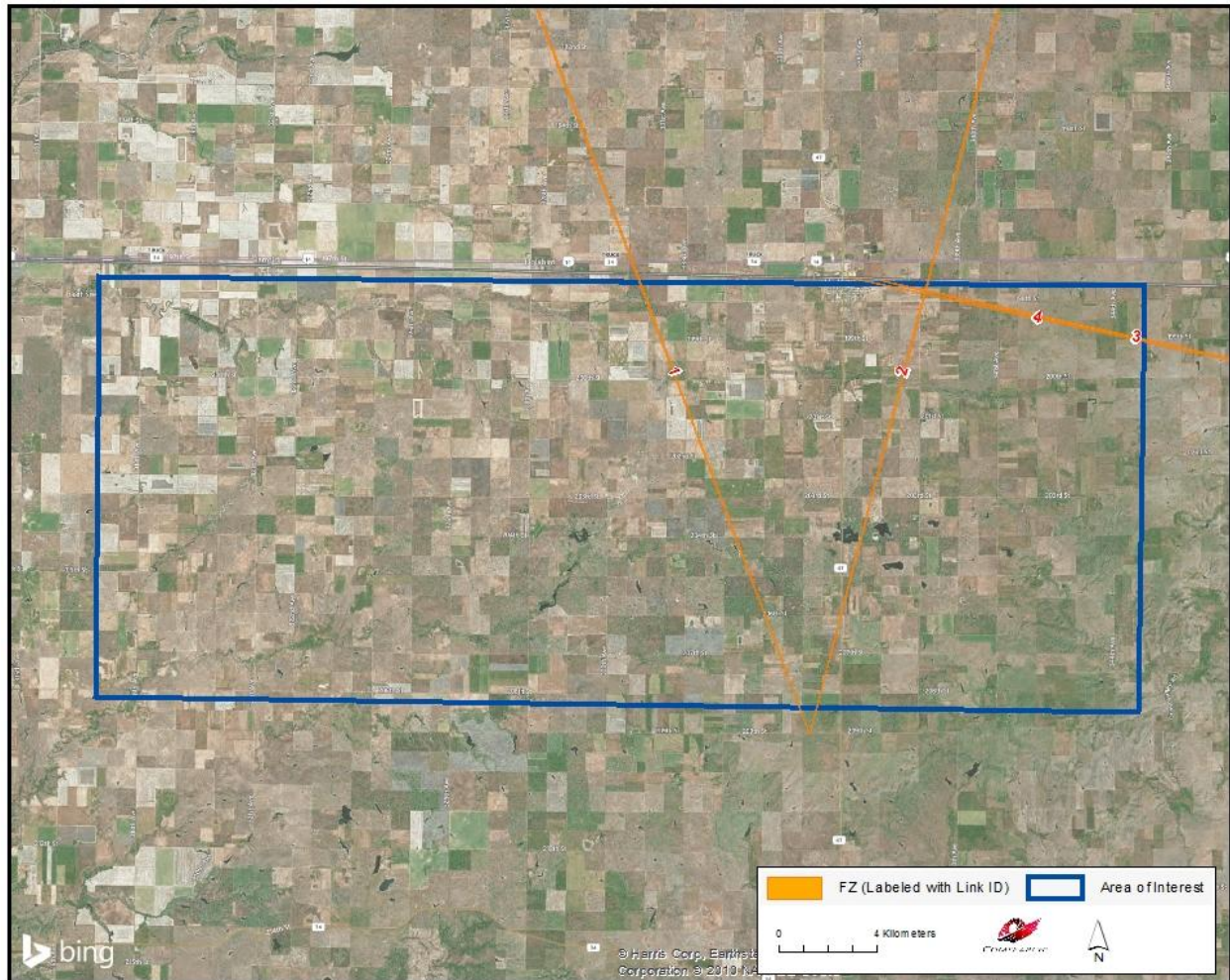
- r = Fresnel Zone radius at a specific point in the microwave path, meters
- n = Fresnel Zone number, 1
- $F_{\text{GHz}}$  = Frequency of microwave system, GHz
- $d_1$  = Distance from antenna 1 to a specific point in the microwave path, kilometers
- $d_2$  = Distance from antenna 2 to a specific point in the microwave path, kilometers

The calculated Fresnel Zone shows the narrow area of signal swath and is calculated for each microwave path in the project area. In general, this is the area where the planned wind turbines should be avoided, if possible. A depiction of the individual Fresnel Zones is shown in Figure 3, and is also included in the shapefiles<sup>3,4</sup>.

