

Appendix C

Updated Telecommunications Studies

Badger Wind, LLC
February 2024

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BADGER WIND FARM

Telecommunications Study

Badger Wind, LLC

Document No.: 10455420-HOU-R-04

Issue: B, **Status:** Final

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Task and objective:

This report presents the results of a telecommunication analysis conducted by DNV on behalf of Badger Wind, LLC.

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1 INTRODUCTION

Badger Wind, LLC (the “Customer”) retained DNV Energy USA Inc. (“DNV”) to conduct a Telecommunication study for Badger Wind Farm (the “Project”) located in Logan County and McIntosh County, North Dakota.

The objective of this analysis is to understand the potential impacts from the Project on nearby radiocommunication and radar systems. This analysis included a detailed review all registered radiocommunication and radar systems within the vicinity of the Project, an evaluation of the potential for interference with these systems, and the development of recommendations based on these results.

2 DESCRIPTION OF THE WIND FARM SITE

2.1 Site description

The Project is situated in relatively simple terrain, consisting of flat farmland, with wind turbine base elevations ranging from approximately 2,000 ft to 2,200 ft above sea level. The ground cover on and near the site is primarily composed of farmland and open fields. Dwellings are interspersed throughout the Project site.

The site is in Logan County and McIntosh County, west of the town of Wishek, North Dakota.

2.2 Wind farm layout and turbine model

The Project layout considered for the analysis includes 103 GE 2.8-127 wind turbine generators with a hub height of 89 m (292 ft). The turbine layout was provided by the Customer [1]. Of the 103 turbine positions, up to 93 of them will be built.

The GE 2.8-127 has a maximum blade tip height of 152.5 m (500 ft), a hub height of 89 m (292 ft), and a rotor diameter of 127 m (417 ft).



3 SYSTEMS INVENTORY

For the purpose of this assessment, the following data review and analysis was conducted by DNV:

- Review of the Federal Communications Commission (FCC) Universal Licensing System (ULS) and information related to microwave systems, air navigation aids, broadcast stations (TV, FM, AM), cellular systems, mobile stations, and radars;
- Review of the Renewable Energy and Defense (READ) Geospatial Database for radar sites (air route surveillance, airport surveillance, NEXRAD weather);
- Review of the US Department of Defense (DoD) Military Installations, Ranges and Training Areas (MIRTA) data; and
- Analysis of licensed microwave paths, including the calculation of the microwave beam width.

Noteworthy assumptions and methodologies used to complete the impact assessment are listed below:

- Private, unlicensed, or governmental radiocommunication systems that are not currently registered with the FCC were not included in this analysis. Therefore, the potential for impact on such systems has not been assessed in this report. DNV has initiated the consultation process with the NTIA to address any possible issues related to such systems.
- The coordinates available through the FCC ULS may be inaccurate. DNV validated the FCC systems in the vicinity of the Project site using aerial imagery, where possible, and through a field validation for one system (WSR667) within the Project site.

3.1 Results

The results of the telecommunication analysis are summarized in the following tables and figure.

Table 1 Radiocommunication Systems within 1 km of Project Wind Turbines

Call Sign	Radio Service Code	Description	Frequency (MHz)	Distance from closest Wind Turbine (km)	Latitude	Longitude	Location	City	Licensee	Contact
					(NAD83)					
WSR667	IG	Land mobile	460.65	0.52	46.266444	-99.714528	7971 32 ND Ave SE - Jahner Landfill	Wishek	Waste Management Holdings, Inc	APCO International, Inc Karen A Sowers 351 N Williamson Blvd Daytona Beach, FL 32114

Note: The Customer verified this location during a field visit. The antenna is placed on the roof of a building (not on a tower) with a listed height of 13 m in the ULS database. This height is lower than the bottom extremity of the circular turbine rotor swept area, and the risk of interference of this signal, through signal scattering by rotating blades, is therefore greatly reduced to a very low level. All other Land mobile or Cellular Systems are located beyond 1 km from a turbine and are not expected to pose interference risks.

