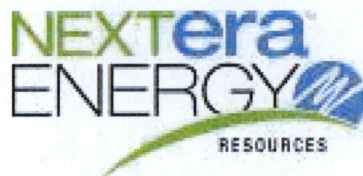


**Brady II Wind Energy Center**

**Acoustic Assessment**  
**Hettinger County, North Dakota**

May 2016

Prepared for



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**ACRONYMS AND ABBREVIATIONS**

|                  |  |
|------------------|--|
| AGL              | above ground level                             |
| CadnaA           | Computer-Aided Noise Abatement Program         |
| dB               | decibel  |
| dBA              | A-weighted decibel                             |
| dBL              | unweighted decibel                             |
| GE               | General Electric                               |
| HH               | hub height                                     |
| Hz               | Hertz  |
| IEC              | International Electrotechnical Commission      |
| ISO              | International Organization for Standardization |
| KHz              | kilohertz                                      |
| L <sub>eq</sub>  | equivalent sound level                         |
| L <sub>max</sub> | maximum sound level                            |
| L <sub>p</sub>   | sound pressure level                           |
| L <sub>w</sub>   | sound power level                              |
| m/s              | meters per second                              |
| mph              | miles per hour                                 |
| MVA              | megavolt ampere                                |
| MW               | megawatt                                       |
| NEER             | NextEra Energy Resources, LLC                  |
| NEMA             | National Electrical Manufacturers Association  |
| Project          | Brady II Wind Energy Center                    |
| PSC              | Public Service Commission                      |
| pW               | picowatt                                       |
| RD               | rotor diameter                                 |
| Tetra Tech       | Tetra Tech, Inc.                               |
| μPa              | microPascal                                    |
| USGS             | United States Geological Survey                |
| UTM              | Universal Transverse Mercator                  |
| W                | watt   |
| WTG              | wind turbine generator                         |

## EXECUTIVE SUMMARY

Tetra Tech, Inc. (Tetra Tech) has completed an acoustic assessment for the proposed Brady II Wind Energy Center located in Hettinger County, North Dakota. A screening-level analysis was completed to evaluate the expected sound levels resulting from the Project wind turbine generators (WTGs) and substation. Although the Project would consist of up to 72 WTGs, 5 alternate WTG locations are included in the layout. Acoustic analyses were completed for the Project "With Alternates" and with "No Alternates" for three different modeling scenarios, for wind turbine operation at cut-in wind speed and at maximum rotational wind speed under both moderate downwind and anomalous meteorological conditions. Analysis of the Project "With Alternates" should be considered conservative, since only 72 WTGs will be built as part of the Project. The overall objective of this study was to determine the feasibility of the Project to operate in compliance with the applicable North Dakota Public Service Commission (PSC) 50 dBA noise limit. Finally, a cumulative impacts assessment was analyzed, which included both the proposed Project WTGs and the proposed Brady Wind Energy Center WTGs north of this Project.

Wind turbine sound source data was obtained from General Electric (GE), the manufacturer of the GE 2.1-116 (2.1 MW) as documented in the turbine noise specification section (GE 2015). Substation data were obtained Brady Wind II, LLC (Brady Wind II) based on a 170 megavolt ampere (MVA) transformer. It is expected that the GE WTGs and substation equipment installed will have similar sound profiles to what was used in the acoustic modeling analysis; however, it is possible that the final warranty sound power levels may vary slightly. Sound propagation modeling was conducted using the Computer-Aided Noise Abatement (CadnaA) program (version 4.6.153), a comprehensive 3-dimensional acoustic modeling computer simulation software, with calculations made in accordance with the International Organization for Standardization (ISO) standard 9613-2 "Attenuation of Sound during Propagation Outdoors". This acoustic modeling software is widely used by acoustical engineers due to its adaptability to evaluate complex acoustic scenarios.

The results of the acoustic modeling analysis were compared to the North Dakota PSC 50 dBA noise limit within 100 feet of an occupied residence. Acoustic modeling results showed that the Project will not generate exceedances of the North Dakota PSC noise limit at any occupied receptor locations.

## 1.0 INTRODUCTION

Brady Wind II, LLC (Brady Wind II), a wholly-owned, indirect subsidiary of NextEra Resources, LLC (NEER), proposes to construct and operate the Brady II Wind Energy Center (Project) in Stark and Hettinger Counties, North Dakota. Brady Wind II is proposing to construct up to 72 wind turbine generators (WTGs). The site layout dated April 22, 2016 includes 65 GE 2.1-116 WTGs, seven GE 1.79-100 WTGs, and five alternate GE 2.1-116 WTG locations. While no more than 72 WTGs will be built, one or more of the alternate WTG locations could be activated in the event that any of the primary WTG locations were eliminated. The rotor diameter of the GE 2.1-116 is 381 feet (116 meters) and it has a hub height (HH) of 262 feet (80 meters). The proposed Project infrastructure also includes a collection substation to enable interconnection to Basin Electric Power Cooperative's transmission system. The substation, which will serve both the proposed Brady Wind Energy Center and the proposed Project, would be located outside of the Brady II Study Area adjacent to 109<sup>th</sup> Avenue SW near its intersection with 52<sup>nd</sup> Street SW. Substation data were obtained from Brady Wind II based on a 170 megavolt ampere (MVA) transformer similar to the HICO 170 MVA transformer in use at other NEER energy facilities.

Acoustic analyses were completed for the Project "With Alternates" and with "No Alternates" for three different modeling scenarios, for wind turbine operation at cut-in wind speed and at maximum rotational wind speed under both moderate downwind and anomalous meteorological conditions. Analysis of the Project "With Alternates" should be considered conservative since only 72 WTGs will be built as part of the Project. Operational sounds levels resulting from the Project were analyzed at existing noise-sensitive receptors (e.g., residential structures) and compliance was assessed relative to the North Dakota Public Service Commission (PSC) noise limit. The results of this analysis are presented in section 3.3. Noise impacts in association with the proposed Brady Wind Energy Center, which is adjacent to the Project, were also modeled in the "Cumulative" assessment. The results of this analysis are presented in Section 4.1.

### 1.1 Study Area

The Brady II Study Area encompasses approximately 27,264 acres (43 square miles) in northern Hettinger County and southern Stark County, although all WTGs will be located in Hettinger County. County and township (section line) roads characterize the existing roadway infrastructure in and around the Study Area. The Study Area is accessed via I-94, U.S. Highway 85, State Highway 22, State Highway 8, and other local two-lane paved and gravel county roads. The land within the Study Area is primarily agricultural with scattered farmstead residences. The turbines will be located on privately-owned land in northern Hettinger County, approximately 15 miles south of Dickinson. This region of North Dakota has topography that can be described as level to rolling plains with isolated sandstone buttes or badlands formations to the west of the Study Area. Gentle slopes characterize most of the Study Area and local relief ranges from less than 2,670 to over 2,920 feet. Current land use within the Study Area is primarily agricultural, supporting both crops and livestock grazing.

Occupied and unoccupied structures are scattered throughout the Study Area. Potential noise sensitive receptor locations within the Study Area and in the vicinity of proposed turbine locations

were included in the acoustical analysis. Of these 175 receptors identified, 114 are occupied structures and 61 are unoccupied. Brady Wind II designed the Project using a minimum turbine setback of 2,000 feet from occupied residences, which exceeds Hettinger County's setback requirement of 1,320 feet. Figure 1 (Appendix A) presents the proposed Brady II WTGs, as well as the noise sensitive receptor locations.

## 1.2 Existing Acoustic Environment

Northern Hettinger County would generally be considered a rural agricultural area. Existing ambient sound levels are expected to be relatively low, although sound levels would be higher near roadways such as I-94, U.S. Highway 85, State Highway 22, State Highway 8. Other human activity such as agricultural operations would seasonally contribute to sound levels in the area associated with crop harvests. Background sound levels are expected to vary both spatially and temporally depending on proximity to area sound sources such as roadways and natural sounds. Typically, background sound levels are quieter during the night than during the daytime, except during periods when evening and nighttime insect noise may contribute to the soundscape, predominantly in the warmer seasons.

## 1.3 Acoustic Terminology

Airborne sound is described as the rapid fluctuation or oscillation of air pressure above and below atmospheric pressure, creating a sound wave. Sound is characterized by properties of the sound waves, which are frequency, wavelength, period, amplitude, and velocity. Noise is defined as unwanted sound. A sound source is defined by a sound power level ( $L_w$ ), which is independent of any external factors. The acoustic sound power is the rate at which acoustical energy is radiated outward and is expressed in units of watts (W). Sound energy travels in the form of a wave, a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure. A sound pressure level ( $L_p$ ) is a measure of this fluctuation and can be directly determined with a microphone or calculated from information about the source sound power level and the surrounding environment through predictive acoustic modeling. While the sound power of a source is strictly a function of the total amount of acoustic energy being radiated by the source, the sound pressure levels produced by a source are a function of the distance from the source and the effective radiating area or physical size of the source. In general, the magnitude of a source's sound power level is always considerably higher than the observed sound pressure level near a source due to the fact that the acoustic energy is being radiated in various directions.

Sound levels are presented on a logarithmic scale to account for the large pressure response range of the human ear, and are expressed in units of decibels (dB). A dB is defined as the ratio between a measured value and a reference value usually corresponding to the lower threshold of human hearing defined as 20 micropascals ( $\mu\text{Pa}$ ). Conversely, sound power is commonly referenced to 1 picowatt (pW), which is one trillionth of a watt. Broadband sound includes sound energy summed across the frequency spectrum. In addition to broadband sound pressure levels, analysis of the various frequency components of the sound spectrum is often completed to determine tonal characteristics. The unit of frequency is Hertz (Hz), which corresponds to the rate in cycles per second that sound pressure waves are generated. Typically, a sound frequency

analysis examines 11 octave (or 33 1/3 octave) bands ranging from 20 Hz (low) to 20,000 Hz (high). This range encompasses the entire human audible frequency range. Since the human ear does not perceive every frequency with equal loudness, spectrally varying sounds are often adjusted with a weighting filter. The A-weighted filter is applied to compensate for the frequency response of the human auditory system. Sound exposure in acoustic assessments is commonly measured and calculated as A-weighted dB (dBA). Unweighted sound levels are referred to as linear. Linear dB are used to determine a sound's tonality and to engineer solutions to reduce or control noise as techniques are different for low and high frequency noise. Sound levels that are linear in this report are presented as dBL.

Sound can be measured, modeled, and presented in various formats, with the most common metric being the equivalent sound level ( $L_{eq}$ ). The equivalent sound level has been shown to provide both an effective and uniform method for comparing time-varying sound levels and is widely used in acoustic assessments in the State of North Dakota. Estimates of noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented in Table 1. Table 2 provides additional reference information on acoustic terminology.

**Table 1. Sound Pressure Levels ( $L_p$ ) and Relative Loudness of Typical Noise Sources and Soundscapes**

| Noise Source or Activity                                  | Sound Level (dBA) | Subjective Impression | Relative Loudness (perception of different sound levels) |
|---|-------------------|-----------------------|--|
| Jet aircraft takeoff from carrier (50 ft)                 | 140               | Threshold of pain     | 64 times as loud   |
| 50-hp siren (100 ft)                                      | 130               |                       | 32 times as loud   |
| Loud rock concert near stage or Jet takeoff (200 ft)      | 120               | Uncomfortably loud    | 16 times as loud   |
| Float plane takeoff (100 ft)                              | 110               |                       | 8 times as loud  |
| Jet takeoff (2,000 ft)                                    | 100               | Very loud             | 4 times as loud  |
| Heavy truck or motorcycle (25 ft)                         | 90                |                       | 2 times as loud  |
| Garbage disposal, food blender (2 ft), or Pneumatic drill | 80                | Loud                  | Reference loudness                                       |
| Vacuum cleaner (10 ft)                                    | 70                |                       | 1/2 as loud  |
| Passenger car at 65 mph (25 ft)                           | 65                | Moderate              |  |
| Large store air-conditioning unit (20 ft)                 | 60                |                       | 1/4 as loud  |
| Light auto traffic (100 ft)                               | 50                | Quiet                 | 1/8 as loud  |
| Quiet rural residential area with no activity             | 45                |                       |  |
| Bedroom or quiet living room or Bird calls                | 40                | Faint                 | 1/16 as loud   |
| Typical wilderness area                                   | 35                |                       |  |
| Quiet library, soft whisper (15 ft)                       | 30                | Very quiet            | 1/32 as loud   |
| Wilderness with no wind or animal activity                | 25                |                       |  |
| High-quality recording studio                             | 20                | Extremely quiet       | 1/64 as loud   |
| Acoustic test chamber                                     | 10                | Just audible          |  |
|   | 0                 | Threshold of hearing  |  |

Adapted from: Beranek 1988; EPA 1971

**Table 2. Acoustic Terms and Definitions**

| <b>Term</b>  | <b>Definition</b>  |
|--|--|
| Noise  | Typically defined as unwanted sound. This word adds the subjective response of humans to the physical phenomenon of sound. It is commonly used when negative effects on people are known to occur.   |
| Sound Pressure Level (L <sub>p</sub> )   | Pressure fluctuations in a medium. Sound pressure is measured in decibels referenced to 20 microPascals, the approximate threshold of human perception to sound at 1,000 Hz.   |
| Sound Power Level (L <sub>w</sub> )  | The total acoustic power of a noise source measured in decibels referenced to picowatts (one trillionth of a watt). Noise specifications are provided by equipment manufacturers as sound power as it is independent of the environment in which it is located. A sound level meter does not directly measure sound power.   |
| A-Weighted Decibel (dBA)   | Environmental sound is typically composed of acoustic energy across all frequencies. To compensate for the auditory frequency response of the human ear, an A-weighting filter is commonly used for describing environmental sound levels. Sound levels that are A-weighted are presented as dBA in this report.   |
| Unweighted Decibels (dBL)  | Unweighted sound levels are referred to as linear. Linear decibels are used to determine a sound's tonality and to engineer solutions to reduce or control noise as techniques are different for low and high frequency noise. Sound levels that are linear are presented as dBL in this report  |
| Propagation and Attenuation  | Propagation is the decrease in amplitude of an acoustic signal due to geometric spreading losses with increased distance from the source. Additional sound attenuation factors include air absorption, terrain effects, sound interaction with the ground, diffraction of sound around objects and topographical features, foliage, and meteorological conditions including wind velocity, temperature, humidity, and atmospheric conditions.  |
| Octave Bands   | The audible range of humans spans from 20 to 20,000 Hz and is typically divided into center frequencies ranging from 31 to 8,000 Hz for noise modeling evaluations.  |
| Broadband Sound  | Noise which covers a wide range of frequencies within the audible spectrum, i.e., 200 to 2,000 Hz.   |
| Masking  | Interference in the perception of one sound by the presence of another sound. At elevated wind speeds, leaf rustle and noise made by the wind itself can mask wind turbine sound levels, which remain relatively constant.   |
| Frequency (Hz)   | The rate of oscillation of a sound, measured in units of Hz or kilohertz (kHz). One hundred Hz is a rate of one hundred times (or cycles) per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate. For comparative purposes, the lowest note on a full range piano is approximately 32 Hz and middle C is 261 Hz. |
| <b>Note: Compiled by Tetra Tech from multiple technical and engineering resources.</b> |  |

## 2.0 NOISE REGULATIONS AND GUIDELINES

A review was conducted of noise regulations applicable to the Project at the federal, state, county, and local levels. There are no federal environmental noise requirements specific to this Project. At the state level, the PSC has established regulations applicable to wind energy facilities. Hettinger County also provides noise limits applicable to the Project via their land use regulations. The controlling regulation for the Project is the PSC's noise limit, which is more stringent than the requirements prescribed by Hettinger County. Both the State's and County's noise regulations are summarized in the subsections that follow.

