Emerson Creek Amendment Case No. 21-1055-EL-BGA

## Exhibit I Microwave Study

## ComSearch

August 16, 2021



# Wind Power GeoPlanner™

# **Microwave Study**

## **Emerson Creek Wind**



Prepared on Behalf of Firelands Wind, LLC

August 16, 2021





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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: Emerson Creek Wind County: Erie and Huron State: Ohio

Number of Turbines: 76 Blade Diameter: 140-158 meters Hub Height: 105-125 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>&</sup>lt;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>&</sup>lt;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 Licensee (km)	
1	Proposed	ASR12344	ASR12014	6.1 GHz	57.40	Wireless Internetwork LLC
2	Proposed	ASR12516	WQQX871	11 GHz	46.18	Wireless Internetwork LLC
3	Licensed	ATTICA	WQKL535	11 GHz	13.73	Bascom Long Distance, Inc.
4	Licensed	ATTICA	WQXG305	23 GHz	1.47	Bascom Long Distance, Inc.
5	Licensed	CASTALIA	WRMN570	11 GHz	4.47	Amplex Electric, Inc.
6	Proposed	CCI87204	GTPOH-53	6.1 GHz	86.79	Wireless Internetwork LLC
7	Proposed	GTPOH	OH96253-	11 GHz	42.17	Wireless Internetwork LLC
8	Licensed	MIL01	WRKR648	11 GHz	17.15	North Coast Wireless Communications LLC
9	Licensed	MIL01	WRMF514	11 GHz	3.76	North Coast Wireless Communications LLC
10	Licensed	WAA857	WAA856	6.1 GHz	41.10	Norfolk Southern Railway Company
11	Licensed	WAA857	WAA858	6.1 GHz	21.79	Norfolk Southern Railway Company
12	Licensed	WAA857	WAA858	6.7 GHz	21.79	Norfolk Southern Railway Company
13	Licensed	WAA857	WBB737	6.1 GHz	44.30	Norfolk Southern Railway Company
14	Licensed	WAA858	WQFI840	6.1 GHz	3.89	Norfolk Southern Railway Company
15	Licensed	WAA859	WAA858	6.7 GHz	31.98	Norfolk Southern Railway Company
16	Licensed	WAL371	WQYY434	6.1 GHz	19.31	FELHC, Inc.
17	Proposed	WESTLODI	WQQX778	11 GHz	31.36	Wireless Internetwork LLC
18	Questionable	WNTV619	KQG77	6.7 GHz	5.92	Ohio Turnpike Commission
19	Licensed	WPJB672	RXONLY	950 MHz	12.62	Elyria-Lorain Broadcasting Co.
20	Licensed	WPJC871	RXONLY	950 MHz	12.63	Elyria-Lorain Broadcasting Co.
21	Licensed	WPOQ484	RXONLY	950 MHz	28.49	BAS Broadcasting, Inc.
22	Licensed	WPUG349	WPUM945	6.1 GHz	40.50	W.A.T.C.H. TV Company Inc.
23	Licensed	WPUR690	RXONLY	950 MHz	7.31	Elyria-Lorain Broadcasting Co.
24	Licensed	WPUR691	RXONLY	950 MHz	7.31	Elyria-Lorain Broadcasting Co.
25	Licensed	WPZQ250	RXONLY	950 MHz	25.36	BAS Broadcasting, Inc.
26	Licensed	WQCH243	RXONLY	950 MHz	50.56	Christian Faith Broadcast, Inc.
27	Licensed	WQHG487	RXONLY	940-960 MHz	26.99	Erie County
28	Licensed	WQJZ740	RXONLY	7 GHz	45.86	Christian Faith Broadcast, Inc.
29	Licensed	WQOH565	WQON201	6.1 GHz	16.03	SW Networks
30	Licensed	WQON201	WQOH566	6.1 GHz	19.70	SW Networks
31	Licensed	WQOT918	WQOT919	6.1 GHz	48.31	Coralinks
32	Licensed	WQOT919	WQOT875	6.1 GHz	40.27	Coralinks
33	Licensed	WQOT919	WQOT875	6.1 GHz	40.27	Coralinks
34	Licensed	WQOY684	WQOY683	940-960 MHz	24.07	Huron, County of
35	Licensed	WQOY684	WQPC438	11 GHz	10.52	Huron, County of
36	Licensed	WQPB810	WQPB813	6.1 GHz	36.08	Kryptick Technologies
37	Licensed	WQPB810	WQPB813	6.7 GHz	36.08	Kryptick Technologies
38	Licensed	WQPB813	WQPB814	6.1 GHz	35.01	Kryptick Technologies
39	Questionable	WQPF783	WQPL304	11 GHz	38.06	Zen Networks, Inc
40	Licensed	WQPH316	WQPH317	6.7 GHz	56.99	High Voltage Communications LLC (CFN)
41	Licensed	WQPH317	WQPH316	6.7 GHz	56.99	High Voltage Communications LLC (CFN)
42	Licensed	WQPI470	WQWF990	11 GHz	30.99	New Line Networks, LLC
43	Licensed	WQPL304	WQPI360	6.1 GHz	36.94	Geodesic Networks LLC