<sup>3</sup> The ESRI® shapefiles enclosed are in NAD 83 UTM Zone 14 projected coordinate system.

<sup>4</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).





*Figure 3: Fresnel Zones in the Area of Interest*

### Discussion of Potential Obstructions

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines intersecting Fresnel Zones
4	N/A	N/A	N/A

For this project, turbine locations were not provided; thus we could not determine if any potential obstructions exist between the planned wind turbines and the incumbent microwave paths. If the latitude and longitude values for turbine locations are provided, Comsearch can identify where a potential conflict might exist.

## **4. Conclusion**

Our study identified four microwave paths intersecting the Triple H Wind Project area. The Fresnel Zones for these microwave paths were calculated and mapped. We recommend that all turbines be sited in locations that will not obstruct the Fresnel Zones.

## **5. Contact**

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

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Title:	Account Manager
Company:	Comsearch
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Fax:	703-726-5595
Email:	<a href="mailto:dfinney@comsearch.com">dfinney@comsearch.com</a>
Web site:	<a href="http://www.comsearch.com">www.comsearch.com</a>



# Wind Power GeoPlanner™

## Microwave Study

### Meridian Wind Project



Prepared on Behalf of  
Meridian Wind Project,  
LLC

February 3, 2020



**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:** Meridian Wind Project

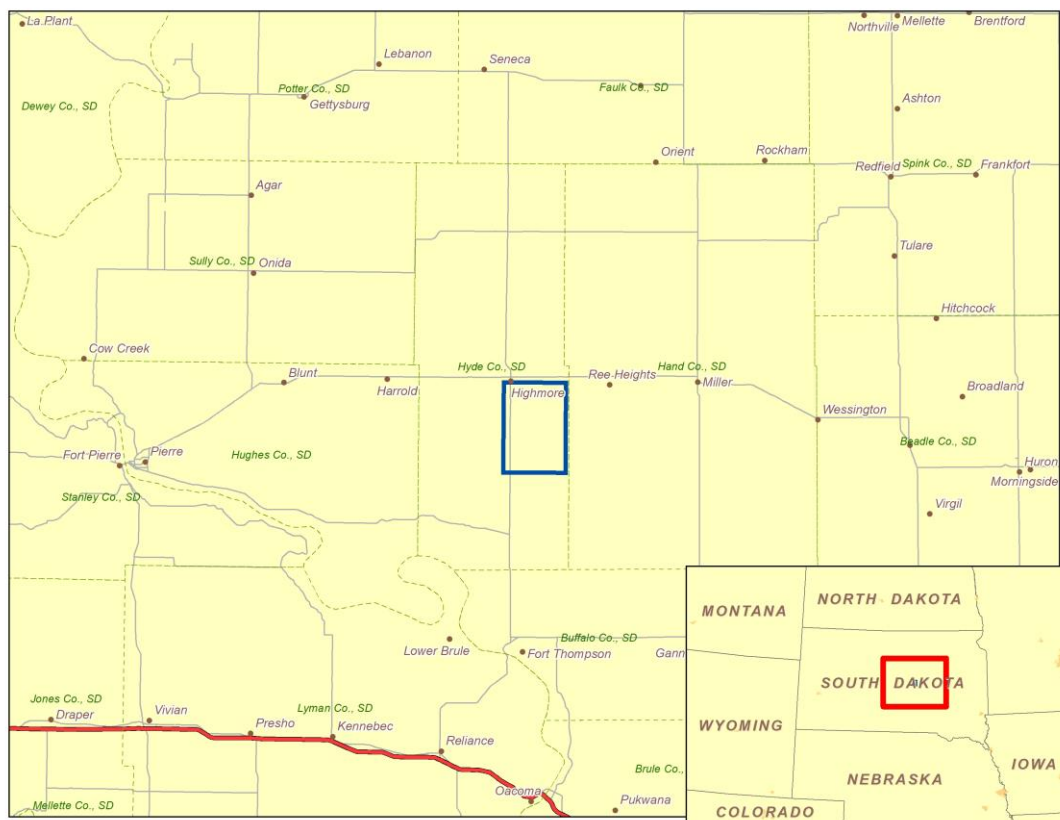
**County:** Hyde

**State:** South Dakota

**Number of Turbines:** 51

**Blade Diameter:** 149 meters

**Hub Height:** 105 meters

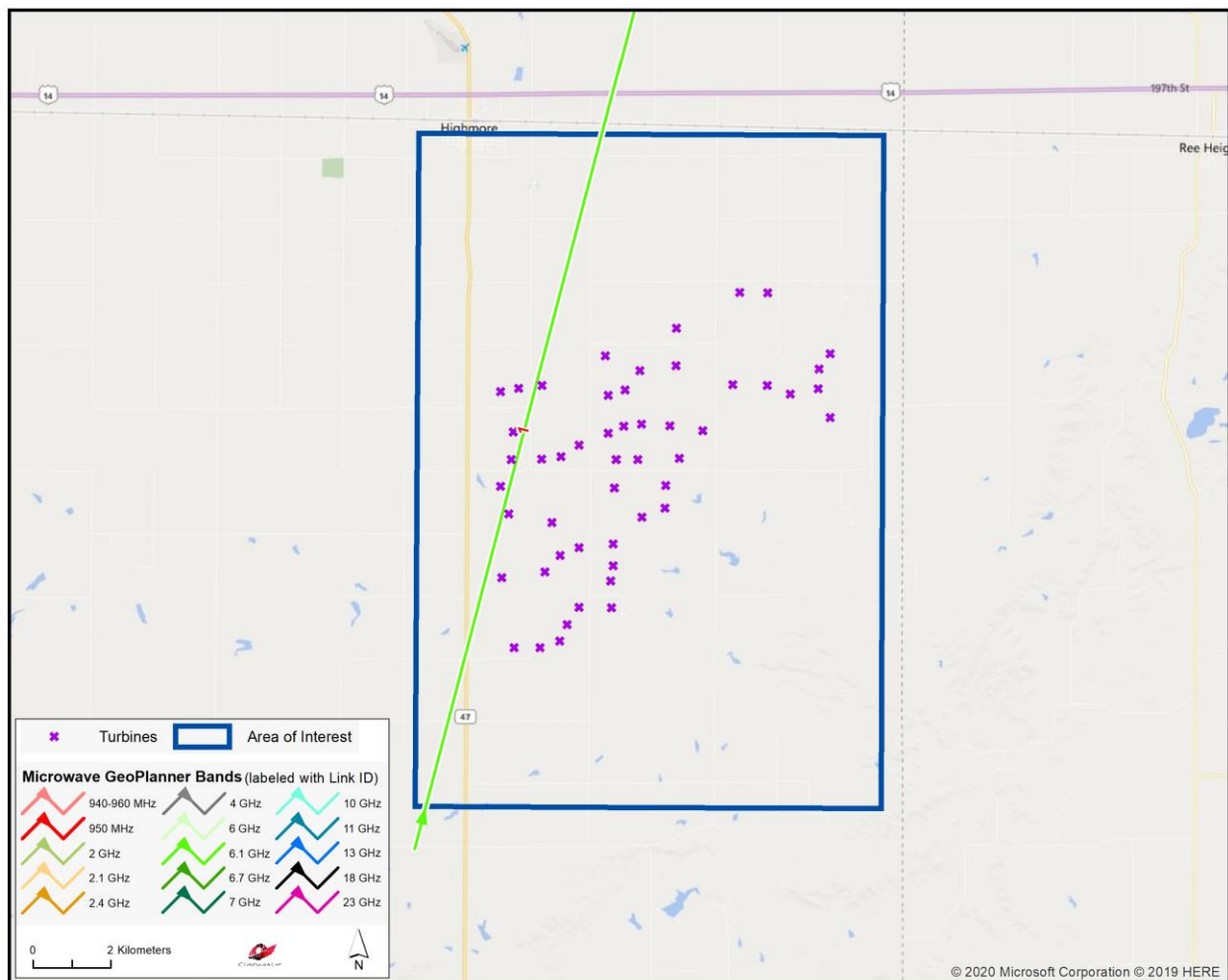


*Figure 1: Area of Interest*

### 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. This path and the area of interest that encompasses the planned turbine locations are shown in Figure 2.