### 2.1 State of North Dakota Public Service Commission Noise Regulations

North Dakota adopted noise regulations for wind energy facilities under the PSC Chapter 69-06-08-01(4) as follows:

*A wind energy conversion facility site must not include a geographic area where, due to operation of the facility, the sound levels within one hundred feet of an inhabited residence or a community building will exceed fifty dBA. The sound level avoidance area criteria may be waived in writing by the owner of the occupied residence or the community building.*

Sound levels resulting from the Project within 100 feet of all identified receptors located in the vicinity of the Project were assessed against the 50 dBA limit to determine whether compliance was achieved. The PSC noise limit is absolute and independent of the existing acoustic environment; therefore, a baseline sound survey is not required to assess conformity.

### 2.2 Hettinger County Zoning Ordinance

The Hettinger County land use regulations include maximum day and night sound level limits in Section 6.7 that are applicable to the Project, specifically:

*Section 6.7—Sustained noise of over 75 decibels (dB) during the day and 65 dB at night is prohibited.*

The 65 dB nighttime limit prescribed by Hettinger County is less conservative than that prescribed by the PSC, so by achieving compliance with the PSC requirements, compliance with the Hettinger County Land Use Regulations is also obtained.

### 3.0 ACOUSTIC MODELING METHODOLOGY AND RESULTS

Sound generated by an operating WTG is comprised of both aerodynamic and mechanical sound with the dominant sound component from modern utility scale WTGs being largely aerodynamic. Aerodynamic sound refers to the sound produced from air flow and the interaction with the WTG tower structure and moving rotor blades. Mechanical sound is generated at the gearbox, generator, and cooling fan, and is radiated from the surfaces of the nacelle and machinery enclosure and by openings in the nacelle casing. Due to the improved design of WTG mechanical components and the use of improved noise damping materials within the nacelle, including elastomeric elements supporting the generator and gearbox, mechanical noise emissions have been minimized. Sound reduction elements designed as a part of the WTGs include impact noise insulation of the gearbox and generator, sound reduced gearbox, sound reduced nacelle, and rotor blades designed to minimize noise generation.

Wind energy facilities, in comparison to other energy-related facilities, are somewhat unique in that the sound generated by each individual WTG will increase as the wind speed across the site increases. Wind turbine sound is negligible when the rotor is at rest, increases as the rotor tip speed increases, and is generally constant once rated power output and maximum rotational speed are achieved. Under this condition, the WTG maximum sound power level will be reached at approximately 7 meters per second [m/s], according to the GE specifications. It is important to recognize as wind speeds increase, the background ambient sound level will generally increase as well, resulting in acoustic masking effects; however, this trend is also affected by local contributing sound sources. The net result is that during periods of elevated wind speeds when higher WTG sound emissions occur, the sound produced from a WTG operating at maximum rotational speed may be largely or fully masked due to wind generated sound in foliage or vegetation. In practical terms, this means a nearby receptor would tend to hear leaves or vegetation rustling rather than WTG noise. This relationship is expected to further minimize the potential for any adverse noise effects of the Project. Conversely, these acoustic masking effects may be limited during periods of unusually high wind shear or at receiver locations that are sheltered from the prevailing wind direction.

#### 3.1 Acoustic Modeling Software and Calculation Methods

The operational acoustic assessment was performed using the proposed Project WTG layout dated April 22, 2016 which includes 65 GE 2.1-116 WTGs, seven GE 1.79-100 WTGs, and five alternate GE 2.1-116 WTG locations. The operational acoustic assessment included an evaluation "With Alternates" consisting of 77 WTG locations (72 planned WTG locations and an additional 5 alternate locations), and an evaluation with "No Alternates" consisting of 72 WTG locations. The Project would use the GE 2.1-116 WTG model, which has a rotor diameter of 381 feet (116 meters) and a hub height of 262 feet (80 meters), and the GE 1.79-100 WTG model, which has a rotor diameter of 328 feet (100 meters) and a hub height of 262 feet (80 meters). The Project would also include a collection substation with a 170 MVA transformer. WTG sound source data were obtained from GE (GE 2013, 2014, and 2015) and substation transformer data were obtained from Brady Wind II.

The acoustic modeling analysis was conducted using the most recent version of DataKustic GmbH's computer-aided noise abatement program or CadnaA (v 4.6.153). CadnaA is a comprehensive 3-dimensional acoustic software model that conforms to the International Organization for Standardization (ISO) standard ISO 9613-2 "Attenuation of Sound during Propagation Outdoors." The engineering methods specified in this standard consist of full (1/1) octave band algorithms that incorporate geometric spreading due to wave divergence, reflection from surfaces, atmospheric absorption, screening by topography and obstacles, ground effects, source directivity, heights of both sources and receptors, seasonal foliage effects, and meteorological conditions. Topographical information was imported into the acoustic model using the official United States Geological Survey (USGS) digital elevation dataset to accurately represent terrain in three dimensions. Terrain conditions, vegetation type, ground cover, and the density and height of foliage can also influence the absorption that takes place when sound waves travel over land. The ISO 9613-2 standard accounts for ground absorption rates by assigning a numerical coefficient of  $G=0$  for acoustically hard, reflective surfaces and  $G=1$  for absorptive surfaces and soft ground. If the ground is hard-packed dirt, typically found in industrial complexes, pavement, bare rock or for sound traveling over water, the absorption coefficient is defined as  $G=0$  to account for reduced sound attenuation and higher reflectivity. In contrast, ground covered in vegetation, including suburban lawns, livestock and agricultural fields (both fallow with bare soil and planted with crops), will be acoustically absorptive and aid in sound attenuation (i.e.,  $G=1.0$ ). A mixed (semi-reflective) ground factor of  $G=0.5$  was used in the Project acoustic modeling analysis. In addition to geometrical divergence, attenuation factors include topographical features, terrain coverage, and/or other natural or anthropogenic obstacles that can affect sound attenuation and result in acoustical screening. To be conservative, sound attenuation through foliage and diffraction around and over existing anthropogenic structures such as buildings was not included in the model.

Sound attenuation by the atmosphere is not strongly dependent on temperature and humidity; however, the temperature of 10°Celsius (50°Fahrenheit) and 70 percent relative humidity parameters were selected as reasonably representative of conditions favorable to sound propagation. Atmospheric absorption depends on temperature and humidity and is most important at higher frequencies. Over short distances, the effects of atmospheric absorption are minimal. The ISO 9613-2 standard calculates attenuation for meteorological conditions favorable to propagation, i.e., downwind sound propagation or what might occur typically during a moderate atmospheric ground level inversion. Though a physical impracticality, the ISO 9613-2 standard simulates omnidirectional downwind propagation. For receivers located between discrete WTG locations or WTG groupings, the acoustic model may result in over-prediction. In addition, the acoustic modeling algorithms essentially assume laminar atmospheric conditions, in which neighboring layers of air do not mix. This conservative assumption does not take into consideration turbulent eddies and micrometeorological inhomogeneities that may form when winds change speed or direction, which can interfere with the sound wave propagation path and increase attenuation effects.

Conversely, there may be meteorological conditions from time to time that will aid in the long-range propagation of sound. These anomalous meteorological conditions may include well-

developed moderate ground-based temperature inversions and Low Level Jets (LLJs). While the North Dakota PSC does not specifically require or suggest that these meteorological conditions be explicitly addressed in modeling assessments, ISO 9613-2 includes a methodology to account for effects produced under these conditions and so they were addressed to ensure a conservative assessment.

### 3.2 Acoustic Modeling Input Parameters

In order to assist project developers and acoustical engineers, wind turbine manufacturers report WTG sound power data at integer wind speeds referenced to the effective hub height, ranging from cut-in to full rated power per International Electrotechnical Commission (IEC) standard IEC 61400-11:2006 Wind Turbine Generator Systems—Part 11: Acoustic Noise Measurement Techniques. This accepted IEC standard was developed to ensure consistent and comparable sound emission data of utility-scale WTGs between manufacturers. Tables 3 and 4 present a summary of sound power data for the GE 1.79-100 and GE 2.1-116 WTGs during normal operations correlated to 10 meter height integer wind speeds 10 meter above ground level (AGL) with a stated roughness length<sup>1</sup> of 0.05 meters, which is representative of level grass-covered terrain (GE 2015). The sound power data for the GE 2.1-116 WTG is not yet available, so data for the GE 2.3-116 WTG was used. GE stated that the sound power profile for the GE 2.3-116 WTG is effectively the same as the profile for the GE 2.1-116 WTG, and therefore this data substitution should not impact results.

The specification for the WTGs includes an expected warranty confidence interval, or k-factor, of 2 dB, which was added to the nominal sound power level in the acoustic model. This confidence interval incorporates the uncertainty in independent sound power level measurements conducted, the applied probability level and standard deviation for test measurement reproducibility, and product variability.

**Table 3. Broadband Sound Power Levels (dBA) Correlated with Wind Speed (GE 1.79-100)**

| 10-meter<br>AGL<br>Wind Speed | WTG L <sub>max</sub> Sound Power Level (L <sub>w</sub> ) at Reference Wind Speed |                       |                     |                       |                     |                     |                     |                         |
|-------------------------------|--|-----------------------|---------------------|-----------------------|---------------------|---------------------|---------------------|-------------------------|
|                               | 11.2<br>mph<br>(5 m/s)   | 12.3 mph<br>(5.5 m/s) | 13.4 mph<br>(6 m/s) | 14.5 mph<br>(6.5 m/s) | 15.7 mph<br>(7 m/s) | 17.9 mph<br>(8 m/s) | 20.1 mph<br>(9 m/s) | 22.4<br>mph (10<br>m/s) |
| GE 1.79-100                   | 98.6   | 101.0                 | 103.2               | 105.5                 | 107.2               | 107.5               | 107.5               | 107.5                   |

<sup>1</sup> The roughness length describes the vertical wind profile per IEC specification in a neutral atmosphere with the wind profile following a logarithmic curve.

**Table 4. Broadband Sound Power Levels (dBA) Correlated with Wind Speed (GE 2.3-116)**

| Wind Speed | WTG L <sub>max</sub> Sound Power Level (L <sub>w</sub> ) at Reference Wind Speed |                     |                     |                     |                     |                     |                      |                      |                      |                      |
|------------|--|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|----------------------|
|            | 8.9  | 11.2                | 13.4                | 15.7                | 17.9                | 14.5                | 20.1                 | 24.6                 | 26.7                 | 29.1                 |
|            | mph<br>(4.0<br>m/s)  | mph<br>(5.0<br>m/s) | mph<br>(6.0<br>m/s) | mph<br>(7.0<br>m/s) | mph<br>(8.0<br>m/s) | mph<br>(9.0<br>m/s) | mph<br>(10.0<br>m/s) | mph<br>(11.0<br>m/s) | mph<br>(12.0<br>m/s) | mph<br>(13.0<br>m/s) |
| GE 2.3-116 | 95.0   | 95.8                | 98.2                | 101.6               | 104.5               | 105.8               | 107.5                | 107.5                | 107.5                | 107.5                |

Wind turbines can be somewhat directional, radiating more sound in some directions than others. The IEC test measurement protocol requires that sound measurements are made for the maximum downwind directional location when reporting apparent sound power levels. Thus, it is assumed that WTG directivity and sound generating efficiencies are inherently incorporated in the sound source data and used in acoustic model development. A summary of sound power data by octave band center frequency for both WTGs operating at maximum rotation are presented in Table 5 (1/1 octave band frequency data provided with stated intended use limited for informational purposes only).

**Table 5. Sound Power Level by Octave Band Center Frequency**

| Frequency (Hz) | Octave Band Sound Power Level (dBA) |      |      |       |       |       |      |      | Broadband (dBA) |
|----------------|-------------------------------------|------|------|-------|-------|-------|------|------|-----------------|
|                | 63                                  | 125  | 250  | 500   | 1000  | 2000  | 4000 | 8000 |                 |
| GE 1.79-100    | 91.0                                | 96.1 | 98.0 | 100.8 | 103.3 | 100.0 | 90.3 | 70.6 | 107.5           |
| GE 2.3-116     | 89.0                                | 95.1 | 99.6 | 102.8 | 102.5 | 97.6  | 87.4 | 66.8 | 107.5           |

### 3.3 Acoustic Modeling Results

Acoustic modeling was completed for WTG cut-in and maximum rotational operating conditions, thereby describing resultant sound pressure levels over the entire operational range of the Project "With Alternates" and with "No Alternates". In addition, sound energy contribution from the Project substation was included in the acoustic modeling analysis. When calculating received sound levels, it was assumed that the Project substation and all WTGs were operating concurrently at the given operating condition. Sound contour plots displaying Project operational sound levels in color-coded isopleths are provided in Figures 2 through 8, in Appendix A. Figures 2 and 3 display the broadband operational sound levels under low-level wind speeds sufficient for the WTGs to operate at initial cut-in rotational speeds. Figures 4 and 5 display broadband operational sound levels at wind speeds sufficient to sustain WTG operation at maximum rotational speeds for moderate downwind propagation. Figures 6 and 7 display broadband operational sound levels at wind speeds sufficient to sustain WTG operation at maximum rotational speeds under anomalous meteorological conditions.