ID	Status	Callsign 1	Callsign 2	Path Band Length Licensee (km)		Licensee
44	Proposed	WQQX778	ASR12516	11 GHz	29.23	Wireless Internetwork LLC
45	Proposed	WQQX778	REPUBLIC	11 GHz	39.48	Wireless Internetwork LLC
46	Licensed	WQQX871	WQXU839	11 GHz	48.42	Wireless Internetwork LLC
47	Proposed	WQRW547	WQRW848	11 GHz	15.31	Sprintcom, Inc
48	Licensed	WQRW848	WQRW547	11 GHz	15.31	Sprintcom, Inc
49	Licensed	WQRW866	WQRW547	11 GHz	14.01	Sprintcom, Inc
50	Licensed	WQRW954	WQRW547	18 GHz	9.55	Sprintcom, Inc
51	Licensed	WQUC996	RXONLY	950 MHz	14.29	BAS Broadcasting, Inc.
52	Licensed	WQUM352	WQZV625	11 GHz	19.57	North Coast Wireless Communications LLC
53	Licensed	WQUP720	WQUP721	18 GHz	7.16	Sprint Spectrum L.P.
54	Licensed	WQUY965	WQZC699	11 GHz	20.59	BLHC LLC
55	Licensed	WQVW473	WPOQ355	11 GHz	4.96	New Cingular Wireless PCS LLC - Ohio
56	Licensed	WQVY409	WQXE708	11 GHz	25.44	Agile Network Builders LLC
57	Licensed	WQWF986	WQWF971	6.1 GHz	42.15	AQ2AT LLC
58	Licensed	WQWF986	WQWF971	6.1 GHz	42.15	AQ2AT LLC
59	Licensed	WQWF990	WQWF989	6.1 GHz	36.94	New Line Networks, LLC
60	Licensed	WQXU839	WQQX778	11 GHz	24.00	Wireless Internetwork LLC
61	Licensed	WQYD931	WREN692	11 GHz	27.37	BLHC LLC
62	Licensed	WQYT575	WQYT658	6.1 GHz	11.66	Cellco Partnership - Ohio
63	Licensed	WQZV625	WRDV670	11 GHz	27.18	North Coast Wireless Communications LLC
64	Licensed	WQZV625	WRMG921	11 GHz	10.25	North Coast Wireless Communications LLC
65	Licensed	WRBM895	WRBM897	18 GHz	10.31	Amplex Electric, Inc.
66	Licensed	WRCE594	WRCF823	11 GHz	4.21	Local TV & Electronics, Inc.
67	Proposed	WRCU510	CASTALIA	11 GHz	9.37	Amplex Electric, Inc.
68	Licensed	WRCW961	WQZC699	18 GHz	20.15	BLHC LLC
69	Licensed	WRCW961	WRCW963	11 GHz	22.34	BLHC LLC
70	Licensed	WRDB226	WRDL638	18 GHz	4.10	Sprintcom, Inc
71	Licensed	WRHY230	MIL01	11 GHz	14.39	North Coast Wireless Communications LLC
72	Licensed	WRJC951	WRJC980	11 GHz	26.80	Huron, County of
73	Licensed	WRJC980	WRJC967	11 GHz	10.02	Huron, County of
74	Proposed	WRKD371	NORTHFAI	11 GHz	19.87	W.A.T.C.H. TV Company Inc.
75	Licensed	WRJC967	WRJC979	11 GHz	10.45	Huron, County of
76	Proposed	WRKD371	REPUBLIC	11 GHz	15.60	W.A.T.C.H. TV Company Inc.
77	Licensed	WRKD371	WRKD387	11 GHz	14.47	W.A.T.C.H. TV Company Inc.
78	Licensed	WRKD371	WRKD409	11 GHz	10.63	W.A.T.C.H. TV Company Inc.
79	Licensed	WRKD404	WRKD409	11 GHz	13.12	W.A.T.C.H. TV Company Inc.
80	Licensed	WRKD429	WRKD387	11 GHz	10.58	W.A.T.C.H. TV Company Inc.
81	Licensed	WRMF514	WRMG921	11 GHz	12.11	North Coast Wireless Communications 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 FCC license. For this project, ten 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 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:



#### 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<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 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>.

<sup>&</sup>lt;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.

<sup>&</sup>lt;sup>4</sup> The ESRI® shapefiles enclosed are in NAD 83 UTM Zone 17 projected coordinate system.

<sup>&</sup>lt;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 <a href="http://www.comsearch.com/files/data\_license.pdf">http://www.comsearch.com/files/data\_license.pdf</a>.





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





Figure 4: Fresnel Zones and Consultation Zones in the Area of Interest (South)

#### Discussion of Potential Two Dimensional Obstructions

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines Intersecting the 2D Fresnel Zones
81	1	76	1

Table 2: Fresnel Zone Analysis Result



For this project, seventy-six turbines were considered in the analysis. Of those turbines, one was found to intersect the 2D Fresnel Zones of one microwave path using the maximum blade radius of 158 meters. Figure 5 contains a detailed depiction of the potential obstruction scenario and Table 3 contains a summary of the affected turbine. A cross sectional analysis was performed in Section 4 to determine the diagonal clearance value for this case with respect to the various potential hub heights.