*Figure 2: Microwave Path that Intersects 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	WBD225	WQRB909	6.1 GHz	59.49	Basin Electric Power Cooperative

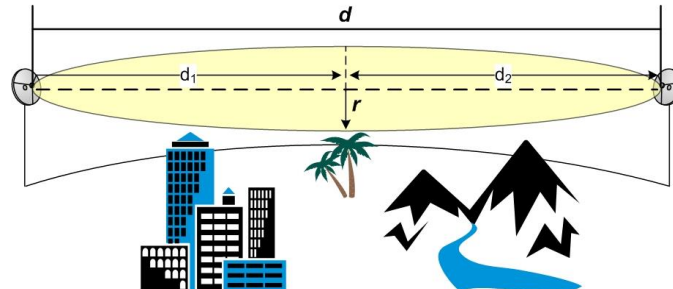
*Table 1: Summary of Microwave Path that Intersects the Area of Interest*

(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, the found 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. Both 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,

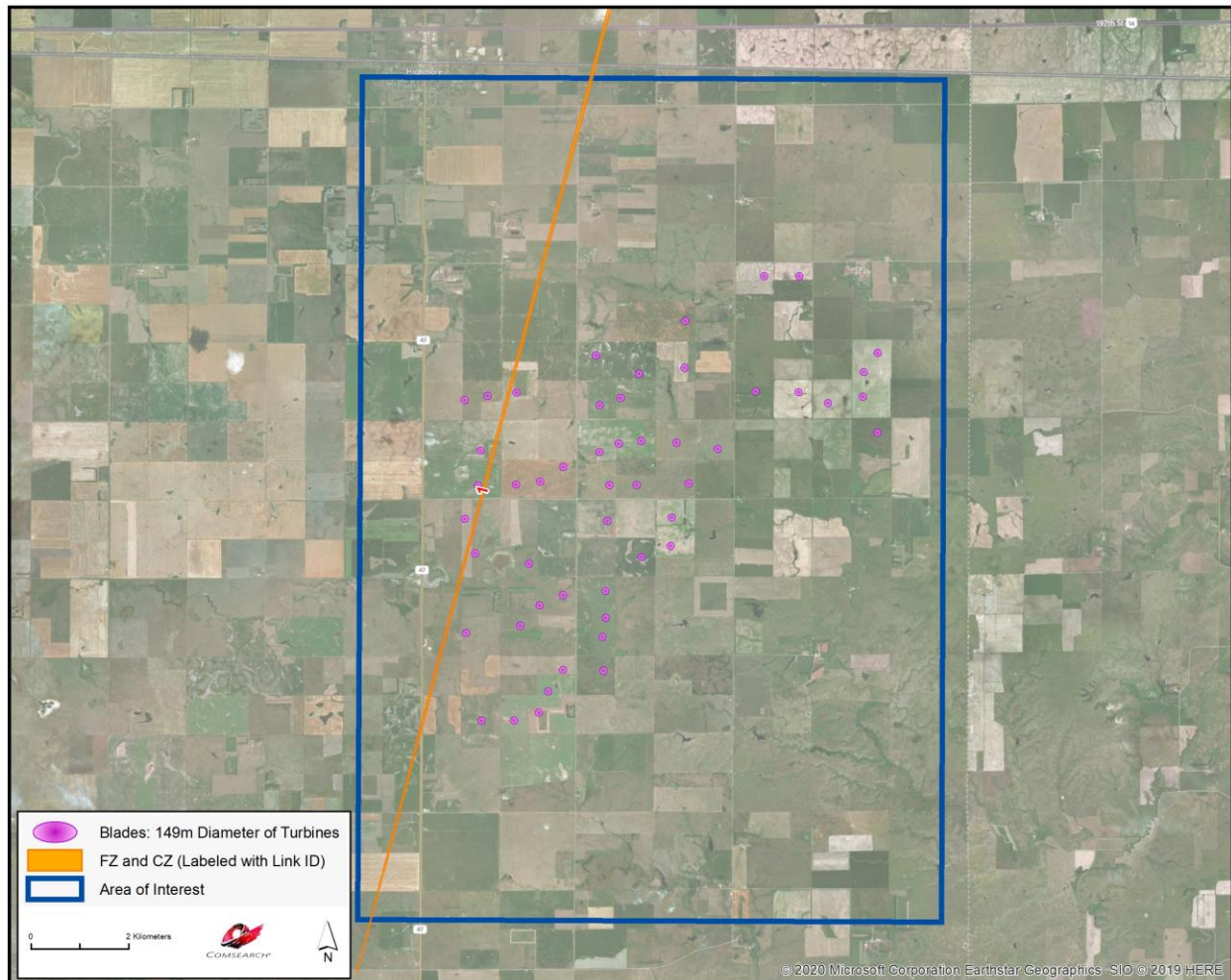
- r = Fresnel Zone radius at a specific point in the microwave path, meters
- n = Fresnel Zone number, 1
- F<sub>GHz</sub> = Frequency of microwave system, GHz
- d<sub>1</sub> = Distance from antenna 1 to a specific point in the microwave path, kilometers
- d<sub>2</sub> = Distance from antenna 2 to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

