Appendix U

Wind Power GEOPlanner

Microwave Study

Wind Power GeoPlanner™

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Philip Wind

Prepared on Behalf of
PHILIP WIND
PARTNERS, 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: Philip Wind

County: Haakon

State: South Dakota

Number of Turbines: 91

Blade Diameter: 163 meters

Hub Height: 98 meters

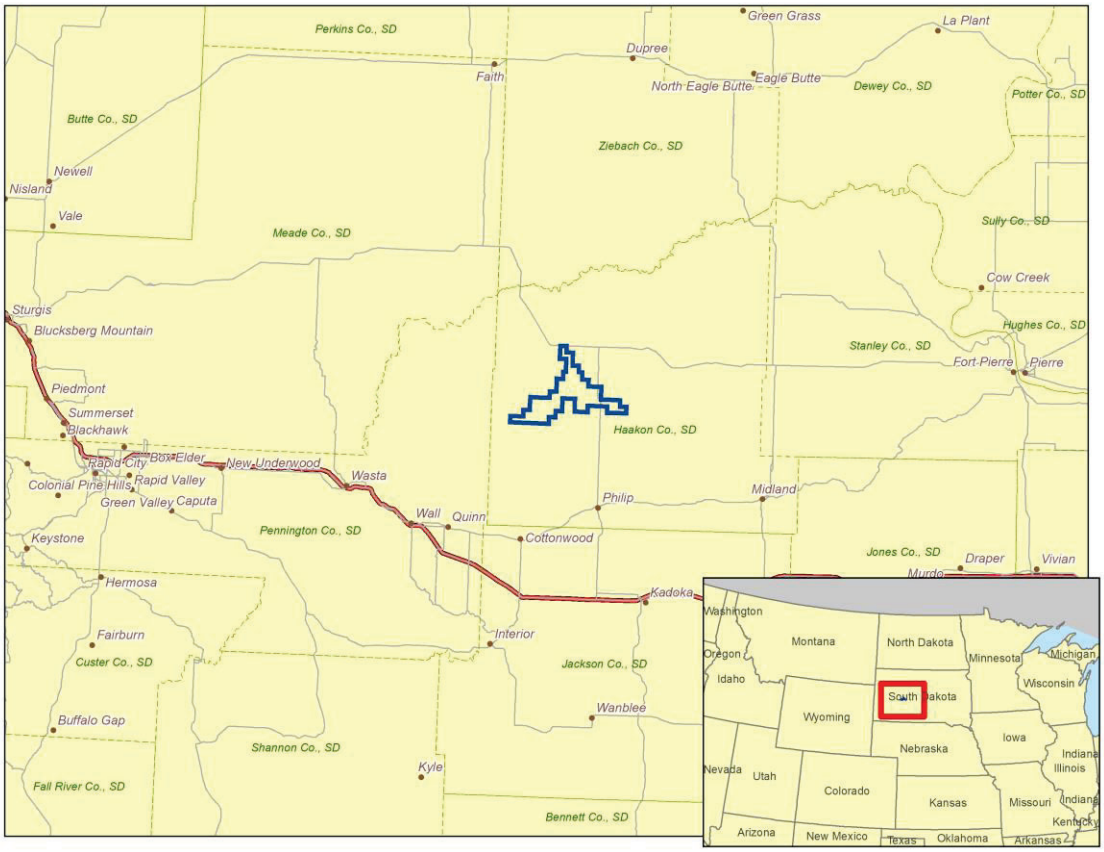


Figure 1: Area of Interest

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[1]. First, we determined all microwave paths that intersect the area of interest[2] and listed them in Table 1. These paths and the area of interest that encompasses the planned turbine locations are shown in Figure 2.