Tables 6 and 7 present the results of the Brady II Wind Energy Center acoustic modeling analysis and includes the ID, Universal Transverse Mercator (UTM) coordinates, receptor status and the received sound levels at each receptor. Table 6 presents results for the Project with "No

Alternates” and Table 7 presents the results for the Project “With Alternates”. Received sound levels are rounded to the nearest whole decimal for consistency with the State of North Dakota noise limit absolute value of 50 dBA. In addition, a 100-foot buffer was included around the receptors, corresponding to the point of compliance identified in the PSC 50 dBA noise limit.

The acoustic modeling results shown in Tables 6 and 7 demonstrate that received sound levels are all below the PSC 50 dBA noise limit at all occupied receptors.

Table 6. Summary of Acoustic Modeling Results - No Alternate WTG Locations

| Receptor ID | Receptor Status | UTM Coordinates (NAD83<br>UTM Zone 13 meters) |                             | Nearest Wind<br>Turbine | Distance to<br>Nearest Wind<br>Turbine (m) | Received Sound Level |              |                          |
|-------------|-----------------|---|-----------------------------|-------------------------|--|----------------------|--------------|--------------------------|
|             |                 | Occupied/Unoccupied                           | Participant/Non-participant |                         |  | Easting (m)          | Northing (m) | Cut-in Rotation<br>(dBA) |
| 401         | Occupied        |   | Non-participant*            | 67                      | 2,819                                      | 20                   | 32           | 34                       |
| 404         | Occupied        |   | Non-participant*            | 67                      | 2,768                                      | 19                   | 31           | 34                       |
| 390009      | Unoccupied      |   | Participant                 | 50                      | 319  | 41                   | 50           | 51                       |
| 400006      | Unoccupied      |   | Non-participant             | 53                      | 11,734                                     | 1                    | 12           | 15                       |
| 400037      | Unoccupied      |   | Non-participant             | 53                      | 12,895                                     | <1                   | 11           | 14                       |
| 420002      | Occupied        |   | Non-participant             | 25                      | 5,033                                      | 17                   | 28           | 31                       |
| 420023      | Occupied        |   | Non-participant             | 25                      | 4,764                                      | 16                   | 28           | 31                       |
| 420029      | Occupied        |   | Non-participant             | 24                      | 4,557                                      | 16                   | 28           | 31                       |
| 420039      | Occupied        |   | Non-participant             | 24                      | 5,689                                      | 16                   | 28           | 30                       |
| 420047      | Occupied        |   | Non-participant             | 24                      | 5,642                                      | 12                   | 24           | 26                       |
| 420051      | Occupied        |   | Non-participant             | 19                      | 5,361                                      | 16                   | 28           | 31                       |
| 420065      | Occupied        |   | Non-participant             | 19                      | 5,505                                      | 16                   | 28           | 31                       |
| 420069      | Occupied        |   | Non-participant             | 19                      | 5,388                                      | 16                   | 28           | 31                       |
| 420076      | Occupied        |   | Non-participant             | 19                      | 5,462                                      | 15                   | 27           | 30                       |
| 420089      | Occupied        |   | Non-participant             | 18                      | 5,492                                      | 16                   | 28           | 31                       |
| 420090      | Occupied        |   | Non-participant             | 18                      | 5,516                                      | 16                   | 28           | 29                       |
| 420100      | Occupied        |   | Non-participant             | 5                       | 5,299                                      | 16                   | 28           | 31                       |
| 420108      | Occupied        |   | Non-participant             | 5                       | 5,316                                      | 16                   | 28           | 31                       |
| 420116      | Occupied        |   | Non-participant             | 18                      | 4,992                                      | 16                   | 29           | 31                       |
| 420117      | Occupied        |   | Non-participant             | 2                       | 6,501                                      | 6                    | 18           | 21                       |
| 420119      | Occupied        |   | Non-participant             | 5                       | 2,013                                      | 24                   | 36           | 38                       |
| 450548      | Occupied        |   | Non-participant             | 71                      | 2,935                                      | 16                   | 29           | 31                       |
| 450554      | Unoccupied      |   | Non-participant             | 71                      | 2,946                                      | 17                   | 30           | 32                       |
| 450562      | Unoccupied      |   | Non-participant             | 67                      | 1,577                                      | 23                   | 36           | 38                       |
| 450563      | Unoccupied      |   | Non-participant             | 59                      | 2,001                                      | 23                   | 35           | 37                       |
| 500002      | Occupied        |   | Non-participant             | 71                      | 2,988                                      | 17                   | 30           | 32                       |
| 500006      | Occupied        |   | Non-participant             | 71                      | 2,927                                      | 18                   | 31           | 33                       |
| 500012      | Occupied        |   | Non-participant             | 71                      | 2,875                                      | 19                   | 31           | 33                       |
| 500016      | Unoccupied      |   | Non-participant             | 67                      | 1,633                                      | 22                   | 35           | 36                       |
| 500018      | Occupied        |   | Non-participant             | 59                      | 2,275                                      | 21                   | 33           | 36                       |
| 500022      | Occupied        |   | Non-participant             | 56                      | 924  | 28                   | 41           | 41                       |
| 500028      | Occupied        |   | Non-participant             | 56                      | 870  | 28                   | 41           | 42                       |
| 500032      | Unoccupied      |   | Participant                 | 66                      | 587  | 35                   | 47           | 47                       |
| 500033      | Unoccupied      |   | Non-participant             | 65                      | 870  | 28                   | 41           | 42                       |
| 500035      | Occupied        |   | Non-participant*            | 63                      | 2,489                                      | 21                   | 33           | 35                       |

Table 6. Summary of Acoustic Modeling Results - No Alternate WTG Locations

| Receptor ID | Receptor Status     |                             | UTM Coordinates (NAD83 UTM Zone 13 meters) |              | Nearest Wind Turbine | Distance to Nearest Wind Turbine (m) | Cut-in Rotation (dBA) |  | Received Sound Level |  |
|-------------|---------------------|-----------------------------|--|--------------|----------------------|--------------------------------------|-----------------------|--|----------------------|--|
|             | Occupied/Unoccupied | Participant/Non-participant | Easting (m)                                | Northing (m) |                      |                                      | Maximum Rotation      | Maximum Rotation under Anomalous (dBA) |                      |  |
| 500039      | Occupied            | Non-participant             | 671766                                     | 5158494      | 46                   | 3,356                                | 19                    | 31                                     | 33                   |  |
| 500053      | Occupied            | Non-participant             | 672221                                     | 5159146      | 63                   | 2,638                                | 22                    | 34                                     | 36                   |  |
| 500054      | Unoccupied          | Non-participant             | 671612                                     | 5161365      | 57                   | 2,390                                | 22                    | 34                                     | 36                   |  |
| 500055      | Unoccupied          | Non-participant             | 670870                                     | 5158304      | 49                   | 2,556                                | 22                    | 34                                     | 36                   |  |
| 500059      | Occupied            | Non-participant*            | 669892                                     | 5159454      | 46                   | 1,261                                | 29                    | 39                                     | 41                   |  |
| 500064      | Occupied            | Non-participant*            | 669899                                     | 5159550      | 46                   | 1,213                                | 29                    | 40                                     | 42                   |  |
| 500068      | Unoccupied          | Non-participant             | 669196                                     | 5158847      | 48                   | 867                                  | 30                    | 41                                     | 42                   |  |
| 500076      | Unoccupied          | Non-participant             | 666743                                     | 5158531      | 36                   | 951                                  | 28                    | 40                                     | 42                   |  |
| 501000      | Occupied            | Non-participant             | 684105                                     | 5172245      | 53                   | 10,357                               | 2                     | 14                                     | 16                   |  |
| 501012      | Occupied            | Non-participant             | 681646                                     | 5173097      | 53                   | 9,231                                | 9                     | 20                                     | 23                   |  |
| 501019      | Occupied            | Non-participant             | 680468                                     | 5175745      | 53                   | 10,909                               | 1                     | 13                                     | 16                   |  |
| 501022      | Occupied            | Non-participant             | 680563                                     | 5175382      | 53                   | 10,620                               | 2                     | 13                                     | 16                   |  |
| 501030      | Occupied            | Non-participant             | 679723                                     | 5174632      | 53                   | 9,592                                | 3                     | 15                                     | 17                   |  |
| 501037      | Occupied            | Non-participant             | 679731                                     | 5171167      | 53                   | 6,541                                | 7                     | 19                                     | 22                   |  |
| 501040      | Occupied            | Non-participant             | 678406                                     | 5173332      | 53                   | 7,915                                | 5                     | 17                                     | 20                   |  |
| 501050      | Occupied            | Non-participant             | 678419                                     | 5173433      | 53                   | 8,015                                | 5                     | 17                                     | 19                   |  |
| 501053      | Unoccupied          | Non-participant             | 678555                                     | 5173259      | 53                   | 7,893                                | 5                     | 17                                     | 20                   |  |
| 501059      | Occupied            | Non-participant             | 678568                                     | 5173250      | 53                   | 7,888                                | 5                     | 17                                     | 20                   |  |
| 501065      | Occupied            | Non-participant             | 678822                                     | 5170389      | 53                   | 5,401                                | 14                    | 26                                     | 28                   |  |
| 501068      | Occupied            | Non-participant             | 677851                                     | 5169797      | 53                   | 4,411                                | 15                    | 26                                     | 28                   |  |
| 501073      | Occupied            | Non-participant             | 681345                                     | 5169634      | 53                   | 6,580                                | 7                     | 19                                     | 21                   |  |
| 501081      | Occupied            | Non-participant             | 681279                                     | 5169706      | 53                   | 6,568                                | 7                     | 19                                     | 21                   |  |
| 501082      | Occupied            | Non-participant             | 675433                                     | 5171946      | 53                   | 6,182                                | 13                    | 24                                     | 27                   |  |
| 501083      | Unoccupied          | Non-participant             | 666768                                     | 5166374      | 23                   | 473                                  | 34                    | 46                                     | 47                   |  |
| 501085      | Occupied            | Non-participant             | 672965                                     | 5164410      | 50                   | 901                                  | 33                    | 42                                     | 43                   |  |
| 501096      | Occupied            | Non-participant             | 672947                                     | 5164396      | 50                   | 899                                  | 33                    | 42                                     | 43                   |  |
| 501097      | Unoccupied          | Non-participant             | 667485                                     | 5163313      | 30                   | 1,289                                | 28                    | 40                                     | 42                   |  |
| 501099      | Occupied            | Participant                 | 675017                                     | 5163411      | 54                   | 856                                  | 31                    | 42                                     | 44                   |  |
| 501104      | Occupied            | Participant                 | 675027                                     | 5163439      | 54                   | 828                                  | 31                    | 42                                     | 44                   |  |
| 501108      | Occupied            | Non-participant             | 670613                                     | 5160034      | 46                   | 1,742                                | 26                    | 37                                     | 39                   |  |
| 501118      | Occupied            | Non-participant             | 659777                                     | 5163091      | 11                   | 1,123                                | 28                    | 40                                     | 41                   |  |
| 501122      | Unoccupied          | Non-participant             | 661117                                     | 5163653      | 11                   | 340                                  | 38                    | 51                                     | 51                   |  |
| 501126      | Occupied            | Non-participant             | 663477                                     | 5163902      | 16                   | 1,049                                | 29                    | 42                                     | 43                   |  |
| 501131      | Occupied            | Non-participant             | 664747                                     | 5163175      | 22                   | 2,051                                | 24                    | 36                                     | 38                   |  |
| 501138      | Occupied            | Participant                 | 664349                                     | 5164755      | 17                   | 690                                  | 33                    | 45                                     | 46                   |  |
| 501141      | Occupied            | Non-participant             | 665127                                     | 5163747      | 22                   | 1,382                                | 27                    | 39                                     | 41                   |  |

