

Appendix D: Signal Interference Reports

Wind Power GeoPlanner™

AM and FM Radio Report

Riverbend Wind Project



Prepared on Behalf of
Liberty Power

November 10, 2021



COMSEARCH
A CommScope Company

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1. Introduction

Comsearch analyzed AM and FM radio broadcast stations whose service could potentially be affected by the proposed Riverbend Wind Project in Sanilac County, Michigan.

2. Summary of Results

AM Radio Analysis

Comsearch found two database records¹ for AM stations within approximately 30 kilometers of the project, as shown in Table 1 and Figure 1. The closest station to the area of interest (AOI) is WMIC, which broadcasts out of Sandusky, MI, located 16.53 km to the north of the project AOI.

ID	Call Sign	Status ²	Frequency (kHz)	Transmit ERP ³ (kW)	Operation Time	Latitude (NAD 83)	Longitude (NAD 83)	Distance to the AOI (km)
1	WMIC	LIC	660	1.0	Daytime	43.392822	-82.834871	16.53
2	WHLS	LIC	1450	1.0	Unlimited	42.977005	-82.464277	25.37

Table 1: AM Radio Stations within 30 Kilometers of Project Area

¹ Comsearch makes no warranty as to the accuracy of the data included in this report beyond the date of the report. The data presented in this report is derived from the AM/FM station's FCC license and governed by Comsearch's data license notification and agreement located at http://www.comsearch.com/files/data_license.pdf.

² LIC = Licensed and operational station; APP = Application for construction permit; CP=Construction permit granted; CP MOD = Modification of construction permit.

³ ERP = Transmit Effective Radiated Power.

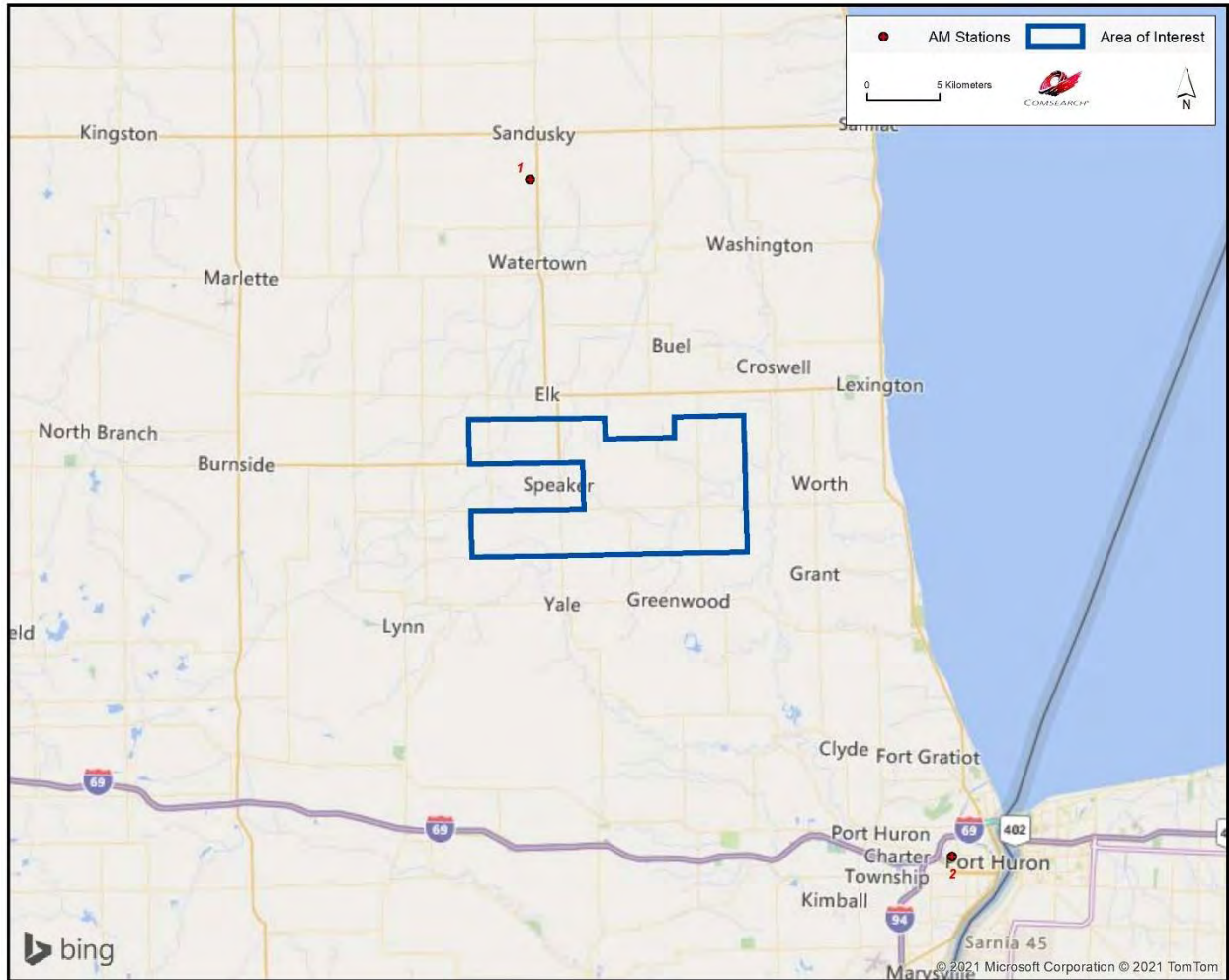


Figure 1: AM Radio Stations within 30 Kilometers of Project Area

FM Radio Analysis

Comsearch determined that there were eighteen database records for FM stations within a 30-kilometer radius of the Riverbend Wind Project, as shown in Table 2 and Figure 2. Sixteen of the stations are currently licensed and operating, four of which are translator stations that operate with limited range. The closest station is WKKM, which is currently licensed in Speaker Township, Michigan, located 1.2 km from the western edge of the project AOI.

ID	Call Sign	Service ⁴	Status ⁵	Frequency (MHz)	Transmit ERP ⁶ (kW)	Latitude (NAD 83)	Longitude (NAD 83)	Distance to the AOI (km)
1	WKKM	FM	LIC	89.7	0.1	43.198917	-82.804111	1.20
2	WNFR	FM	LIC	90.7	42.0	43.174194	-82.600194	3.54
3	WBGV	FM	LIC	92.5	3.0	43.286139	-82.971333	8.64
4	WBTI	FM	LIC	96.9	3.0	43.209472	-82.536028	8.93
5	WHYT	FM	LIC	88.1		43.175028	-83.067167	15.33
6	WKKM	FM	CP	91.5	6.0	43.175028	-83.067167	15.33
7	WHYT	FM	APP	88.1		43.175528	-83.067333	15.34
8	WTGV-FM	FM	LIC	97.7	3.0	43.392806	-82.834944	16.53
9	W237EQ	FX	LIC	95.3	0.25	43.393361	-82.834944	16.59
10	W247CU	FX	LIC	97.3	0.025	43.068917	-82.479917	16.98
11	WGRT	FM	LIC	102.3	3.0	43.068917	-82.479917	16.98
12	WORW	FM	LIC	91.9		43.025028	-82.436000	22.87
13	WNFA	FM	LIC	88.3	1.3	42.993361	-82.468250	23.71
14	W224DT	FX	LIC	92.7	0.125	42.976972	-82.464361	25.37
15	W288BT	FX	LIC	105.5	0.049	42.976972	-82.464361	25.37
16	WSAQ	FM	LIC	107.1	6.0	42.976972	-82.464333	25.37
17	WQUS	FM	LIC	103.1	2.6	43.078639	-83.189944	26.90
18	WRSX	FM	LIC	91.3	0.12	42.978639	-82.429056	26.98

Table 2: FM Radio Stations within 30 km

⁴ FM = FM broadcast station; FX = FM translator station; FS = FM auxiliary (backup) station; FB = FM booster station.

⁵ LIC = Licensed and operational station; APP = Application for construction permit; CP=Construction permit granted; CP MOD = Modification of construction permit.

⁶ ERP = Transmit Effective Radiated Power.

ID	Call Sign	Status ⁷	Frequency (MHz)	Antenna Make	Antenna Model	Antenna Size (m)	Recommended Minimum Separation Distance ⁸ (km)
1	WKKM	LIC	89.7	ETC	FM1-CP	3.34	0.007

Table 3: FM Radio Stations within 2 km of the Project Area with Separation Distances

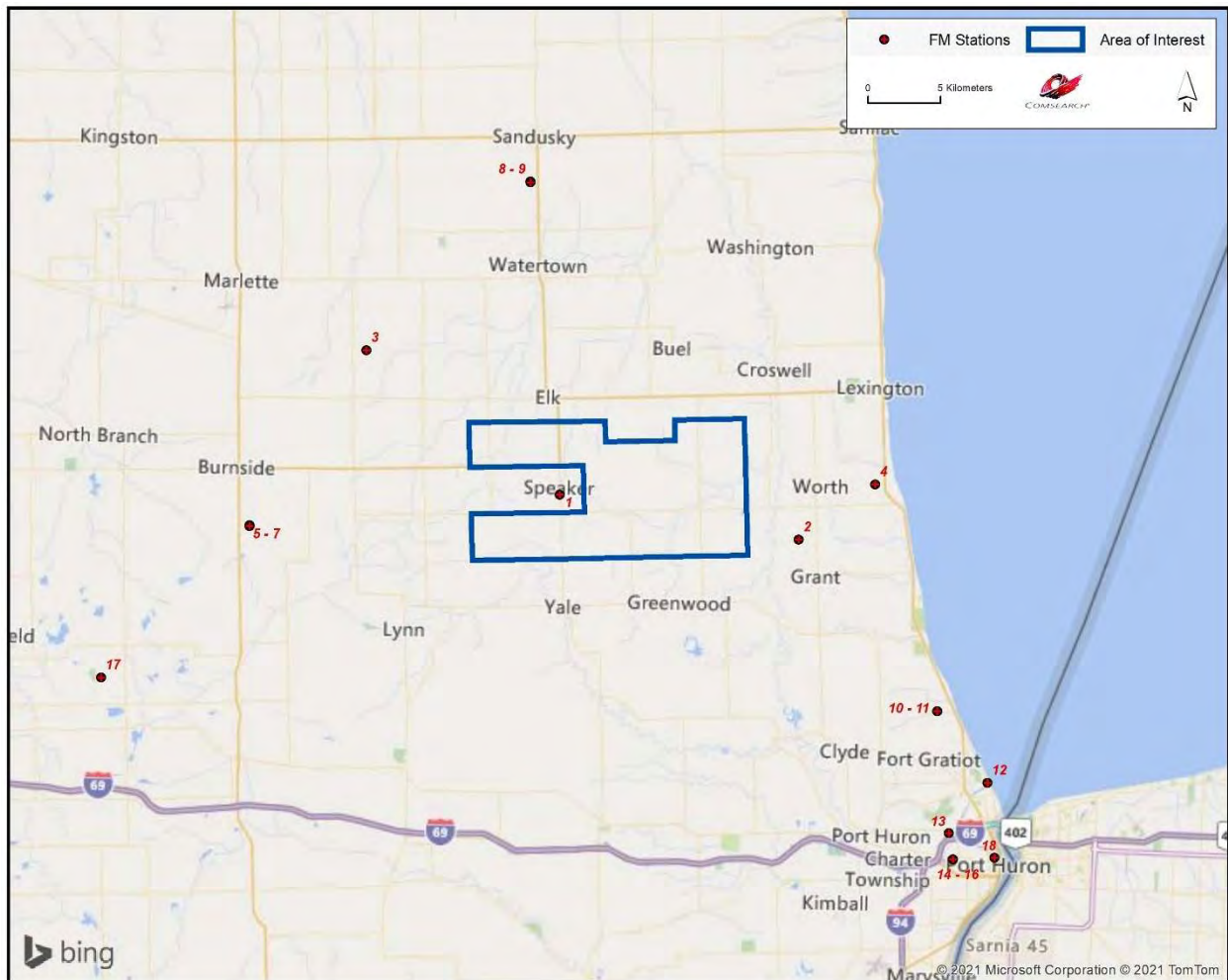


Figure 2: FM Radio Stations within 30 km

⁷ LIC = Licensed and operational station; APP = Application for construction permit; CP=Construction permit granted; CP MOD = Modification of construction permit.

