APPENDIX D – PRE-CONSTRUCTION WIND TURBINE NOISE ANALYSIS

Pre-Construction Wind Turbine Noise Analysis

for the proposed

Deuel Harvest North Wind Farm

November 2018

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1. Introduction

This report describes a pre-construction noise analysis conducted by Hankard Environmental for the proposed Deuel Harvest North Wind Farm (the Project) in support of its Energy Facility Permit. Deuel Harvest Wind Energy LLC (Deuel Harvest, the Applicant), an affiliate of Invenergy LLC (Invenergy), is developing the up to 310.1 megawatt (MW) Project to be located in Deuel County, South Dakota. Deuel Harvest intends to construct and operate the Project, which is located in the townships of Portland, Lowe, Altamont, Glenwood, Clear Lake, and Herrick. Figure 1-1 shows the general location of the Project, which is bordered by 166th Street to the north, State Line Road to the east, County Highway 309 to the south, and County Highway 443 to the west.

This report assesses potential sound levels of the Project and confirms compliance with the Zoning Ordinance of Deuel County, Section 1215: Wind Energy System (WES) Requirement of 45 dBA at non-participating residences. Our analysis confirmed that sound levels will not exceed 44.9 dBA at non-participating residences. Described herein are the applicable noise standard, the Project and its environs, the methods and data used to model noise levels, the results of the noise level predictions, and demonstration of compliance with the Zoning Ordinance.

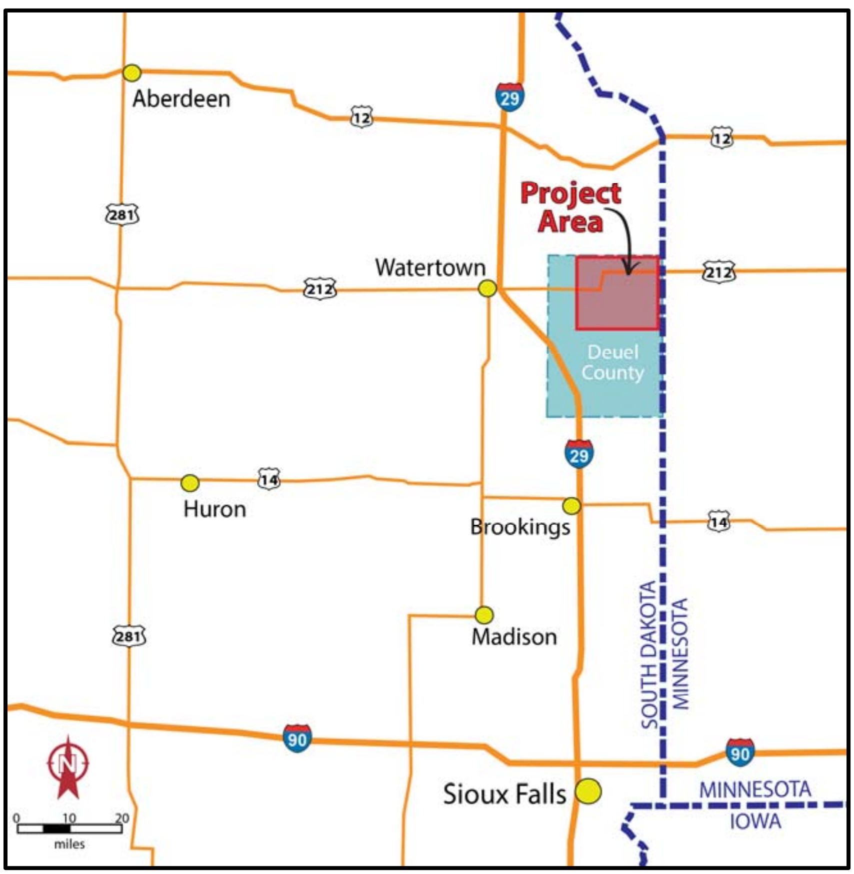


Figure 1-1. General Location of the Proposed Deuel Harvest North Wind Farm

2. Applicable Noise Standards

On May 23, 2017, the Board of County Commissioners passed Ordinance 82004-01-23B, which amended the Deuel County Zoning Ordinance, Section 1215.03: General Provisions, Paragraph 13: Noise & Shadow Flicker, Subparagraph a to read:

> *a. Noise level shall not exceed 45 dBA average A-Weighted Sound pressure at the perimeter of existing residences, for non-participating residences.*

This amendment became effective on June 20, 2017. This is the only numerical noise limit applicable to wind energy systems in Deuel County, South Dakota. There are no other *numerical* local, state or federal noise limits applicable to the Project.

There is one other noise-related requirement at the state level: South Dakota Administrative Rule 20:10:22:33.02 requires that an application for an Energy Facility Permit include "Anticipated noise levels during construction and operation". The noise levels reported herein are those expected during operation. Construction noise levels will be typical of those produced by standard construction equipment.

3. Project Description

The Project is located in a predominantly agricultural area of central-western South Dakota; wind turbines and associated facilities are thus sited primarily on agricultural lands. The Project will consist of up to 112 wind turbines generating up to 300 MW of electrical power with a nameplate capacity of 310.1 MW. Associated facilities include graveled roads to access each turbine and below-surface electrical cabling to collect and transmit the power to a project substation. Deuel Harvest is proposing one layout for the Project, which is approximately 42,000 acres in size, and was selected based upon review and analysis of wind resources, economic considerations, landowner interest, availability of easements, access to transmission routes, interconnection of the Project to existing transmission facilities and lines, geographic features, and environmental resources. The Project is located in an area with a strong wind resource and is situated near existing electric transmission infrastructure.

Table 3-1 lists the two turbine types that were analyzed for noise compliance. The layout analyzed includes 111 units of General Electric (GE) model 2.82-127 wind turbines and 13 units of GE 2.3-116 wind turbines, all fitted with Low Noise Trailing Edge (LNTE) blades. Note that while the sound modeling included 124 turbines, only up to 112 turbines will be installed: 10 of the GE 2.82-127 wind turbines included in the noise analysis are alternates, and 2 of the GE 2.3-116 wind turbines included in the noise analysis are alternates. The layout is shown graphically in the figures in Appendix A. Also shown in the figures are the locations of all 122 non-participating and 109 participating residences within two miles of any turbine or the 34.5 kV to 345 kV transformer. The geographic coordinates of each modeled receptor and each Project noise source (turbines and transformers) are provided in Appendix B and C, respectively.

Table 3-1. Project's Wind Turbine Noise Sources

Turbines					Transformers	
Model	Blades	Rotor Diameter (m)	Hub Height (m)	Number of Turbines	Type	Number
GE 2.3-116	LNTE	116	80.0	13	standard utility scale	2
GE 2.82-127	LNTE	127	88.6	111*		

* There is a total number of wind turbines in noise model of 124, which includes 12 alternates.

4. Noise Modeling Method

Noise levels from the proposed Deuel Harvest North Wind Farm were predicted using the modeling method set forth in International Organization for Standardization (ISO) Standard 9613-2: Attenuation of Sound During Propagation Outdoors. The method was implemented using the SoundPLAN v7.4 acoustical modeling program and cross-checked with a spreadsheet calculation. Figure 4-1 shows a representative three-dimensional view of the SoundPLAN model of the Project.