Table 6. Summary of Acoustic Modeling Results - No Alternate WTG Locations

| Receptor ID | Receptor Status     |                             | UTM Coordinates (NAD83 UTM Zone 13 meters) |              | Nearest Wind Turbine | Distance to Nearest Wind Turbine (m) | Received Sound Level  |                        |  |
|-------------|---------------------|-----------------------------|--|--------------|----------------------|--------------------------------------|-----------------------|------------------------|--|
|             | Occupied/Unoccupied | Participant/Non-participant | Easting (m)                                | Northing (m) |                      |                                      | Cut-in Rotation (dBA) | Maximum Rotation (dBA) | Maximum Rotation under Anomalous (dBA) |
| 501147      | Occupied            | Non-participant             | 665442                                     | 5161863      | 30                   | 1,855                                | 22                    | 35                     | 36                                     |
| 501156      | Occupied            | Participant                 | 674657                                     | 5162748      | 58                   | 717                                  | 32                    | 44                     | 45                                     |
| 501162      | Occupied            | Non-participant             | 666164                                     | 5171091      | 23                   | 5,054                                | 13                    | 25                     | 28                                     |
| 501165      | Occupied            | Non-participant             | 668751                                     | 5170669      | 25                   | 4,630                                | 17                    | 29                     | 32                                     |
| 501168      | Occupied            | Non-participant             | 668562                                     | 5170280      | 23                   | 4,237                                | 14                    | 26                     | 29                                     |
| 501172      | Occupied            | Non-participant             | 662856                                     | 5171199      | 18                   | 5,552                                | 16                    | 28                     | 31                                     |
| 501173      | Occupied            | Non-participant             | 661884                                     | 5171096      | 5                    | 5,422                                | 15                    | 28                     | 30                                     |
| 501174      | Occupied            | Non-participant             | 661893                                     | 5171077      | 5                    | 5,404                                | 15                    | 28                     | 30                                     |
| 501175      | Occupied            | Non-participant             | 661018                                     | 5169970      | 5                    | 4,347                                | 17                    | 30                     | 32                                     |
| 501176      | Occupied            | Non-participant             | 660668                                     | 5170916      | 5                    | 5,329                                | 15                    | 27                     | 30                                     |
| 610001      | Occupied            | Non-participant             | 657943                                     | 5169457      | 2                    | 4,918                                | 15                    | 28                     | 30                                     |
| 610009      | Occupied            | Non-participant*            | 657243                                     | 5168249      | 2                    | 4,229                                | 16                    | 28                     | 31                                     |
| 610014      | Occupied            | Non-participant*            | 657329                                     | 5168365      | 2                    | 4,270                                | 16                    | 28                     | 31                                     |
| 610018      | Unoccupied          | Non-participant             | 657481                                     | 5167671      | 2                    | 3,632                                | 16                    | 29                     | 31                                     |
| 610021      | Occupied            | Non-participant             | 658588                                     | 5168791      | 2                    | 4,068                                | 12                    | 25                     | 27                                     |
| 610025      | Occupied            | Non-participant             | 659083                                     | 5169071      | 4                    | 4,125                                | 17                    | 30                     | 32                                     |
| 610031      | Occupied            | Non-participant             | 660171                                     | 5167459      | 4                    | 2,186                                | 23                    | 35                     | 37                                     |
| 610042      | Occupied            | Non-participant             | 662190                                     | 5167946      | 5                    | 2,330                                | 20                    | 33                     | 35                                     |
| 610045      | Occupied            | Non-participant             | 662204                                     | 5167951      | 5                    | 2,338                                | 20                    | 33                     | 35                                     |
| 610049      | Occupied            | Non-participant             | 662204                                     | 5167986      | 5                    | 2,392                                | 19                    | 32                     | 34                                     |
| 610053      | Occupied            | Non-participant             | 660982                                     | 5167398      | 5                    | 1,894                                | 24                    | 37                     | 39                                     |
| 610057      | Occupied            | Non-participant             | 660875                                     | 5167437      | 5                    | 1,922                                | 24                    | 37                     | 39                                     |
| 610059      | Unoccupied          | Non-participant             | 662665                                     | 5165804      | 10                   | 394                                  | 39                    | 51                     | 51                                     |
| 610063      | Unoccupied          | Non-participant             | 661981                                     | 5166658      | 5                    | 1,033                                | 30                    | 42                     | 44                                     |
| 610079      | Unoccupied          | Non-participant             | 661962                                     | 5163992      | 12                   | 436                                  | 37                    | 49                     | 50                                     |
| 610084      | Occupied            | Non-participant*            | 668867                                     | 5164930      | 23                   | 1,197                                | 27                    | 39                     | 41                                     |
| 610089      | Occupied            | Non-participant*            | 668413                                     | 5169125      | 24                   | 3,179                                | 20                    | 32                     | 34                                     |
| 610091      | Unoccupied          | Non-participant             | 668196                                     | 5169582      | 24                   | 3,671                                | 19                    | 30                     | 33                                     |
| 610094      | Occupied            | Non-participant             | 663473                                     | 5168761      | 18                   | 3,040                                | 21                    | 33                     | 35                                     |
| 610098      | Occupied            | Non-participant             | 664446                                     | 5167109      | 19                   | 1,239                                | 27                    | 40                     | 41                                     |
| 610102      | Occupied            | Non-participant*            | 669505                                     | 5169577      | 25                   | 3,472                                | 18                    | 29                     | 31                                     |
| 610108      | Occupied            | Non-participant*            | 669518                                     | 5169514      | 25                   | 3,409                                | 19                    | 31                     | 34                                     |
| 610111      | Occupied            | Non-participant             | 670742                                     | 5169632      | 25                   | 3,729                                | 20                    | 32                     | 34                                     |
| 610116      | Unoccupied          | Non-participant             | 671898                                     | 5169600      | 42                   | 3,504                                | 31                    | 43                     | 46                                     |
| 610118      | Unoccupied          | Non-participant             | 671916                                     | 5169648      | 42                   | 3,545                                | 30                    | 43                     | 46                                     |
| 610121      | Occupied            | Participant                 | 672258                                     | 5168851      | 42                   | 2,694                                | 27                    | 39                     | 42                                     |

Table 6. Summary of Acoustic Modeling Results - No Alternate WTG Locations

| Receptor ID | Receptor Status     |                             | UTM Coordinates (NAD83 UTM Zone 13 meters) |              | Distance to Nearest Wind Turbine (m) | Nearest Wind Turbine | Received Sound Level  |                        |  |
|-------------|---------------------|-----------------------------|--|--------------|--------------------------------------|----------------------|-----------------------|------------------------|--|
|             | Occupied/Unoccupied | Participant/Non-participant | Easting (m)                                | Northing (m) |                                      |                      | Cut-in Rotation (dBA) | Maximum Rotation (dBA) | Maximum Rotation under Anomalous (dBA) |
| 610125      | Unoccupied          | Non-participant             | 672486                                     | 5169786      | 3,593                                | 42                   | 32                    | 44                     | 47                                     |
| 610130      | Unoccupied          | Non-participant             | 673973                                     | 5169036      | 3,065                                | 30                   | 18                    | 30                     | 33                                     |
| 610134      | Unoccupied          | Non-participant             | 674002                                     | 5169040      | 3,100                                | 42                   | 18                    | 30                     | 33                                     |
| 610139      | Occupied            | Non-participant             | 675979                                     | 5170362      | 4,572                                | 53                   | 14                    | 25                     | 28                                     |
| 610144      | Unoccupied          | Non-participant             | 675675                                     | 5169238      | 3,464                                | 53                   | 19                    | 31                     | 33                                     |
| 610145      | Unoccupied          | Non-participant             | 675358                                     | 5166322      | 838                                  | 53                   | 29                    | 41                     | 42                                     |
| 610149      | Occupied            | Non-participant             | 674773                                     | 5165354      | 1,050                                | 52                   | 31                    | 43                     | 44                                     |
| 610155      | Unoccupied          | Non-participant             | 669944                                     | 5164888      | 653                                  | 28                   | 33                    | 46                     | 46                                     |
| 610164      | Unoccupied          | Non-participant             | 669983                                     | 5164876      | 693                                  | 28                   | 33                    | 46                     | 46                                     |
| 610170      | Occupied            | Participant                 | 667574                                     | 5164565      | 1,627                                | 26                   | 27                    | 39                     | 41                                     |
| 610181      | Occupied            | Participant                 | 670466                                     | 5167264      | 1,490                                | 25                   | 23                    | 34                     | 38                                     |
| 610185      | Occupied            | Participant                 | 670516                                     | 5167245      | 1,507                                | 25                   | 23                    | 34                     | 36                                     |
| 610188      | Unoccupied          | Non-participant             | 668519                                     | 5166787      | 925                                  | 24                   | 28                    | 41                     | 42                                     |
| 610190      | Unoccupied          | Non-participant             | 669313                                     | 5167829      | 1,737                                | 25                   | 22                    | 34                     | 37                                     |
| 610194      | Unoccupied          | Non-participant             | 669326                                     | 5167878      | 1,785                                | 25                   | 21                    | 33                     | 35                                     |
| 610197      | Unoccupied          | Non-participant             | 673253                                     | 5168730      | 2,576                                | 42                   | 21                    | 33                     | 36                                     |
| 610203      | Unoccupied          | Non-participant             | 670759                                     | 5168861      | 3,018                                | 25                   | 21                    | 32                     | 35                                     |
| 706192      | Unoccupied          | Non-participant             | 656694                                     | 5166353      | 3,456                                | 1                    | 17                    | 30                     | 32                                     |
| 800268      | Unoccupied          | Non-participant             | 670007                                     | 5160023      | 1,142                                | 46                   | 29                    | 40                     | 41                                     |
| 800288      | Unoccupied          | Non-participant             | 664145                                     | 5164372      | 1,003                                | 17                   | 31                    | 43                     | 44                                     |
| 800292      | Unoccupied          | Non-participant             | 664102                                     | 5164281      | 1,090                                | 17                   | 30                    | 43                     | 44                                     |
| 800304      | Unoccupied          | Non-participant             | 670346                                     | 5166290      | 837                                  | 25                   | 29                    | 41                     | 42                                     |
| 800308      | Occupied            | Participant                 | 667354                                     | 5158391      | 861                                  | 36                   | 30                    | 42                     | 43                                     |
| 800311      | Occupied            | Participant                 | 667332                                     | 5158349      | 903                                  | 36                   | 28                    | 40                     | 41                                     |
| 800317      | Occupied            | Non-participant             | 662260                                     | 5158285      | 5,195                                | 36                   | 13                    | 25                     | 28                                     |
| 800342      | Unoccupied          | Non-participant             | 670035                                     | 5161380      | 993                                  | 40                   | 30                    | 41                     | 43                                     |
| 800364      | Unoccupied          | Non-participant             | 669001                                     | 5162054      | 279                                  | 40                   | 39                    | 52                     | 52                                     |
| 811069      | Unoccupied          | Non-participant             | 682736                                     | 5175254      | 11,613                               | 53                   | 1                     | 12                     | 15                                     |
| 811201      | Occupied            | Non-participant             | 680019                                     | 5177169      | 12,066                               | 53                   | 0                     | 12                     | 15                                     |
| 811205      | Occupied            | Non-participant             | 679691                                     | 5178020      | 12,773                               | 53                   | <1                    | 12                     | 14                                     |
| 811210      | Occupied            | Non-participant             | 680887                                     | 5178421      | 13,541                               | 53                   | <1                    | 11                     | 14                                     |
| 811214      | Unoccupied          | Non-participant             | 680759                                     | 5178424      | 13,498                               | 53                   | <1                    | 11                     | 14                                     |
| 811217      | Unoccupied          | Non-participant             | 680753                                     | 5178482      | 13,551                               | 53                   | <1                    | 11                     | 14                                     |
| 811224      | Unoccupied          | Non-participant             | 680747                                     | 5178483      | 13,549                               | 53                   | <1                    | 11                     | 14                                     |
| 811228      | Unoccupied          | Non-participant             | 682023                                     | 5174120      | 10,276                               | 53                   | 2                     | 14                     | 16                                     |
| 811231      | Unoccupied          | Non-participant             | 682042                                     | 5174165      | 10,324                               | 53                   | 2                     | 14                     | 16                                     |

Table 6. Summary of Acoustic Modeling Results - No Alternate WTG Locations

| Receptor ID | Receptor Status     |                             | UTM Coordinates (NAD83 UTM Zone 13 meters) |              | Nearest Wind Turbine | Distance to Nearest Wind Turbine (m) | Cut-in Rotation (dBA)  |                                  | Received Sound Level |  |
|-------------|---------------------|-----------------------------|--|--------------|----------------------|--------------------------------------|------------------------|----------------------------------|----------------------|--|
|             | Occupied/Unoccupied | Participant/Non-participant | Easting (m)                                | Northing (m) |                      |                                      | Maximum Rotation (dBA) | Maximum Rotation Anomalous (dBA) |                      |  |
| 811236      | Unoccupied          | Non-participant             | 682274                                     | 5174639      | 53                   | 10,844                               | 1                      | 13                               | 16                   |  |
| 811237      | Unoccupied          | Non-participant             | 679990                                     | 5178775      | 53                   | 13,582                               | <1                     | 11                               | 14                   |  |
| 811285      | Unoccupied          | Non-participant             | 657284                                     | 5169323      | 2                    | 5,095                                | 15                     | 27                               | 30                   |  |
| 811287      | Occupied            | Non-participant             | 655467                                     | 5168218      | 2                    | 5,489                                | 8                      | 20                               | 23                   |  |
| 811290      | Occupied            | Non-participant             | 650090                                     | 5167200      | 1                    | 9,782                                | 1                      | 13                               | 16                   |  |
| 880001      | Occupied            | Non-participant             | 680270                                     | 5173773      | 53                   | 9,051                                | 8                      | 20                               | 23                   |  |
| 900002      | Occupied            | Participant                 | 661988                                     | 5161930      | 11                   | 2,051                                | 23                     | 35                               | 37                   |  |
| 900007      | Occupied            | Participant                 | 662323                                     | 5161469      | 11                   | 2,621                                | 21                     | 33                               | 36                   |  |
| 900011      | Occupied            | Non-participant             | 662065                                     | 5161089      | 11                   | 2,810                                | 20                     | 32                               | 34                   |  |
| 900015      | Occupied            | Non-participant             | 658130                                     | 5161120      | 1                    | 3,339                                | 18                     | 30                               | 33                   |  |
| 900019      | Occupied            | Non-participant             | 658166                                     | 5161105      | 1                    | 3,340                                | 18                     | 30                               | 33                   |  |
| 900025      | Unoccupied          | Non-participant             | 666717                                     | 5161478      | 31                   | 754                                  | 32                     | 44                               | 45                   |  |
| 900027      | Occupied            | Non-participant             | 664500                                     | 5161670      | 30                   | 2,813                                | 23                     | 35                               | 38                   |  |
| 900031      | Occupied            | Non-participant             | 665522                                     | 5158935      | 36                   | 1,869                                | 24                     | 36                               | 38                   |  |
| 900035      | Occupied            | Non-participant*            | 665494                                     | 5159171      | 36                   | 1,872                                | 24                     | 36                               | 38                   |  |
| 900039      | Occupied            | Non-participant*            | 665496                                     | 5159110      | 36                   | 1,873                                | 24                     | 36                               | 38                   |  |
| 900042      | Unoccupied          | Non-participant             | 666233                                     | 5158189      | 36                   | 1,552                                | 25                     | 37                               | 39                   |  |
| 900047      | Occupied            | Non-participant             | 663971                                     | 5160025      | 37                   | 3,418                                | 16                     | 29                               | 31                   |  |
| 900053      | Occupied            | Non-participant             | 664011                                     | 5160036      | 37                   | 3,379                                | 19                     | 31                               | 33                   |  |
| 900056      | Unoccupied          | Non-participant             | 664009                                     | 5160071      | 37                   | 3,366                                | 19                     | 31                               | 34                   |  |
| 900059      | Occupied            | Non-participant             | 665090                                     | 5160153      | 37                   | 2,331                                | 23                     | 35                               | 38                   |  |
| 900063      | Unoccupied          | Non-participant             | 665463                                     | 5160848      | 31                   | 1,838                                | 24                     | 37                               | 39                   |  |
| 900068      | Unoccupied          | Non-participant             | 665093                                     | 5160747      | 31                   | 2,217                                | 22                     | 34                               | 37                   |  |
| 900070      | Occupied            | Non-participant             | 679567                                     | 5171280      | 53                   | 6,543                                | 10                     | 22                               | 23                   |  |
| 900537      | Unoccupied          | Non-participant             | 662248                                     | 5160947      | 11                   | 3,021                                | 20                     | 32                               | 34                   |  |
| 900539      | Unoccupied          | Non-participant             | 659745                                     | 5159757      | 11                   | 3,971                                | 14                     | 27                               | 29                   |  |
| 900542      | Occupied            | Non-participant             | 664710                                     | 5156553      | 36                   | 3,785                                | 10                     | 22                               | 24                   |  |
| 900543      | Unoccupied          | Non-participant             | 664547                                     | 5156573      | 36                   | 3,887                                | 12                     | 24                               | 27                   |  |
| 900546      | Occupied            | Non-participant             | 664516                                     | 5156546      | 36                   | 3,929                                | 10                     | 22                               | 23                   |  |
| 900547      | Occupied            | Non-participant             | 665655                                     | 5157082      | 36                   | 3,929                                | 16                     | 29                               | 31                   |  |
| 900548      | Occupied            | Non-participant             | 665667                                     | 5156254      | 49                   | 3,165                                | 2                      | 14                               | 13                   |  |
| 900549      | Unoccupied          | Non-participant             | 667277                                     | 5156374      | 49                   | 1,900                                | 4                      | 16                               | 18                   |  |

\* Denotes receptors categorized as Non-Participating because the receptor is located on land that is not covered by an easement. However, the landowners at these receptors are participants of the Project on property located elsewhere in the Project Area.