⁸ Recommended minimum separation distance is based on the far field distance of the antenna or 1.5 km if no antenna information is available and includes separation from both the turbine towers and blades.

3. Impact Assessment

The exclusion distance for AM broadcast stations varies as a function of the antenna type and broadcast frequency. For directional antennas, the exclusion distance is calculated by taking the lesser of 10 wavelengths or 3 kilometers. For non-directional antennas, the exclusion distance is simply equal to 1 wavelength. Potential problems with AM broadcast coverage are only anticipated when AM broadcast stations are located within their respective exclusion distance limit from wind turbine towers. The closest AM station (WMIC) is located 16.53 km from the project. As there were no stations found within 3 kilometers of the project, which is the maximum possible exclusion distance based on a directional AM antenna broadcasting at 1000 KHz or less, the project should not impact the coverage of local AM stations.

The coverage of FM stations is generally not sensitive to interference due to wind turbines, especially when large objects (e.g., wind turbines) are located in the far field region of the radiating antenna to avoid the risk of distorting its radiation pattern. Station WKKM is the nearest FM station to the AOI at 1.2 km away. Based on the licensed antenna information, WKKM requires a minimum separation distance of 0.007 km from any turbine tower and blade. Since the station is located 1.2 km outside of the project AOI, there should be adequate separation to avoid radiation pattern distortion. All other FM stations are located 3.54 km or further from the AOI and would not be impacted by the wind project.

4. Recommendations

Since no impact on the licensed and operational AM and FM broadcast stations was identified in our analysis, no recommendations or mitigation techniques are required for AM and FM stations for this project.

5. Contact

For questions or information regarding the AM and FM Radio Report, please contact:

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Wind Power GeoPlanner™

Land Mobile & Emergency Services Report

Riverbend Wind Project



Prepared on Behalf of
Liberty Power

November 8, 2021



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1. Introduction

An assessment of the emergency services in the Riverbend Wind Project area was performed by Comsearch to identify potential impact from the planned turbines. We evaluated the registered frequencies for the following types of first responder entities: police, fire, emergency medical services, emergency management, hospitals, public works, transportation and other state, county, and municipal agencies. We also identified all industrial and business land mobile radio (LMR) systems and commercial E911 operators within the proposed wind energy facility boundaries. This information is useful in the planning stages of the wind energy facility because the data can be used in support of facility communications needs and to evaluate any potential impact on the emergency services provided in that region. An overview of the project area, which is located in Sanilac County, Michigan, appears below in Figure 1.



Figure 1: Area of Interest (AOI)

2. Summary of Results

Our land mobile and emergency services incumbent data¹ was derived from the FCC's Universal Licensing System (ULS) and the FCC's Public Safety & Homeland Security bureau. We identified both site-based licenses as well as regional area-wide licenses designated for public safety use.

Site-Based Licenses

The site-based licenses were imported into GIS software and geographically mapped relative to the wind energy project area of interest as defined by the customer. Each site on the map was given an ID number and associated with site information in a data table. A depiction of the fixed-site licenses in the project area appears in Figure 2.

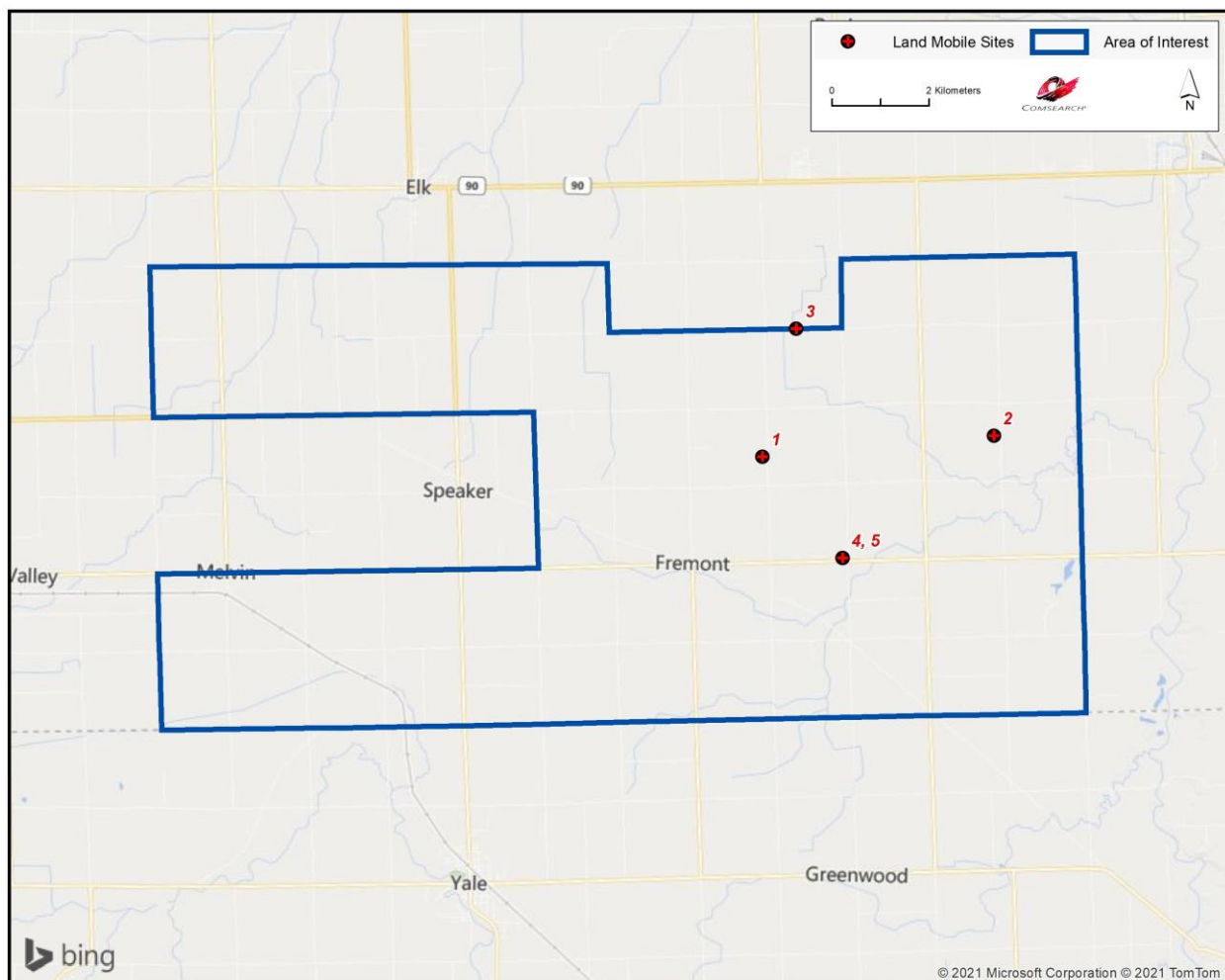


Figure 2: Land Mobile & Emergency Service Sites in Area of Interest

Figure 2 identifies five site-based licenses in the Riverbend Wind Project area of interest. Specific information about these sites is provided in Table 1.

ID	Call Sign	Frequency Band (MHz)	Licensee	Antenna Height AGL (m)	Latitude (NAD83)	Longitude (NAD83)
1	WQOQ761	150-174	BOB SHINN FARMS, LLC	20.0	43.210222	-82.726500
2	WQUN442	450-470	NOLL DAIRY FARM, INC.	20.0	43.214972	-82.667972
3	WQUP424	150-174	GORDON, FREDERICK	9.1	43.234028	-82.718583
4	WQZG559	150-174	Gardner Family Farming, LLC	14.0	43.191778	-82.705694
5	WRKB601	450-470	Gardner Family Farming, LLC	6.1	43.191778	-82.705694

Table 1: Land Mobile & Emergency Service Sites in Area of Interest

Mobile Licenses

In addition to the fixed-site licenses above, 287 mobile licenses defined by center point and radius were found to intersect the Riverbend Wind Project area. Appendix A contains a tabular summary of these stations.

Area-Wide Licenses

The regional area-wide licenses were compiled from FCC data sources and identified for each county intersected by the wind energy project area. The Riverbend Wind Project is located in Sanilac County, Michigan, part of Public Safety Region #21, which contains all the counties in Michigan. The regional public safety operations are overseen by the entity listed below.

Keith M. Bradshaw

Chair

Michigan Public Safety Communications System
42145 West Seven Mile Road, Northville, MI 48167

Phone: 248-380-1080

Email: bradshawk@michigan.gov

The chairperson for Region #21 serves as the representative for all public safety entities in the area and is responsible for coordinating current and future public safety use in the wireless spectrum. In the bands licensed by the FCC for area-wide first responders, which include 220 MHz, 700 MHz, 800 MHz and 4.9 GHz, as well as the traditional Part 90 public safety pool of

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frequencies, fifteen licenses were found for the State of Michigan and three for the County of Sanilac (see Table 2). These area-wide licenses are designated for mobile use only.

ID	Licensee	Area of Operation	Frequency Band (MHz)
1	AMERICAN NATIONAL RED CROSS	Statewide: MI	25-50
2	American National Red Cross	Statewide: MI	25-50
3	BERRIEN COUNTY PUBLIC SAFETY COMMUNICATION CENTER	Statewide: MI	150-174
4	BLAIR, TOWNSHIP OF	Statewide: MI	150-174
5	GRAND RAPIDS, CITY OF	Statewide: MI	150-174
6	LANSING, CITY OF	Statewide: MI	150-174
7	MARLETTE REGIONAL HOSPITAL	Countywide: SANILAC, MI	150-174
8	MICHIGAN DEPT OF Health and Human Services	Statewide: MI	450-470
9	MICHIGAN, STATE OF	Statewide: MI	0-10, 25-50, 150-174, 421-430, 450-470, 769-775/799-805, 800/900, 2450-2500, 4940-4990
10	Muskegon Central Dispatch 911	Statewide: MI	150-174
11	MUSKEGON, CITY OF	Statewide: MI	150-174
12	MUSKEGON, COUNTY OF	Statewide: MI	150-174
13	NATIONAL SKI PATROL SYSTEM INC	Statewide: MI	150-174
14	NORTHERN INDIANA SEARCH & RESCUE	Statewide: MI	150-174
15	SANILAC CO ROAD COMMISSION	Countywide: SANILAC, MI	450-470
16	SANILAC, COUNTY OF	Countywide: SANILAC, MI	150-174
17	STATE OF MICHIGAN, DEPT OF HEALTH AND HUMAN SERVICES	Statewide: MI	150-174
18	UNIVERSITY OF MICHIGAN HOSPITALS	Statewide: MI	150-174

Table 2: Regional Licenses

E911 Operators

Wireless operators are granted area-wide licenses from the FCC to deploy their cellular networks, which often include handsets with E911 capabilities. Since mobile phone market boundaries differ from service to service, we disaggregated the carriers' licensed areas down to the county level. We have identified the type of service for each carrier in Sanilac County, Michigan, in Table 3.

Mobile Phone Carrier	Service ²
AT&T	700 MHz, AWS, Cellular, PCS, WCS
DISH Network	700 MHz, AWS
TerreStar	AWS
Thumb Cellular	700 MHz, AWS, Cellular
T-Mobile	700 MHz, AWS, PCS
Verizon	700 MHz, AWS, PCS

Table 3: Mobile Phone Carriers in Area of Interest with E911 Service

3. Impact Assessment

The first responder, industrial/business land mobile sites, area-wide public safety, and commercial E-911 communications as described in this report are typically unaffected by the presence of wind turbines, and we do not anticipate any significant harmful effect to these services in the Riverbend Wind Project area. Although each of these services operates in different frequency ranges and provides different types of service including voice, video and data applications, there is commonality among these different networks with regard to the impact of wind turbines on their service. Each of these networks is designed to operate reliably in a non-line-of-sight (NLOS) environment. Many land mobile systems are designed with multiple base transmitter stations covering a large geographic area with overlap between adjacent transmitter sites in order to provide handoff between cells. Therefore, any signal blockage caused by the wind turbines does not materially degrade the reception because the end user is likely receiving signals from multiple transmitter locations. Additionally, the frequencies of operation for these services have characteristics that allow the signal to

² AWS: Advanced Wireless Service at 1.7/2.1 GHz
CELL: Cellular Service at 800 MHz
PCS: Personal Communication Service at 1.9 GHz
WCS: Wireless Communications Service at 2.3 GHz
700 MHz: Lower 700 MHz Service

propagate through wind turbines. As a result, very little, if any, change in their coverage should occur when the wind turbines are installed.