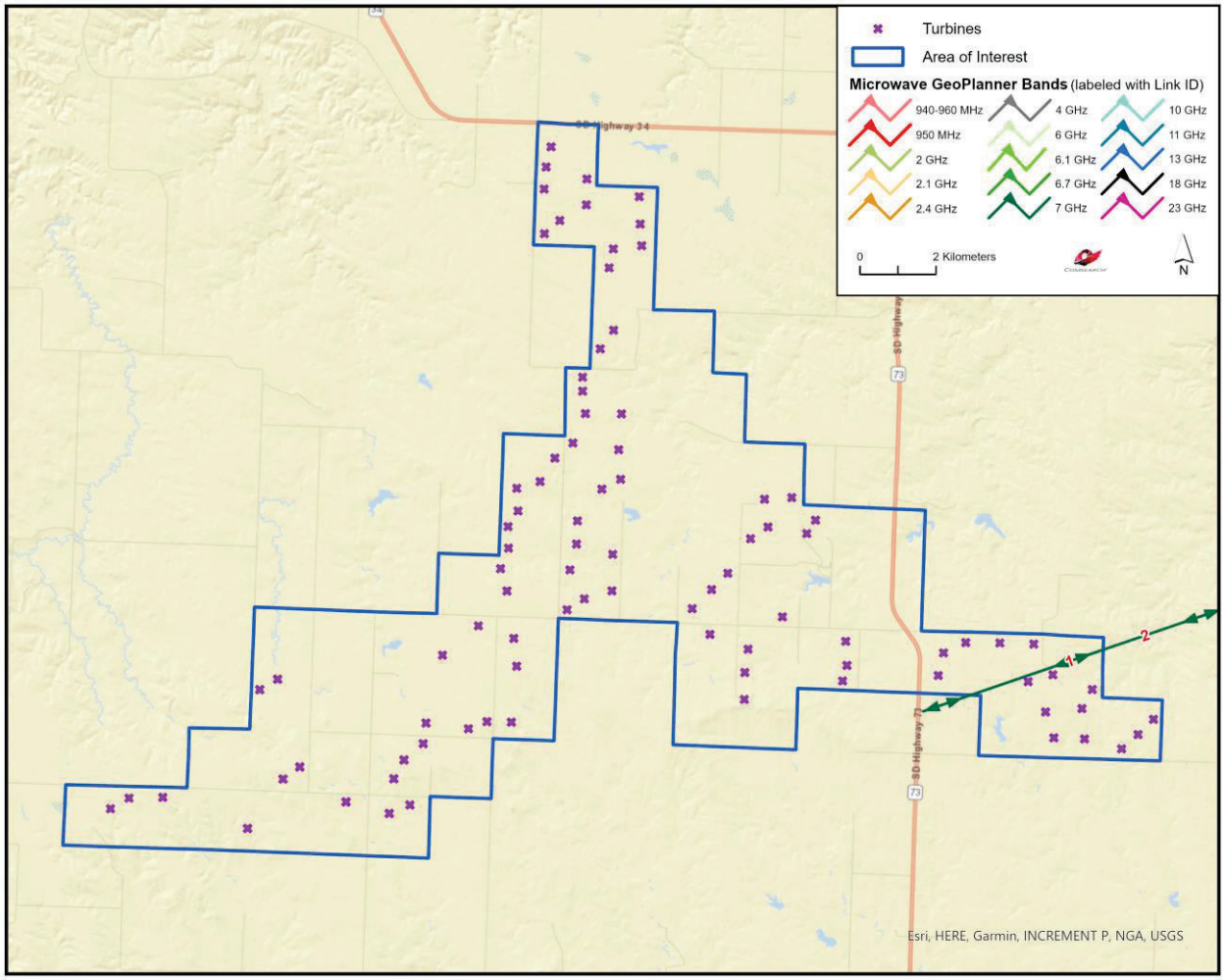


Figure 2: Microwave Paths that Intersect the Area of Interest

[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.