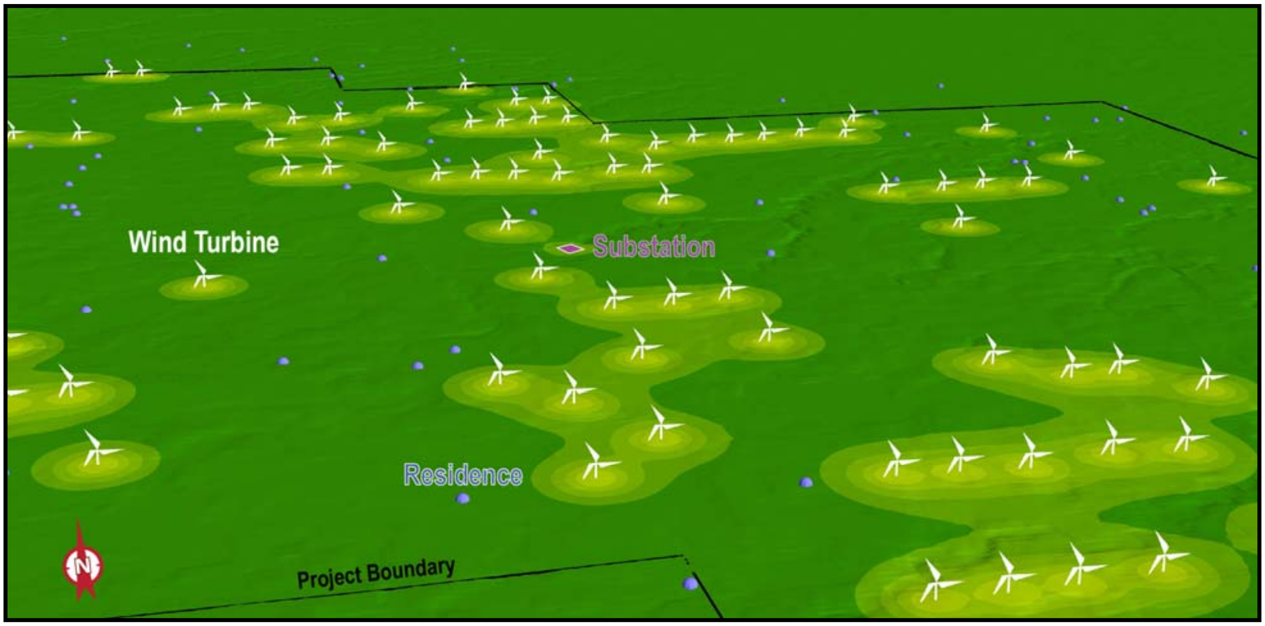


Figure 4-1. Three-Dimensional View of the SoundPLAN Noise Model

There are several parameters in the ISO 9613-2 method, including the locations of the noise sources and receivers, noise source level and frequency characteristics, terrain and ground type, and atmospheric propagation conditions. The ISO method assumes optimal acoustic propagation in all directions, specifically that a "well-developed, moderate ground-based temperature inversion" is present or, equivalently, that all receptors are downwind of all noise sources at all times. The specific ISO 9613-2 settings used in this analysis are described below.

Receptors

In the SoundPLAN model, receptors (prediction points) were located at each of the 122 non-participating and 109 participating residences located within the Project study area, which includes any residence located within approximately two miles of any turbine or main transformer. The geographic locations of the residences were provided by Deuel Harvest Wind. Ground elevations were determined using Digital Elevation Model (DEM) data from the U.S. Geological Survey (USGS) National Elevation Dataset. In accordance with ISO 9613-2, each receptor's height was set to 1.5 meters (5 feet) above the ground. The location of each receptor is shown in the figures in Appendix A. The geographic coordinates and ground elevation of each modeled non-participating and participating receptor are listed in Appendix B and C, respectively.

Noise Sources

In the SoundPLAN model, each turbine was represented as an acoustical point source located at its hub height, which is 80 meters above the ground for the GE 2.3-116 units, 88.6 meters above the ground for the GE 2.82-127 units, and 3 meters for the transformers. No directivity was applied to any noise source, thus assuming maximum acoustic output in all directions, and all turbines were assumed to be operating in normal mode (versus noise-reduction mode). The locations of the turbines were provided by Deuel Harvest (State Permit Layout_Rev1 (124 WTGs Numbered.shp)). The location of the substation containing the two main step-up (34.5 kV to 345 kV) transformers was also provided by Deuel Harvest. The location of each turbine in each layout is shown in the site plan figures in Appendix A. The geographic coordinates, ground elevation, and hub-height elevation of each modeled turbine and transformer are listed in Appendix D. The ground elevation for each turbine location was determined using DEM data from the USGS National Elevation Dataset.

Table 4-1 lists the octave band sound power levels for all modeled noise sources in the Project. The levels are expressed in terms of unweighted decibels (dB) for each of nine standard frequency bands, as defined by the American National Standards Institute (ANSI) Standard S1.11: Specification for Octave-Band and Fractional Octave-Band Analog and Digital Filters. The noise level data for each turbine was provided by the manufacturer and was determined according to International Electrotechnical Commission standard 61400-11. This standard requires wind turbine sound power levels to be reported for a number of wind speed bins across the operating range of the turbine. In general, sound levels increase with increasing winds speeds, up to approximately 10 m/s at hub height. Noise levels do not further increase above this wind speed because the turbines reach a maximum rotational speed. This relationship between wind speed and noise level holds true for each octave band. This analysis used octave band noise levels reported the manufacturer for the 10 m/s wind speed at hub height, as this is the speed at which the overall noise level first reaches its maximum level. The manufacturer's uncertainty factor was not applied to this data.

Table 4-1. Source Sound Power Levels

Source	Octave Band Sound Power Level (dB)									Overall Sound Power Level (dBA)
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	
GE 2.3-116 LNTE*	118.3	115.3	111.7	107.2	102.5	99.5	98.1	92.3	74.6	106.0
GE 2.82-127 LNTE*	122.3	118.8	113.3	106.8	103.6	103.8	101.5	94.0	78.0	108.5
Transformer	95.0	100.8	102.7	97.2	97.8	91.6	86.4	81.6	72.5	98.0

* For 10 m/s hub-height wind speed

The Project's collector substation will contain two transformers, switch gear, metering, electrical control and communication systems, and other equipment required to transform Project wind generated power. The only significant noise-producing equipment are the Project's main step-up transformers. The noise analysis assumed the simultaneous operation of two 120 MVA transformers at the substation. The sound power levels from the transformers are listed in Table 4-1. The substation location is shown in the figures in Appendix A. Ground elevations for the transformers were determined using the USGS National Elevation Dataset. The transformers were modeled as point sources located 3 meters (10 feet) above the ground, with no barriers or directivity reductions. The spectral shape of transformer noise emissions was estimated using published data and adjusted to match the overall sound power level of 98 dBA, which is a typical and achievable level estimated for utility-scale transformer.

Terrain and Ground Effect

The terrain in the project area was modeled by importing digital elevation model (DEM) data from the U.S. Geological Survey National Elevation Dataset into SoundPLAN. The acoustical effect of the ground was modeled using the ISO 9613-2 General Method. This requires the selection of ground absorption factors for the ground near the source, near the receiver, and in between. Ground factors range from 0.0 to 1.0 and represent the proportion of sound that is absorbed or reflected when sound waves interact with the ground. A value of 0.0 represents completely reflective ground material such as pavement or flat water, and results in a higher level of sound reaching a receptor. A value of 1.0 represents absorptive material such as thick grass, crops, or fresh snow, and results in a lower level of sound reaching a receptor. For this project, we conservatively assumed a ground factor of 0.0 (completely reflective). Actual ground conditions could at times be 0.0 when the ground is completely frozen, but would generally be closer to 0.5 when the ground is covered with new snow or crops, or when the ground is bare and unfrozen.

Atmospheric Conditions

The air temperature, relative humidity, and atmospheric pressure were set to standard-day conditions of 10°C, 70%, and 1 atmosphere, respectively. These values represent the lowest amount of atmospheric absorption of sound available in the ISO 9613-2 method, and result in the highest levels of sound reaching the receptors.

Validation of Noise Prediction Method

The noise level prediction method employed on the Project has been validated by Hankard Environmental by comparing predicted noise levels to those measured at operating wind farms. Most notably, Hankard Environmental compared the noise levels measured over the course of four months near an existing Illinois wind farm employing similar turbines to the noise levels predicted by an acoustical model of that project using the methods described above. The validation compared the predicted levels to the very highest turbine-only noise levels measured. A majority of the time, actual turbine noise levels will be lower than those predicted. This is because, in addition to the conservative ground attenuation factor and atmospheric absorption conditions, sound levels were calculated assuming maximum turbine operations (which will not always be the case) and the ISO 9613-2 method assumes that all receptors are downwind of all noise sources at all times (a physical impossibility for this turbine layout).

The noise level modeling method employed on this Project has been validated by many acoustical consultants, including Hankard Environmental. Hankard Environmental has conducted numerous wind turbine noise level compliance surveys, and routinely compares the results of these measurements with corresponding predicted levels using the same methods employed on this Project. We consistently find that our predicted levels are at least 1 dB higher than the loudest measured hourly turbine only noise levels.

5. Predicted Noise Levels

Non-Participating Residences

Noise levels from the full and continuous operation of 111 GE 2.82-127 LNTE turbines, 13 GE 2.3-116 LNTE turbines, and two main step-up transformers were predicted at each residence. Table 5-1 lists the predicted turbine noise levels at the 12 non-participating residences where the loudest levels are predicted. All of these predicted levels are less than the County's 45 dBA limit. Predicted noise levels at all other non-participating residences are lower. Overall, levels range from 24 dBA to less than 45 dBA, with an average of 36 dBA. The predicted noise levels at each of the 122 non-participating residences are listed in Appendix B.