When planning the wind energy turbine locations in the area of interest, a conservative approach would dictate not locating any turbines within 77.5 meters of land mobile fixed-base stations to avoid any possible impact to the communications services provided by these stations. This distance is based on FCC interference emissions from electrical devices in the land mobile frequency bands. As long as the turbines are located more than 77.5 meters from the land mobile stations, they will meet the setback distance criteria for FCC interference emissions in the land mobile bands.

4. Recommendations

In the event that a public safety entity believes its coverage has been compromised by the presence of the wind energy facility, it has many options to improve its signal coverage to the area through optimization of a nearby base station or even adding a repeater site. Utility towers, meteorological towers or even the turbine towers within the wind project area can serve as the platform for a base station or repeater site.

5. Contact

For questions or information regarding the Land Mobile & Emergency Services Report, please contact:

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Web site:	www.comsearch.com

Appendix A

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
1	WPYU980	450-470	Aclara Technologies LLC	80.0	43.306389	-83.358861
2	WNVT752	450-470	ADAMIC, JOHN	40.0	43.175028	-83.067167
3	WPGI436	150-174	AL PARSCH OIL CO	40.0	43.050028	-83.111611
4	WQNE523	450-470	ALBERTSON, DANIEL	40.0	43.289722	-83.137500
5	KTJ777	25-50	ALBRECHT SAND & GRAVEL	45.0	43.418083	-82.982722
6	KNAZ541	450-470	ALLAN K SHAW INC	40.0	43.445583	-83.048556
7	WPMQ269	450-470	ALLEN ELECTRONICS INC	32.0	43.027250	-82.807972
8	WPQJ946	450-470	ALLEN ELECTRONICS INC	32.0	43.027250	-82.807972
9	KGL388	25-50	American National Red Cross	121.0	43.006139	-83.697444
10	WNJX618	150-174	ANCHOR BAY SCHOOL DISTRICT	121.0	42.742250	-82.685750
11	WPF288	800/900	ASHCROFT ITV INC	113.0	43.392528	-83.924139
12	KVU205	450-470	Auto Club Group	121.0	42.327528	-83.217417
13	WQNL855	450-470	Bader & Co DBA Tri County Equipment	25.0	43.048361	-83.102944
14	WQNL855	450-470	Bader & Co DBA Tri County Equipment	20.0	43.134667	-82.543389
15	WQNS531	450-470	Bader & Co DBA Tri County Equipment	25.0	43.214389	-82.922972
16	KPG474	150-174	BEASLEY MEDIA GROUP LICENSES, LLC	322.0	42.470861	-83.249917
17	WXM792	450-470	Bischer Farms Partnership	72.0	43.685583	-82.992167
18	WQOQ761	150-174	BOB SHINN FARMS, LLC	30.0	43.210222	-82.726500
19	WQSW395	450-470	Bordine Nursery, Ltd.	80.0	42.895333	-83.735389
20	WPTS874	150-174	BOY SCOUTS OF AMERICA	40.0	42.964194	-83.256611
21	WQPP649	150-174	BreitBurn Operating L.P.	40.0	43.259750	-83.268833
22	KB91389	450-470	BRINK'S INCORPORATED	121.0	42.330028	-83.049083
23	KD28632	450-470	BRINK'S INCORPORATED	121.0	43.416694	-83.983306
24	WNZR492	25-50	BROWN CITY, CITY OF	32.0	43.212528	-82.988833

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
25	WPZR706	150-174	BUSH, DONALD T	40.0	43.463361	-82.908000
26	WQNU354	150-174	CARSONVILLE PORT SANILAC SCHOOLS	40.0	43.431139	-82.630194
27	WNYB733	450-470	CENTRAL ALARM SIGNAL INC	120.0	42.431306	-83.177333
28	WPVL607	450-470	Central Alarm Signal, Inc.	120.0	42.431306	-83.177333
29	WQMI622	450-470	CINTAS FIRE PROTECTION	80.0	42.640306	-82.834222
30	WRFE944	450-470	City of Imlay City	32.0	43.021111	-83.066944
31	WQAE606	450-470	CITY OF TROY	80.0	42.562194	-83.154472
32	WNVT753	450-470	COLLINS, CLIFTON R	48.0	43.378083	-83.185778
33	WNXB460	450-470	ComSource Inc	115.0	42.555000	-83.687222
34	WPEA990	450-470	Comsource Inc	121.0	42.555000	-83.687222
35	WPGS686	450-470	ComSource Inc	121.0	42.555000	-83.687222
36	KZD560	150-174	CONLEY SECURITY	161.0	43.472250	-83.941639
37	WQNR911	150-174	CONSTANCE A. KREGER FARM DBA KREGER FARMS LLC	32.0	43.497333	-82.975556
38	WQYB386	150-174	Country View Bulk Foods	30.0	43.421667	-83.009750
39	WPTP499	150-174	CRESTHILL FARMS	40.0	43.436111	-82.673056
40	WQOU495	150-174	CSX Transporation	40.0	42.828944	-82.497639
41	WPRW821	150-174	D AND G RICH FARMS INC	40.0	43.341694	-82.714917
42	WQQR909	450-470	D ARCY FARMS, INC.	40.0	43.421972	-83.098833
43	WPJV529	450-470	DAIRY QUEEN	121.0	42.828917	-83.268000
44	WQSS343	450-470	DALE-STAMP FARMS	32.0	43.339722	-83.025556
45	WNFS239	150-174	DAVID W. BRUSIE & SONS INC.	56.0	43.220028	-83.136056
46	WPKW252	450-470	DAYTON HUDSON CORPORATION	120.0	42.330028	-83.049083
47	WQAC900	450-470	DD Transportation Services LLC	120.0	42.635583	-83.008611
48	WPFC689	450-470	DEARBORN PUBLIC SCHOOLS	121.0	42.338083	-83.163806

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
49	WNPB738	450-470	DEERING, PAMELA A:DEERING, BRYAN S DBA D & W SALVAGE, Inc.	48.0	42.868639	-82.970222
50	WPGS347	450-470	DeltaCom	113.0	42.371139	-83.076583
51	WQNI627	150-174, 450-470, 470-512	DETROIT TELEVISION STATION WKBD INC	100.0	42.483361	-83.311306
52	WPXE752	800/900	Detroit Transportation Corporation	113.0	42.333333	-83.051389
53	WPXE752	800/900	Detroit Transportation Corporation	113.0	42.331972	-83.044917
54	WNVA932	450-470	DON MARTIN TRANSPORT & SONS INC	56.0	43.483917	-83.089944
55	KA5423	450-470	DTE Electric Company	113.0	42.736694	-83.035500
56	KB8150	25-50	DTE Electric Company	120.0	42.738889	-83.666667
57	KD29960	450-470	DTE Electric Company	120.7	42.487528	-83.497722
58	KQB279	150-174	DTE Electric Company	40.0	42.926417	-82.463806
59	KQB280	150-174	DTE Electric Company	40.0	43.416694	-82.837167
60	KQB283	150-174	DTE Electric Company	40.0	43.035583	-83.320778
61	KZD60	150-174	DTE Electric Company	40.0	43.035583	-83.320778
62	KZD60	150-174	DTE Electric Company	40.0	43.416694	-82.837167
63	KZD60	150-174	DTE Electric Company	40.0	42.926417	-82.463806
64	WPME473	216-220	DTE Electric Company	200.0	42.333917	-83.057694
65	WQGE385	150-174	DTE Electric Company	40.0	43.196000	-82.514639
66	WRJA459	800/900	DTE Electric Company	113.0	43.410000	-83.368056
67	WRJA459	800/900	DTE Electric Company	113.0	42.453667	-83.298222
68	WRJA459	800/900	DTE Electric Company	113.0	43.794222	-83.112167
69	WRJA459	800/900	DTE Electric Company	113.0	42.802222	-83.110833
70	WRJA459	800/900	DTE Electric Company	113.0	43.417500	-82.815833
71	WRJA459	800/900	DTE Electric Company	113.0	43.809444	-82.788611
72	WNWX583	150-174	Durand, Tom	32.0	43.324194	-82.791611

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
73	WPQJ741	450-470	DYCK SECURITY SERVICES INC	56.0	42.962528	-82.428806
74	KEF534	450-470	DYCK SECURITY SERVICES INC	40.0	42.988917	-82.486028
75	KMH513	450-470	EASTPOINT COMMUNITY SCHOOLS	80.0	42.463083	-82.963528
76	WRFY453	450-470	Eggink, Bette	34.0	43.531222	-82.663889
77	KD3809	450-470	Enbridge Energy Company, Inc.	80.0	43.173056	-83.834444
78	KD3809	450-470	Enbridge Energy Company, Inc.	80.0	43.267222	-83.252500
79	WNVJ380	450-470	Enbridge Energy Company, Inc.	48.0	42.988917	-82.486028
80	KB78213	450-470	FCA US LLC	120.7	42.330028	-83.049083
81	WQAK831	150-174	Fischer, Allan P	40.0	43.357222	-83.050000
82	WPHM830	450-470	FLINT INSTITUTE OF MUSIC	80.0	43.000028	-83.666611
83	WNVC224	450-470	Ford Motor Company	121.0	42.314472	-83.211306
84	WNYM575	421-430	Ford Motor Company	80.0	42.835306	-83.087444
85	KUG820	25-50	FREEPORT AGGREGATE INC	121.0	42.184194	-83.269361
86	WQSG854	150-174	FRITZ, ARNOLD	80.0	43.801389	-83.200500
87	WQZG559	150-174	Gardner Family Farming, LLC	40.0	43.191778	-82.705694
88	WRKB601	450-470	Gardner Family Farming, LLC	32.0	43.191778	-82.705694
89	KNNK720	800/900	GENERAL MOTORS RESEARCH CORPORATION	113.0	42.715861	-83.263278
90	WPJX865	800/900	GENERAL MOTORS RESEARCH CORPORATION	113.0	42.258083	-83.401056
91	WPLV908	800/900	GENERAL MOTORS RESEARCH CORPORATION	113.0	42.465583	-83.040194
92	WPMW871	800/900	GENERAL MOTORS RESEARCH CORPORATION	113.0	42.985028	-83.716056
93	WQTS451	800/900	General Motors Research Corporation	113.0	42.382528	-83.044083
94	WQTU697	800/900	GENERAL MOTORS RESEARCH CORPORATION	113.0	43.029000	-83.632861
95	WQTU702	800/900	GENERAL MOTORS RESEARCH CORPORATION	113.0	42.972472	-83.794194
96	WQTU703	800/900	GENERAL MOTORS RESEARCH CORPORATION	113.0	42.692111	-83.397944
97	WQTU730	800/900	GENERAL MOTORS RESEARCH CORPORATION	113.0	42.672111	-83.283917