Figure 5: Potential Obstruction Cases

Turbine ID	Latitude (NAD83)	Longitude (NAD83)	Affected Microwave Path ID	Fresnel Zone Width at Turbine Location (m)	Horizontal off-path Distance (m)	Distance along the path from site 1 (km)	Horizontal Clearance (m)
T59a	41.130851	-82.822823	63	13.35	92	15.45	-0.35

Table 3: Turbine Intersecting Fresnel Zone Using Maximum Blade Lengths of 79 Meters



## 4. Cross Sectional Analysis

Our Fresnel Zone analysis in the previous section identified one potential obstruction case that needs to be further examined from a cross sectional perspective. The case 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 on the next page. It shows the distance between the hub and the edge of the Fresnel Zones for various proposed hub heights. This is the maximum blade length that would result in sufficient clearance to the Fresnel Zone for this case in order to avoid signal degradation.



Microwave Path ID	Microwave Centerline Height at Turbine Location (m)	Turbine ID	Maximum Blade Length with 105 Meter Hub Height (m)	Maximum Blade Length with 107.5 Meter Hub Height (m)	Maximum Blade Length with 109 Meter Hub Height (m)	Maximum Blade Length with 110 Meter Hub Height (m)	Maximum Blade Length with 120 Meter Hub Height (m)	Maximum Blade Length with 125 Meter Hub Height (m)
63	54.55	T59a	91.58	92.80	93.56	94.07	99.56	102.53

Table 4:	Cross S	ectional	Analysis	Results
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## 5. Conclusion

Our study identified eighty-one microwave paths within the Emerson Creek Wind project area. The Fresnel Zones for these microwave paths were calculated and mapped. One potential 2D Fresnel Zone obstruction case was analyzed in Table 4 and that turbine was found to have sufficient clearance with respect to all considered hub heights and blade lengths. Therefore no impact on any of the microwave systems is expected from the Emerson Creek Wind Project.

## 6. Contact

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

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## **Appendix: Turbine Locations**

Name	Latitude	Longitude
T71a	41.087239	-82.777073
T57a	41.137759	-82.825678
T78a	41.135758	-82.822173
T64a	41.099168	-82.827888
T59a	41.130851	-82.822823
T1	41.337099	-82.797348
T3	41.331478	-82.687075
T4	41.327532	-82.684178
T5	41.327445	-82.680048
T6	41.318518	-82.797724
T7	41.318058	-82.783116
Т9	41.314171	-82.787936
T10a	41.310117	-82.787187
T11	41.309764	-82.799758
T12	41.305625	-82.787644
T13	41.305136	-82.781572
T14	41.303812	-82.696973
T15	41.303067	-82.688404
T16	41.301869	-82.683928
T17	41.297781	-82.741593
T18	41.294916	-82.754027
T19	41.295024	-82.737831
T20	41.291788	-82.735136
T21	41.286781	-82.755324
T22	41.284053	-82.736867
T23	41.263792	-82.757029
T24	41.261483	-82.809768
T25	41.256906	-82.811458
T26	41.255537	-82.804804
T27	41.247748	-82.775591
T28	41.247453	-82.755314
T29	41.246016	-82.796831
T30	41.244499	-82.771250
T31	41.244317	-82.752199
T32	41.242342	-82.797958
T33	41.241991	-82.744465
T34	41.240377	-82.832119
T35	41.238179	-82.771069
T36	41.238023	-82.751004
T37	41.235910	-82.826307
T38	41.234849	-82.833901
T39	41.229099	-82.804858
T41	41.203883	-82.781494
T42	41.200371	-82.777267



Name	Latitude	Longitude
T43	41.198120	-82.831094
T44	41.192600	-82.774717
T45	41.187739	-82.775040
T46	41.181878	-82.781891
T48	41.154789	-82.811488
T49	41.151725	-82.781459
T50	41.150273	-82.822234
T51	41.148403	-82.811770
T52	41.142003	-82.832671
T53	41.138740	-82.832559
T56	41.137187	-82.791469
T58	41.132710	-82.769038
T60	41.115604	-82.744427
T61	41.113891	-82.809376
T62	41.110972	-82.744301
T63	41.107609	-82.807075
T65	41.096587	-82.806809
T66a	41.095787	-82.763585
T67	41.094273	-82.770638
T68	41.092720	-82.777421
T69	41.091700	-82.788939
T70	41.088123	-82.817984
T72	41.317424	-82.790103
T73	41.309850	-82.815974
T74	41.307057	-82.817892
T75	41.260514	-82.803118
T77	41.197454	-82.776176
T79	41.110900	-82.740275
T84	41.329699	-82.741720
T85	41.329181	-82.753073
T86	41.327925	-82.736455
T87	41.241985	-82.827102

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Summary: Application - 11 of 13 (Exhibit I – Microwave Study) electronically filed by Christine M.T. Pirik on behalf of Firelands Wind, LLC