Table 5-1. Highest Predicted Noise Levels ($L_{eq\ (1\ Hr)}$) at Non-Participating Residences

Receptor ID	Noise Level (dBA)	Receptor ID	Noise Level (dBA)
258	44.9	201	43.6
260	44.9	259	43.6
233	44.5	200	43.4
245	44.0	196	43.3
198	43.7	231	43.3
299	43.7	242	43.3

Participating Residences

Table 5-2 lists the 12 participating residences where the highest noise levels are predicted. Overall, levels range from 28 dBA to less than 50 dBA, with an average of 40 dBA. Predicted noise levels at all other participating residences are lower. The predicted noise levels at each of the 109 participating residences are listed in Appendix C.

Table 5-2. Highest Predicted Noise Levels ($L_{eq\ (1\ Hr)}$) at Participating Residences

Receptor ID	Noise Level (dBA)	Receptor ID	Noise Level (dBA)
458	49.8	400	48.0
302	48.8	433	48.0
452	48.5	436	47.7
438	48.4	414	47.6
380	48.1	459	47.6
257	48.0	455	47.4

Predicted Noise Level Contours

Noise levels are indicated graphically in the form of noise level contours in the figures in Appendix E. Each of the green contour lines encircles one or more turbines to indicate the positions at which the predicted noise level is 45 dBA. All of the area between a contour line and any turbine that it surrounds has a predicted noise level in excess of the 45 dBA level. All of the area outside of a contour has a predicted noise level less than the 45 dBA level.

6. Construction Noise Levels

Construction for a wind turbine farm is expected to include the wind turbine sites, substation, access roads, and underground transmission lines. The construction will generate temporary noise from a variety equipment. Table 6-1 provides a list of potential construction equipment for each type, phase and sub-phase for construction of a wind farm project. In general, each individual wind turbine site is estimated to take about two to three weeks to construct, with the substation taking about three to four months and the entire wind farm around twelve months.

Table 6-1. Potential Construction Equipment to be Employed on a Wind Turbine Project

Type	Phase	Sub-Phase	Equipment
Turbines	Site Preparation	Clearing	Chainsaw, Feller Buncher, Grapple Loader, Log Truck
		Road/Site	Dozer, Excavator, Grader, Roller, Dump Trucks
		Foundation	Drill Rig, Track Hoe, Dozer, RT Crane, Concrete Truck
	Installation	Delivery	Fork Lift, RT Crane, Tractor Trailer
		Components	Crawler Crane
	Site Finishing	---	Dozer, Moto Grader, Skid Steer, Seed Drill
Substation	Site Preparation	Clearing	Chainsaw, Feller Buncher, Grapple Loader, Log Truck
		Road/Site	Dozer, Excavator, Grader, Roller, Dump Truck
		Foundation	Drill Rig, Track Hoe, Dozer, RT Crane, Concrete Truck
	Construction	Delivery	Fork Lift, RT Crane, Tractor Trailer
		Components	Fork Lift, Bucket Truck, Truck Crane
	Site Finishing	---	Dozer, Moto Grader, Skid Steer, Seed Drill
Roadways	Site Preparation	---	Chainsaws, Feller Buncher, Grapple Loader, Log Truck
	Construction	---	Dozer, Moto Grader, Back Hoe, Dump Truck, Roller
	Site Finishing	---	Dozer, Moto Grader, Skid Steer, Seed Drill
Underground Electrical Collections	Trenching	---	Trencher, Track Hoe, HDD machine
	Installation	---	Cable Layer
	Site Finishing	---	Track Hoe, Skid Steer, Seed Drill

Construction noise at off-site receptor locations will usually be dependent on the loudest one or two pieces of equipment in operation at a particular time. Noise levels from diesel-powered equipment at 50 feet generally range from 80 dBA to 95 dBA. Table 6-2 provides a list of common construction equipment, its maximum noise level expected at 50 feet, the typical duration a particular piece of equipment is used in any one-hour period, and the resulting hourly equivalent noise level ($L_{eq\ (1\ Hr)}$) for the piece of equipment.

Table 6-2. Noise Source Characteristics of the Construction Equipment

Equipment	L_{max} Noise Level at 50 ft (dBA)	Usage Factor (%)	$L_{eq(1\ Hr)}$ Noise Level at 50 ft (dBA)
Back Hoe	82	40	77.6
Belly Dump Truck	88	40	84.0
Bucket Truck	82	20	74.7
Cable Layer	70	50	67.0
Chain Saw	91	20	83.7
Concrete Truck	88	20	81.4
Crawler Crane	89	16	80.6
Dozer	86	40	81.7
Drill Rig	86	20	79.1
Dump Truck	81	40	76.5
Excavator	85	40	80.7
Feller Buncher	89	40	85.0
Fork Lift	69	40	65.0
Grapple Loader	83	40	79.1
Horizontal Drill	88	25	82.0
Log Truck	78	40	74.3
Moto Grader	89	40	85.0
Roller	84	40	80.0
RT Crane	89	16	80.6
Seed Drill	83	50	80.0
Semi Trucks	78	40	74.3
Skid Steer	83	40	79.1
Track Hoe	82	40	77.6
Tractor Trailer	78	40	74.3
Trencher	83	50	80.4
Truck Crane	87	16	80.6

Construction noise from the Project is not expected to create any significant impacts. That said, the following steps could be taken by the Project to minimize the impact of construction noise:

- Limit any necessary nighttime work near residences to quiet activities such as finishing,
- Maintain equipment to manufacturers' specifications, particularly mufflers,
- Use ambient controlled broadband backup alarms versus tonal back-up alarms,
- Minimize backing up on site of delivery trucks to the degree practicable,
- Provide a 24-hour telephone complaint number for residents to use if needed,
- Attempt to resolve any legitimate problems in a prompt manner,
- Notify residences of expected construction schedule for the entire Project.

7. Conclusions

Noise levels from the full and continuous operation of the Project were predicted at each non-participating and participating residence located within two miles of any Project noise source. Noise levels are predicted to be less than 45 dBA at all non-participating residences. The noise modeling (prediction) method used in this analysis has been demonstrated by Hankard Environmental and other acoustical consultants to result in predicted levels that are at least 1 dB higher than the loudest measured hourly turbine only noise levels. Therefore, we confidently conclude that noise levels from the Project, once operational, will be less than the Deuel County limit under any circumstances. A majority of the time, when either turbines are at less than full operation, or off, or when atmospheric conditions are less than ideal for sound propagation, noise levels will be significantly less than those reported herein

The noise modeling analysis is based on the following assumptions:

