

# Dodge County Wind, MN Electromagnetic Interference Analysis

Dodge County Wind LLC

The following document was prepared by WindLogics Inc. (WindLogics), an indirect wholly-owned subsidiary of NextEra Energy Resources, LLC (NEER) for the use of Dodge County Wind, LLC, as an indirect wholly-owned subsidiary of NEER. WindLogics Inc. has prepared this report based on available government information by the Federal Communications Commission (FCC) and internal analysis methods. We cannot guarantee the accuracy of the data collected by the FCC. Microwave tower and link information may be inaccurate or incomplete due to FCC applicant error.

## **Executive Summary**

WindLogics, an affiliate of Dodge County Wind LLC (Dodge County) assessed the potential for interference of licensed communication links in close proximity to the proposed Dodge County Wind Project area for the purposes of determining exclusion zones to aid the design of a proposed wind energy generation project. This report summarizes the microwave links and towers along with local cellular towers, media towers (AM and FM), television, and aviation towers, identified within and near the assessment area.

A review of the Federal Communications Commission (FCC) national database and the Universal Licensing System was conducted to identify these possible constraints. Wind turbine offset distances were taken in consideration for the design of the wind turbine array.

Electromagnetic analysis results show that interference is not expected to impact nearby microwave, AM, FM, cellular, TV, and aviation towers based on the array design.

The analysis is current as of June 28, 2018. WindLogics recommends a refresh of this analysis if the proposed wind energy generation project has not been constructed after two years.

This report only provides analysis for licensed radio towers and links found within the FCC database. Many local municipalities (police, fire, etc.) do not license microwave links, WindLogics recommends that Dodge County LLC coordinate with the appropriate local municipality officials. Also not included within the database are microwave towers and links utilized by the Federal government (Dept. of Defense, Dept. of Commerce, etc.), again for public safety concerns. A letter stating "No Harmful Interference Anticipated (NHIA)" has been received from the National Telecommunications and Information Agency (NTIA).

### <u>Dodge County Wind, MN - Electromagnetic Interference</u>

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A review of the FCC national database and the Universal Licensing System was conducted to identify these possible constraints. Wind turbine offset distances were taken into consideration for the design of the wind turbine array.

The site is located in Dodge and Steele County, Minnesota, roughly 28 kilometers west of the city of Rochester, Minnesota. Figure 1 below, depicts the project location of Dodge County Wind.

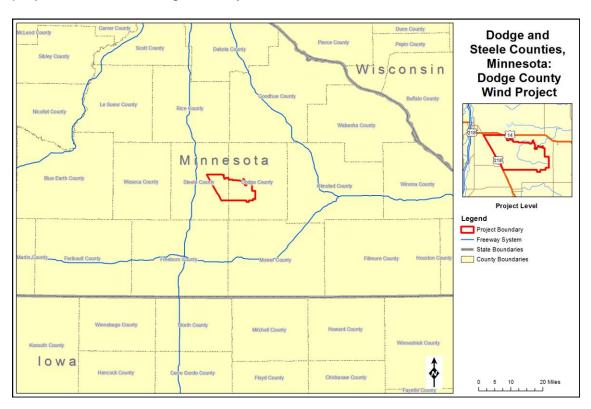


Figure 1: Dodge County Wind Project Location

### **Turbine Technology**

Dodge County Wind is a proposed hybrid wind energy generation site that consists of 72 turbine locations. The layout is composed of 64 (60 primary and 4 alternate) GE2.5-116 turbines (2.5MW rated capacity, 116m rotor diameter (RD)) and 8 GE2.3-116 turbines (2.3MW rated capacity, 116m RD) for a total capacity of 168.4MW. Turbine layout details are included in Table 1 and Figure 2.

Turbine Technology	GE2.5-116 / GE2.3-116		
Turbine Count	60(4) / 8		
Hub Height (m)	90 / 80		
Rotor Diameter (m)	116 / 116		
Turbine Rated Power (MW)	2.5 / 2.3		
Total Capacity (MW)	168.4		