Table 7. Summary of Acoustic Modeling Results - With Alternate WTG Locations

| Receptor ID | Receptor Status | UTM Coordinates (NAD83 UTM Zone 13 meters) |                             | Nearest Wind Turbine | Distance to Nearest Wind Turbine (m) | Received Sound Level  |                        |  |             |
|-------------|-----------------|--|-----------------------------|----------------------|--------------------------------------|-----------------------|------------------------|--|-------------|
|             |                 | Occupied/Unoccupied                        | Participant/Non-participant |                      |                                      | Cur-In Rotation (dBA) | Maximum Rotation (dBA) | Maximum Rotation under Anomalous (dBA) |             |
|             |                 |  |                             |                      |                                      |                       |                        |  | Easting (m) |
| 401         | Occupied        | Non-participant*                           | 681106                      | 5162818              | 67                                   | 2,819                 | 20                     | 32                                     | 34          |
| 404         | Occupied        | Non-participant*                           | 681064                      | 5162775              | 67                                   | 2,768                 | 19                     | 31                                     | 34          |
| 390009      | Unoccupied      | Participant                                | 673486                      | 5163982              | 50                                   | 319                   | 41                     | 50                                     | 51          |
| 400006      | Unoccupied      | Non-participant                            | 680072                      | 5178797              | 53                                   | 11,734                | 1                      | 13                                     | 15          |
| 400037      | Unoccupied      | Non-participant                            | 681527                      | 5177443              | 53                                   | 12,895                | <1                     | 11                                     | 14          |
| 420002      | Occupied        | Non-participant                            | 668875                      | 5171095              | 25                                   | 5,033                 | 17                     | 28                                     | 31          |
| 420023      | Occupied        | Non-participant                            | 668410                      | 5170735              | 25                                   | 4,764                 | 16                     | 28                                     | 31          |
| 420029      | Occupied        | Non-participant                            | 668316                      | 5170507              | 24                                   | 4,557                 | 16                     | 28                                     | 31          |
| 420039      | Occupied        | Non-participant                            | 667891                      | 5171580              | 24                                   | 5,689                 | 16                     | 28                                     | 30          |
| 420047      | Occupied        | Non-participant                            | 667886                      | 5171532              | 24                                   | 5,642                 | 12                     | 24                                     | 26          |
| 420051      | Occupied        | Non-participant                            | 664044                      | 5171213              | 19                                   | 5,361                 | 16                     | 29                                     | 31          |
| 420065      | Occupied        | Non-participant                            | 664088                      | 5171360              | 19                                   | 5,505                 | 16                     | 28                                     | 31          |
| 420069      | Occupied        | Non-participant                            | 663975                      | 5171244              | 19                                   | 5,398                 | 16                     | 29                                     | 31          |
| 420076      | Occupied        | Non-participant                            | 663894                      | 5171299              | 19                                   | 5,462                 | 15                     | 27                                     | 30          |
| 420089      | Occupied        | Non-participant                            | 663065                      | 5171180              | 18                                   | 5,492                 | 16                     | 28                                     | 31          |
| 420090      | Occupied        | Non-participant                            | 662974                      | 5171187              | 18                                   | 5,516                 | 16                     | 28                                     | 29          |
| 420100      | Occupied        | Non-participant                            | 662342                      | 5170932              | 5                                    | 5,299                 | 16                     | 29                                     | 31          |
| 420108      | Occupied        | Non-participant                            | 662543                      | 5170920              | 5                                    | 5,316                 | 5                      | 29                                     | 31          |
| 420116      | Occupied        | Non-participant                            | 662765                      | 5170601              | 18                                   | 4,992                 | 16                     | 29                                     | 31          |
| 420117      | Occupied        | Non-participant                            | 654920                      | 5169153              | 2                                    | 6,501                 | 7                      | 19                                     | 22          |
| 420119      | Occupied        | Non-participant                            | 660825                      | 5167514              | 5                                    | 2,013                 | 24                     | 36                                     | 39          |
| 450548      | Occupied        | Non-participant                            | 681287                      | 5160073              | 71                                   | 2,935                 | 16                     | 29                                     | 31          |
| 450554      | Unoccupied      | Non-participant                            | 681307                      | 5160130              | 71                                   | 2,946                 | 17                     | 30                                     | 32          |
| 450562      | Unoccupied      | Non-participant                            | 679454                      | 5163350              | 67                                   | 1,577                 | 23                     | 36                                     | 38          |
| 450563      | Unoccupied      | Non-participant                            | 679450                      | 5164236              | 59                                   | 2,001                 | 23                     | 35                                     | 37          |
| 500002      | Occupied        | Non-participant                            | 680617                      | 5158589              | 71                                   | 2,988                 | 17                     | 30                                     | 32          |
| 500006      | Occupied        | Non-participant                            | 679633                      | 5157936              | 71                                   | 2,927                 | 18                     | 31                                     | 33          |
| 500012      | Occupied        | Non-participant                            | 679628                      | 5157991              | 71                                   | 2,875                 | 19                     | 33                                     | 33          |
| 500016      | Unoccupied      | Non-participant                            | 679508                      | 5163376              | 67                                   | 1,633                 | 22                     | 35                                     | 36          |
| 500018      | Occupied        | Non-participant                            | 679256                      | 5165366              | 59                                   | 2,275                 | 21                     | 33                                     | 36          |
| 500022      | Occupied        | Non-participant                            | 677510                      | 5165047              | 56                                   | 924                   | 28                     | 41                                     | 41          |
| 500028      | Occupied        | Non-participant                            | 677401                      | 5165136              | 56                                   | 870                   | 28                     | 41                                     | 42          |
| 500032      | Unoccupied      | Participant                                | 677690                      | 5161966              | 66                                   | 587                   | 35                     | 47                                     | 47          |
| 500033      | Unoccupied      | Non-participant                            | 674884                      | 5159598              | 65                                   | 870                   | 28                     | 41                                     | 42          |
| 500035      | Occupied        | Non-participant*                           | 673147                      | 5158516              | 63                                   | 2,489                 | 21                     | 33                                     | 35          |

Table 7. Summary of Acoustic Modeling Results - With Alternate WTG Locations

| Receptor ID | Receptor Status | UTM Coordinates (NAD83 UTM Zone 13 meters) |                             | Nearest Wind Turbine | Distance to Nearest Wind Turbine (m) | Received Sound Level |              |                       |                        |  |
|-------------|-----------------|--|-----------------------------|----------------------|--------------------------------------|----------------------|--------------|-----------------------|------------------------|--|
|             |                 | Occupied/Unoccupied                        | Participant/Non-participant |                      |                                      | Easting (m)          | Northing (m) | Cur-In Rotation (dBA) | Maximum Rotation (dBA) | Maximum Rotation under Anomalous (dBA) |
|             |                 |  |                             |                      |                                      |                      |              |                       |                        |  |
| 500039      | Occupied        |  | Non-participant             | 671766               | 5158494                              | 46                   | 3,356        | 19                    | 31                     | 33                                     |
| 500053      | Occupied        |  | Non-participant             | 672221               | 5159146                              | 63                   | 2,638        | 22                    | 34                     | 36                                     |
| 500054      | Unoccupied      |  | Non-participant             | 671612               | 5161365                              | 57                   | 2,390        | 22                    | 34                     | 36                                     |
| 500055      | Unoccupied      |  | Non-participant             | 670870               | 5158304                              | 49                   | 2,556        | 22                    | 34                     | 36                                     |
| 500059      | Occupied        |  | Non-participant*            | 669892               | 5159454                              | 46                   | 1,261        | 29                    | 39                     | 41                                     |
| 500064      | Occupied        |  | Non-participant*            | 669899               | 5159550                              | 46                   | 1,213        | 29                    | 40                     | 42                                     |
| 500068      | Unoccupied      |  | Non-participant             | 669196               | 5158847                              | 48                   | 867          | 30                    | 41                     | 42                                     |
| 500076      | Unoccupied      |  | Non-participant             | 666743               | 5158531                              | 36                   | 951          | 28                    | 40                     | 42                                     |
| 501000      | Occupied        |  | Non-participant             | 684105               | 5172245                              | 53                   | 10,357       | 2                     | 14                     | 16                                     |
| 501012      | Occupied        |  | Non-participant             | 681646               | 5173097                              | 53                   | 9,231        | 9                     | 20                     | 23                                     |
| 501019      | Occupied        |  | Non-participant             | 680468               | 5175745                              | 53                   | 10,909       | 2                     | 13                     | 16                                     |
| 501022      | Occupied        |  | Non-participant             | 680563               | 5175382                              | 53                   | 10,620       | 2                     | 13                     | 16                                     |
| 501030      | Occupied        |  | Non-participant             | 679723               | 5174632                              | 53                   | 9,592        | 3                     | 15                     | 17                                     |
| 501037      | Occupied        |  | Non-participant             | 679731               | 5171167                              | 53                   | 6,541        | 7                     | 19                     | 22                                     |
| 501040      | Occupied        |  | Non-participant             | 678406               | 5173332                              | 53                   | 7,915        | 5                     | 17                     | 20                                     |
| 501050      | Occupied        |  | Non-participant             | 678419               | 5173433                              | 53                   | 8,015        | 5                     | 17                     | 20                                     |
| 501053      | Unoccupied      |  | Non-participant             | 678555               | 5173259                              | 53                   | 7,893        | 5                     | 17                     | 20                                     |
| 501059      | Occupied        |  | Non-participant             | 678568               | 5173250                              | 53                   | 7,888        | 5                     | 17                     | 20                                     |
| 501065      | Occupied        |  | Non-participant             | 678822               | 5170399                              | 53                   | 5,401        | 14                    | 26                     | 28                                     |
| 501068      | Occupied        |  | Non-participant             | 677851               | 5169797                              | 53                   | 4,411        | 15                    | 26                     | 28                                     |
| 501073      | Occupied        |  | Non-participant             | 681345               | 5168634                              | 53                   | 6,580        | 7                     | 19                     | 21                                     |
| 501081      | Occupied        |  | Non-participant             | 681279               | 5169706                              | 53                   | 6,568        | 7                     | 19                     | 21                                     |
| 501082      | Occupied        |  | Non-participant             | 675433               | 5171946                              | 53                   | 6,192        | 13                    | 24                     | 27                                     |
| 501083      | Unoccupied      |  | Non-participant             | 666768               | 5166374                              | 23                   | 473          | 34                    | 46                     | 47                                     |
| 501085      | Occupied        |  | Non-participant             | 672965               | 5164410                              | 50                   | 901          | 33                    | 42                     | 43                                     |
| 501086      | Occupied        |  | Non-participant             | 672947               | 5164396                              | 50                   | 899          | 33                    | 42                     | 43                                     |
| 501087      | Unoccupied      |  | Non-participant             | 667485               | 5163313                              | 30                   | 1,299        | 28                    | 40                     | 42                                     |
| 501089      | Occupied        | Participant                                | Participant                 | 675017               | 5163411                              | 54                   | 856          | 31                    | 42                     | 44                                     |
| 501104      | Occupied        |  | Non-participant             | 675027               | 5163439                              | 54                   | 828          | 31                    | 42                     | 44                                     |
| 501108      | Occupied        |  | Non-participant             | 670613               | 5160034                              | 46                   | 1,742        | 26                    | 37                     | 39                                     |
| 501118      | Occupied        |  | Non-participant             | 659777               | 5163091                              | 11                   | 1,123        | 30                    | 43                     | 44                                     |
| 501122      | Unoccupied      |  | Non-participant             | 661117               | 5163653                              | 11                   | 340          | 39                    | 51                     | 51                                     |
| 501126      | Occupied        |  | Non-participant             | 663477               | 5163902                              | 16                   | 1,049        | 29                    | 42                     | 43                                     |
| 501131      | Occupied        |  | Non-participant             | 664747               | 5163175                              | 22                   | 2,051        | 24                    | 36                     | 39                                     |
| 501138      | Occupied        |  | Participant                 | 664349               | 5164755                              | 17                   | 690          | 33                    | 45                     | 46                                     |
| 501141      | Occupied        |  | Non-participant             | 665127               | 5163747                              | 22                   | 1,382        | 27                    | 39                     | 41                                     |