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
98	WQUN819	800/900	GENERAL MOTORS RESEARCH CORPORATION	113.0	43.012361	-83.701083
99	KNBG218	150-174	GENESEE, COUNTY OF	161.0	43.191972	-83.864972
100	WNUI683	150-174	GENTNER, KEITH	64.0	43.686972	-82.711333
101	WQRG711	150-174	GERSTENBERGER, ALAN	40.0	43.417250	-82.999944
102	WNPH624	150-174	Gordon, Blake	32.0	43.276417	-82.729083
103	WQUP424	150-174	GORDON, FREDERICK	32.0	43.234028	-82.718583
104	KLS622	150-174	GRAND TRUNK WESTERN RAILROAD COMPANY	40.0	42.963056	-82.462583
105	KNFX756	150-174	GRAND TRUNK WESTERN RAILROAD COMPANY	40.0	42.807250	-82.748639
106	KNHQ540	150-174	GRAND TRUNK WESTERN RAILROAD COMPANY	40.0	43.013361	-82.951056
107	KUP337	150-174	GRAND TRUNK WESTERN RAILROAD COMPANY	40.0	42.964083	-82.467917
108	KUS494	150-174	GRAND TRUNK WESTERN RAILROAD COMPANY	40.0	42.963056	-82.462583
109	WQTE656	450-470	Grand Trunk Western Railroad Company	40.0	42.964278	-82.482944
110	WQVF982	150-174	GRAND TRUNK WESTERN RAILROAD COMPANY	40.0	42.966111	-82.502000
111	WQYT248	150-174	GRAND TRUNK WESTERN RAILROAD COMPANY	40.0	43.049056	-83.310667
112	WQYT248	150-174	GRAND TRUNK WESTERN RAILROAD COMPANY	40.0	43.009722	-82.929278
113	WREY776	150-174	GRAND TRUNK WESTERN RAILROAD COMPANY	40.0	42.912972	-82.602972
114	WPTS248	150-174	GRANT, TOWNSHIP OF	13.0	43.135167	-82.581028
115	BLP00677	25-50, 150-174, 450-470, 470-512	GRAY TELEVISION LICENSEE, LLC	129.0	43.013917	-83.692444
116	KNAH775	450-470	Gray Television Licensee, LLC	113.0	43.230278	-84.058889
117	KNAH775	450-470	Gray Television Licensee, LLC	80.0	43.008333	-83.665556
118	KR9978	150-174	GRAY TELEVISION LICENSEE, LLC	113.0	43.230028	-84.059694
119	WPNX785	150-174	Gray Television Licensee, LLC	113.0	43.230306	-84.058861
120	WPEX767	150-174	GRAY, JAMES D	80.0	43.083361	-83.627444
121	WPGZ715	150-174	GREENWOOD, TOWN OF	21.0	43.095028	-82.714639

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
122	WNQN802	150-174	GROUT, JEFF	56.0	43.277528	-82.677139
123	WQFG900	450-470	Guardian Alarm Co. of Michigan	80.0	42.524639	-83.223500
124	KNBE478	150-174	HAMILTON FEED & FUEL	80.0	42.855861	-83.439944
125	WPEA750	150-174	HARRAR, JOHN	32.0	43.446694	-82.687972
126	WQDB422	450-470	HARTUNG BROTHERS INC	32.0	43.022861	-83.086056
127	WQVY373	450-470	HEUSSNER, SCOTT M	30.0	43.416056	-83.043417
128	WPLW868	450-470	HI SPEC TUBING INC	24.0	43.341417	-83.094111
129	KC25111	450-470	HOLY FAMILY COMMUNICATIONS, INC	402.0	40.766167	-83.837167
130	WQOP859	150-174	Huron & Eastern Railway Company	30.0	43.212167	-82.989167
131	WNGA577	450-470	IMLAY CITY COMMUNITY SCHOOLS	32.0	43.015306	-83.088833
132	WQLA777	450-470	I-Q LIFE SAFETY SYSTEMS	80.0	42.672222	-83.341389
133	WQEH497	450-470	JCPENNEY SHARED SERVICES CENTER	32.0	43.036944	-82.456667
134	WPSI355	450-470	JERRYS MARKET	121.0	42.203889	-83.166944
135	WNDU907	450-470	KIMMEL, JAMES L	64.0	43.404472	-83.473556
136	KQH608	25-50	KOCIAN, MARY	121.0	42.435028	-83.477167
137	WPLV357	150-174	KOHLER OIL & PROPANE CO	40.0	43.211417	-83.003000
138	WQRJ692	150-174	KUBACKI, DANIEL	40.0	43.587889	-82.935944
139	WNWI452	450-470	LAKE SHORE PUBLIC SCHOOLS	121.0	42.523917	-82.879917
140	WPEN914	150-174	LAKE STATE RAILWAY COMPANY	128.0	44.265861	-83.491639
141	KXA791	150-174	LAPEER COUNTY INTERMEDIATE SCHOOLS	40.0	43.045306	-83.314667
142	WPJT364	800/900	Louchart Enterprises L.L.C.	113.0	43.704472	-84.010250
143	KNRT993	800/900	LOUCHART ENTERPRISES LLC	113.0	43.259750	-83.951361
144	WPAV933	450-470	Louchart Enterprises LLC	64.0	43.322806	-83.376333
145	WPAV933	450-470	Louchart Enterprises LLC	64.0	43.625028	-83.074944
146	WPBD347	800/900	Louchart Enterprises LLC	113.0	43.704472	-84.010250

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
147	WPGI852	800/900	LOUCHART ENTERPRISES LLC	113.0	43.259750	-83.951361
148	WQIP973	150-174	Lowe, Alan	40.0	43.560556	-83.016389
149	KNDC583	25-50	M.J. Electric, LLC	121.0	42.215306	-83.348556
150	WRCE668	150-174	Maedel, Steven	32.0	43.330528	-82.773222
151	KTH457	450-470	MARLETTE COMMUNITY SCHOOLS	29.0	43.175028	-83.067167
152	WQZC207	450-470	Material Control Inc	16.0	43.285556	-82.616389
153	KBP604	150-174	MAYVILLE AREA AMBULANCE SERVICE	56.0	43.335306	-83.351611
154	WNWD539	150-174	MAYVILLE COMMUNITY SCHOOLS	40.0	43.333361	-83.352722
155	WPJT750	150-174	MC ALLISTER, DUANE R	40.0	43.265306	-82.868278
156	KIY254	150-174	MC KEE CHAPMAN DAIRY	40.0	43.243083	-83.109667
157	WPXN209	150-174	MC KENZIE MEMORIAL HOSPITAL	40.0	43.334194	-82.830500
158	WNNZ224	450-470	MCCONNACHIE FARMS INC	72.0	43.512250	-82.709389
159	WRJC239	450-470	McConnachie, Jason	32.0	43.502472	-82.732778
160	BLP01056	25-50	MEREDITH CORPORATION	121.0	43.433361	-83.938028
161	BLP01476	150-174, 450-470, 470-512	MEREDITH CORPORATION	92.0	43.470556	-83.843333
162	WQVY260	150-174	MICHIGAN AGRICULTURAL COMMODITIES	32.0	43.321611	-83.080833
163	WQVY260	450-470	MICHIGAN AGRICULTURAL COMMODITIES	38.0	43.321611	-83.080833
164	WQVY260	150-174	MICHIGAN AGRICULTURAL COMMODITIES	32.0	43.209472	-82.976861
165	WQVY260	450-470	MICHIGAN AGRICULTURAL COMMODITIES	38.0	43.209472	-82.976861
166	WPTX922	450-470	MICHIGAN SUGAR CO.	20.0	43.283889	-82.608056
167	WPTX922	450-470	MICHIGAN SUGAR CO.	32.0	43.283889	-82.608056
168	WNNN685	450-470	MID MICHIGAN REPEATERS	80.0	43.175028	-83.067167
169	WNRC864	450-470	Mid Michigan Repeaters	80.0	43.175028	-83.067167
170	WNWB676	450-470	Mid Michigan Repeaters	56.0	43.686111	-82.994444

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
171	WPBW223	450-470	MID MICHIGAN REPEATERS	72.0	43.175028	-83.067167
172	WPKD943	450-470	MID MICHIGAN REPEATERS	80.0	43.685583	-82.992167
173	WPKT239	450-470	MID MICHIGAN REPEATERS	32.0	42.922528	-82.651028
174	WPKV292	450-470	MID MICHIGAN REPEATERS	80.0	43.175028	-83.067167
175	WPRL353	450-470	MID MICHIGAN REPEATERS	32.0	43.175028	-83.067167
176	KNDB286	450-470	MID-MICHIGAN REPEATERS	80.0	43.758361	-83.097444
177	KRL995	25-50	MONTGOMERY AND SONS INC	121.0	42.707806	-83.303833
178	WQSU235	450-470	MUXLOW STOCK FARM, INC.	15.0	43.255917	-83.046611
179	KLM573	150-174	NEW WORLD COMMUNICATIONS OF DETROIT, INC.	120.0	42.460583	-83.213806
180	KYY292	450-470	NEW WORLD COMMUNICATIONS OF DETROIT, INC.	120.0	42.460583	-83.213806
181	WQUN442	450-470	NOLL DAIRY FARM, INC.	32.0	43.214972	-82.667972
182	WNCG984	450-470	NORTH BRANCH SCHOOLS	32.0	43.270861	-83.222167
183	WNPL890	450-470	NOVAK, GERALD E	40.0	43.331694	-83.353833
184	WPPA702	150-174	OPIFICIUS, GERALD	40.0	43.064194	-82.900222
185	WNUY386	421-430	OXFORD EMERGENCY SAFETY AUTHORITY	80.0	42.820861	-83.259111
186	WQQA659	450-470	P&C Ag Solutions LLC	25.0	43.370583	-82.928000
187	WPIF912	800/900	PDV Spectrum Holding Company, LLC	113.0	42.437500	-83.474444
188	WPIF912	800/900	PDV Spectrum Holding Company, LLC	80.0	42.701417	-83.253000
189	WPIF912	800/900	PDV Spectrum Holding Company, LLC	113.0	42.331944	-83.045000
190	WPIM743	800/900	PDV Spectrum Holding Company, LLC	113.0	42.484194	-83.463000
191	WPIM743	800/900	PDV Spectrum Holding Company, LLC	113.0	42.331944	-83.045000
192	WPLP521	800/900	PDV Spectrum Holding Company, LLC	113.0	42.216972	-83.333278
193	WPLZ282	800/900	PDV Spectrum Holding Company, LLC	113.0	42.331972	-83.044917
194	WPMA468	800/900	PDV Spectrum Holding Company, LLC	113.0	42.437500	-83.474444
195	WPMA468	800/900	PDV Spectrum Holding Company, LLC	113.0	42.713083	-83.228833

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
196	WPMH625	800/900	PDV Spectrum Holding Company, LLC	113.0	42.330028	-83.049083
197	WPMV760	800/900	PDV Spectrum Holding Company, LLC	113.0	42.331944	-83.045000
198	WPPY535	800/900	PDV Spectrum Holding Company, LLC	113.0	42.713083	-83.228833
199	WPPZ808	800/900	PDV Spectrum Holding Company, LLC	113.0	42.713083	-83.228833
200	WPPZ905	800/900	PDV Spectrum Holding Company, LLC	113.0	42.713083	-83.228833
201	WPRV772	800/900	PDV Spectrum Holding Company, LLC	113.0	42.331944	-83.045000
202	WPSH867	800/900	PDV Spectrum Holding Company, LLC	113.0	42.331972	-83.044917
203	WPTM987	800/900	PDV Spectrum Holding Company, LLC	113.0	42.458639	-83.121583
204	WPVM619	800/900	PDV Spectrum Holding Company, LLC	113.0	42.683333	-83.552778
205	WPVM619	800/900	PDV Spectrum Holding Company, LLC	113.0	42.331944	-83.045000
206	WPVT932	800/900	PDV Spectrum Holding Company, LLC	113.0	42.331944	-83.045000
207	WPYP818	800/900	PDV Spectrum Holding Company, LLC	113.0	42.331944	-83.045000
208	WQTD794	800/900	PDV Spectrum Holding Company, LLC	113.0	42.437778	-83.311667
209	WQTE377	800/900	PDV Spectrum Holding Company, LLC	113.0	42.437778	-83.311667
210	WPQD711	450-470	PHILLIPS, DALE	30.0	43.306139	-83.044111
211	WQRY713	450-470	PINE KNOB SKI RESORT	80.0	42.742250	-83.367167
212	WPAU493	150-174	PORT HURON AREA SCHOOLS	40.0	42.952806	-82.482694
213	WPGF913	450-470	PORT HURON HOSPITAL	40.0	42.986417	-82.429917
214	WPGF913	450-470	PORT HURON HOSPITAL	32.0	42.986778	-82.429722
215	WPZY272	150-174	Port Huron Hospital	40.0	42.986722	-82.427778
216	KB94493	150-174	PORT HURON, CHARTER TOWNSHIP OF	56.0	42.980306	-82.478806
217	KQK500	150-174	PORT HURON, CHARTER TOWNSHIP OF	56.0	42.980306	-82.478806
218	KNJC601	150-174	PORT HURON, CITY OF	32.0	43.016972	-82.439639
219	WQEV221	450-470	PORTILLO'S HOT DOGS LLC	80.0	42.626306	-82.984778
220	WPCA219	150-174	QUANDT, DENNIS	56.0	43.303083	-82.851056