**Table 1: Dodge County Layout Summary** 

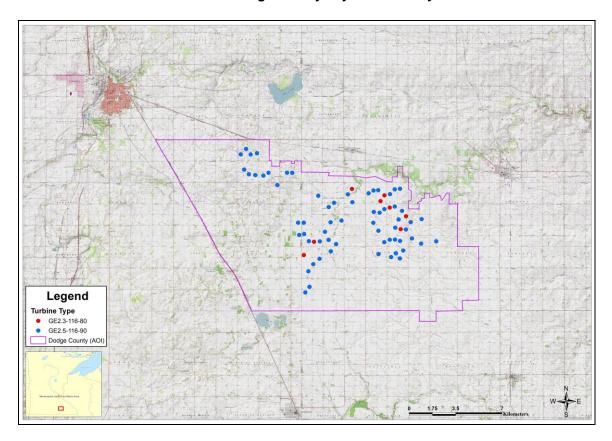


Figure 2: Dodge County Wind Turbine Technology Allocation

#### **Data Sources**

Within the United States, the location of industrial and commercial telecommunication systems, including microwave links, are collected and maintained by the Wireless Telecommunications Bureau (WTB), a division of the FCC. This data is made publicly available through the ULS database, which contains licensing information on both current and permit pending facilities for microwave, cellular, media, and several radio services utilized by private industry (non-Federal telecommunication systems). License information supplied within the ULS database is updated daily, and is dependent upon information provided by each individual applicant.

WindLogics used several data sources (ESRI satellite imagery, Google Earth, etc.) of high resolution imagery to aid in assessing the accuracy of the geographic locations of each microwave tower with links intersecting the project boundary or area of interest (AOI).

#### **Methodology**

The ULS database, described earlier, was used to identify the microwave towers, microwave links, cellular, AM, FM, and aviation towers within a 25-kilometer radius that may impact the Dodge County Wind Farm. Television towers were identified within a 100-kilometer radius. The database provides detailed information for each radio tower and link, which was used to calculate turbine exclusion zones to ensure interference compliance.

Exclusion zones for wind turbines near microwave links are calculated using a theory proposed by Bacon (2002), which identifies the radius of the 2<sup>nd</sup> Fresnel zone, a theoretical sphere representative of a propagating radio wave, as an appropriate offset distance. Calculations of the 2<sup>nd</sup> Fresnel zone can be determined by:

$$2nd \ Fresnel \ zone \ Radius = \sqrt{\frac{2\lambda d_1 d_2}{d_1 + d_2}} \tag{1}$$

Where:

 $d_1$ ,  $d_2$  = distances from each end of the radio path.  $\lambda$ = wavelength of the corresponding radio frequency.

To account for precision errors within the ULS database, and to further reduce the potential for interference from a wind turbine, a Worst Case Fresnel Zone (WCFZ) was calculated for each microwave link. The WCFZ provides the maximum offset distance required, and is determined by the 2<sup>nd</sup> Fresnel zone

radius obtained at the midpoint of the link, where  $d_1 = d_2$ . Adjusting Eq. 1 to calculate the WCFZ in meters yields the following:

$$WCFZ = 17.32 \sqrt{\frac{nD}{4(F)}} \tag{2}$$

Where:

D = distance between the transmitter and receiver towers.

F = frequency in GHz.

n = Fresnel zone, which for the  $2^{nd}$  Fresnel Zone n = 2.

The calculated radius distance from Eq. 2 provides a three-dimensional turbine exclusion zone around each microwave link that can be used to guide wind turbine array design.

In addition to the WCFZ calculated for each microwave link, WindLogics applies an offset of one-half RD plus 10 meter to account for turbine blade overhang. A turbine overhang offset using a 116 m turbine technology is included within this analysis to represent the GE2.5-116 wind turbine generator.

The WTB cannot provide quality assurance for every license within the ULS database, so accuracy of the data relies on applicant certifications, and, in extreme cases, license audits. It has been WindLogics' experience that most inaccuracies occur with regard to the location of the radio towers, where approximation or lack of precision of the geographic coordinates can result in a difference in the position of the tower by as much as 500 meters.

To fully account for these location errors, WindLogics recommends on-site verification to identify the exact location of the transmitter and receiver towers. However, for this analysis, WindLogics used high-resolution satellite imagery to identify possible tower location errors. Most microwave, media, and cellular towers extend well over 80m above ground level, and can be clearly viewed within high resolution satellite imagery. Each tower that may impact the project boundary was investigated for potential location error. Adjustments to the location of the microwave, media, and cellular towers are only made if clear evidence from the satellite imagery shows an inaccuracy.

## Microwave Links and Microwave Towers

No microwave towers were identified within the Project area. However, twelve microwave links have been identified near the project area and ten have been found to intersect the AOI. The WCFZ for all of these links has been calculated, and the appropriate turbine offset has been used to minimize any harmful impact from the proposed turbine layout.

Figure 3 below illustrates the position of each microwave link with respect to the project boundary and turbine locations.