Table 7. Summary of Acoustic Modeling Results - With Alternate WTG Locations

| Receptor ID | Receptor Status     |                             | UTM Coordinates (NAD83 UTM Zone 13 meters) |              | Nearest Wind Turbine | Distance to Nearest Wind Turbine (m) | Received Sound Level  |                        |  |
|-------------|---------------------|-----------------------------|--|--------------|----------------------|--------------------------------------|-----------------------|------------------------|--|
|             | Occupied/Unoccupied | Participant/Non-participant | Easting (m)                                | Northing (m) |                      |                                      | Cut-in Rotation (dBA) | Maximum Rotation (dBA) | Maximum Rotation under Anomalous (dBA) |
|             |                     |                             |  |              |                      |                                      |                       |                        |  |
| 501147      | Occupied            | Non-participant             | 665442                                     | 5161863      | 30                   | 1,855                                | 23                    | 35                     | 36                                     |
| 501156      | Occupied            | Participant                 | 674657                                     | 5162748      | 58                   | 717                                  | 32                    | 44                     | 45                                     |
| 501162      | Occupied            | Non-participant             | 666164                                     | 5171091      | 23                   | 5,054                                | 13                    | 25                     | 28                                     |
| 501165      | Occupied            | Non-participant             | 668751                                     | 5170669      | 25                   | 4,630                                | 17                    | 29                     | 32                                     |
| 501168      | Occupied            | Non-participant             | 666562                                     | 5170280      | 23                   | 4,237                                | 14                    | 27                     | 29                                     |
| 501172      | Occupied            | Non-participant             | 662856                                     | 5171199      | 18                   | 5,552                                | 16                    | 28                     | 31                                     |
| 501173      | Occupied            | Non-participant             | 661884                                     | 5171096      | 5                    | 5,422                                | 15                    | 28                     | 30                                     |
| 501174      | Occupied            | Non-participant             | 661893                                     | 5171077      | 5                    | 5,404                                | 15                    | 28                     | 30                                     |
| 501175      | Occupied            | Non-participant             | 661018                                     | 5169979      | 5                    | 4,347                                | 17                    | 30                     | 32                                     |
| 501176      | Occupied            | Non-participant             | 660668                                     | 5170916      | 5                    | 5,329                                | 15                    | 28                     | 30                                     |
| 610001      | Occupied            | Non-participant             | 657943                                     | 5169457      | 2                    | 4,918                                | 16                    | 28                     | 31                                     |
| 610009      | Occupied            | Non-participant*            | 657243                                     | 5168249      | 2                    | 4,229                                | 16                    | 29                     | 31                                     |
| 610014      | Occupied            | Non-participant*            | 657329                                     | 5168365      | 2                    | 4,270                                | 16                    | 29                     | 31                                     |
| 610018      | Unoccupied          | Non-participant             | 657481                                     | 5167671      | 2                    | 3,632                                | 16                    | 29                     | 31                                     |
| 610021      | Occupied            | Non-participant             | 658588                                     | 5168791      | 2                    | 4,068                                | 13                    | 25                     | 28                                     |
| 610025      | Occupied            | Non-participant             | 659083                                     | 5169071      | 4                    | 4,125                                | 17                    | 30                     | 32                                     |
| 610031      | Occupied            | Non-participant             | 660171                                     | 5167459      | 4                    | 2,186                                | 23                    | 35                     | 37                                     |
| 610042      | Occupied            | Non-participant             | 662190                                     | 5167946      | 5                    | 2,330                                | 20                    | 33                     | 35                                     |
| 610045      | Occupied            | Non-participant             | 662204                                     | 5167951      | 5                    | 2,338                                | 20                    | 33                     | 35                                     |
| 610049      | Occupied            | Non-participant             | 662204                                     | 5167966      | 5                    | 2,382                                | 20                    | 32                     | 34                                     |
| 610053      | Occupied            | Non-participant             | 660882                                     | 5167398      | 5                    | 1,884                                | 24                    | 37                     | 39                                     |
| 610057      | Occupied            | Non-participant             | 660875                                     | 5167437      | 5                    | 1,922                                | 24                    | 37                     | 39                                     |
| 610059      | Unoccupied          | Non-participant             | 662665                                     | 5165804      | 10                   | 394                                  | 39                    | 51                     | 51                                     |
| 610063      | Unoccupied          | Non-participant             | 661981                                     | 5166658      | 5                    | 1,033                                | 30                    | 42                     | 44                                     |
| 610079      | Unoccupied          | Non-participant             | 661962                                     | 5163992      | 12                   | 436                                  | 37                    | 50                     | 50                                     |
| 610084      | Occupied            | Non-participant*            | 666867                                     | 5164930      | 23                   | 1,197                                | 27                    | 39                     | 41                                     |
| 610089      | Occupied            | Non-participant*            | 668413                                     | 5169125      | 24                   | 3,179                                | 20                    | 32                     | 34                                     |
| 610091      | Unoccupied          | Non-participant             | 668196                                     | 5169582      | 24                   | 3,671                                | 19                    | 30                     | 33                                     |
| 610094      | Occupied            | Non-participant             | 663473                                     | 5168761      | 18                   | 3,040                                | 21                    | 33                     | 36                                     |
| 610098      | Occupied            | Non-participant             | 664446                                     | 5167109      | 19                   | 1,239                                | 27                    | 40                     | 41                                     |
| 610102      | Occupied            | Non-participant*            | 669505                                     | 5169577      | 25                   | 3,472                                | 18                    | 29                     | 31                                     |
| 610108      | Occupied            | Non-participant*            | 669518                                     | 5169514      | 25                   | 3,409                                | 19                    | 31                     | 34                                     |
| 610111      | Occupied            | Non-participant             | 670742                                     | 5169632      | 25                   | 3,729                                | 20                    | 32                     | 34                                     |
| 610116      | Unoccupied          | Non-participant             | 671898                                     | 5169600      | 42                   | 3,504                                | 31                    | 43                     | 46                                     |
| 610118      | Unoccupied          | Non-participant             | 671916                                     | 5169648      | 42                   | 3,545                                | 30                    | 43                     | 46                                     |
| 610121      | Occupied            | Participant                 | 672258                                     | 5168851      | 42                   | 2,694                                | 27                    | 39                     | 42                                     |

Table 7. Summary of Acoustic Modeling Results - With Alternate WTG Locations

| Receptor ID | Receptor Status     |                             | UTM Coordinates (NAD83 UTM Zone 13 meters) |              | Nearest Wind Turbine | Distance to Nearest Wind Turbine (m) | Received Sound Level  |                        |  |
|-------------|---------------------|-----------------------------|--|--------------|----------------------|--------------------------------------|-----------------------|------------------------|--|
|             | Occupied/Unoccupied | Participant/Non-participant | Easting (m)                                | Northing (m) |                      |                                      | Cur-In Rotation (dBA) | Maximum Rotation (dBA) | Maximum Rotation under Anomalous (dBA) |
|             |                     |                             |  |              |                      |                                      |                       |                        |  |
| 610125      | Unoccupied          | Non-participant             | 672486                                     | 5169786      | 42                   | 3,593                                | 32                    | 44                     | 47                                     |
| 610130      | Unoccupied          | Non-participant             | 673973                                     | 5169036      | 42                   | 3,085                                | 18                    | 30                     | 33                                     |
| 610134      | Unoccupied          | Non-participant             | 674002                                     | 5169040      | 42                   | 3,100                                | 18                    | 30                     | 33                                     |
| 610139      | Occupied            | Non-participant             | 675979                                     | 5170382      | 53                   | 4,572                                | 14                    | 25                     | 28                                     |
| 610144      | Unoccupied          | Non-participant             | 675675                                     | 5169238      | 53                   | 3,464                                | 19                    | 31                     | 33                                     |
| 610145      | Unoccupied          | Non-participant             | 675358                                     | 5166322      | 53                   | 838                                  | 29                    | 41                     | 42                                     |
| 610149      | Occupied            | Non-participant             | 674773                                     | 5165354      | 52                   | 1,050                                | 31                    | 43                     | 44                                     |
| 610155      | Unoccupied          | Non-participant             | 669944                                     | 5164888      | 28                   | 653                                  | 34                    | 46                     | 46                                     |
| 610164      | Unoccupied          | Non-participant             | 669893                                     | 5164876      | 28                   | 693                                  | 33                    | 46                     | 46                                     |
| 610170      | Occupied            | Participant                 | 667574                                     | 5164565      | 26                   | 1,627                                | 27                    | 39                     | 41                                     |
| 610181      | Occupied            | Participant                 | 670486                                     | 5167264      | 25                   | 1,490                                | 23                    | 34                     | 38                                     |
| 610185      | Occupied            | Participant                 | 670516                                     | 5167245      | 25                   | 1,507                                | 23                    | 34                     | 36                                     |
| 610188      | Unoccupied          | Non-participant             | 668519                                     | 5166787      | 24                   | 925                                  | 28                    | 41                     | 42                                     |
| 610190      | Unoccupied          | Non-participant             | 669313                                     | 5167829      | 25                   | 1,737                                | 22                    | 34                     | 37                                     |
| 610194      | Unoccupied          | Non-participant             | 669326                                     | 5167878      | 25                   | 1,785                                | 21                    | 33                     | 35                                     |
| 610197      | Unoccupied          | Non-participant             | 673253                                     | 5168730      | 42                   | 2,576                                | 21                    | 33                     | 36                                     |
| 610203      | Unoccupied          | Non-participant             | 670759                                     | 5168861      | 25                   | 3,018                                | 21                    | 32                     | 35                                     |
| 706192      | Unoccupied          | Non-participant             | 656694                                     | 5166353      | All3                 | 3,341                                | 18                    | 31                     | 33                                     |
| 800268      | Unoccupied          | Non-participant             | 670007                                     | 5160023      | 46                   | 1,142                                | 29                    | 40                     | 41                                     |
| 800288      | Unoccupied          | Non-participant             | 664145                                     | 5164372      | 17                   | 1,003                                | 31                    | 43                     | 44                                     |
| 800292      | Unoccupied          | Non-participant             | 664102                                     | 5164281      | 17                   | 1,090                                | 30                    | 43                     | 44                                     |
| 800304      | Unoccupied          | Non-participant             | 670346                                     | 5166290      | 25                   | 837                                  | 29                    | 41                     | 42                                     |
| 800308      | Occupied            | Participant                 | 667354                                     | 5158391      | 36                   | 861                                  | 30                    | 42                     | 43                                     |
| 800311      | Occupied            | Participant                 | 667332                                     | 5158349      | 36                   | 903                                  | 28                    | 40                     | 41                                     |
| 800317      | Occupied            | Non-participant             | 662260                                     | 5158285      | All4                 | 4,253                                | 15                    | 28                     | 30                                     |
| 800342      | Unoccupied          | Non-participant             | 670035                                     | 5161380      | 40                   | 993                                  | 30                    | 41                     | 43                                     |
| 800364      | Unoccupied          | Non-participant             | 669001                                     | 5162054      | 40                   | 279                                  | 39                    | 52                     | 52                                     |
| 811069      | Unoccupied          | Non-participant             | 682736                                     | 5175254      | 53                   | 11,613                               | 1                     | 12                     | 15                                     |
| 811201      | Occupied            | Non-participant             | 680019                                     | 5177169      | 53                   | 12,066                               | 1                     | 12                     | 15                                     |
| 811205      | Occupied            | Non-participant             | 679691                                     | 5178020      | 53                   | 12,773                               | <1                    | 12                     | 15                                     |
| 811210      | Occupied            | Non-participant             | 680887                                     | 5178421      | 53                   | 13,541                               | <1                    | 11                     | 14                                     |
| 811214      | Unoccupied          | Non-participant             | 680759                                     | 5178424      | 53                   | 13,498                               | <1                    | 11                     | 14                                     |
| 811217      | Unoccupied          | Non-participant             | 680753                                     | 5178462      | 53                   | 13,551                               | <1                    | 11                     | 14                                     |
| 811224      | Unoccupied          | Non-participant             | 680747                                     | 5178463      | 53                   | 13,549                               | <1                    | 11                     | 14                                     |
| 811228      | Unoccupied          | Non-participant             | 682023                                     | 5174120      | 53                   | 10,276                               | 2                     | 14                     | 16                                     |
| 811231      | Unoccupied          | Non-participant             | 682042                                     | 5174165      | 53                   | 10,324                               | 2                     | 14                     | 16                                     |