Table 2 Television Broadcasting Stations

Call Sign	Distance from closest turbine (km)	Distance from closest turbine (mi)	Latitude (NAD83)	Longitude (NAD83)	Station Location	Licensee Name
KXMB-TV	91.3	56.7	46.589717	-100.806518	Bismarck	Nexstar Media Inc.
KJRE	47.6	29.6	46.298859	-98.866216	Ellendale	Prairie Public Broadcasting, Inc.
KBME-TV	90.9	56.5	46.589717	-100.80124	Bismarck	
KFYR-TV	91.8	57.1	46.605634	-100.80774	Bismarck	Gray Television Licensee, LLC

Note: DNV did not identify any TV broadcasting stations within 5 km of any of the Project turbines. Significant signal obstruction or shadowing is not expected beyond this distance.

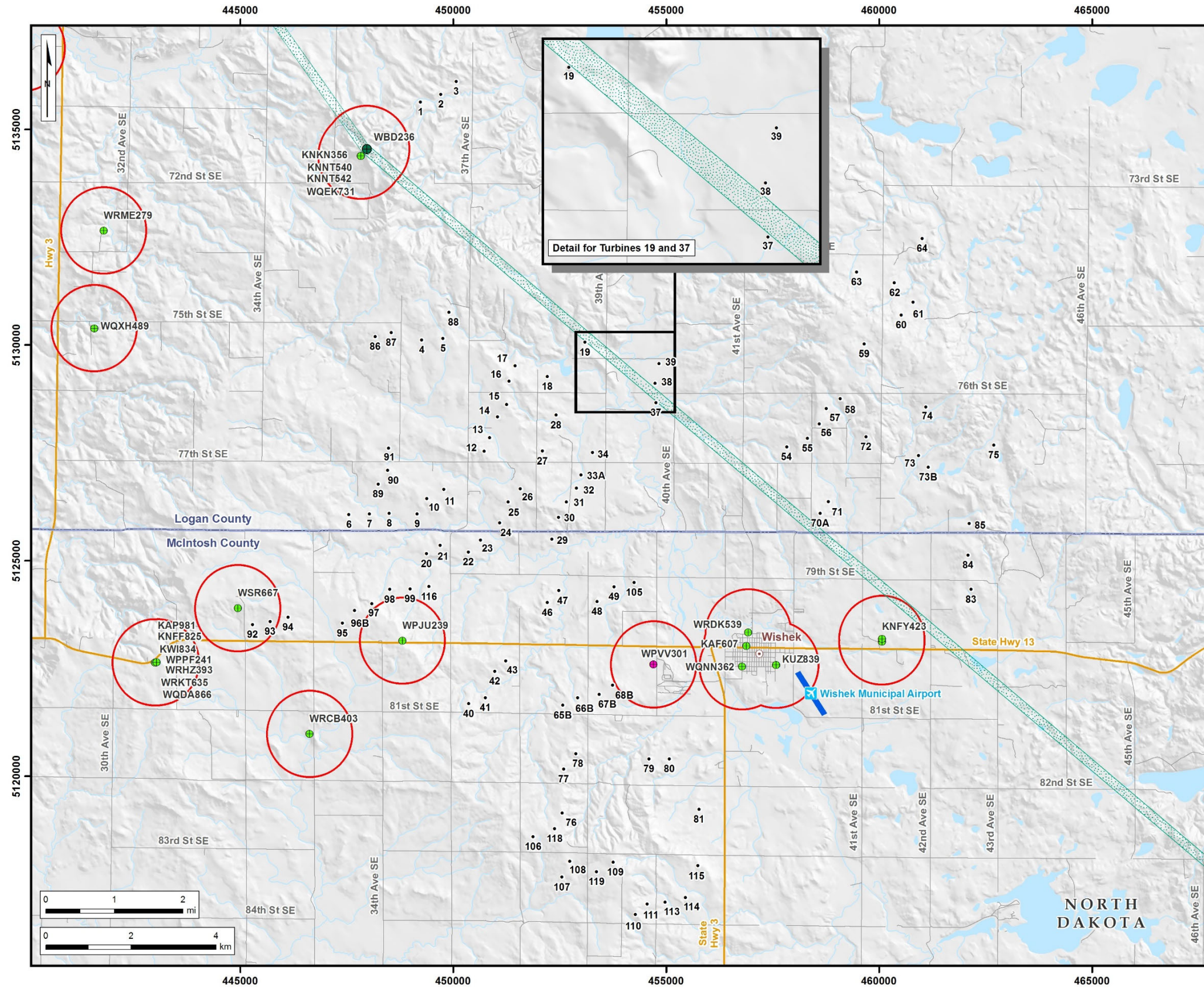
The table above presents only the stations with TV service contours that potentially overlap Project turbines. These were evaluated for signal reflection risks.