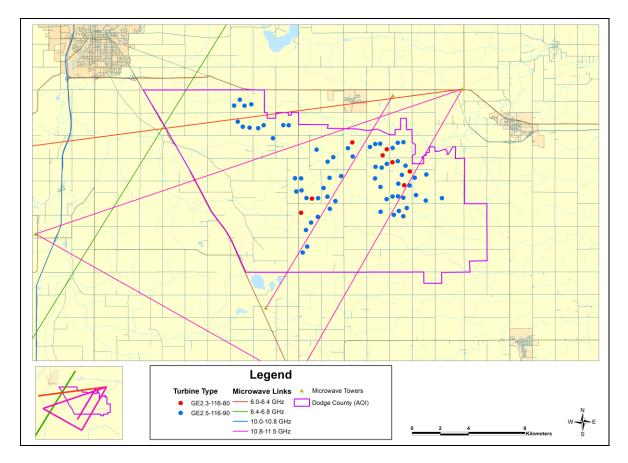


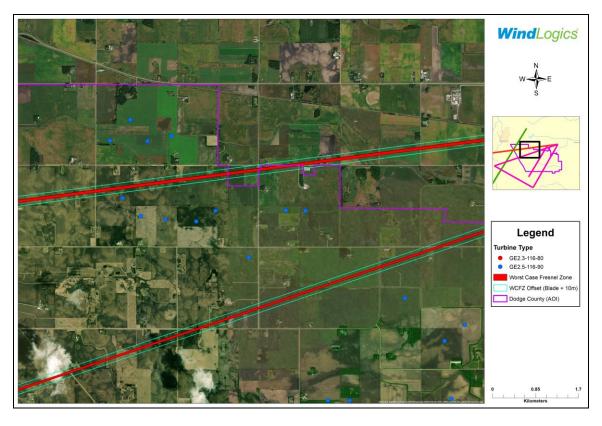
Figure 3: Dodge County Wind With Microwave Links

Table 2 provides more detailed information on each microwave link in proximity to the area with the calculated WCFZ.

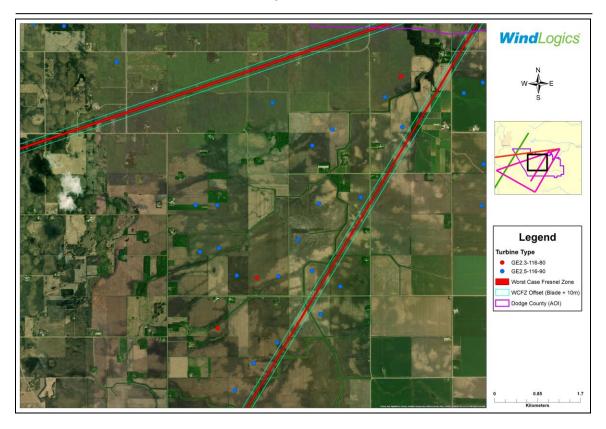
ID	STATUS	TRANSMITTER CALLSIGN	MICROWAVE NAME	BAND FREQ (GHz)	WCFZ (m)	BEAM LENGTH (Km)
	1 Active	WHI758	UNION PACIFIC RAILROAD COMPANY	6.6	30.25	40.17
	2 Active	WHI759	UNION PACIFIC RAILROAD COMPANY	6.7	29.89	40.17
	3 Active	WQJE209	Minnesota, State of	6.1	28.39	32.75
	4 Active	WQJY578	Minnesota, State of	6.3	27.82	32.75
	5 Active	WQQD451	Radio Link Internet	10.8	17.18	21.16
	6 Active	WQQD451	Radio Link Internet	10.8	18.14	23.77
	7 Active	WQQD451	Radio Link Internet	11.0	16.99	21.16
	8 Active	WQQD451	Radio Link Internet	10.9	18.07	23.77
	9 Active	WQQD513	Radio Link Internet	11.2	20.63	31.92
	10 Active	WQQD513	Radio Link Internet	11.3	17.74	23.77
	11 Active	WQWJ905	T-MOBILE LICENSE LLC	11	15.44	17.5
	12 Active	WQWJ906	T-MOBILE LICENSE LLC	11.5	15.11	17.5

Table 2: Detailed Information on Microwave Links That Intersect the Project Boundary

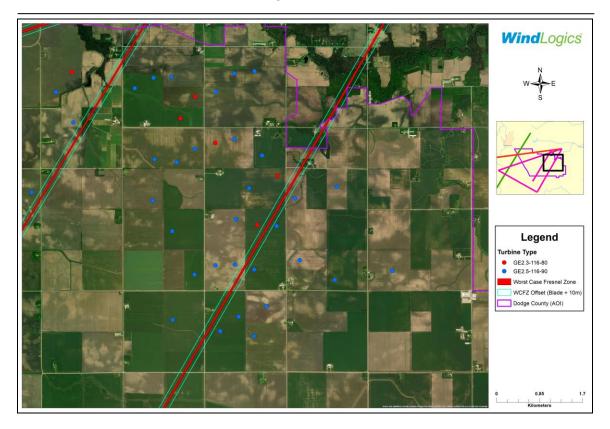
There are a number of links that are within relatively close proximity to turbines. The Worst Case Fresnel Zone was calculated for each microwave link and a conservative offset of 68 meters was used to reduce the probability of harmful interference. Figures 4-6 provide aerial imagery of the turbine layout relative to the Fresnel zones and their offsets that intersect the project boundary.