Table 7. Summary of Acoustic Modeling Results - With Alternate WTG Locations

| Receptor ID | Receptor Status | UTM Coordinates (NAD83 UTM Zone 13 meters) |                             | Nearest Wind Turbine | Distance to Nearest Wind Turbine (m) | Received Sound Level  |              |                                  |                        |
|-------------|-----------------|--|-----------------------------|----------------------|--------------------------------------|-----------------------|--------------|----------------------------------|------------------------|
|             |                 | Occupied/Unoccupied                        | Participant/Non-participant |                      |                                      | Cut-in Rotation (dBA) |              | Maximum Rotation Anomalous (dBA) |                        |
|             |                 |  |                             |                      |                                      | Easting (m)           | Northing (m) |                                  | Maximum Rotation (dBA) |
| 811236      | Unoccupied      | Non-participant                            | 682274                      | 5174639              | 53                                   | 10,844                | 1            | 13                               | 16                     |
| 811237      | Unoccupied      | Non-participant                            | 679890                      | 5178775              | 53                                   | 13,582                | <1           | 11                               | 14                     |
| 811285      | Unoccupied      | Non-participant                            | 657284                      | 5169323              | 2                                    | 5,095                 | 15           | 27                               | 30                     |
| 811287      | Occupied        | Non-participant                            | 655467                      | 5168218              | 2                                    | 5,489                 | 8            | 21                               | 23                     |
| 811290      | Occupied        | Non-participant                            | 650090                      | 5167200              | AI3                                  | 9,500                 | 1            | 14                               | 17                     |
| 880001      | Occupied        | Non-participant                            | 680270                      | 5173773              | 53                                   | 9,051                 | 8            | 20                               | 23                     |
| 900002      | Occupied        | Participant                                | 661988                      | 5161930              | AI4                                  | 670                   | 30           | 42                               | 43                     |
| 900007      | Occupied        | Participant                                | 662323                      | 5161469              | AI4                                  | 1,240                 | 25           | 38                               | 39                     |
| 900011      | Occupied        | Non-participant                            | 662065                      | 5161089              | AI4                                  | 1,469                 | 24           | 36                               | 38                     |
| 900015      | Occupied        | Non-participant                            | 658130                      | 5161120              | AI2                                  | 1,388                 | 24           | 36                               | 38                     |
| 900019      | Occupied        | Non-participant                            | 658166                      | 5161105              | AI2                                  | 1,361                 | 24           | 36                               | 38                     |
| 900025      | Unoccupied      | Non-participant                            | 666717                      | 5161478              | 31                                   | 754                   | 32           | 44                               | 45                     |
| 900027      | Occupied        | Non-participant                            | 664500                      | 5161670              | 30                                   | 2,813                 | 23           | 36                               | 38                     |
| 900031      | Occupied        | Non-participant                            | 665522                      | 5158935              | 36                                   | 1,869                 | 24           | 36                               | 38                     |
| 900035      | Occupied        | Non-participant*                           | 665494                      | 5159171              | 36                                   | 1,872                 | 24           | 36                               | 38                     |
| 900039      | Occupied        | Non-participant*                           | 665496                      | 5159110              | 36                                   | 1,873                 | 24           | 36                               | 38                     |
| 900042      | Unoccupied      | Non-participant                            | 666233                      | 5158189              | 36                                   | 1,552                 | 25           | 37                               | 39                     |
| 900047      | Occupied        | Non-participant                            | 663971                      | 5160025              | AI4                                  | 3,407                 | 17           | 29                               | 32                     |
| 900053      | Occupied        | Non-participant                            | 664011                      | 5160036              | 37                                   | 3,379                 | 19           | 32                               | 34                     |
| 900056      | Unoccupied      | Non-participant                            | 664009                      | 5160071              | 37                                   | 3,386                 | 20           | 32                               | 34                     |
| 900059      | Occupied        | Non-participant                            | 665090                      | 5160153              | 37                                   | 2,331                 | 23           | 36                               | 38                     |
| 900063      | Unoccupied      | Non-participant                            | 665463                      | 5160848              | 31                                   | 1,838                 | 25           | 37                               | 39                     |
| 900068      | Unoccupied      | Non-participant                            | 665093                      | 5160747              | 31                                   | 2,217                 | 22           | 35                               | 37                     |
| 900070      | Occupied        | Non-participant                            | 679567                      | 5171280              | 53                                   | 6,543                 | 10           | 22                               | 23                     |
| 900537      | Unoccupied      | Non-participant                            | 662248                      | 5160947              | AI4                                  | 1,666                 | 23           | 36                               | 38                     |
| 900539      | Unoccupied      | Non-participant                            | 659745                      | 5158757              | AI2                                  | 1,871                 | 20           | 33                               | 35                     |
| 900542      | Occupied        | Non-participant                            | 664710                      | 5156553              | 36                                   | 3,785                 | 10           | 22                               | 24                     |
| 900543      | Unoccupied      | Non-participant                            | 664547                      | 5156573              | 36                                   | 3,887                 | 12           | 25                               | 27                     |
| 900546      | Occupied        | Non-participant                            | 664516                      | 5156546              | 36                                   | 3,929                 | 10           | 22                               | 23                     |
| 900547      | Occupied        | Non-participant                            | 665655                      | 5157082              | 36                                   | 2,762                 | 17           | 29                               | 31                     |
| 900548      | Occupied        | Non-participant                            | 665667                      | 5156254              | 49                                   | 3,165                 | 3            | 14                               | 13                     |
| 900549      | Unoccupied      | Non-participant                            | 667277                      | 5156374              | 49                                   | 1,900                 | 5            | 17                               | 19                     |

\* Denotes receptors categorized as Non-Participating because the receptor is located on land that is not covered by an easement. However, the landowners at these receptors are participants of the Project on property located elsewhere in the Project Area.

## 4.0 OTHER SOUND CONSIDERATIONS

### 4.1 Cumulative Impacts

An assessment of cumulative environmental impacts considers the potential impact of a proposed Project in the context of past, present, and reasonably foreseeable developments to ensure that any potential environmental impacts are not considered in isolation. The cumulative effects can result from individually minor, but collectively more significant actions taking place over a given period of time. For the purpose of this analysis, cumulative impacts are restricted to noise impacts from wind energy developments. A wind energy facility would need to be located within approximately 2 to 3 km of the Project in order to present a potential cumulative noise impact.

Cumulative wind energy noise impacts from the Project were considered in association the Brady Wind Energy Center, an adjacent facility in southern Stark County that has yet to be built. The Brady Wind Energy Center would have a total of 87 WTGs, consisting of 80 GE 1.7-103 WTGs and 7 GE 1.79-100 WTGs. Table 8 below provides summary sound power data for the GE 1.7-103 WTGs and the GE1.79-100 (GE 2014, 2015). A confidence interval of k=2 was incorporated into the acoustic modeling analysis per the manufacturer specification.

**Table 8. Broadband Sound Power Levels (dBA) Correlated with Wind Speed**

| 10-meter<br>AGL<br>Wind Speed | WTG L <sub>max</sub> Sound Power Level (L <sub>w</sub> ) at Reference Wind Speed |                       |                     |                       |                     |                     |                     |                         |
|-------------------------------|--|-----------------------|---------------------|-----------------------|---------------------|---------------------|---------------------|-------------------------|
|                               | 11.2<br>mph<br>(5 m/s)   | 12.3 mph<br>(5.5 m/s) | 13.4 mph<br>(6 m/s) | 14.5 mph<br>(6.5 m/s) | 15.9 mph<br>(7 m/s) | 17.9 mph<br>(8 m/s) | 20.1 mph<br>(9 m/s) | 22.4<br>mph (10<br>m/s) |
| GE 1.7-103                    | 100.3  | 102.6                 | 104.9               | 106.9                 | 107.0               | 107.0               | 107.0               | 107.0                   |
| GE 1.79-100                   | 98.6   | 101.0                 | 103.2               | 105.5                 | 107.2               | 107.5               | 107.5               | 107.5                   |

A summary of sound power data for the GE 1.7-103 WTG and 1.79-100 WTG by octave band center frequency is presented in Table 9.

**Table 9. Sound Power Level by Octave Band Center Frequency**

| Frequency<br>(Hz) | Octave Band Sound Power Level (dBA) |      |      |       |       |       |      |      | Broadband<br>(dBA) |
|-------------------|-------------------------------------|------|------|-------|-------|-------|------|------|--------------------|
|                   | 63                                  | 125  | 250  | 500   | 1000  | 2000  | 4000 | 8000 |                    |
| GE 1.7-103        | 90.5                                | 95.7 | 97.7 | 100.3 | 102.6 | 99.6  | 91.4 | 74.1 | 107.0              |
| GE 1.79-100       | 91.0                                | 96.1 | 98.0 | 100.8 | 103.3 | 100.0 | 90.3 | 70.6 | 107.5              |

Brady and Brady II would sometimes operate concurrently; therefore a cumulative wind energy noise impact assessment was completed. Cumulative effects were assessed for all WTGs, assuming "No Alternates" for both facilities, in conjunction with operation of the on-site substation servicing both of the facilities.

Acoustic modeling these two projects was completed for concurrent WTG cut-in and maximum rotational operating conditions. Table 10 presents the results of the cumulative acoustic modeling analysis and includes the ID, status, UTM coordinates, receptor status and the received sound levels at each receptor. The receptor status is based on the most recent receptor status

information provided by NEER. Sound contour plots displaying Project operational sound levels in color-coded isopleths are provided in Figures 8 through 10 (Appendix A) and are also rounded to the nearest whole decimal for consistency with the State of North Dakota noise limit absolute value of 50 dBA. These values reflect all WTGs operating under the cut-in rotational speed, maximum rotational speed, and maximum rotational speed under anomalous meteorological conditions, respectively. A 100-foot buffer was included around the receptors, corresponding to the point of compliance identified in the PSC noise standard. The results of the cumulative analysis are presented in Table 10.

The acoustic modeling results demonstrate that received sound levels are all below the 50 dBA State noise standard at occupied receptors.

Table 10. Summary of Acoustic Modeling Results - Cumulative

| Receptor ID | Receptor Status | UTM Coordinates (NAD83 UTM Zone 13 meters) |              | Nearest Wind Turbine | Project  | Distance to Nearest Wind Turbine (m) | Received Sound Level  |                        |  |
|-------------|-----------------|--|--------------|----------------------|----------|--------------------------------------|-----------------------|------------------------|--|
|             |                 | Easting (m)                                | Northing (m) |                      |          |                                      | Cut-in Rotation (dBA) | Maximum Rotation (dBA) | Maximum Rotation under Anomalous (dBA) |
| 401         | Occupied        | 681106                                     | 5162818      | 67                   | Brady II | 2,819                                | 24                    | 34                     | 36                                     |
| 404         | Occupied        | 681064                                     | 5162775      | 67                   | Brady II | 2,768                                | 22                    | 32                     | 35                                     |
| 390009      | Unoccupied      | 673486                                     | 5163982      | 50                   | Brady II | 319                                  | 41                    | 50                     | 51                                     |
| 400006      | Unoccupied      | 680072                                     | 5178797      | 77                   | Brady I  | 2,497                                | 26                    | 33                     | 35                                     |
| 400037      | Unoccupied      | 681527                                     | 5177443      | 77                   | Brady I  | 1,226                                | 30                    | 36                     | 38                                     |
| 420002      | Occupied        | 668875                                     | 5171095      | 24                   | Brady I  | 3,314                                | 26                    | 33                     | 36                                     |
| 420023      | Occupied        | 668410                                     | 5170735      | 24                   | Brady I  | 2,728                                | 26                    | 34                     | 36                                     |
| 420029      | Occupied        | 668316                                     | 5170507      | 24                   | Brady I  | 2,528                                | 26                    | 34                     | 36                                     |
| 420039      | Occupied        | 667891                                     | 5171580      | 24                   | Brady I  | 2,927                                | 25                    | 33                     | 35                                     |
| 420047      | Occupied        | 667886                                     | 5171532      | 24                   | Brady I  | 2,885                                | 25                    | 32                     | 34                                     |
| 420051      | Occupied        | 664044                                     | 5171213      | 23                   | Brady I  | 2,595                                | 28                    | 35                     | 37                                     |
| 420065      | Occupied        | 664088                                     | 5171360      | 23                   | Brady I  | 2,690                                | 27                    | 35                     | 37                                     |
| 420069      | Occupied        | 663975                                     | 5171244      | 23                   | Brady I  | 2,661                                | 27                    | 35                     | 37                                     |
| 420076      | Occupied        | 663894                                     | 5171299      | 23                   | Brady I  | 2,755                                | 25                    | 33                     | 36                                     |
| 420089      | Occupied        | 663065                                     | 5171180      | 22                   | Brady I  | 3,050                                | 27                    | 34                     | 37                                     |
| 420090      | Occupied        | 662974                                     | 5171187      | 20                   | Brady I  | 3,096                                | 27                    | 33                     | 36                                     |
| 420100      | Occupied        | 662342                                     | 5170932      | 14                   | Brady I  | 2,690                                | 27                    | 35                     | 37                                     |
| 420108      | Occupied        | 662543                                     | 5170920      | 14                   | Brady I  | 2,737                                | 27                    | 35                     | 37                                     |
| 420116      | Occupied        | 662765                                     | 5170601      | 20                   | Brady I  | 2,516                                | 28                    | 35                     | 38                                     |
| 420117      | Occupied        | 654920                                     | 5169153      | 1                    | Brady I  | 2,694                                | 20                    | 27                     | 30                                     |
| 420119      | Occupied        | 660825                                     | 5167514      | 15                   | Brady I  | 712                                  | 38                    | 45                     | 46                                     |
| 450548      | Occupied        | 681287                                     | 5160073      | 71                   | Brady II | 2,935                                | 17                    | 29                     | 31                                     |
| 450554      | Unoccupied      | 681307                                     | 5160130      | 71                   | Brady II | 2,946                                | 18                    | 30                     | 33                                     |
| 450562      | Unoccupied      | 679454                                     | 5163350      | 67                   | Brady II | 1,577                                | 26                    | 37                     | 39                                     |
| 450563      | Unoccupied      | 679450                                     | 5164236      | 59                   | Brady II | 2,001                                | 27                    | 37                     | 39                                     |
| 500002      | Occupied        | 680617                                     | 5158589      | 71                   | Brady II | 2,988                                | 18                    | 30                     | 32                                     |
| 500006      | Occupied        | 679633                                     | 5157936      | 71                   | Brady II | 2,927                                | 19                    | 31                     | 33                                     |
| 500012      | Occupied        | 679628                                     | 5157991      | 71                   | Brady II | 2,875                                | 19                    | 31                     | 34                                     |
| 500016      | Unoccupied      | 679508                                     | 5163376      | 67                   | Brady II | 1,633                                | 25                    | 35                     | 38                                     |
| 500018      | Occupied        | 679256                                     | 5163366      | 59                   | Brady I  | 1,742                                | 29                    | 38                     | 40                                     |
| 500022      | Occupied        | 677510                                     | 5165047      | 56                   | Brady II | 924                                  | 31                    | 41                     | 42                                     |
| 500028      | Occupied        | 677401                                     | 5165136      | 56                   | Brady II | 870                                  | 31                    | 42                     | 43                                     |
| 500032      | Unoccupied      | 677690                                     | 5161986      | 66                   | Brady II | 587                                  | 35                    | 47                     | 47                                     |
| 500033      | Unoccupied      | 674884                                     | 5158598      | 65                   | Brady II | 870                                  | 28                    | 41                     | 42                                     |
| 500035      | Occupied        | 673147                                     | 5158516      | 63                   | Brady II | 2,489                                | 21                    | 33                     | 35                                     |