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

<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.



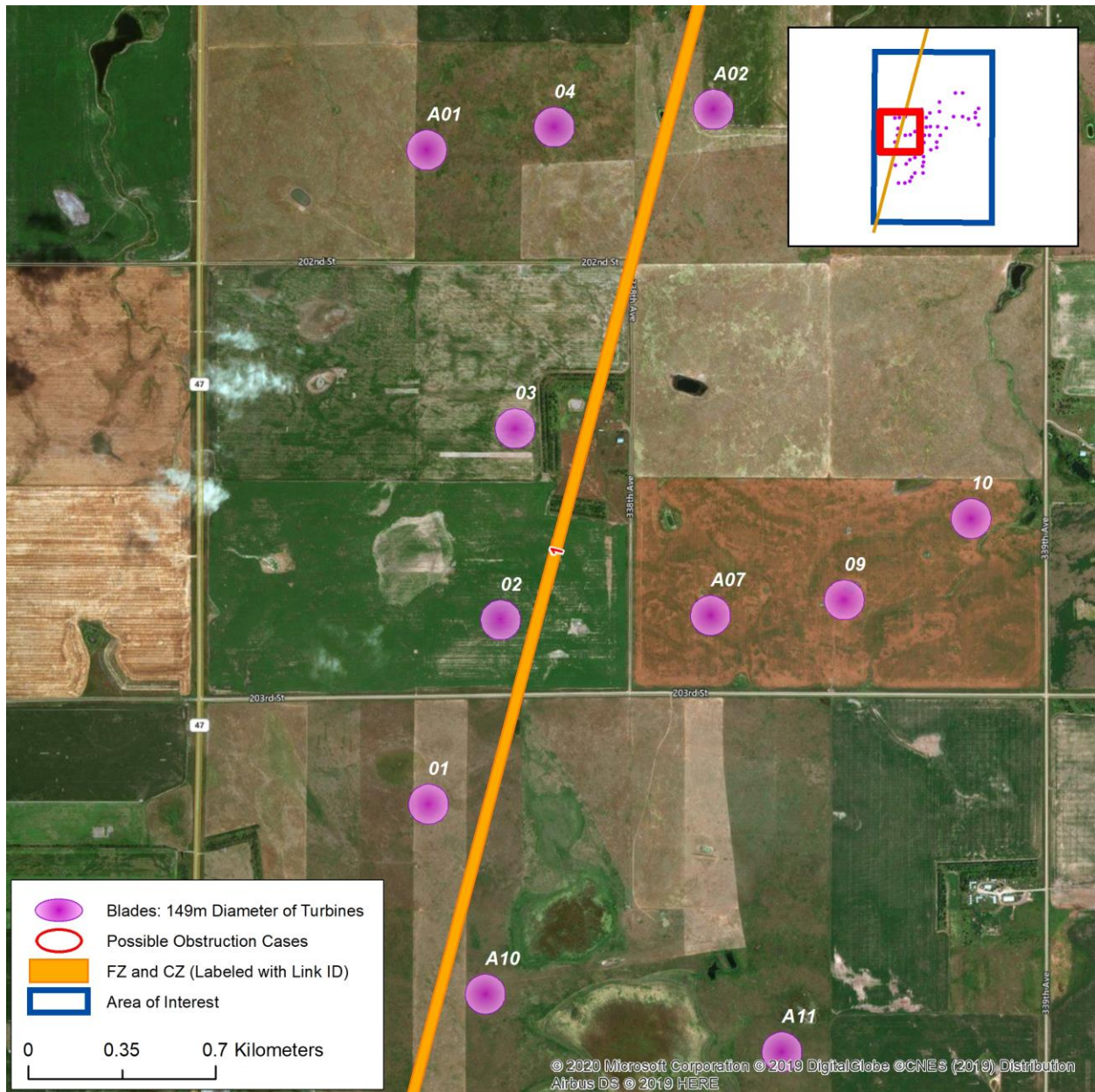
Zones and Consultation Zones for each microwave path listed can be found in Figures 3 and 4, and is also included in the enclosed shapefiles<sup>4,5</sup>.