**Figure 4: Dodge County Wind Fresnel Zone Northwest** 



**Figure 5: Dodge County Wind Fresnel Zone West** 



**Figure 6: Dodge County Wind Fresnel Zone East** 

# **Cellular Towers**

No cellular towers were identified within the project boundary. Thirteen cellular towers were discovered within 25 km of the project boundary and are identified in Table 3 and figure 7.

Harmful interference associated with cellular towers is not likely as cellular transitions or packet switching occurs when a cellular link becomes unavailable.

ID	STATUS	CALLSIGN	LICENSEE	LATITUDE	LONGITUDE	DISTANCE TO AOI(km)
1	Active	KNKN403	Alltel Communications, LLC	43.87508	-93.04960	6.73
2	Active	KNKN416	Alltel Communications, LLC	43.88539	-92.81930	8.00
3	Active	KNKN572	AT&T Mobility Spectrum LLC	43.91286	-93.07440	2.53
4	Active	KNKA667	AT&T Mobility Spectrum LLC	44.00672	-92.71860	13.25
5	Active	WPSJ612	Alltel Communications, LLC	44.00694	-92.71940	13.19
6	Active	KNKA667	AT&T Mobility Spectrum LLC	44.02406	-92.59830	23.08
7	Active	WPSJ612	Alltel Communications, LLC	44.05111	-92.87640	4.64
8	Active	KNKN572	AT&T Mobility Spectrum LLC	44.06072	-93.16470	1.01
9	Active	KNLH690	Verizon Wireless (VAW) LLC	44.08283	-93.22030	4.58
10	Active	KNKN403	Alltel Communications, LLC	44.09361	-93.25390	7.35
11	Active	KNKN416	Alltel Communications, LLC	44.09556	-92.79830	12.43
12	Active	KNKN403	Alltel Communications, LLC	44.11167	-93.18280	6.68
13	Active	KNKN416	Alltel Communications, LLC	44.25556	-92.98170	23.88

Table 3: Cellular Towers within 25 km of the Project Boundary

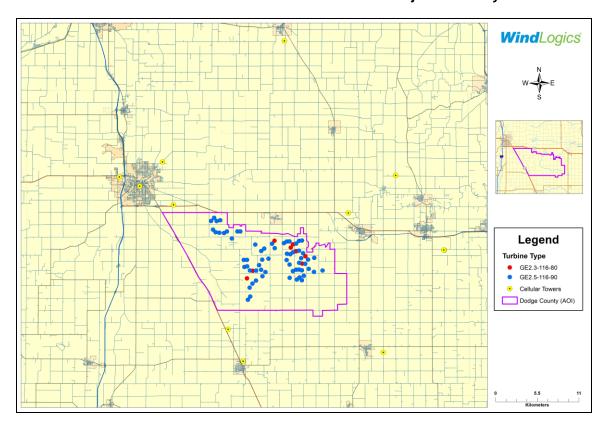


Figure 7: Cellular Towers within 25 km of the Project Boundary

### **Media Towers**

No active AM radio towers were identified within the project boundary. 11 AM towers were discovered within 25 km of the project boundary and are included in Table 4 and figure 8.

While no harmful interference to the AM towers is expected, reception of AM radio stations near each individual turbine may be impacted, especially for areas on the edge of AM radio coverage. The exclusion distance from AM towers is 1 wavelength from non-directional antennas and 10 wavelengths or 3 kilometers from directional antennas (Marlowe, 2015). Given most AM radio receptors will be nearby dwellings, which should have a sufficient offset from each turbine, any interruption to reception from the installation of wind turbines is expected to be minimal. The closest AM towers, KRFO, are located 2.5 km from the project boundary, and have a broadcasting frequency of 1390 kHz which corresponds to a wavelength of 216 m. Thus, the proposed layout is greater than 10 wavelengths away from the closest station.