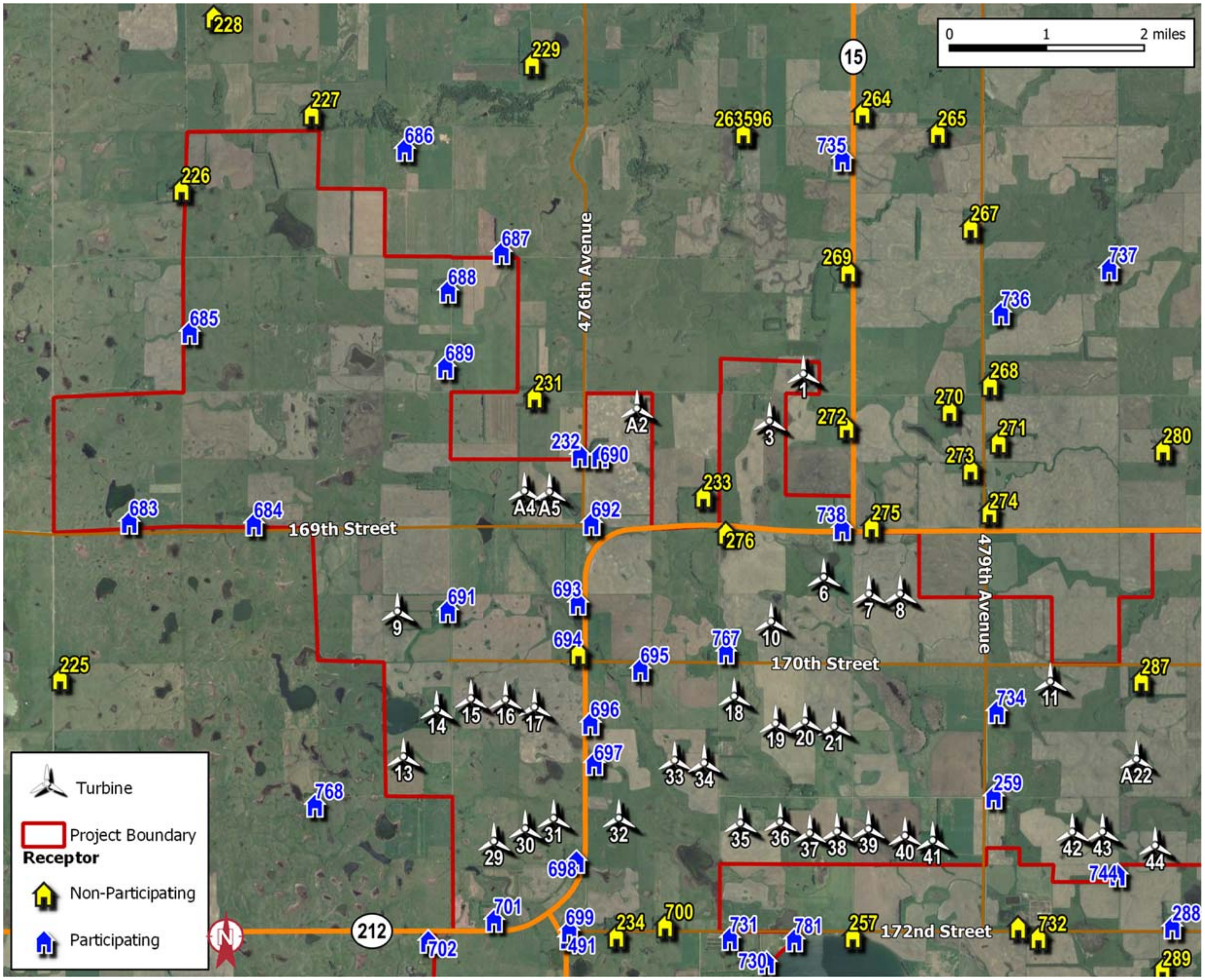
1) The use of a 0.0 ground attenuation factor, which results in higher levels of predicted noise than would result from a higher ground factor. Hankard Environmental has found that measured levels never exceed those predicted using 0.0 and are often lower.
2) The model assumes atmospheric conditions that result in efficient sound propagation and therefore higher noise levels. These conditions, primarily wind direction and the presence of either a temperature inversion or a wind gradient, will only be present a certain percentage of time. When they are not present, noise levels will be lower than those reported herein. In addition, the ISO 9613-2 method assumes that all receptors are downwind of all noise sources at all times. For many receptors (those with turbines located in different directions around them), this is not physically possible.
3) All turbines and transformers are modeled without any source directivity. In reality, these sources project different levels of sound in different directions. In the model, they are assumed to radiate their highest levels in all directions.
4) All turbines and transformers are assumed to be operating in their maximum-noise state, which will not always be the case.
5) All of the GE 2.3-116 and 2.82-127 wind turbines are fitted with LNTE blades.

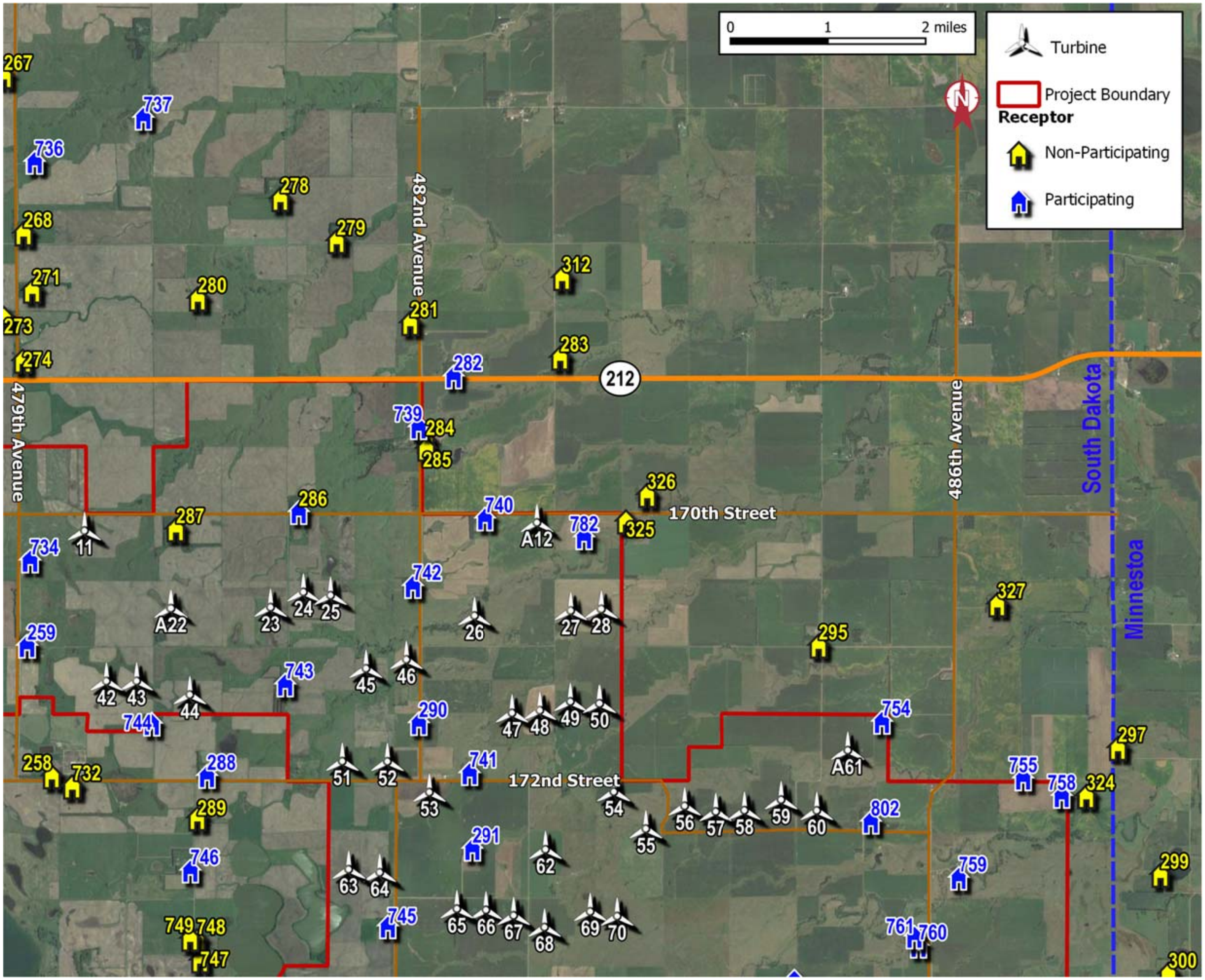
Note that the results described herein are valid for the receptor locations provided, the turbine layout analyzed, and the wind turbine sound power levels as provided by the manufacturer. If the Applicant makes any significant changes to the Project, including layout, turbine type, or mix of standard and LNTE blades, this noise analysis should be updated and compliance with the noise limit again demonstrated.