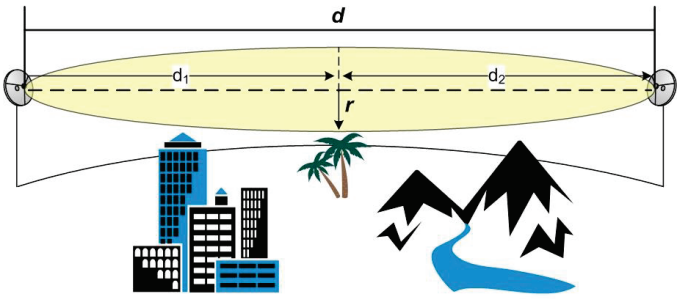
ID	Status	Callsign 1	Callsign 2	Band	Path Length (km)	Licensee
1	Licensed	WPUG509	RXONLY	7 GHz	33.45	South Dakota Brd of Dir of ED Telecom
2	Licensed	WPUG498	RXONLY	7 GHz	33.45	South Dakota Brd of Dir of ED Telecom

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, both 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. Both of its towers were found to be slightly off and were moved to their locations based on the aerial photos[3].

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
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

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

[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.

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].

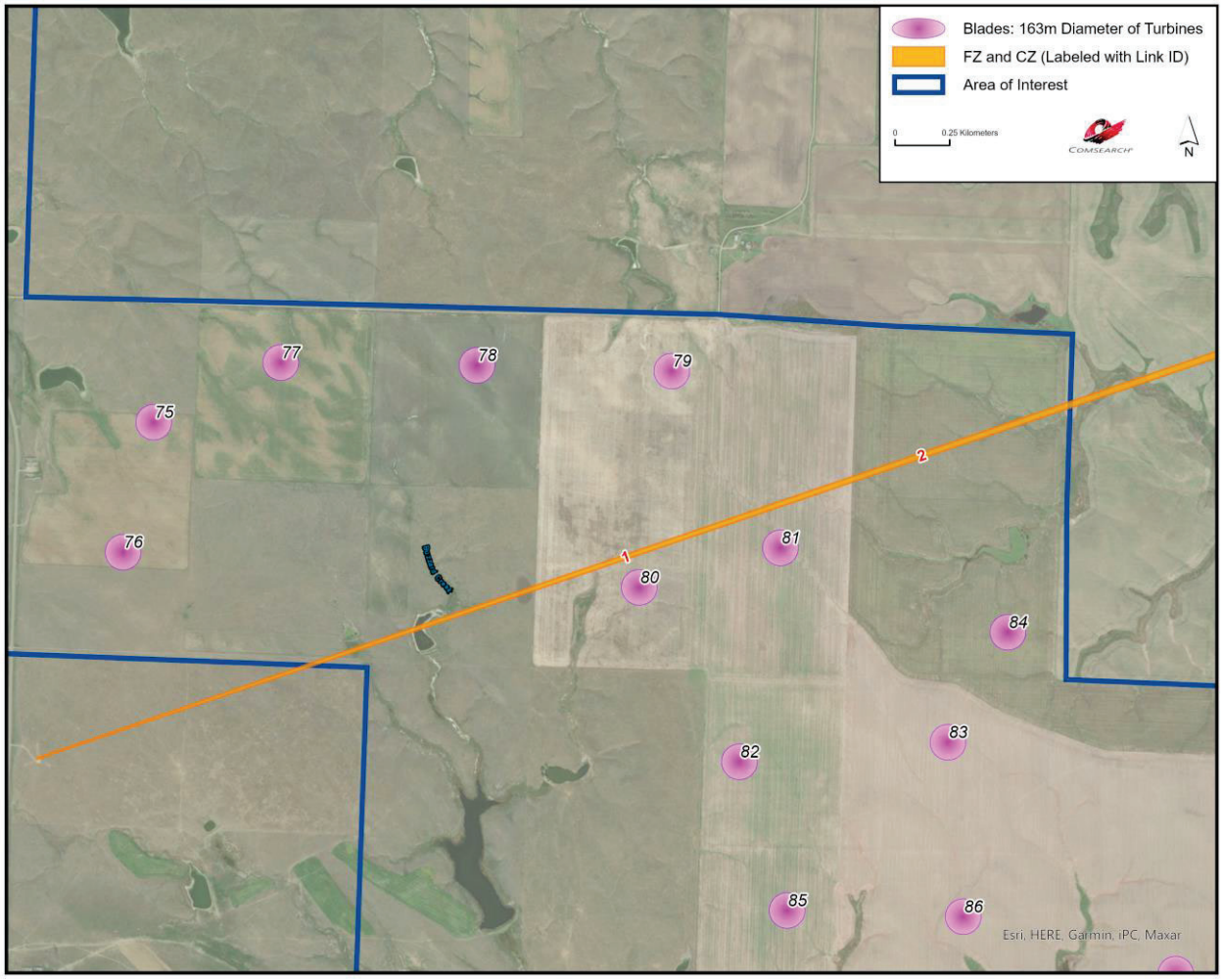


Figure 3: Microwave Paths with Fresnel Zones

[4] The ESRI® shapefiles enclosed are in NAD 83 UTM Zone 14 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.

4. Conclusion

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines intersecting the Fresnel Zones
2	0	91	0

Table 2: Fresnel Zone Analysis Result

Our study identified two microwave paths intersecting the Philip 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 ninety-one turbines were considered in the analysis, each with a blade diameter of 163 meters and a hub height of 98 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

Appendix: Turbine Locations

Name	Latitude	Longitude
1	44.367477	-101.774257
2	44.372023	-101.773095
3	44.372982	-101.763802
4	44.395688	-101.794825
5	44.390855	-101.796240
6	44.352777	-101.772081
7	44.348245	-101.776315
8	44.332761	-101.780452
9	44.341379	-101.781798
10	44.338053	-101.781676
11	44.332989	-101.768571
12	44.321986	-101.790019
13	44.325705	-101.784267
14	44.324496	-101.769098
15	44.316315	-101.794644
16	44.314995	-101.774196
17	44.317475	-101.768173