DNV performed a baseline TV signal evaluation in 2022 [2], which concluded that signals from the TV stations listed above were “generally poor” and too weak to provide “sufficient signal strength for proper reception in Wishek and Lehr”. Only two stations (KXMB and KFYR) had adequate coverage in the town of Napoleon. However, no interference is expected in that case because the Project is farther away from those broadcasting towers than the town of Napoleon itself. Similarly, dwellings outside those population centers are expected to also have poor signals or otherwise not be close enough to turbines to experience signal reflection interference.



DNV also performed a review of potential interference risks to military aids, air navigation aids, or weather radars, summarized below:

- The closest NEXRAD weather radars are located in Aberdeen and Bismarck airports at distances of approximately 60 miles and 76 miles respectively. Beyond 50 km (31 miles), the risk of interference is deemed negligible for such radars.
- The closest NORAD radar (Finley ARSR-4) is located 111 miles away from the Project, beyond the 75 nautical mile (NM) (or 86 mile) evaluation zone for this specific radar [3], and does not pose notable interference risk from the Project.
- The closest air surveillance radars are located 60 miles and 81 miles away at Bismarck and Gettysburg. No notable risk is anticipated at these distances, pending review by the FAA.
- No military flight training routes overlap with the Project.



Legend

Project Components

- Wind Turbine GE 2.8-127

Airports

- ✈ Airport
- ✈ Airstrip

Radiocommunication Towers

- Microwave
- Land Mobile
- Cellular Tower

Evaluation Zones

- Point-to-Point Link > 0.89 GHz
- 2D Max. of Second Fresnel Zone Plus Blade Length
- Radiocommunication Tower (1 km)

Base Map

- Secondary Road
- Local Road
- Watercourse
- Waterbody



Orsted

Badger Wind

RADIOCOMMUNICATION SYSTEMS
-LOCAL-

10455420-240112-IE
January 12, 2024
Projection: UTM 14 NAD 83
Sources: ArcGIS Online, FAA, FCC, TIGER, 3DEP (USGS)

Figure 1 Telecommunication Systems and Turbine Layout

4 CONCLUSIONS AND RECOMMENDATIONS

Based on the systems inventory and impact assessment completed for the Project, DNV has reached the following conclusions:

The risk of interference (obstruction or reflection) with broadcasting systems (TV, AM, FM) is low. Although several TV and AM towers have broadcast service contours of varying intensity that overlap the Project area, the low population density near the turbines and the large distances from the broadcasting towers and adequate spacing between turbines and residences significantly alleviates the risk of signal-related problems at residences. DNV notes the following:

- AM signals: The nearest AM tower is located 81 km (over 50 miles) from the nearest Project turbine. Signal obstruction is unlikely at this distance.
- FM signals: The nearest FM tower is located 64 km (40 miles) from the nearest Project turbine. Signal obstruction is unlikely at this distance.
- TV signals: The nearest digital TV tower (KJRE) is located 48 km (30 miles) from the nearest Project turbine. Signal obstruction is unlikely at this distance.

DNV's recommended setbacks between wind turbines and broadcast towers vary from 2 km (1.2 miles) to 15 km (9.3 miles) depending on the system. There are no turbines within those distances.

In the unlikely event of observed broadcast signal degradation at residences after the start of commercial operation, possible mitigations could be implemented. Such a mitigation measures may include actions such as installing better quality rooftop antennas or paying for a cable or satellite TV/radio subscription at the impacted residences.