APPENDIX A

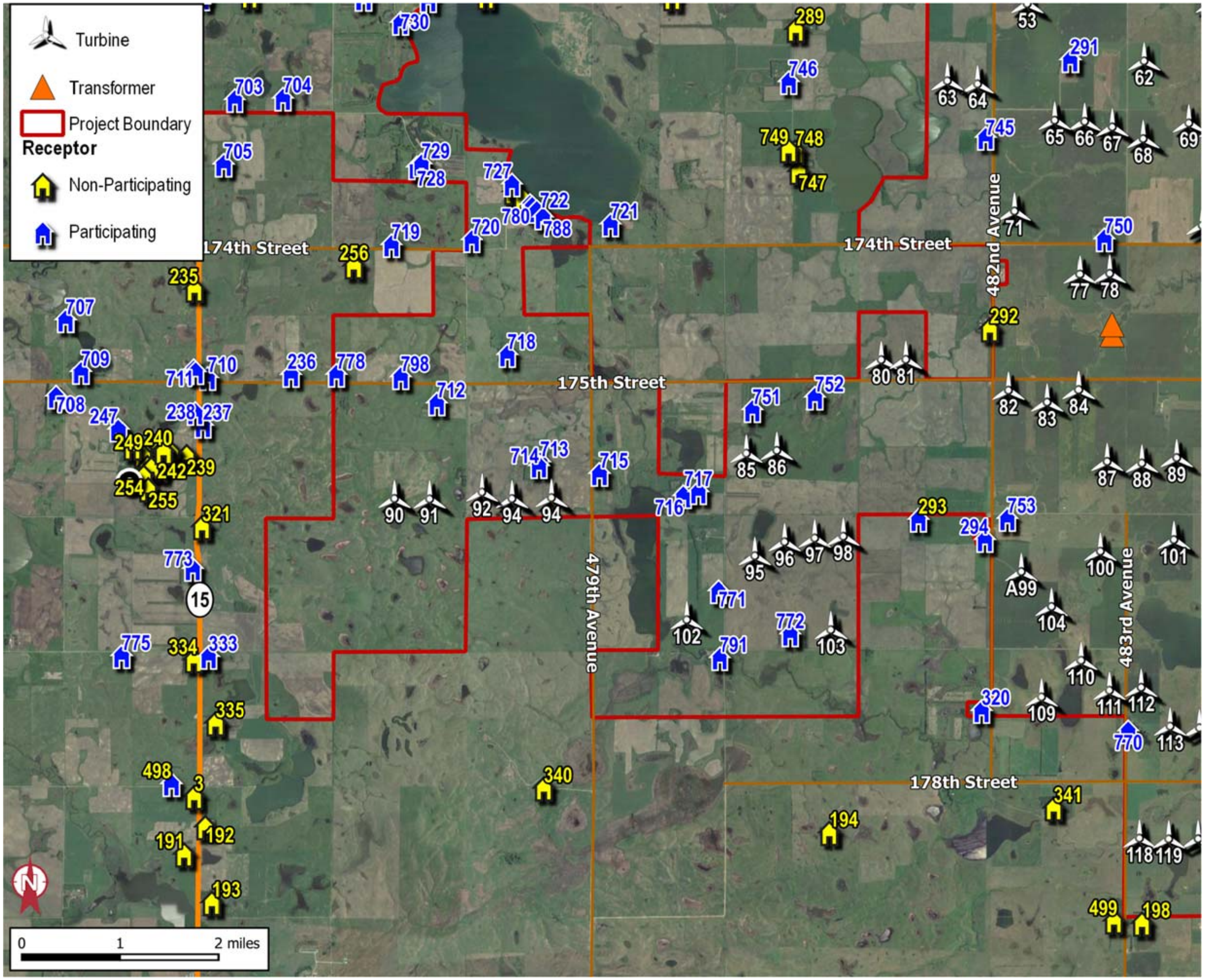
Site Plan Figures

Site Plan – Northwest Area



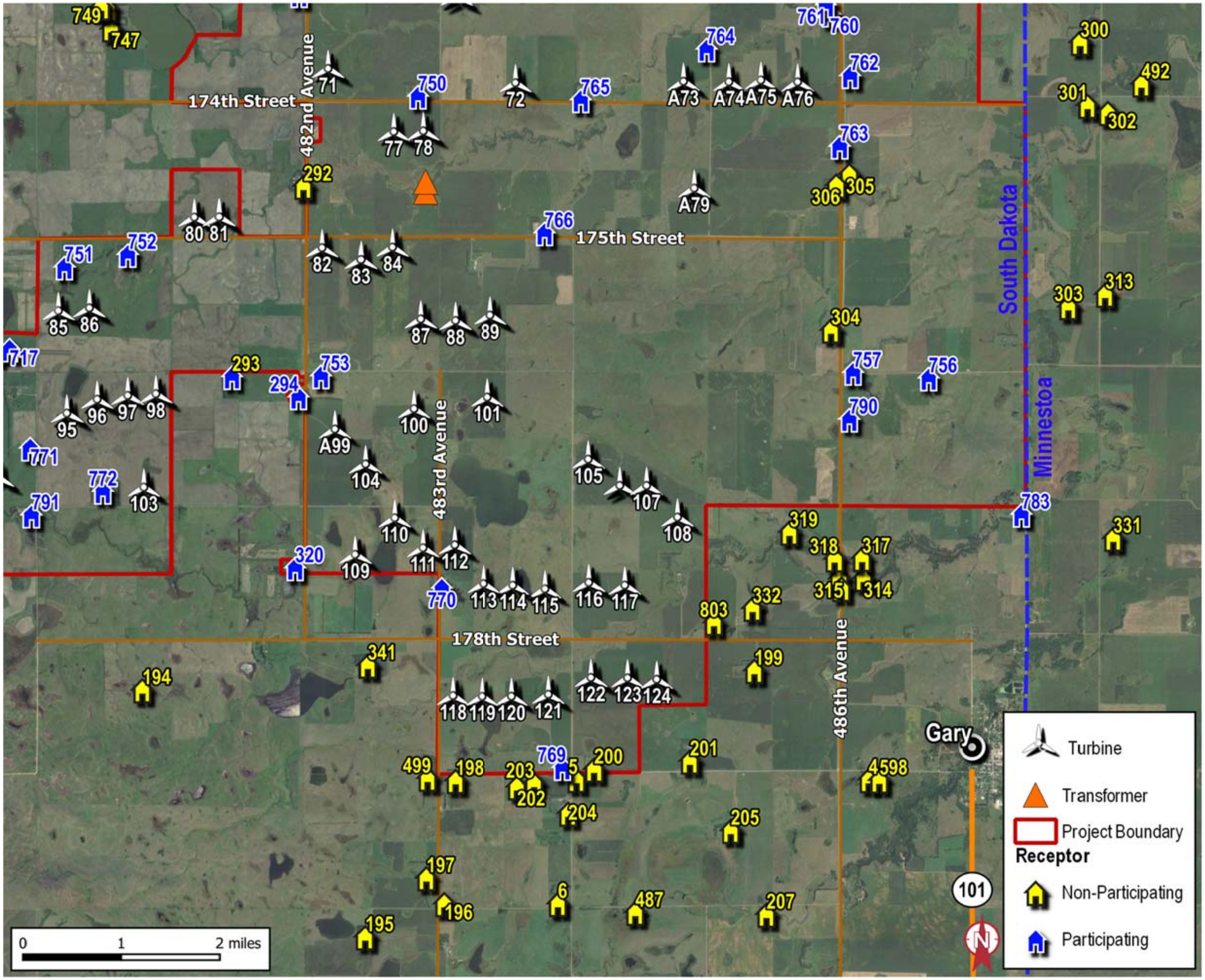


Site Plan – Northeast Area



Site Plan – Southwest Area

Site Plan – Southeast Area



APPENDIX B

Non-Participating Receptor Locations and Noise Levels

Non-Participant Receptor	UTM 14N NAD83 Easting (m)	UTM 14N NAD83 Northing (m)	Ground Elevation (m asl)	Noise Level (dBA)
185	683223.3	4963725.5	567.4	27.9
186	699671.6	4962705.9	491.3	33.9
187	696154.6	4962599.8	512.5	43.2
188	695975.2	4961104.2	503.3	36.3
189	683121.2	4963032.3	560.0	26.7
190	683367.4	4963366.8	561.5	27.5
191	683471.7	4962460.7	558.2	26.3
192	690893.9	4963516.8	526.6	36.7
193	693658.3	4960633.8	515.8	34.2
194	694600.3	4961061.0	507.1	36.0
195	694374.9	4961364.6	507.5	36.9
196	694692.3	4962541.8	504.5	43.3
197	698258.8	4963972.6	490.8	40.3
198	696362.3	4962729.2	508.9	43.7
199	697509.2	4962861.4	504.8	41.3
200	695438.7	4962489.8	510.5	43.4
201	695644.7	4962536.6	509.5	43.6
202	696067.1	4962192.1	509.2	40.9
203	698033.0	4962045.9	494.4	36.6
204	698494.4	4961052.6	497.9	33.4
205	676853.0	4976228.5	580.5	30.2
206	678135.3	4982121.6	516.1	27.5
207	679673.7	4983072.5	514.0	28.1
208	678464.2	4984192.1	519.1	24.0
209	682307.1	4983747.3	488.4	29.2
210	682450.2	4979759.1	515.7	40.7
211	684510.6	4978629.9	507.5	41.9
212	683614.2	4973333.9	524.8	41.2
213	683053.3	4969806.3	545.9	33.6
214	683016.0	4967807.4	559.2	32.8
215	682674.5	4967857.3	561.1	32.1
216	682638.8	4967747.5	564.7	32.0
217	682713.4	4967752.7	566.4	32.1
218	682793.7	4967839.3	563.0	32.3
219	682755.1	4967757.6	567.3	32.2
220	682689.4	4967819.0	562.2	32.1
221	682830.8	4967838.0	562.4	32.4
222	682502.2	4967842.4	561.1	31.8
223	682496.2	4967798.5	562.4	31.7