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
221	WQSM399	150-174	QUANTUM RESOURCES	40.0	43.259750	-83.268833
222	WRDZ634	800/900	REPEATER SYSTEMS INC	113.0	42.701389	-83.253056
223	WQYH817	150-174	Rickett Jr, Don:Rickett Sr, Don DBA Rickett Farms	32.0	43.427806	-82.661028
224	KNNT443	800/900	Road Commission for Oakland County	113.0	42.742222	-83.391944
225	WNKT340	450-470	ROBINSON, JAMES G	80.0	43.685583	-82.992167
226	WPXI676	450-470	ROBINSON, MARY A	32.0	43.175000	-83.067222
227	WPAL978	450-470	ROBINSON, MARY ANN	56.0	42.922528	-82.651028
228	WPCA542	450-470	ROBINSON, MARY ANN G	56.0	42.922528	-82.651028
229	WPDI236	450-470	ROBINSON, MARY ANN G	64.0	43.175028	-83.067167
230	KNIB689	150-174	ROCK WAY INC	120.7	42.209472	-83.382722
231	KNIB689	150-174	ROCK WAY INC	120.7	42.158917	-83.178250
232	KNIB689	150-174	ROCK WAY INC	120.7	42.458639	-83.121583
233	WREY660	450-470	Rodzoz Family Farms, Inc.	80.0	42.932778	-82.840139
234	WNRW280	450-470	RUGGLES FARM	64.0	43.327250	-83.068000
235	WPMX834	150-174	SAINT CLAIR, COUNTY OF	32.0	43.010306	-82.933833
236	WPMX834	150-174	SAINT CLAIR, COUNTY OF	32.0	42.983639	-82.654639
237	WPYR888	150-174	SANDUSKY COMMUNITY SCHOOLS	40.0	43.414722	-82.820278
238	WPXZ946	450-470	SANDUSKY, CITY OF	32.0	43.418889	-82.819444
239	WQCC275	150-174	Sanilac County Health Department	32.0	43.418639	-82.910778
240	KZF304	150-174	SANILAC INTERMEDIATE SCHOOL DISTRICT	40.0	43.421972	-82.826333
241	KYM361	450-470	SCHMANDT FARMS	64.0	43.337806	-83.332722
242	KPF376	150-174	SCRIPPS BROADCASTING HOLDINGS LLC	354.0	42.470583	-83.250194
243	WPYC618	450-470	SCRIPPS BROADCASTING HOLDINGS LLC	100.0	42.470556	-83.250278
244	WQAC634	450-470	SCRIPPS BROADCASTING HOLDINGS LLC	100.0	42.470556	-83.250278
245	WYR216	450-470	SCRIPPS BROADCASTING HOLDINGS LLC	80.0	42.496139	-82.974361

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
246	WPUF542	450-470	Security Central Protection	120.0	42.454833	-83.174500
247	KNJA267	150-174	SIEMEN, LARRY	64.0	43.788083	-82.724111
248	WQVR331	450-470	SKS FARMS, LLC	32.0	43.444806	-83.059917
249	WRCM481	450-470	SPECTRUM HOLDINGS INCORPORATED	32.0	43.150361	-82.627778
250	WYQ292	150-174	SPENCER FARMS INC	72.0	42.951417	-83.023556
251	WPKW413	150-174	SPEZIA, RICHARD	24.0	43.268917	-83.136611
252	WQNP952	450-470	St. Clair County Regional Educational Service Agency	32.0	42.983639	-82.656306
253	WPJT372	800/900	STANLEY ALARMS INC	113.0	43.704472	-84.010250
254	WSP405	150-174	STEMPEL, WILLIAM O	32.0	43.306694	-82.986611
255	WQPG357	450-470	Stoutenberg Farms LLC	25.0	43.409833	-82.850694
256	WSS669	450-470	STOUTENBURG FARMS	32.0	43.424278	-82.804472
257	WNWD877	150-174	STUEVER, ALFRED C	40.0	43.098083	-82.940222
258	WPTW814	25-50, 150-174	T. & J. INC.	32.0	42.948056	-82.562500
259	WPII329	450-470	TANGLEWOOD GOLF COURSE	113.0	42.452806	-83.651611
260	WPEA445	800/900	Teletrac License Inc.	80.0	42.709472	-83.230222
261	WPEA445	800/900	Teletrac License Inc.	80.0	42.731139	-83.038278
262	WPEA445	800/900	Teletrac License Inc.	80.0	42.544194	-82.902417
263	WQSL616	150-174	THOM, DONALD	40.0	43.273361	-82.748556
264	WPEM814	150-174	THORMAN, MICHEAL	56.0	43.115583	-83.137444
265	WNGC872	450-470	THUMB RADIO INC	72.0	43.685583	-82.992167
266	WNNZ225	450-470	Thumb Radio Inc	72.0	43.273361	-82.616028
267	WSZ720	450-470	TINSEY, GILBERT:HASEN, FRED L DBA T & H FARMS	80.0	43.685583	-82.992167
268	WQTD992	150-174	TODD FARMS LLC	24.0	43.247528	-82.679083
269	WSF976	150-174	TUCKEY CONCRETE INC	56.0	43.600306	-83.191056
270	WPGT417	800/900	TUSCOLA, COUNTY OF	113.0	43.503917	-83.391889

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
271	WPGN494	800/900	TUSCOLA, COUNTY OF Central Dispatch	113.0	43.505028	-83.395222
272	WNJV808	421-430	UNIVERSAL MACOMB AMBULANCE SERVICE INC	80.0	42.562528	-83.041583
273	WRAK751	450-470	Vandamme, Bill	12.0	43.214167	-82.922500
274	WQMN631	450-470	Vigilante Security, Inc	80.0	42.489056	-83.221944
275	WQMN631	450-470	Vigilante Security, Inc	80.0	42.540750	-83.181528
276	WQYC775	150-174	Vincent, James	32.0	43.129222	-82.701000
277	WRAU295	450-470	Walbro, LLC	80.0	43.595750	-83.180778
278	WNAA676	150-174	WALTON, NORMAN:WALTON, WARREN:WALTON, GA DBA NORMAN WALTON & SONS	48.0	43.084472	-83.110222
279	WQYC255	450-470	Weaverland Farms	32.0	43.437278	-82.869250
280	WQEZ435	150-174	WENGER, NEVIN	40.0	43.374833	-82.983806
281	WNVE229	150-174	WHITICAN, CLIFF	56.0	43.041694	-82.550194
282	WQHB974	450-470	Wood, Dale R	32.0	43.359444	-83.019444
283	WPXH934	150-174	Wood, Matt	32.0	43.337861	-83.105361
284	WPMK809	25-50	YALE PUBLIC SCHOOLS	75.0	43.130028	-82.799083
285	WNPI529	450-470	ZIMBA FARMS	48.0	43.486972	-83.121333
286	WQVQ913	150-174	ZIMMERMAN, DARRELL	35.0	43.427889	-82.988889
287	WSP404	150-174	ZIMMERMAN, PAUL	40.0	43.518917	-82.964667

Table A: Mobile Licenses Intersecting Project Area

Wind Power GeoPlanner™

Microwave Study

Riverbend Wind Project



Prepared on Behalf of
Liberty Power

November 9, 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: Riverbend Wind Project

County: Sanilac

State: Michigan

Number of Turbines: TBD

Blade Diameter: 162 meters

Hub Height: 119 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 GHz¹. First, we determined all microwave paths that intersect the area of interest² and listed them in Table 1. This path and the area of interest that encompasses the planned turbine locations are shown in Figure 2.

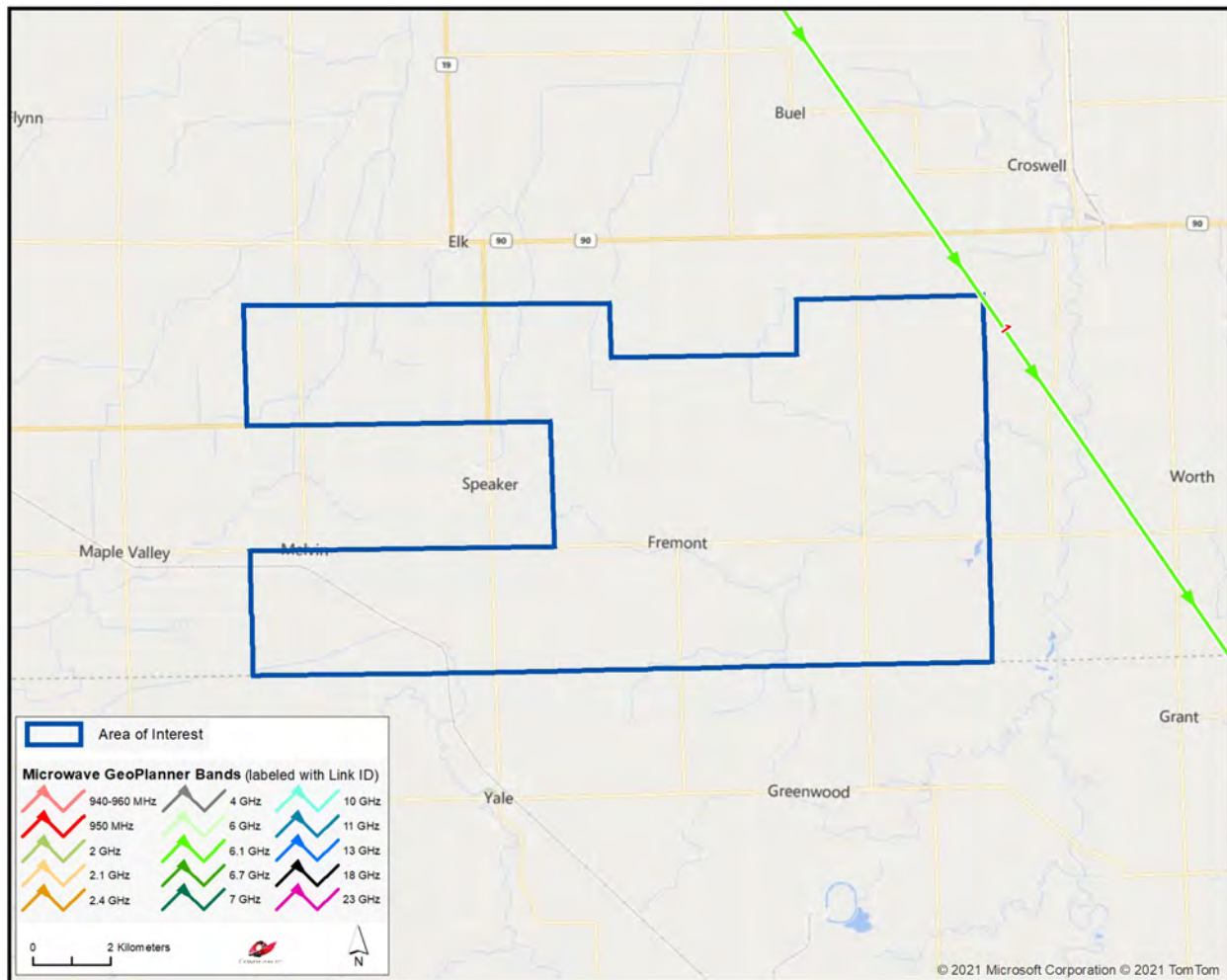


Figure 2: Microwave Paths that Intersect the Area of Interest

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

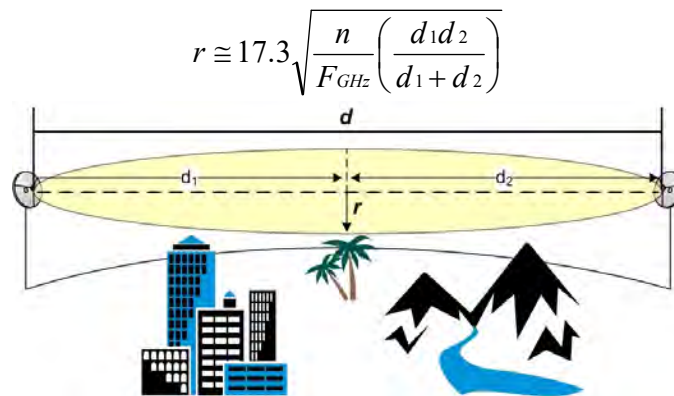
² We use FCC-licensed coordinates to determine which paths intersect the area of interest. It is possible that as-built coordinates may differ slightly from those on the FCC license.