ID	CALLSIGN	LICENSEE	FREQUENCY (kHz)	LATITUDE	LONGITUDE	DISTANCE TO AOI(km)
1	KDHL	TOWNSQUARE MEDIA FARIBAULT LICENSE, LLC	920	44.26306	-93.27472	24.62
2	KDHL	TOWNSQUARE MEDIA FARIBAULT LICENSE, LLC	920	44.26306	-93.27472	24.62
3	KQAQ	HOMETOWN BROADCASTING OF AUSTIN, INC.	970	43.70750	-92.94583	24.58
4	KQAQ	HOMETOWN BROADCASTING OF AUSTIN, INC.	970	43.70750	-92.94583	24.58
5	KOWZ	MAIN STREET BROADCASTING, INC.	1170	44.04472	-93.38556	16.25
6	KOWZ	MAIN STREET BROADCASTING, INC.	1170	44.04472	-93.38556	16.25
7	KOWZ	MAIN STREET BROADCASTING, INC.	1170	44.04472	-93.38556	16.25
8	KRFO	CUMULUS LICENSING LLC	1390	44.07389	-93.18000	2.48
9	KRFO	CUMULUS LICENSING LLC	1390	44.07389	-93.18000	2.48
10	KRFO	TOWNSQUARE MEDIA FARIBAULT LICENSE, LLC	1390	44.07389	-93.18000	2.48
11	KRFO	TOWNSQUARE MEDIA FARIBAULT LICENSE, LLC	1390	44.07389	-93.18000	2.48

Table 4: AM Transmitter Towers within 25 km of the Project Boundary

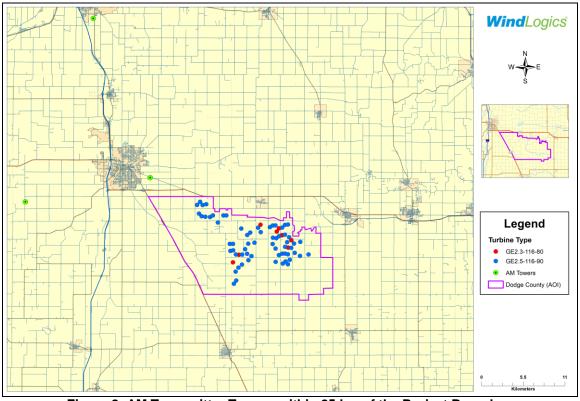


Figure 8: AM Transmitter Towers within 25 km of the Project Boundary

No active FM radio towers were identified within the project boundary. Fifteen FM towers were discovered within 25 km of the project boundary and are included in Table 5 and figure 9.

While no harmful interference to the FM towers is expected, reception of FM radio stations near each individual turbine may be impacted, especially for areas on the edge of FM radio coverage. The recommended exclusion distance for FM towers is approximately 4 kilometers. FM stations that are closer than 4 kilometers to wind turbines have the potential to experience interference (Marlowe, 2015). Given most FM radio receptors will be nearby dwellings, which should have a sufficient offset from each turbine, any interruption to reception from the installation of wind turbines is expected to be minimal. Three FM towers are located less than 4 km from the AOI, K234DB, KCJL-LP and KRFO-FM, and are the most vulnerable to experience interference. However, the nearest wind turbines are located 4.8 km and 7.1 km away from the towers.

ID	CALLSIGN	LICENSEE	FREQUENCY (MHz)	LATITUDE	LONGITUDE	DISTANCE TO AOI(km)
1	KRUE	MAIN STREET BROADCASTING, INC.	92.1	44.04556	-93.3839	16.11
2	K228DR	OWATONNA AREA CHRISTIAN RADIO, INC.	93.5	44.08983	-93.2246	5.40
3	K232FY	HOMETOWN BROADCASTING OF AUSTIN, INC.	94.3	43.78806	-92.9081	15.64
4	K234DB	TOWNSQUARE MEDIA FARIBAULT LICENSE, LLC	94.7	44.07389	-93.1800	2.48
5	KCJL-LP	ONE DAY CHURCH PROJECT, INC.	95.1	43.99250	-92.8600	2.13
6	KWWK	TOWNSQUARE MEDIA ROCHESTER LICENSE, LLC	96.5	44.03306	-92.6028	22.97
7	NEW	TOWNSQUARE MEDIA FARIBAULT LICENSE, LLC	98.1	44.26361	-93.2736	24.65
8	K253CH	MINN-IOWA CHRISTIAN BROADCASTING, INC.	98.5	43.88708	-92.8489	6.52
9	KOWZ-FM	BLOOMING PRAIRIE FARM RADIO INC.	100.9	44.04556	-93.3839	16.11
10	KRCH	CC LICENSES, LLC, AS DEBTOR IN POSSESSION	101.7	44.11639	-92.6894	20.64
11	K280EC	MINNESOTA PUBLIC RADIO	103.9	44.08861	-93.1403	4.10
12	KRFO-FM	TOWNSQUARE MEDIA FARIBAULT LICENSE, LLC	104.9	44.07389	-93.1800	2.48
13	K289AE	MINNESOTA PUBLIC RADIO	105.7	44.08861	-93.1403	4.10
14	K292GU	MAIN STREET BROADCASTING, INC.	106.3	44.04556	-93.3839	16.11
15	KBGY	MILESTONE RADIO II LLC	107.5	44.21167	-93.3383	21.70