Non-Participant Receptor	UTM 14N NAD83 Easting (m)	UTM 14N NAD83 Northing (m)	Ground Elevation (m asl)	Noise Level (dBA)
224	682553.2	4967662.2	566.17	31.8
225	682698.1	4967682.3	566.88	32.1
226	682687.8	4967635.2	567.1	32
227	682600.4	4967648.9	566.94	31.9
228	682510.5	4967548.6	572.76	31.7
229	682569.6	4967398.2	570.81	31.6
230	684962.8	4970140.5	532.33	35.8
231	686461.4	4973410.6	521.19	43.3
232	688453.7	4973580.2	512.72	42.1
233	688112.4	4975133.4	509.45	44.5
234	684868.5	4982990.1	484.73	31.9
235	686291	4983273	475.78	31
236	687203.5	4983063.8	460.97	31.1
237	687635.7	4981939.8	470.02	32.9
238	687925.8	4980067	479.57	36
239	686172.7	4981375.2	484.94	36.8
240	687441.5	4979742.1	489.45	37.5
241	688048.6	4979384.7	486.52	37
242	686207.6	4979503.3	498.55	43.3
243	687721.2	4979046.4	494.36	38.3
244	687962.6	4978543.2	494.48	39.1
245	686544.9	4978326	503.26	44
246	684796.8	4978196.3	506.25	42.2
247	690981	4980569.6	430.56	33.1
248	691673.5	4980086.5	424.97	33.7
249	690024.4	4979348.4	466.85	35.5
250	692581.5	4979132.2	422.62	35.3
251	694403	4978772.8	404.11	35.9
252	692811.6	4977723.4	430.54	38.9
253	692819.9	4977635.7	430.47	39.1
255	689844.2	4976580.3	491.17	42.6
256	690203.5	4973129.4	509.08	41.6
258	692648.6	4969610	491.32	44.9
259	691851.4	4967302.8	524.3	43.6
260	692664.9	4967084.4	508	44.9
261	697617.8	4975422	394.32	39.8
262	701252.8	4974308.3	366.79	33.1
263	701812.8	4972806.4	369.12	32.7
264	701946	4971621.4	376.55	32.8

Non-Participant Receptor	UTM 14N NAD83 Easting (m)	UTM 14N NAD83 Northing (m)	Ground Elevation (m asl)	Noise Level (dBA)
265	702056.2	4970870.1	369.33	32.6
266	702304.6	4970791.8	378.87	32
267	701906.7	4968451.2	390.67	32.3
268	699056.3	4968081.9	440.76	37.4
269	699213.5	4969951.9	424.16	40.3
270	699065.3	4969818.3	425.49	40.4
271	694397.5	4979727	400.45	33.7
272	702339.6	4968613.3	396.99	31.6
273	699535	4965117.9	442.96	36.4
274	699248	4965104	463.78	37.2
275	699273.9	4964989.1	455.4	37.1
276	699509.9	4965356.5	456.69	36.5
277	699184	4965340.1	451.89	37.5
278	698630.7	4965643.5	462.34	39.7
279	683225.4	4966962.8	563.32	33
280	700890.4	4973720.1	371.67	34.2
281	695248.1	4976837.3	409.53	42.1
282	695494.3	4977161.4	403.25	39.9
283	699752.5	4975983.3	369.51	34.3
284	702529.8	4965693	404.94	30.3
285	698213.9	4964717.3	483.07	41.1
286	683170.8	4965364.8	576.8	30.6
287	683454.3	4964614.5	564	29.8
288	687436	4963949.2	526.07	34.4
289	693591.4	4963892.8	504.28	43.1
290	696906.7	4961026.8	497.94	35.4
291	702697.4	4971146.5	374.43	31.2
292	682784.8	4967784.9	566.07	32.3
293	682366.5	4967893.1	557.49	31.5
294	682741.4	4967850.5	563.02	32.2
296	694353.6	4962559.5	509.79	42.5
297	684870.5	4982990.3	484.75	31.9
298	699799.9	4962703.4	491.08	33.7
299	683065.9	4976706.9	519.89	43.7
300	684197	4973476.3	522.61	41.7
301	688701.2	4973464.8	514.3	41.8
303	690288	4971428.4	507	39.8
304	690240.1	4971667.4	506.38	39.9
305	690159.7	4971684.3	505.47	39.8
306	697749.1	4964532.6	482.68	43.3
307	686903	4971039.13	522.55	37.2
308	686878.58	4971059.48	522.68	37.2
309	686858.23	4971085.93	520.15	37.2
310	686977.64	4971007.65	520.89	37.2

APPENDIX C

Participating Receptor Locations and Noise Levels

Participant Receptor	UTM 14N NAD83 Easting (m)	UTM 14N NAD83 Northing (m)	Ground Elevation (m asl)	Noise Level (dBA)
254	691313.4	4976830.2	472.4	42.7
257	693520.0	4972862.5	476.2	48.0
295	682947.0	4963870.2	564.7	27.6
302	689627.2	4974244.6	498.5	48.8
373	683015.8	4979077.0	516.6	45.5
374	684244.6	4968816.6	542.9	35.6
375	683201.7	4968177.8	554.9	33.3
376	683105.3	4968327.7	551.9	33.1
377	682193.0	4968103.2	560.8	31.4
378	693123.1	4978508.8	424.2	36.8
379	690304.8	4973638.7	503.5	43.3
380	692830.0	4974346.6	472.4	48.1
381	692686.3	4965034.0	511.4	44.2
382	683349.4	4965409.2	579.0	31.1
383	683038.8	4973296.5	524.2	41.3
384	678753.4	4971110.6	573.5	30.1
385	679474.7	4970841.3	579.1	30.7
386	677625.2	4978123.6	555.7	31.1
387	679116.5	4978144.4	536.6	34.7
388	678280.9	4980415.5	528.9	30.0
389	680799.2	4982675.4	502.8	29.9
390	682004.7	4981475.4	511.4	33.6
391	681367.7	4980995.9	521.8	33.8
393	683253.9	4979073.0	514.3	45.1
394	681474.1	4977172.2	530.9	45.1
395	683177.2	4978265.8	515.6	45.2
396	683042.0	4977307.6	521.7	42.2
397	683810.7	4976537.3	522.6	43.7
398	683233.3	4975874.1	523.7	45.9
399	683292.3	4975394.0	522.1	46.6
400	683113.3	4974215.3	525.8	48.0
401	683050.3	4973378.1	526.4	41.8
402	682141.1	4973481.5	531.2	42.7
403	681350.5	4973208.6	542.4	39.0
404	683469.2	4972089.4	530.6	37.1
405	684053.0	4972123.8	527.3	37.4
406	683358.3	4971312.1	537.0	35.5
407	680530.4	4970174.8	576.2	31.2
408	681526.9	4969394.7	570.5	31.5
409	681438.5	4968477.9	582.6	30.5
410	681726.7	4968780.4	563.1	31.2
411	683242.5	4968750.6	543.2	33.4
412	683072.1	4968840.2	542.5	33.1
413	686006.5	4968526.1	529.7	41.2
414	687276.8	4967856.4	525.4	47.6
416	687993.6	4967738.7	518.6	44.2
417	689008.9	4967501.4	515.4	44.0
418	689189.4	4967554.5	515.0	45.2
419	686844.1	4969130.3	522.4	38.9
420	685404.9	4970406.8	527.7	36.1
421	686371.3	4970494.0	529.6	36.8
422	685684.0	4971346.6	524.7	37.0
423	685738.3	4971384.7	525.2	37.0
424	685437.7	4973071.4	521.1	41.1
425	684985.7	4973346.4	522.0	41.9
426	688118.1	4976154.8	506.0	44.1
427	686067.5	4982709.5	485.5	32.3
428	688032.1	4980925.9	477.2	34.4
429	689311.1	4981491.8	437.9	32.4
430	686191.8	4978291.3	504.4	44.9
431	692720.6	4977888.1	430.4	38.3
432	693554.9	4976820.7	430.0	44.5
433	693459.3	4973767.0	467.1	48.0
434	692708.7	4975985.9	461.7	45.5
435	691212.5	4974762.1	488.1	46.0
436	692529.3	4971902.9	500.1	47.7
437	690138.1	4972499.6	509.2	40.4
438	693990.9	4970730.4	485.5	48.4
439	689816.3	4968557.1	516.2	46.6
440	690565.8	4968729.6	503.1	44.8
441	692928.4	4967344.8	506.2	45.0
442	698402.5	4974533.1	393.6	44.5
443	700128.7	4973908.8	378.5	36.0
444	700246.2	4967542.9	421.3	35.0
445	699332.8	4967581.8	444.6	36.8
446	700599.4	4973713.4	373.8	34.9
447	699386.7	4972694.9	394.8	38.9
448	698926.4	4971865.8	407.6	42.3