ID	Status	Callsign 1	Callsign 2	Band	Path Length (km)	Licensee
1	Licensed	WPJD618	WPJD610	6.1 GHz	40.11	Michigan, State Of

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:



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
- d₁ = Distance from antenna 1 to a specific point in the microwave path, kilometers
- d₂ = 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. 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 individual Fresnel and Consultation Zones is shown in Figure 3, and is also included in the shapefiles^{3,4}.

³ The ESRI® shapefiles enclosed are in NAD 83 UTM Zone 17 projected coordinate system.

⁴ 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.

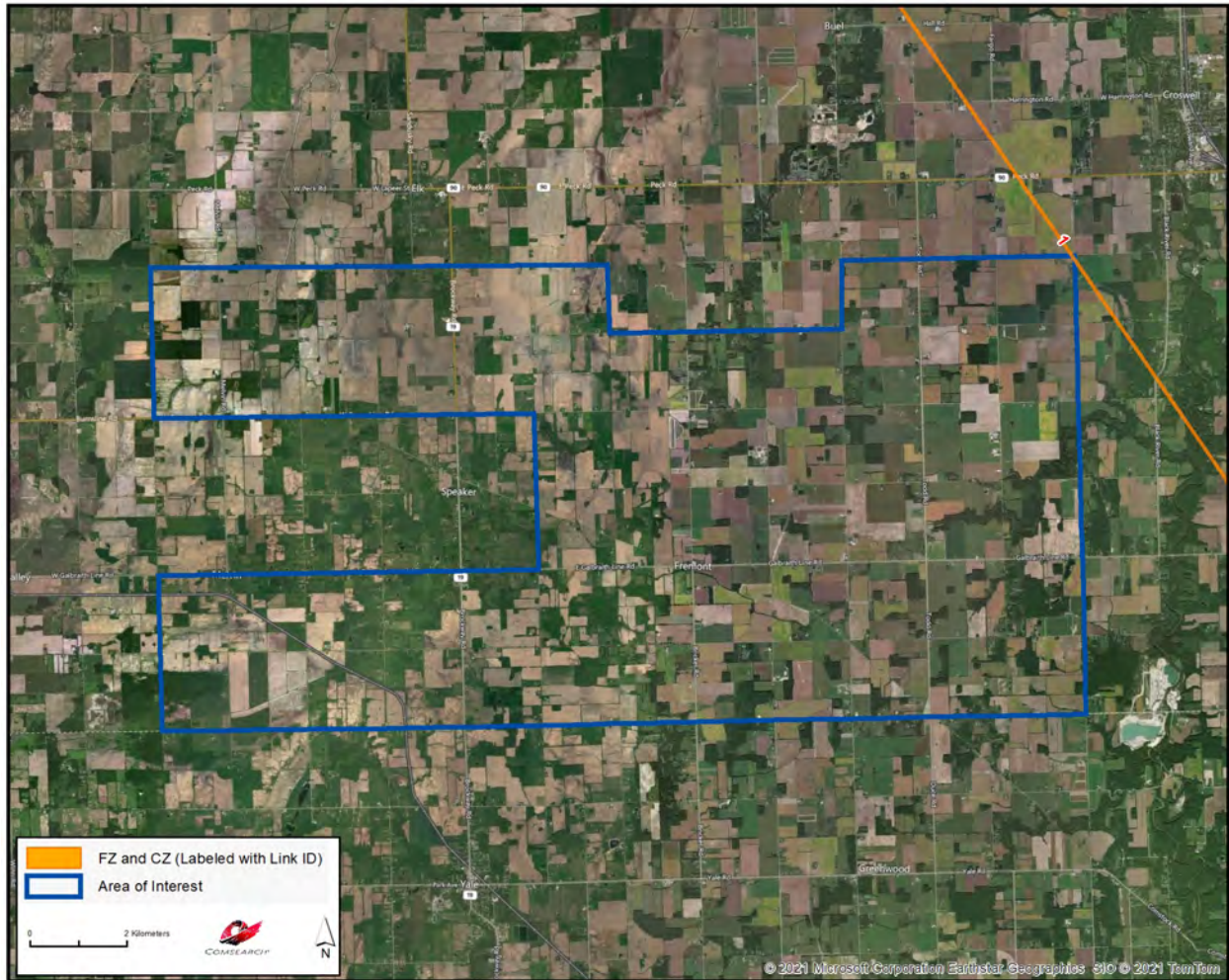


Figure 3: Fresnel and Consultation Zones in the Area of Interest

Discussion of Potential Obstructions

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines intersecting Fresnel Zones
1	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 one microwave path intersecting the Riverbend Wind Project area. The Fresnel and Consultation Zones for these microwave paths were calculated and mapped. We recommend that all turbines be sited in locations that will not encroach on these exclusion zones.

5. Contact

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Wind Power GeoPlanner™

Mobile Phone Carrier Report

Riverbend Wind Project



Prepared on Behalf of
Liberty Power

November 8, 2021



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1. Introduction

Comsearch has developed and maintains comprehensive technical databases containing information on licensed mobile phone carriers across the US. Mobile phone carriers operate in multiple frequency bands and are often referred to as Advanced Wireless Service (AWS), Personal Communication Service (PCS), 700 MHz Band, Wireless Communications Service (WCS), and Cellular. They hold licenses on an area-wide basis which are typically comprised of several counties.

This report focuses on the potential impact of wind turbines on mobile phone operations in and around the project area.

2. Summary of Results

Methodology

Our mobile phone analysis was performed using Comsearch's proprietary carrier database, which is derived from a variety of sources including the Federal Communications Commission (FCC). Since mobile phone market boundaries differ from service to service, we disaggregated the carriers' licensed areas down to the county level. Then we compiled a list of all mobile phone carriers in the main counties that intersect the area of interest. The area of interest was defined by the client and encompasses the planned turbine locations. A depiction of the wind project area and counties appears below.

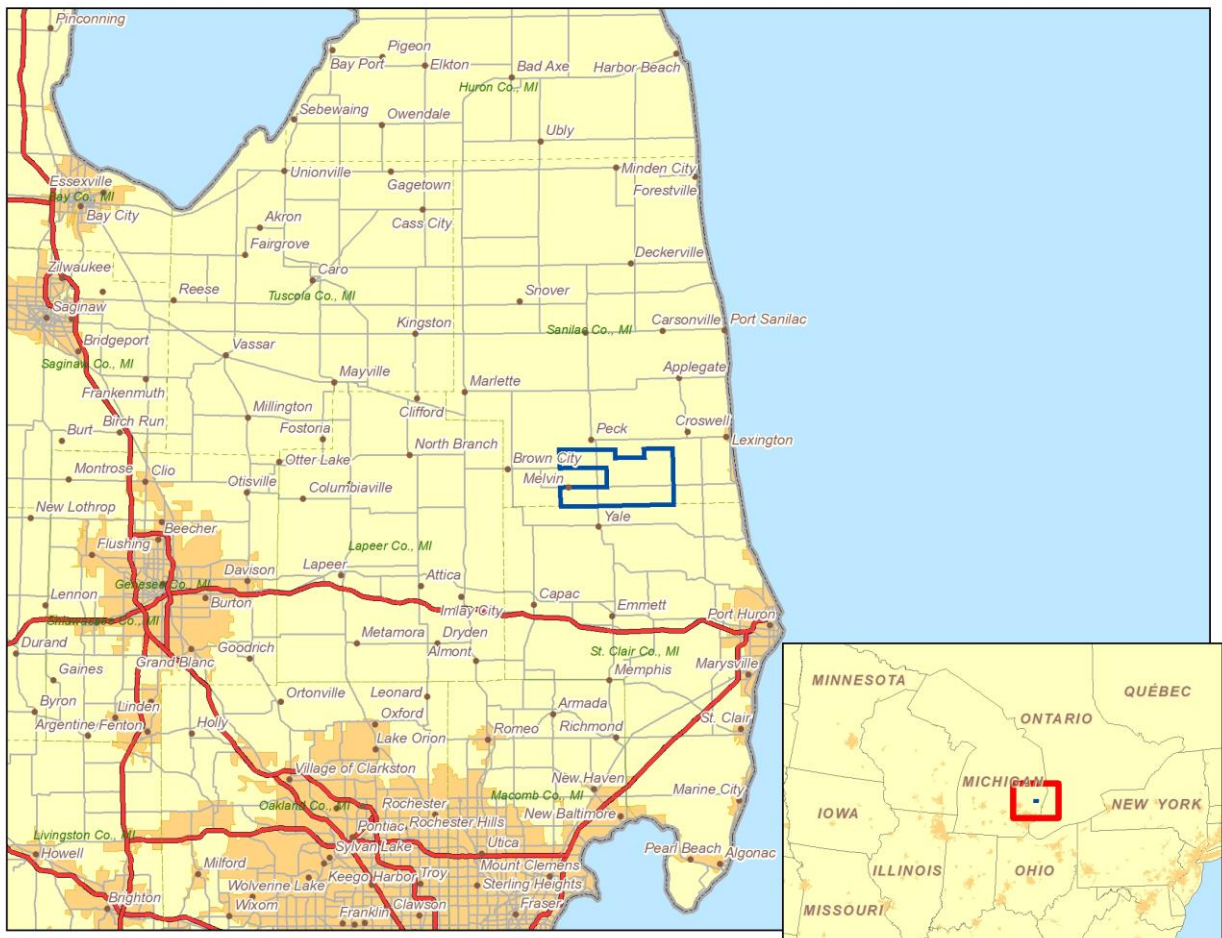


Figure 1: Counties that intersect the Area of Interest

Results

The Riverbend Wind Project is located in Sanilac County, Michigan. We have identified the type of service, channel block, market ID and FCC callsign for each carrier in the county of interest. A description of the various service types and geographic market areas is below with a summary table on the following page.

AWS

AWS licensees won their spectrum in an auction that started in August 2006. The licensees are authorized by 734 Cellular Market Areas (CMA) for Block A, 176 Economic Areas (BEA) for Blocks B and C, and 12 Regional Economic Area Groupings (REAG) for Blocks D, E and F. This spectrum at 1.7 and 2.1 GHz was allocated for mobile broadband and advanced wireless services. Partitioning and leases are permitted in the band.

Cellular

Licensees are authorized by Metropolitan and Rural Statistical Areas, also known as CMAs. Unserved areas can be covered by licensees other than the original A or B block licensee. To determine the most realistic coverage, we compiled the Cellular Geographic Service Areas (CGSA) from the 32 dBu contours defined by Part 22.911(a) of the FCC rules. Mobile services are provided at 800 MHz and partitioning and leases are permitted in the band.

PCS

There have been nine auctions for this band, with the last one being held in August 2008. Licensees are authorized by 51 Major Trading Areas (MTA) for Blocks A and B, 493 Basic Trading Areas (BTA) for Blocks C through F, and 176 Economic Areas (EA) for Block G. This band has been heavily partitioned and disaggregated both by counties and by smaller polygons within counties (known as undefined areas or partial counties). The 1.9 GHz PCS carriers provide mobile services and leases are permitted in the band.