Table 5: FM Transmitter Towers within 25 km of the Project Boundary

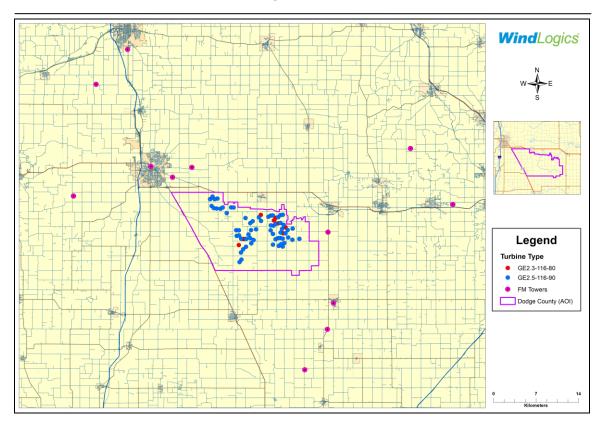


Figure 9: FM Transmitter Towers within 25 km of the Project Boundary

### **Television Stations**

No digital or analog television stations were identified within the project boundary. Table 6 and figure 10 identifies licensed television stations within 100 km of the project boundary as determined by the FCC. There are 14 stations less than 50 km from the project boundary which are likely to be broadcasting to the region.

ID	CALLSIGN	LICENSEE	SERVICE	CHANNEL	ERP (kW)	Latitude	Longitude	DISTANCE TO AOI(km)
1	K48KJ-D	THREE ANGELS BROADCASTING NETWORK, INC.	LD	48	1.5	43.82532	-93.43253	29.90
2	DK43DH	TELEVIEW SYSTEMS OF MINNESOTA	TX	43	1.47	43.63832	-93.14712	33.32
3	DK53DI	TELEVIEW SYSTEMS OF MINNESOTA	TX	53	1.47	43.63832	-93.14712	33.32
4	DK55FJ	TELEVIEW SYSTEMS OF MINNESOTA	TX	55	1.47	43.63832	-93.14712	33.32
5	DK57EU	TELEVIEW SYSTEMS OF MINNESOTA	TX	57	1.47	43.63832	-93.14712	33.32
6	DK61EU	TELEVIEW SYSTEMS OF MINNESOTA	TX	61	1.47	43.63832	-93.14712	33.32
7	K52HH	MS COMMUNICATIONS, LLC	TX	52	0.004	43.97112	-92.41520	37.24
8	K40JT	TRINITY BROADCASTING NETWORK	TX	40	10.7	43.62782	-93.36383	40.59
9	K25NK-D	THREE ANGELS BROADCASTING NETWORK, INC.	LD	25	15	44.03556	-92.3406	43.66
10	K56HW	TRINITY BROADCASTING NETWORK	TX	56	75	44.04222	-92.340794	43.75
11	K58GC	THREE ANGELS BROADCASTING NETWORK, INC.	TX	58	29	44.04222	-92.34079	43.75
12	KSMQ-TV	KSMQ PUBLIC SERVICE MEDIA, INC.	DT	20	319.2	43.64282	-92.52660	43.78
13	KAAL	KAAL-TV, LLC	DT	36	620	43.64278	-92.5267	43.78
14	KXLT-TV	SAGAMOREHILL OF MINNESOTA LICENSES, LLC	DT	46	220	43.64278	-92.5267	43.78
15	KIMT	NVT MASON CITY LICENSEE, LLC	DT	42	800	43.47562	-92.70831	53.12
16	KYIN	IOWA PUBLIC BROADCASTING BOARD	DT	18	533	43.47562	-92.708305	53.12
17	KTTC	KTTC LICENSE, LLC	DT	10	43.1	43.57083	-92.4272	55.08
18	KWJM-LD	DTV AMERICA CORPORATION	LD	15	6	44.69528	-93.0183	71.67
19	KILW-LD	DTV AMERICA CORPORATION	LD	28	6	44.69528	-93.0183	71.67
20	KMQV-LD	DTV AMERICA CORPORATION	LD	49	6	44.69528	-93.0181	71.67
21	DK34JZ-D	SOUTH CENTRAL ELECTRIC ASSOCIATION	LD	34	0.17	43.58582	-93.929648	77.83
22	K14KD-D	SOUTH CENTRAL ELECTRIC ASSOCIATION	LD	14	3	43.58582	-93.92965	77.83
23	K23FY-D	COOPERATIVE TELEVISION ASSOCIATION OF SOUTHERN MINNESOTA	LD	23	3	43.58582	-93.92965	77.83
24	K27FI-D	SOUTH CENTRAL ELECTRIC ASSOCIATION	LD	27	3	43.58582	-93.929648	77.83
25	K29IF-D	BLUE EARTH-NICOLLET-FARIBAULT COOP ELECTRIC ASSN	LD	29	3.1	43.58582	-93.929648	77.83
26	K31EF-D	SOUTH CENTRAL ELECTRIC ASSOCIATION	LD	31	3	43.58582	-93.929648	77.83
27	K35IU-D	SOUTH CENTRAL ELECTRIC ASSOCIATION	LD	35	3	43.58582	-93.929648	77.83
28	K40JS-D	BLUE EARTH-NICOLLET FARIBAULT COOPERATIVE ELECTRIC ASSN.	LD	40	3	43.58582	-93.929648	77.83
29	K49JG-D	BLUE EARTH-NICOLLET FARIBAULT COOPERATIVE ELECTRIC ASSN.	LD	49	3	43.58582	-93.929648	77.83
30	K51KB-D	SOUTH CENTRAL ELECTRIC ASSOCIATION	LD	51	3	43.58582	-93.92965	77.83
31	K21KF-D	COOPERATIVE TELEVISION ASSOCIATION OF SOUTHERN MINNESOTA	LD	21	3	43.58583	-93.9297	77.84
32	K47MI-D	COOPERATIVE TELEVISION ASSOCIATION OF SOUTHERN MINNESOTA	LD	47	3	43.58583	-93.9297	77.84
33	K43JE-D	THREE ANGELS BROADCASTING NETWORK, INC.	LD	43	10.82	44.05152	-94.29996	89.50
34	W47CO-D	STATE OF WISCONSIN - EDUCATIONAL COMMUNICATIONS BOARD	LD	47	1.6	44.90282	-92.69131	98.76
35	KEYC-TV	UNITED COMMUNICATIONS CORPORATION	DT	12	52.7	43.93694	-94.4108	99.30