Participant Receptor	UTM 14N NAD83		Ground Elevation (m asl)	Noise Level (dBA)
	Easting (m)	Northing (m)		
449	698873.5	4971974.6	395.0	42.0
450	699187.4	4971136.0	412.5	44.1
451	699090.2	4970286.5	422.5	42.4
452	697449.2	4971400.9	425.6	48.5
453	695957.9	4970746.4	456.6	44.6
454	695570.0	4969140.0	484.6	43.0
455	684839.2	4976773.8	513.0	47.4
456	679945.9	4974799.4	546.5	39.3
457	695980.8	4962736.2	510.1	44.6
458	694456.0	4964842.7	513.2	49.8
459	689468.4	4966375.1	528.7	47.6
460	690352.7	4965883.0	513.2	47.1
461	683128.1	4966458.4	576.3	32.3
462	682308.4	4965388.9	576.6	28.8
463	684792.0	4968834.1	536.9	37.0
464	685763.7	4973352.6	516.3	42.8
465	694755.7	4976631.9	419.6	45.9
466	701419.6	4965944.4	414.2	32.5
467	699305.1	4967019.5	451.2	36.9
468	689508.0	4965573.1	512.6	45.2
469	683095.7	4968817.0	542.3	33.2
470	685562.5	4968827.6	531.9	38.9
471	698305.7	4973332.9	403.4	45.4
472	688036.1	4970731.6	519.8	37.7
473	687187.9	4970835.6	521.6	37.2
474	687112.6	4970888.5	519.2	37.2
475	686839.9	4971175.5	517.3	37.2
476	687064.7	4970935.3	519.5	37.2
477	687092.8	4970913.8	519.0	37.2
478	687148.3	4970867.1	520.6	37.2
479	687224.9	4970790.6	520.4	37.2

APPENDIX D

Noise Source Locations

Source ID	UTM 14N NAD83		Ground Elevation (m asl)	Source / Hub Height (m agl)	Source Type
	Easting (m)	Northing (m)			
1	685677.5	4980059.2	498.3	88.6	GE 2.5-127 LNTE
3	685286.2	4979482.5	506.0	88.6	GE 2.5-127 LNTE
6	685993.6	4977635.8	512.4	88.6	GE 2.5-127 LNTE
7	686537.1	4977450.4	512.6	80.0	GE 2.3-116 LNTE
8	686913.8	4977461.8	512.4	88.6	GE 2.5-127 LNTE
9	680870.2	4977077.3	537.2	88.6	GE 2.5-127 LNTE
10	685375.2	4977085.1	514.5	88.6	GE 2.5-127 LNTE
11	688757.1	4976465.5	499.7	88.6	GE 2.5-127 LNTE
13	680991.7	4975340.0	539.9	88.6	GE 2.5-127 LNTE
14	681374.9	4975918.1	540.4	88.6	GE 2.5-127 LNTE
15	681784.7	4976058.6	537.3	88.6	GE 2.5-127 LNTE
16	682204.7	4976059.3	531.3	80.0	GE 2.3-116 LNTE
17	682556.9	4975979.7	526.8	88.6	GE 2.5-127 LNTE
18	684956.0	4976177.0	514.8	88.6	GE 2.5-127 LNTE
19	685464.1	4975867.9	515.2	88.6	GE 2.5-127 LNTE
20	685817.8	4975902.0	513.6	88.6	GE 2.5-127 LNTE
21	686171.6	4975852.6	513.0	88.6	GE 2.5-127 LNTE
23	691010.3	4975614.8	487.6	88.6	GE 2.5-127 LNTE
24	691400.6	4975809.5	478.7	88.6	GE 2.5-127 LNTE
25	691728.5	4975779.1	479.1	88.6	GE 2.5-127 LNTE
26	693463.4	4975588.0	443.6	88.6	GE 2.5-127 LNTE
27	694624.1	4975683.2	427.4	88.6	GE 2.5-127 LNTE
28	694987.1	4975713.8	422.8	88.6	GE 2.5-127 LNTE
29	682114.3	4974358.9	532.8	88.6	GE 2.5-127 LNTE
30	682486.9	4974520.9	528.4	88.6	GE 2.5-127 LNTE
31	682826.0	4974654.8	521.6	88.6	GE 2.5-127 LNTE
32	683605.1	4974679.7	522.9	88.6	GE 2.5-127 LNTE
33	684257.2	4975390.4	521.3	88.6	GE 2.5-127 LNTE
34	684614.4	4975369.8	518.5	88.6	GE 2.5-127 LNTE
35	685075.1	4974663.5	519.7	88.6	GE 2.5-127 LNTE
36	685554.6	4974691.5	518.7	88.6	GE 2.5-127 LNTE
37	685914.1	4974566.8	519.2	88.6	GE 2.5-127 LNTE
38	686240.1	4974595.1	516.4	88.6	GE 2.5-127 LNTE
39	686613.6	4974636.5	514.1	88.6	GE 2.5-127 LNTE

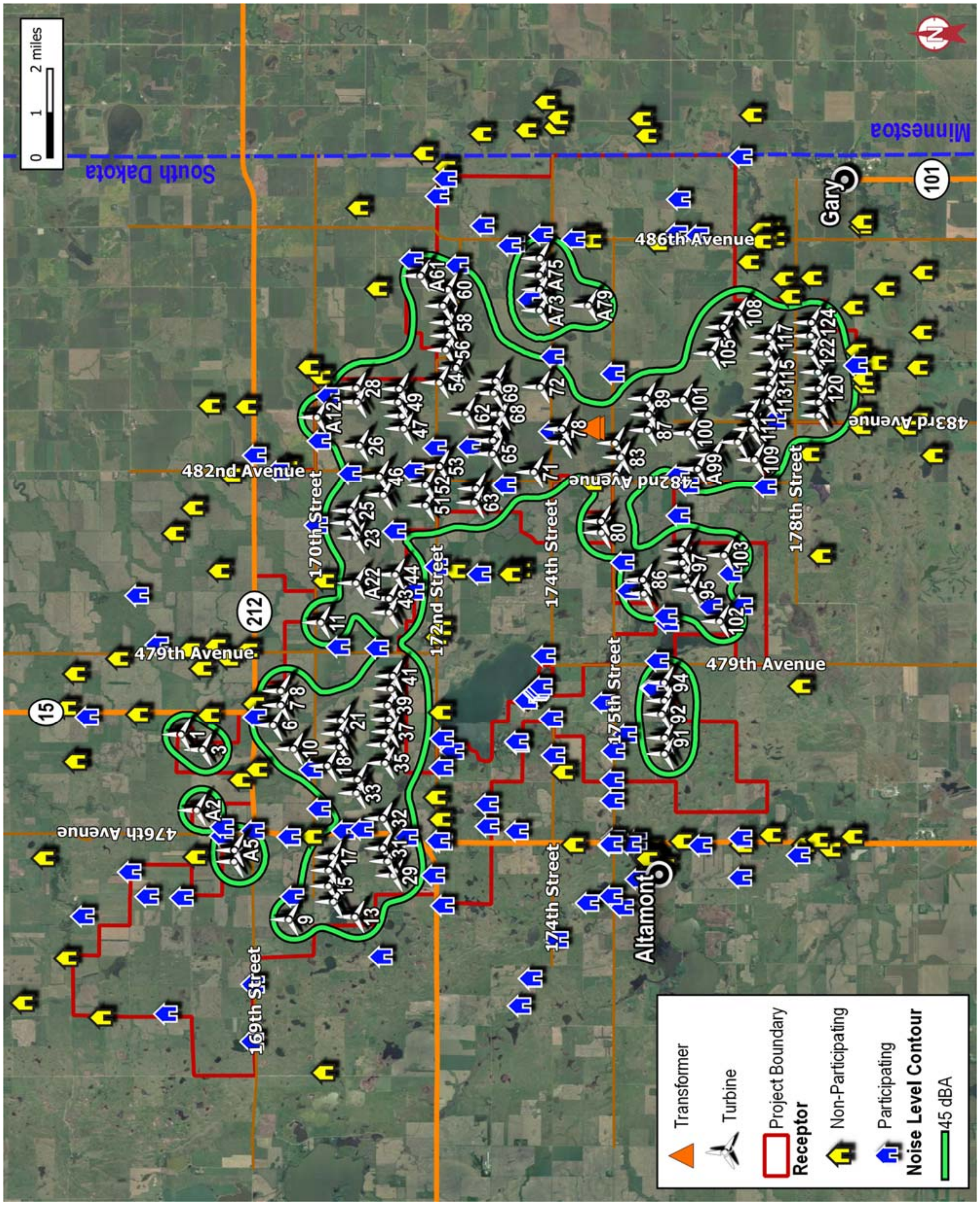
Source ID	UTM 14N NAD83		Ground Elevation (m asl)	Source / Hub Height (m agl)	Source Type
	Easting (m)	Northing (m)			
40	687055.9	4974567.9	516.5	88.6	GE 2.5-127 LNTE
41	687392.0	4974522.8	515.5	88.6	GE 2.5-127 LNTE
42	689073.8	4974673.0	500.4	88.6	GE 2.5-127 LNTE
43	689432.1	4974684.8	496.9	88.6	GE 2.5-127 LNTE
44	690071.1	4974539.5	495.0	88.6	GE 2.5-127 LNTE
45	692176.3	4974916.9	476.5	88.6	GE 2.5-127 LNTE
46	692658.6	4975038.2	472.1	88.6	GE 2.5-127 LNTE
47	693954.5	4974436.9	455.7	88.6	GE 2.5-127 LNTE
48	694288.6	4974478.5	444.3	88.6	GE 2.5-127 LNTE
49	694652.6	4974594.5	436.3	88.6	GE 2.5-127 LNTE
50	695001.4	4974582.1	433.8	88.6	GE 2.5-127 LNTE
51	691929.4	4973797.0	490.5	88.6	GE 2.5-127 LNTE
52	692466.5	4973810.4	478.7	88.6	GE 2.5-127 LNTE
53	692983.4	4973458.1	473.6	88.6	GE 2.5-127 LNTE
54	695203.2	4973530.6	438.5	88.6	GE 2.5-127 LNTE
55	695602.1	4973099.2	438.9	88.6	GE 2.5-127 LNTE
56	696061.0	4973387.0	428.3	88.6	GE 2.5-127 LNTE
57	696437.7	4973330.7	424.2	88.6	GE 2.5-127 LNTE
58	696787.1	4973357.0	420.8	88.6	GE 2.5-127 LNTE
59	697225.0	4973496.8	411.8	88.6	GE 2.5-127 LNTE
60	697658.5	4973381.1	409.9	88.6	GE 2.5-127 LNTE
62	694406.5	4972815.4	466.5	88.6	GE 2.5-127 LNTE
63	692045.0	4972505.6	500.7	88.6	GE 2.5-127 LNTE
64	692414.1	4972479.8	494.9	88.6	GE 2.5-127 LNTE
65	693356.6	4972072.6	481.8	88.6	GE 2.5-127 LNTE
66	693712.0	4972068.8	481.2	88.6	GE 2.5-127 LNTE
67	694046.8	4972013.3	475.7	88.6	GE 2.5-127 LNTE
68	694423.6	4971883.8	473.8	88.6	GE 2.5-127 LNTE
69	694968.0	4972088.2	464.6	88.6	GE 2.5-127 LNTE
70	695288.7	4972042.6	460.7	88.6	GE 2.5-127 LNTE
71	692905.0	4970970.0	490.3	88.6	GE 2.5-127 LNTE
72	695166.0	4970868.0	467.3	88.6	GE 2.5-127 LNTE
77	693713.2	4970238.0	487.5	88.6	GE 2.5-127 LNTE
78	694069.2	4970257.3	485.0	80.0	GE 2.3-116 LNTE