700 MHz Band

Originally used for analog television broadcasting, this band consists of an upper and lower band, each having its own set of frequency blocks. There have been three auctions in this band with the last one (Auction 73) being held in 2008 and mobile phone carriers eventually winning licenses for Blocks A, B, and C of the Lower 700 MHz band and Block C of the Upper 700 MHz band. Licensees are authorized by 176 Economic Areas (EA) for Lower Block A, 734 Cellular Market Areas (CMA) for Lower Blocks B and C, and 12 Regional Economic Area Groupings (REAG) for Upper Block C. Partitioning and leases are permitted in the band.

WCS

Mobile services provided in the 2.3 GHz band occupy frequency blocks above and below the spectrum allocated for Satellite Digital Audio Radio Service (SDARS) from 2320 MHz to 2345 MHz. WCS licensees are authorized by 52 Major Economic Areas (MEA) for Blocks A and B and 12 Regional Economic Area Groupings (REAG) for Blocks C and D. Partitioning and leases are permitted in the band.

Service ¹	Mobile Phone Carrier	Channel Block	County	ST	Market ID	Callsign
700 MHz	T-Mobile	Lower A	Sanilac	MI	BEA057	WQJQ705
700 MHz	Thumb Cellular	Lower B	Sanilac	MI	CMA481	WQIZ357
700 MHz	Thumb Cellular	Lower C	Sanilac	MI	CMA481	WPWU888
700 MHz	AT&T	Lower D	Sanilac	MI	EAG704	WPZA238
700 MHz	DISH Network	Lower E	Sanilac	MI	BEA057	WQJY997
700 MHz	Verizon	Upper C	Sanilac	MI	REA003	WQJQ691
AWS	Thumb Cellular	A	Sanilac	MI	CMA481	WQGL809
AWS	T-Mobile	B	Sanilac	MI	BEA057	WQPZ989
AWS	T-Mobile	C	Sanilac	MI	BEA057	WQGA726
AWS	Verizon	D	Sanilac	MI	REA003	WQPW450
AWS	Verizon	E	Sanilac	MI	REA003	WQPZ950
AWS	Verizon	F	Sanilac	MI	REA003	WQGA717
Cellular	AT&T	A	Sanilac	MI	CMA481	KNKN711
Cellular	Thumb Cellular	B	Sanilac	MI	CMA481	KNKQ268
PCS	AT&T	A	Sanilac	MI	MTA005	KNLF210
PCS	Sprint	B	Sanilac	MI	MTA005	KNLF211
PCS	Verizon	B	Sanilac	MI	MTA005	WQYH213
PCS	Sprint	B	Sanilac	MI	MTA005	WQYL209
PCS	T-Mobile	C	Sanilac	MI	BTA112	WPOL262
PCS	AT&T	C	Sanilac	MI	BTA112	WQFA877
PCS	Verizon	D	Sanilac	MI	BTA112	KNLH202
PCS	Sprint	E	Sanilac	MI	BTA112	KNLH289
PCS	AT&T	F	Sanilac	MI	BTA112	KNLF970
PCS	Sprint	G	Sanilac	MI	BEA057	WQKT271
WCS	AT&T	A	Sanilac	MI	MEA016	KNLB304
WCS	AT&T	B	Sanilac	MI	MEA016	KNLB278
WCS	AT&T	C	Sanilac	MI	REA003	WPQL632
WCS	AT&T	D	Sanilac	MI	REA003	KNLB325

Table 1: Mobile Phone Carriers in the Area of Interest

¹ AWS: Advanced Wireless Service at 1.7/2.1 GHz
 CELL: Cellular Service at 800 MHz
 PCS: Personal Communication Service at 1.9 GHz
 700 MHz: Commercial Mobile Phone at 700 MHz
 WCS: Wireless Communication Service at 2.3 GHz

FCC-Licensed Sites

For competitive and confidentiality reasons, most mobile phone carriers' individual sites are not licensed with the FCC. However, in the cellular band, if a base station extends the existing Cellular Geographic Service Area (CGSA), then it must be recorded with the FCC. We identified three cellular sites near the Riverbend Wind Project area of interest. Figure 2 on the next page depicts their locations in relation to the area of interest and Table 2 contains the technical parameters on the FCC license.

Callsign	Licensee	Structure Height to Tip (m)	ASR Number	Location Address	Latitude (NAD83)	Longitude (NAD83)
KNKN711	AT&T	97.2	1057269	7042 ARENDT ROAD (94876)	43.214444	-82.845833
KNKQ268	Thumb Cellular	97.2	1057269	7042 ARENDT ROAD	43.214444	-82.845833
KNKA231	AT&T	93.9	1225772	11800 Jeddo Road (107516)	43.145944	-82.811306

Table 2: FCC-Licensed Mobile Phone Sites

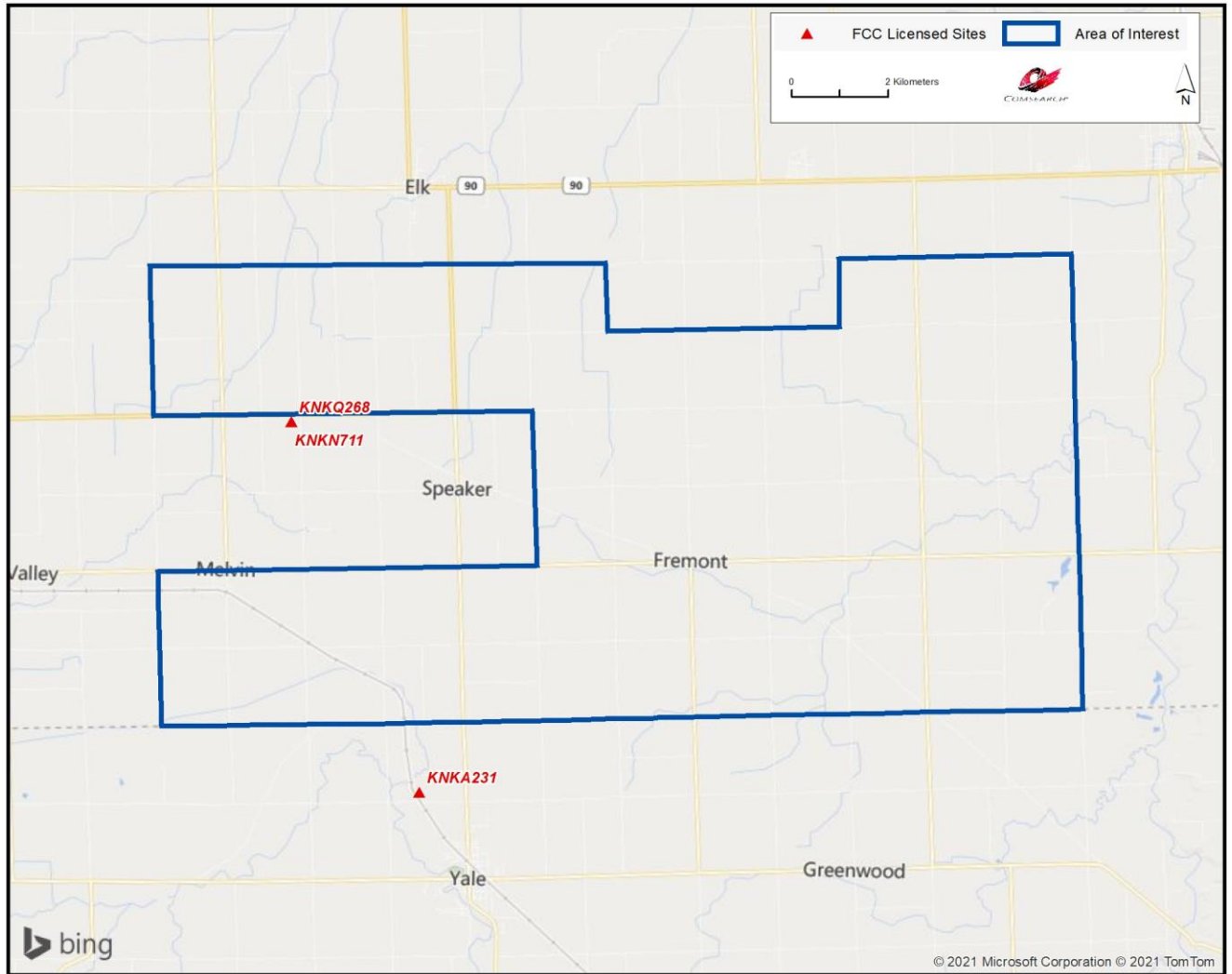


Figure 2: FCC-Licensed Mobile Phone Sites Near the Project Area

Impact Assessment and Distance Setback Requirements

The cellular mobile phone signal propagation is typically not affected by physical structures because the beam widths of the radiated signal from the base stations and mobile units are very wide and the wavelength of the signal is long enough to wrap around objects such as wind turbine towers and blades. In addition, the cellular network consists of multiple base stations that are designed so that if the connection cannot be made to one base station it will shift to adjacent base stations to make the connection. This enables cellular mobile telephone systems to provide coverage in areas that are congested with physical structures such as downtown urban areas. Areas containing wind turbines have less of a coverage issue than urban areas, so the wind turbines presence does not require any special setback for signal obstruction consideration other than physical clearance of the blades. From an electromagnetic interference standpoint, the emissions from the wind turbines, which are specified by the FCC, should be taken into account to ensure they will not interfere with the base stations or the mobile units. Part 15 of the FCC regulations covers the emissions from unintentional radiating devices, such as wind turbines. The field strength limits for the emissions from unintentional radiators is given in paragraph 15.109 of Part 15 of the FCC rules. The emission limits are stated for a distance of 3 meters or approximately 10 feet and are shown below.

Radiated Emission Limits at 3 Meters

<u>Frequency of Emission (MHz)</u>	<u>Field Strength (microVolts/meter)</u>
30 – 88	100
88 – 216	150
216 – 960	200
> 960	500

From these limits and the receiver sensitivity of the cellular base stations and mobile units we can determine a setback requirement for wind turbines and cellular system. The typical sensitivity of mobile units is -90 dBm (1×10^{-12} Watts) and the typical sensitivity of base stations is -93 dBm (5×10^{-13} Watts). The gain of mobile unit antennas are -10dB or 0.1 and the gain of base station antennas are 17 dB or 50. The effective area (A) of the mobile unit and base station antennas are determined from the following formula.

$$A = G \cdot \lambda^2 / 4 \cdot \pi$$

Where,

G = Antenna Gain, number

λ = Wavelength, 0.353 meters

π = 3.14

This gives us an effective area for the mobile unit antenna of 9.9×10^{-4} meter² and the effective area for the base station antenna of 0.496 meter². Using the typical receiver sensitivities of the mobile and base units above, we can determine their power flux density (P_D) from the following formula:

$$P_D = S/A$$

Where S is defined as the sensitivity for Mobile Unit or for the Base Station expressed in Watts

To calculate the electric field strength (E) we use the following formula:

$$E = (P_D * 377)^{1/2}$$

So for the mobile unit, $P_D = 1.01 \times 10^{-9}$ Watts/meter² and $E = 617$ microVolts/meter. And, for the base station unit, $P_D = 1.008 \times 10^{-12}$ Watts/meter² and $E = 19.4$ microVolts/meter.

These results show that the mobile units' sensitivity expressed as field strength is above the level allowed as an emission for the wind turbines at a distance of 3 meters. Therefore, no setback for the use of a mobile unit is needed beyond 3 meters. Since the base station has field strength sensitivity below the allowed emission level of the wind turbines a setback distance is needed to ensure that the base stations will not be affected. The field strength of the emission is inversely proportional to separation distance in meters. To determine the setback distance to reduce the field strength to 19.4 microVolts/meter the following formula is used.

$$D = (500 \text{ MicroVolts/meter}) * (3 \text{ meters}) / 19.4 \text{ MicroVolts/meter}$$

Where,

D = Setback Distance for Base Station to avoid interference, meters

Thus the setback distance for the cellular tower base station from the wind turbines should be 77.3 meters or greater.