Table 6: Television Stations within 100 km of the Project Boundary

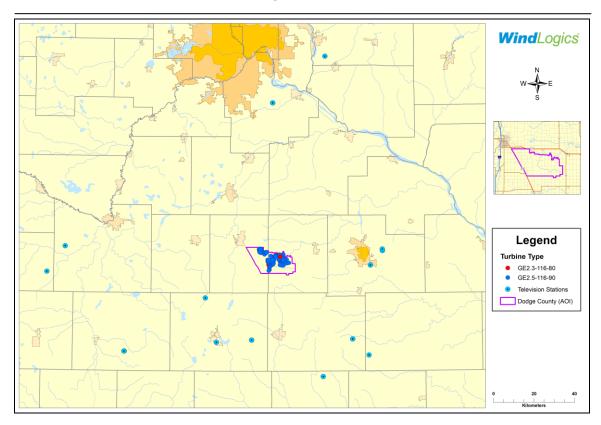


Figure 10: Television Stations within 100 km of the Project Boundary

While the impact of wind turbines on digital television reception is not well known due to limited cases and testing, any interference is expected to be limited to areas near the edge of station reception, areas near a turbine that is within the line-of-sight between the transmit tower and receptor, and areas of complex topography (OfCom, 2009). Most of the stations within 100km are low power stations or translator stations and have limited range and are not anticipated to experience reception degradation. There are seven full power stations KXLT-TV, KSMQ-TV, KAAL, KIMT, KYIN, KEYC-TV, and KTTC which have a possibility of experiencing reception degradation if the proposed wind farm is located in the line-of-sight.

It is important to note that this assessment is based on broad assumptions, as it is difficult to accurately pinpoint the impact a large wind farm may have on each individual household due to a large number of external variables (topography, weather, antennae, etc.) which affect the propagation of the television radio signal.

#### **Aviation Towers**

No active Aviation towers were identified within the project boundary. Ten aviation towers were discovered within 25 km of the project boundary and are included in Table 7 and figure 11.

While no harmful interference is expected for the aviation towers; Dodge County Wind is subject to a Federal Aviation Agency (FAA) to determine any exclusion zones. Proposed turbine locations will maintain the standard appropriate offset distances in addition to any setbacks set by the agency to minimize harmful impact.