18	44.307302	-101.781924
19	44.301816	-101.781949
20	44.299662	-101.769941
21	44.295376	-101.806692
22	44.295624	-101.783835
23	44.290139	-101.804359
24	44.286173	-101.784308
25	44.288877	-101.778742
26	44.291000	-101.769792
28	44.309345	-101.703445
29	44.313890	-101.720470
30	44.314536	-101.711542
31	44.307354	-101.719038
32	44.306104	-101.706193
33	44.304448	-101.724675
34	44.287422	-101.743087
35	44.292095	-101.736965
36	44.296086	-101.731790
37	44.286200	-101.713282
38	44.388363	-101.782603
39	44.385621	-101.796643
40	44.382234	-101.782504
41	44.378294	-101.791076
42	44.375066	-101.796024
44	44.264694	-101.884668
45	44.267280	-101.878888
46	44.243705	-101.875942

Name	Latitude	Longitude
47	44.246719	-101.870580
48	44.264748	-101.589982
49	44.238820	-101.854907
50	44.236447	-101.840552
51	44.238642	-101.833875
52	44.244693	-101.839481
53	44.249223	-101.836327
54	44.253282	-101.830158
55	44.258157	-101.829509
56	44.257198	-101.815482
57	44.259029	-101.809437
58	44.259070	-101.801417
59	44.281648	-101.813355
60	44.272388	-101.800315
62	44.278960	-101.801587
67	44.278245	-101.724271
68	44.272726	-101.725052
69	44.266333	-101.724988
73	44.271471	-101.692758
74	44.275200	-101.691520
75	44.278911	-101.659804
76	44.273512	-101.661326
77	44.281538	-101.652630
78	44.281685	-101.641366
79	44.281704	-101.630182
80	44.272746	-101.631651
81	44.274563	-101.623621
82	44.265689	-101.625584
83	44.266768	-101.613661
84	44.271380	-101.610421
85	44.259623	-101.622576
86	44.259599	-101.612467
87	44.257510	-101.600177
88	44.261023	-101.594873
89	44.314520	-101.802286
90	44.309187	-101.801629
91	44.300294	-101.804327
92	44.235272	-101.932431
93	44.237960	-101.926446
94	44.238401	-101.915327
95	44.231718	-101.887015
101	44.274393	-101.824837
102	44.384564	-101.765144
103	44.378106	-101.764563
104	44.281481	-101.736997
105	44.280882	-101.692185
108	44.305389	-101.804731