*Figure 3: Microwave Path with Fresnel Zone and Consultation 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).



*Figure 4: Microwave Path with Fresnel Zone and Consultation Zones*

## 4. Conclusion

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines intersecting the Fresnel Zones
1	0	51	0

*Table 2: Fresnel Zone Analysis Result*

Our study identified one microwave path intersecting the Meridian Wind Project area of interest. The Fresnel and Consultation Zones for this microwave path was calculated and mapped in order to assess the potential impact from the turbines. A total of 51 turbines were considered in the analysis, each with a blade diameter of 149 meters and a hub height of 105 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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Fax: 703-726-5595  
Email: [dmeyer@comsearch.com](mailto:dmeyer@comsearch.com)  
Web site: [www.comsearch.com](http://www.comsearch.com)



## Appendix: Turbine Locations

Latitude	Longitude	TurbID	Array
44.449577	-99.426785	03	
44.415817	-99.430257	19	
44.436934	-99.430756	01	
44.428673	-99.414152	A11	ALT
44.417211	-99.416295	20	
44.443872	-99.411332	09	
44.446624	-99.405402	10	
44.458128	-99.396046	05	
44.459438	-99.390707	A06	ALT
44.463944	-99.386071	06	
44.399608	-99.426191	30	
44.399690	-99.417757	31	
44.401178	-99.411403	32	
44.423745	-99.394321	23	
44.418760	-99.394265	A15	ALT
44.430033	-99.385184	24	
44.482094	-99.344722	A05	ALT
44.465082	-99.374285	07	
44.458657	-99.337208	15	
44.464435	-99.327992	17	
44.467982	-99.324409	18	
44.415202	-99.395032	36	
44.408972	-99.394741	35	
44.451513	-99.385395	12	
44.443345	-99.386532	A14	ALT
44.432122	-99.377679	25	
44.443142	-99.427419	02	
44.450101	-99.365605	28	
44.451204	-99.376280	A09	ALT
44.460663	-99.344781	14	
44.422889	-99.405279	22	
44.443679	-99.373111	27	
44.405081	-99.409009	33	
44.467295	-99.397048	A03	ALT
44.436686	-99.393947	A12	ALT

Latitude	Longitude	TurbID	Array
44.453238	-99.324382	29	
44.437376	-99.377405	26	
44.449407	-99.396053	11	
44.409051	-99.405258	34	
44.421005	-99.411346	21	
44.473765	-99.374173	08	
44.458915	-99.430998	A01	ALT
44.460335	-99.417580	A02	ALT
44.459711	-99.425037	04	
44.450997	-99.391137	A08	ALT
44.482084	-99.353818	A04	ALT
44.460759	-99.355911	13	
44.430563	-99.428043	A10	ALT
44.443327	-99.417599	A07	ALT
44.443301	-99.393425	A13	ALT
44.459899	-99.328182	16	