- According to the FCC inventory, one land mobile system (WSR667) is located just under 1 km from turbines 92 and 93 (see Figure 1), which is DNV's recommended "best practice" evaluation zone. As the location of this antenna could not be verified using aerial imagery, the Customer performed a field survey to verify its location. The antenna is placed on the roof of a building (not on a tower) with a listed height of 13 m above ground in the ULS database. This height is lower than the bottom extremity of the circular turbine rotor swept area, and the risk of interference of this signal by rotating blades is therefore greatly reduced to a very low level.
- One high-frequency microwave link between towers with call signs WBD235 and WBD236 has been identified overlapping the Project area. Turbines 19 and 37 are the closest turbines to the beam path and have been positioned in a way that clears the recommended setback distance. No adverse impact is expected.
- A high-level review of air navigation systems and weather radar demonstrates that the risk of interference with such systems is low. However, this needs to be confirmed through the FAA permitting process and the NTIA consultation. These applications are currently under way.

The overall risk of interference caused by the Project turbines for the types of communication systems investigated herein is low.



5 REFERENCES

- [1] Badger Wind Turbine locations received 9 November 2023
- [2] DNV. *10306372-HOU-R-04-B. TV Signal Baseline Measurements*. 26 August 2022.
- [3] NORAD radars of concern – proposed setbacks. August 7 2023.

APPENDIX A – WIND TURBINE COORDINATES

ID	UTM Zone 14, NAD 83 Datum	
	Easting [m]	Northing [m]
1	449232	5135638
2	449714	5135812
3	450071	5136111
4	449260	5130118
5	449758	5130152
6	447550	5126069
7	448035	5126080
8	448497	5126098
9	449154	5126084
10	449386	5126438
11	449781	5126652
12	450728	5127537
13	450860	5127853
14	451041	5128333
15	451256	5128620
16	451315	5129160
17	451460	5129521
18	452210	5129270
19	453099	5130065
20	449376	5125160
21	449699	5125356
22	450359	5125200
23	450646	5125478
24	451091	5125879
25	451295	5126363
26	451577	5126666
27	452097	5127541
28	452421	5128376
29	452323	5125495
30	452479	5126004
31	452664	5126361
32	452894	5126680
33A	453003	5126987
34	453276	5127510
37	454764	5128664

ID	UTM Zone 14, NAD 83 Datum	
	Easting [m]	Northing [m]
38	454742	5129112
39	454835	5129566
40	450370	5121682
41	450760	5121822
42	450982	5122434
43	451235	5122676
46	452216	5124027
47	452481	5124306
48	453381	5124054
49	453778	5124395
54	457834	5127638
55	458325	5127835
56	458601	5128175
57	458765	5128525
58	459094	5128759
59	459656	5130026
60	460523	5130695
61	460803	5130994
62	460359	5131441
63	459474	5131693
64	461020	5132473
65B	452574	5121646
66B	452928	5121822
67B	453431	5121899
68B	453743	5122114
70A	458619	5126099
71	458816	5126367
72	459697	5127871
73	460934	5127435
73B	461159	5127167
74	461104	5128566
75	462699	5127679
76	452565	5119147
77	452596	5120163
78	452882	5120526

ID	UTM Zone 14, NAD 83 Datum	
	Easting [m]	Northing [m]
79	454604	5120400
80	455082	5120401
81	455774	5119232
83	462165	5124334
84	462095	5125131
85	462125	5125862
86	448174	5130196
87	448552	5130291
88	449901	5130762
89	448243	5126773
90	448461	5127094
91	448482	5127610
92	445292	5123520
93	445705	5123590
94	446125	5123690
95	447398	5123549
96B	447688	5123845
97	448092	5124004
98	448512	5124333
99	448991	5124344
105	454252	5124496
106	451880	5118601
107	452555	5117661
108	452740	5118025
109	453762	5118008
110	454279	5116798
111	454557	5117036
113	454981	5117083
114	455457	5117189
115	455748	5117927
116	449433	5124398
118	452384	5118784
119	453366	5117786



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