Source ID	UTM 14N NAD83		Ground Elevation (m asl)	Source / Hub Height (m agl)	Source Type
	Easting (m)	Northing (m)			
80	691347.7	4969141.0	503.5	88.6	GE 2.5-127 LNTE
81	691643.8	4969153.7	497.9	80.0	GE 2.3-116 LNTE
82	692896.9	4968821.3	502.4	80.0	GE 2.3-116 LNTE
83	693367.2	4968693.2	503.4	80.0	GE 2.3-116 LNTE
84	693739.8	4968853.3	496.4	88.6	GE 2.5-127 LNTE
85	689760.4	4967972.5	515.2	88.6	GE 2.5-127 LNTE
86	690127.3	4968017.0	521.9	88.6	GE 2.5-127 LNTE
87	694106.4	4968003.4	506.7	88.6	GE 2.5-127 LNTE
88	694526.1	4967997.1	503.4	88.6	GE 2.5-127 LNTE
89	694943.4	4968074.8	498.9	88.6	GE 2.5-127 LNTE
90	685530.5	4967305.9	547.1	88.6	GE 2.5-127 LNTE
91	685954.6	4967313.2	543.0	88.6	GE 2.5-127 LNTE
92	686585.6	4967413.9	531.1	88.6	GE 2.5-127 LNTE
94	687427.6	4967370.9	528.3	88.6	GE 2.5-127 LNTE
94	686952.3	4967345.9	531.8	88.6	GE 2.5-127 LNTE
95	689898.8	4966747.6	522.6	88.6	GE 2.5-127 LNTE
96	690253.4	4966924.9	521.9	88.6	GE 2.5-127 LNTE
97	690614.7	4966980.9	524.4	88.6	GE 2.5-127 LNTE
98	690953.4	4967012.4	527.2	80.0	GE 2.3-116 LNTE
100	694057.4	4966925.2	515.9	88.6	GE 2.5-127 LNTE
101	694940.1	4967090.9	509.8	88.6	GE 2.5-127 LNTE
102	689096.9	4965955.5	522.2	88.6	GE 2.5-127 LNTE
103	690841.6	4965887.3	520.2	88.6	GE 2.5-127 LNTE
104	693493.8	4966245.3	519.8	88.6	GE 2.5-127 LNTE
105	696180.1	4966384.2	505.7	88.6	GE 2.5-127 LNTE
106	696564.5	4966080.4	493.9	88.6	GE 2.5-127 LNTE
107	696887.8	4966089.6	489.0	88.6	GE 2.5-127 LNTE
108	697272.2	4965722.4	490.0	88.6	GE 2.5-127 LNTE
109	693406.1	4965157.8	512.1	88.6	GE 2.5-127 LNTE
110	693864.8	4965610.3	513.1	88.6	GE 2.5-127 LNTE
111	694217.1	4965261.5	515.2	80.0	GE 2.3-116 LNTE
112	694598.6	4965308.7	514.8	80.0	GE 2.3-116 LNTE
113	694961.9	4964854.0	509.0	88.6	GE 2.5-127 LNTE
114	695316.4	4964845.1	502.3	88.6	GE 2.5-127 LNTE

Source ID	UTM 14N NAD83		Ground Elevation (m asl)	Source / Hub Height (m agl)	Source Type
	Easting (m)	Northing (m)			
115	695706.7	4964814.1	501.1	88.6	GE 2.5-127 LNTE
116	696232.2	4964906.3	495.8	88.6	GE 2.5-127 LNTE
117	696661.7	4964887.5	485.3	88.6	GE 2.5-127 LNTE
118	694632.5	4963500.0	511.8	88.6	GE 2.5-127 LNTE
119	694986.2	4963501.7	509.7	88.6	GE 2.5-127 LNTE
120	695340.9	4963513.9	507.2	88.6	GE 2.5-127 LNTE
121	695785.0	4963550.3	503.7	88.6	GE 2.5-127 LNTE
122	696292.8	4963767.6	497.4	80.0	GE 2.3-116 LNTE
123	696728.7	4963776.6	497.0	88.6	GE 2.5-127 LNTE
124	697081.4	4963770.0	497.6	80.0	GE 2.3-116 LNTE
A2	683682.6	4979586.5	506.3	88.6	GE 2.5-127 LNTE
A4	682362.8	4978561.3	521.2	88.6	GE 2.5-127 LNTE
A5	682663.9	4978561.9	516.2	88.6	GE 2.5-127 LNTE
A12	694185.4	4976724.8	424.8	88.6	GE 2.5-127 LNTE
A22	689815.1	4975566.5	497.4	80.0	GE 2.3-116 LNTE
A61	698004.0	4974113.6	401.0	88.6	GE 2.5-127 LNTE
A73	697183.7	4970946.8	432.9	88.6	GE 2.5-127 LNTE
A74	697735.8	4970958.2	423.8	88.6	GE 2.5-127 LNTE
A75	698120.7	4970991.2	423.7	88.6	GE 2.5-127 LNTE
A76	698564.3	4970981.8	421.0	88.6	GE 2.5-127 LNTE
A79	697352.6	4969671.5	447.9	88.6	GE 2.5-127 LNTE
A99	693117.3	4966652.6	515.7	80.0	GE 2.3-116 LNTE
X-01	694116.5	4969633.4	476.9	3.0	Transformer
X-02	694116.3	4969652.7	476.8	3.0	Transformer

APPENDIX E

Predicted Noise Level Contours



Predicted Noise Level Contours