ID	STATUS	CALLSIGN	LICENSEE	SERVICE	LATITUDE	LONGITUDE	DISTANCE TO AOI(km)
1	Active	WGE2	MINNESOTA, STATE OF	AF Aeronautical and Fixed	44.02025	-92.82960	5.72
2	Active	WRLB2051	MINNESOTA, STATE OF	AR Aviation Radionavigation	44.07389	-93.15560	2.47
3	Active	WRLA2017	MINNESOTA, STATE OF	AR Aviation Radionavigation	44.07389	-93.12190	2.46
4	Active	WRLG2026	MINNESOTA, STATE OF	AR Aviation Radionavigation	44.11969	-93.25580	9.55
5	Active	WPZQ973	Owatonna, City of	AF Aeronautical and Fixed	44.12136	-93.25020	9.44
6	Active	WJZ8	MINNESOTA, STATE OF	AF Aeronautical and Fixed	44.12139	-93.25030	9.44
7	Active	WRLL2041	MINNESOTA, STATE OF	AR Aviation Radionavigation	44.12914	-93.27270	11.22
8	Active	WQSR490	Minnesota, State of MNDOT Aeronautics	AR Aviation Radionavigation	44.12975	-93.27190	11.23
9	Active	WRLO2040	MINNESOTA, STATE OF	AR Aviation Radionavigation	44.20442	-93.37050	22.66
10	Active	WRNV2064	MINNESOTA, STATE OF	AR Aviation Radionavigation	44.20444	-93.37060	22.67

Table 7: Aviation Towers within 25 km of the Project Boundary

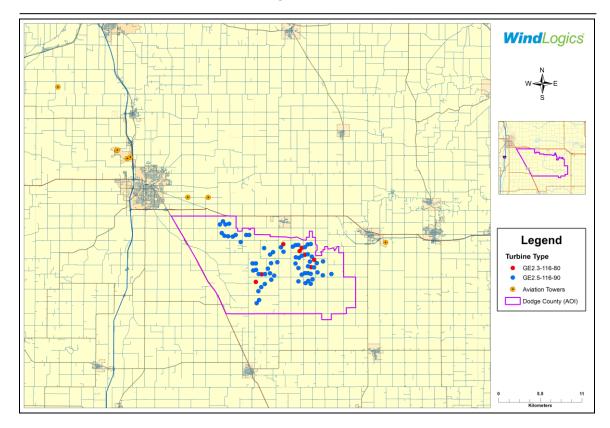


Figure 11: Aviation Towers within 25 km of the Project Boundary

# **Conclusion and Recommendations**

WindLogics analyzed the potential for wind turbine interference on licensed microwave links located within the proposed Dodge County Wind Project energy generation site. This report summarizes the microwave towers, microwave links, cellular towers, media towers, television towers, and aviation towers within and near the project boundary.

Ten microwave links were found to intersect the project boundary, and an appropriate offset to the WCFZ has been utilized to mitigate harmful interference from the proposed turbine layout. No interference from the proposed turbine layout is expected near microwave, AM, FM, cellular, aviation, and TV towers. This analysis is current as of June 28, 2018. WindLogics recommends a refresh of this analysis if the proposed wind energy generation project has not been constructed after two years.

It is important to note that this report only provides analysis for licensed radio towers and links found within the FCC-ULS database. Many local municipalities (police, fire, etc.) do not license microwave links, WindLogics recommends Dodge County Wind LLC coordinate with the appropriate local municipality officials. Also not included within the database are microwave towers and links

utilized by the Federal government (Dept. of Defense, Dept. of Commerce, etc.), again for public safety concerns. A Federal communications study by the National Telecommunications and Information Agency (NTIA) has been conducted stating no harmful interference is expected in the project area.

#### References

- Bacon, David F.,"A proposed method for establishing an exclusion zone around a terrestrial fixed radio link outside of which a wind turbine will cause negligible degradation of the radio link performance."
  - http://www.ofcom.org.uk/radiocomms/ifi/licensing/classes/fixed/Windfarms/windfarmdavid bacon.pdf,Version 1.1,Oct 2002.
- Ofcom, "Tall structures and their impact on broadcast and other wireless services." <a href="http://www.ofcom.org.uk/radiocomms/ifi/licensing/classes/fixed/Windfarms/tallstructures.pdf">http://www.ofcom.org.uk/radiocomms/ifi/licensing/classes/fixed/Windfarms/tallstructures.pdf</a>, August 2009.
- Marlowe, Frank. "The Importance of Electromagnetic-impact Analyses for Wind Permitting." *Windpower Engineering & Development*. Broadcast Wind, 2015. Web. 19 July 2017.