Summary

The telephone communications in the mobile phone carrier bands are typically unaffected by the presence of the wind turbines and we do not anticipate any significant harmful effect to mobile phone services in the Riverbend Wind Project area. Mobile phone systems are designed with multiple base transmitter stations covering a specific area. Since mobile telephone signals are designed with overlap between adjacent base transmitter sites in order to provide handoff between cells, any signal blockage caused by the wind turbines does not materially degrade the reception because the end user may be receiving from multiple transmitter locations. For example, if a particular turbine attenuates the signal reception into a mobile phone, the phone may receive an alternate signal from a different transmit location, resulting in no disruption in service. Mobile phone systems that are implemented in urban areas near large structures and buildings often have to combat even more problematic signal attenuation and reflection conditions than rural areas containing a wind energy turbine facility.

For the cellular towers located within the project area, no setback distance is required from an interference standpoint other than physical clearance of the blades. From an electromagnetic



standpoint, a setback distance of 77.3 meters should be used to meet FCC emission requirements.

In the unlikely event that a mobile phone carrier believes their coverage has been compromised by the presence of the wind energy facility, they have many options to improve their signal coverage to the area through optimization of a nearby base transmitter or even adding a new sector or cell site. Utility towers, meteorological towers or even the turbine towers within the wind project area can serve as the platform for a base transmit site or cell enhancer.

3. Contact Us

For questions or information regarding the Mobile Phone Carrier Report, please contact:

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Wind Power GeoPlanner™

Wireless Internet Services Report

Riverbend Wind Project



Prepared on Behalf of
Liberty Power

November 8, 2021



COMSEARCH
A CommScope Company

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1. Introduction

Wireless internet providers, often called WISPs (Wireless Internet Service Providers), deliver internet services via radio transmission to business and/or residential subscribers. They compete with wired internet service providers such as the local phone and cable companies. Wireless internet providers can use various frequency bands in both licensed and unlicensed spectrum. Many rural community WISPs operate in the unlicensed spectrum since there is a lower barrier to entry without the costs associated with acquiring licensed spectrum. The most common unlicensed bands for this purpose are the 900 MHz, 2.4 GHz, and 5.8 GHz bands. There is also some activity in the “lite-licensed” 3.65 GHz band.

This report attempts to identify wireless internet providers in proximity to the Riverbend Wind project and evaluates the potential impact of wind turbines on their operations in and around the project area.

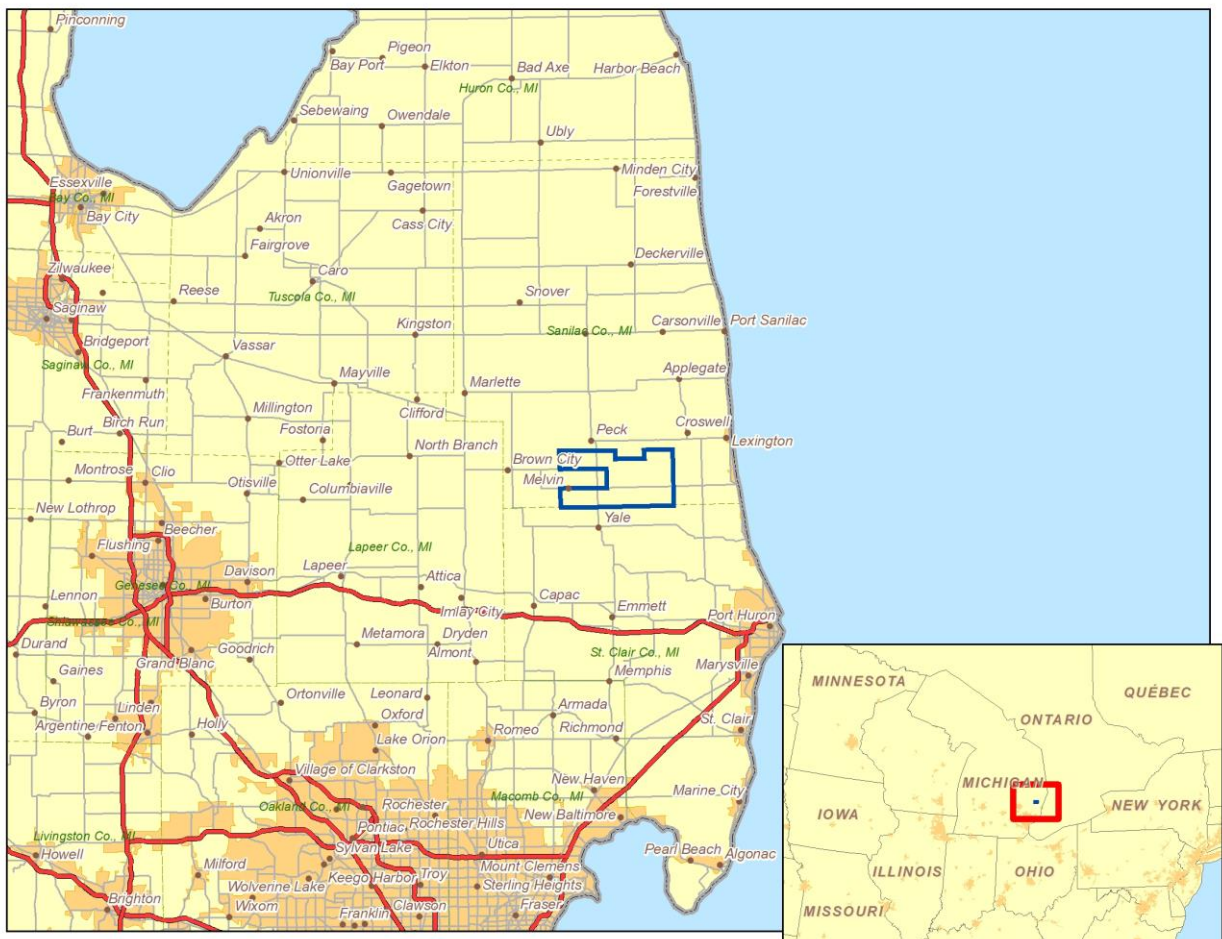


Figure 1: Riverbend Wind Project Area

2. Summary of Results

Methodology

Most bands used for wireless internet services (primarily the unlicensed bands) have no reliable data source available since according to FCC rules, these systems are not required to license or register their transmitter locations. Therefore, the only band with a reliable data set to evaluate is the 3.65 GHz WBS (Wireless Broadband Systems) band, which by FCC rule requires registration of base and fixed transmitters. Our analysis will include any providers found in this band, but will not necessarily include providers with unlicensed systems. This is due to the lack of available data and the providers' lack of interference protection as a consequence of their unlicensed status.

Results

Our 3.65 GHz band search identified two wireless internet systems within 50 km of the proposed turbines in the Riverbend Wind Project. Our search results are shown in the map on the next page. The distances listed in Table 1 below correspond to the shortest distance between the proposed turbines and wireless transmitter(s) for each operator.

Call Sign(s)	Licensee	FRN	Number of Licensed Antennas	Distance to the Area of Interest (km)
WQPC525	Ford Motor Company - Michigan Proving Ground	0021654439	13	37.07
WQQI374	M3 Wireless Inc.	0018976985	9	40.43

Table 2: Summary of Licensed WISP Operators within 50 km of the Riverbend Wind Project

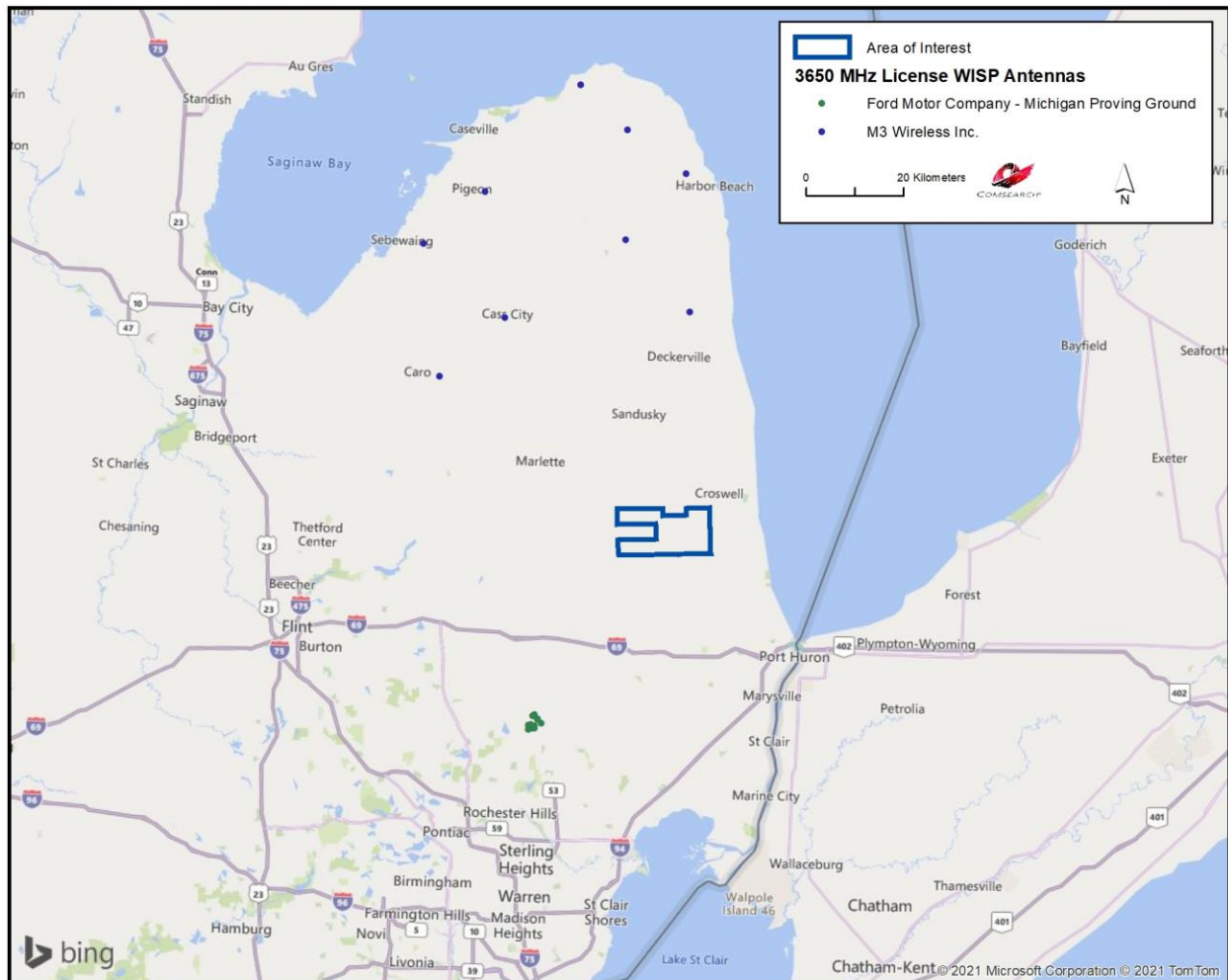


Figure 2: Licensed 3.65 GHz Transmitters within 50 km of the Proposed Turbine Project

Unlicensed Bands

As mentioned previously, there are no reliable data sources for unlicensed wireless internet systems because they are not required to license or register their transmitter locations according to FCC rules.

Impact Assessment

The presence of wind turbines within a coverage area of a wireless Internet provider is unlikely to pose a problem for their provision of service. As shown in the map above, all but one of the providers identified in this report use multiple base transmitter sites in and around the project area. Therefore, some locations within their service area could receive coverage from more than one base transmitter in which case a WISP could simply assign a subscriber to the best-serving base transmitter (i.e., highest signal level). Hence, if a wind turbine obstructs the line-of-sight between a particular subscriber and a transmitter, the WISP could assign the affected subscriber to an alternate signal from a different transmitter location, thereby resulting in no disruption to service.

3. Conclusion

The presence of wind turbines within a coverage area of a wireless Internet provider is unlikely to pose a problem for their provision of service. In the event that a WISP carrier believes that their coverage has been compromised by the presence of the wind energy facility, they have many options to improve their signal coverage to the area. This includes the optimization of surrounding base stations or the addition of a new sector or cell site. Utility towers, other communications towers, or even a turbine tower within the wind project area can serve as the platform for a new base station, cell enhancer, or repeater.

4. Contact

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