Table 10. Summary of Acoustic Modeling Results - Cumulative

| Receptor ID | Receptor Status | UTM Coordinates (NAD83 UTM Zone 13 meters) |              | Nearest Wind Turbine | Project  | Distance to Nearest Wind Turbine (m) | Received Sound Level |                             |                        |
|-------------|-----------------|--|--------------|----------------------|----------|--------------------------------------|----------------------|-----------------------------|------------------------|
|             |                 | Easting (m)                                | Northing (m) |                      |          |                                      | Occupied/Unoccupied  | Participant/Non-participant | Maximum Rotation (dBA) |
| 500039      | Occupied        | 671766                                     | 5158484      | 46                   | Brady II | 3,356                                | 20                   | 31                          | 34                     |
| 500053      | Occupied        | 672221                                     | 5159146      | 63                   | Brady II | 2,638                                | 22                   | 34                          | 36                     |
| 500054      | Unoccupied      | 671612                                     | 5161385      | 57                   | Brady II | 2,390                                | 23                   | 34                          | 36                     |
| 500055      | Unoccupied      | 670870                                     | 5158304      | 49                   | Brady II | 2,556                                | 22                   | 34                          | 36                     |
| 500059      | Occupied        | 669892                                     | 5159454      | 46                   | Brady II | 1,261                                | 29                   | 39                          | 41                     |
| 500064      | Occupied        | 669899                                     | 5159550      | 46                   | Brady II | 1,213                                | 29                   | 40                          | 42                     |
| 500068      | Unoccupied      | 669196                                     | 5158847      | 48                   | Brady II | 867                                  | 30                   | 41                          | 42                     |
| 500076      | Unoccupied      | 666743                                     | 5158531      | 36                   | Brady II | 951                                  | 28                   | 40                          | 42                     |
| 501000      | Occupied        | 684105                                     | 5172245      | 87                   | Brady I  | 2,509                                | 24                   | 31                          | 33                     |
| 501012      | Occupied        | 681646                                     | 5173097      | 79                   | Brady I  | 907                                  | 38                   | 44                          | 45                     |
| 501019      | Occupied        | 680468                                     | 5175745      | 70                   | Brady I  | 1,699                                | 30                   | 37                          | 39                     |
| 501022      | Occupied        | 680563                                     | 5175382      | 70                   | Brady I  | 1,324                                | 32                   | 39                          | 40                     |
| 501030      | Occupied        | 679723                                     | 5174632      | 70                   | Brady I  | 1,290                                | 32                   | 39                          | 41                     |
| 501037      | Occupied        | 679731                                     | 5171167      | 82                   | Brady I  | 838                                  | 37                   | 44                          | 45                     |
| 501040      | Occupied        | 678406                                     | 5173332      | 64                   | Brady I  | 676                                  | 38                   | 45                          | 45                     |
| 501050      | Occupied        | 678419                                     | 5173433      | 64                   | Brady I  | 766                                  | 37                   | 44                          | 45                     |
| 501053      | Unoccupied      | 678555                                     | 5173259      | 64                   | Brady I  | 726                                  | 38                   | 45                          | 45                     |
| 501059      | Occupied        | 678568                                     | 5173250      | 64                   | Brady I  | 730                                  | 38                   | 45                          | 45                     |
| 501065      | Occupied        | 678822                                     | 5170399      | 82                   | Brady I  | 909                                  | 37                   | 44                          | 45                     |
| 501068      | Occupied        | 677851                                     | 5168797      | 48                   | Brady I  | 630                                  | 39                   | 47                          | 48                     |
| 501073      | Occupied        | 681345                                     | 5169634      | 86                   | Brady I  | 820                                  | 34                   | 41                          | 42                     |
| 501081      | Occupied        | 681279                                     | 5168706      | 86                   | Brady I  | 769                                  | 34                   | 41                          | 41                     |
| 501082      | Occupied        | 675433                                     | 5171946      | 61                   | Brady I  | 1,933                                | 30                   | 37                          | 39                     |
| 501083      | Unoccupied      | 666768                                     | 5166374      | 23                   | Brady II | 473                                  | 35                   | 47                          | 47                     |
| 501085      | Occupied        | 672965                                     | 5164410      | 50                   | Brady II | 901                                  | 33                   | 42                          | 44                     |
| 501095      | Occupied        | 672947                                     | 5164396      | 50                   | Brady II | 899                                  | 33                   | 42                          | 44                     |
| 501097      | Unoccupied      | 667485                                     | 5163313      | 30                   | Brady II | 1,299                                | 28                   | 40                          | 42                     |
| 501099      | Occupied        | 675017                                     | 5163411      | 54                   | Brady II | 856                                  | 32                   | 43                          | 44                     |
| 501104      | Occupied        | 675027                                     | 5163439      | 54                   | Brady II | 828                                  | 32                   | 43                          | 44                     |
| 501108      | Occupied        | 670613                                     | 5160034      | 46                   | Brady II | 1,742                                | 26                   | 37                          | 39                     |
| 501118      | Occupied        | 659777                                     | 5163091      | 11                   | Brady II | 1,123                                | 29                   | 41                          | 42                     |
| 501122      | Unoccupied      | 661117                                     | 5163653      | 11                   | Brady II | 340                                  | 38                   | 51                          | 51                     |
| 501126      | Occupied        | 663477                                     | 5163902      | 16                   | Brady II | 1,049                                | 30                   | 42                          | 43                     |
| 501131      | Occupied        | 664747                                     | 5163175      | 22                   | Brady II | 2,051                                | 25                   | 36                          | 39                     |
| 501138      | Occupied        | 664349                                     | 5164755      | 17                   | Brady II | 690                                  | 33                   | 46                          | 46                     |
| 501141      | Occupied        | 665127                                     | 5163747      | 22                   | Brady II | 1,382                                | 27                   | 39                          | 41                     |

Table 10. Summary of Acoustic Modeling Results - Cumulative

| Receptor ID | Receptor Status     |                             | UTM Coordinates (NAD83 UTM Zone 13 meters) |              |                        |  | Nearest Wind Turbine | Project | Distance to Nearest Wind Turbine (m) | Received Sound Level   |  |  |
|-------------|---------------------|-----------------------------|--|--------------|------------------------|--|----------------------|---------|--------------------------------------|------------------------|--|--|
|             | Occupied/Unoccupied | Participant/Non-participant | Eastings (m)                               | Northing (m) | Maximum Rotation (dBA) | Maximum Rotation (dBA) under Anomalous |                      |         |                                      | Maximum Rotation (dBA) |  |  |
| 501147      | Occupied            | Non-participant             | 665442                                     | 5161863      | 30                     | Brady II                               | 1,855                | 23      | 34                                   | 36                     |  |  |
| 501156      | Occupied            | Participant                 | 674657                                     | 5162748      | 58                     | Brady II                               | 717                  | 32      | 44                                   | 45                     |  |  |
| 501162      | Occupied            | Non-participant             | 666164                                     | 5171091      | 24                     | Brady I                                | 1,846                | 26      | 33                                   | 35                     |  |  |
| 501165      | Occupied            | Non-participant             | 668751                                     | 5170669      | 24                     | Brady I                                | 2,987                | 27      | 34                                   | 37                     |  |  |
| 501168      | Occupied            | Non-participant             | 666562                                     | 5170280      | 24                     | Brady I                                | 1,123                | 31      | 38                                   | 40                     |  |  |
| 501172      | Occupied            | Non-participant             | 662856                                     | 5171199      | 20                     | Brady I                                | 3,109                | 27      | 34                                   | 37                     |  |  |
| 501173      | Occupied            | Non-participant             | 661884                                     | 5171096      | 14                     | Brady I                                | 2,774                | 27      | 34                                   | 37                     |  |  |
| 501174      | Occupied            | Non-participant             | 661893                                     | 5171077      | 14                     | Brady I                                | 2,756                | 27      | 34                                   | 37                     |  |  |
| 501175      | Occupied            | Non-participant             | 661018                                     | 5169979      | 14                     | Brady I                                | 1,764                | 30      | 38                                   | 40                     |  |  |
| 501176      | Occupied            | Non-participant             | 660668                                     | 5170916      | 9                      | Brady I                                | 2,621                | 27      | 35                                   | 37                     |  |  |
| 610001      | Occupied            | Non-participant             | 657943                                     | 5169457      | 4                      | Brady I                                | 1,524                | 31      | 38                                   | 40                     |  |  |
| 610009      | Occupied            | Non-participant*            | 657243                                     | 5168249      | 2                      | Brady I                                | 1,099                | 35      | 41                                   | 43                     |  |  |
| 610014      | Occupied            | Non-participant*            | 657329                                     | 5168365      | 4                      | Brady I                                | 1,097                | 34      | 41                                   | 42                     |  |  |
| 610018      | Unoccupied          | Non-participant             | 657481                                     | 5167671      | 2                      | Brady I                                | 535                  | 40      | 46                                   | 47                     |  |  |
| 610021      | Occupied            | Non-participant             | 658588                                     | 5168791      | 5                      | Brady I                                | 657                  | 37      | 44                                   | 45                     |  |  |
| 610025      | Occupied            | Non-participant             | 659083                                     | 5169071      | 5                      | Brady I                                | 922                  | 35      | 42                                   | 43                     |  |  |
| 610031      | Occupied            | Non-participant             | 660171                                     | 5167459      | 8                      | Brady I                                | 667                  | 39      | 46                                   | 47                     |  |  |
| 610042      | Occupied            | Non-participant             | 662190                                     | 5167946      | 14                     | Brady I                                | 664                  | 39      | 46                                   | 46                     |  |  |
| 610045      | Occupied            | Non-participant             | 662204                                     | 5167951      | 14                     | Brady I                                | 673                  | 39      | 45                                   | 46                     |  |  |
| 610049      | Occupied            | Non-participant             | 662204                                     | 5167996      | 14                     | Brady I                                | 648                  | 39      | 45                                   | 46                     |  |  |
| 610053      | Occupied            | Non-participant             | 660882                                     | 5167398      | 15                     | Brady I                                | 671                  | 38      | 45                                   | 46                     |  |  |
| 610057      | Occupied            | Non-participant             | 660875                                     | 5167437      | 15                     | Brady I                                | 671                  | 38      | 45                                   | 46                     |  |  |
| 610059      | Unoccupied          | Non-participant             | 662665                                     | 5165804      | 10                     | Brady II                               | 394                  | 41      | 52                                   | 52                     |  |  |
| 610063      | Unoccupied          | Non-participant             | 661981                                     | 5166658      | 17                     | Brady I                                | 464                  | 41      | 49                                   | 49                     |  |  |
| 610079      | Unoccupied          | Non-participant             | 661962                                     | 5163992      | 12                     | Brady II                               | 436                  | 37      | 50                                   | 50                     |  |  |
| 610084      | Occupied            | Non-participant*            | 666867                                     | 5164930      | 23                     | Brady II                               | 1,197                | 29      | 40                                   | 41                     |  |  |
| 610089      | Occupied            | Non-participant*            | 668413                                     | 5169125      | 29                     | Brady I                                | 2,165                | 29      | 37                                   | 39                     |  |  |
| 610091      | Unoccupied          | Non-participant             | 668196                                     | 5169592      | 24                     | Brady I                                | 2,098                | 28      | 36                                   | 38                     |  |  |
| 610094      | Occupied            | Non-participant             | 663473                                     | 5168761      | 21                     | Brady I                                | 660                  | 38      | 44                                   | 45                     |  |  |
| 610098      | Occupied            | Non-participant             | 664446                                     | 5167109      | 25                     | Brady I                                | 637                  | 39      | 46                                   | 47                     |  |  |
| 610102      | Occupied            | Non-participant*            | 669505                                     | 5169577      | 33                     | Brady I                                | 1,970                | 29      | 36                                   | 38                     |  |  |
| 610108      | Occupied            | Non-participant*            | 669518                                     | 5169514      | 33                     | Brady I                                | 1,920                | 29      | 36                                   | 39                     |  |  |
| 610111      | Occupied            | Non-participant             | 670742                                     | 5169632      | 32                     | Brady I                                | 1,040                | 33      | 40                                   | 41                     |  |  |
| 610116      | Unoccupied          | Non-participant             | 671898                                     | 5169600      | 32                     | Brady I                                | 574                  | 39      | 46                                   | 48                     |  |  |
| 610118      | Unoccupied          | Non-participant             | 671916                                     | 5169648      | 32                     | Brady I                                | 624                  | 39      | 46                                   | 47                     |  |  |
| 610121      | Occupied            | Participant                 | 672258                                     | 5168851      | 32                     | Brady I                                | 672                  | 38      | 45                                   | 46                     |  |  |

Table 10. Summary of Acoustic Modeling Results - Cumulative

| Receptor ID | Receptor Status     |                             | UTM Coordinates (NAD83 UTM Zone 13 meters) |              |               |                       | Nearest Wind Turbine | Project | Distance to Nearest Wind Turbine (m) | Received Sound Level   |  |  |
|-------------|---------------------|-----------------------------|--|--------------|---------------|-----------------------|----------------------|---------|--------------------------------------|------------------------|--|--|
|             | Occupied/Unoccupied | Participant/Non-participant | Eastings (m)                               | Northing (m) | Northings (m) | Cut-in Rotation (dBA) |                      |         |                                      | Maximum Rotation (dBA) | Maximum Rotation under Anomalous (dBA) |  |
| 610125      | Unoccupied          | Non-participant             | 672486                                     | 5169786      |               | 32                    | Brady I              | 1,101   | 38                                   | 45                     | 47                                     |  |
| 610130      | Unoccupied          | Non-participant             | 673973                                     | 5169036      |               | 35                    | Brady I              | 653     | 35                                   | 42                     | 43                                     |  |
| 610134      | Unoccupied          | Non-participant             | 674002                                     | 5169040      |               | 35                    | Brady I              | 673     | 35                                   | 42                     | 43                                     |  |
| 610139      | Occupied            | Non-participant             | 675979                                     | 5170362      |               | 44                    | Brady I              | 1,214   | 33                                   | 40                     | 42                                     |  |
| 610144      | Unoccupied          | Non-participant             | 675675                                     | 5169238      |               | 44                    | Brady I              | 931     | 34                                   | 41                     | 43                                     |  |
| 610145      | Unoccupied          | Non-participant             | 675358                                     | 5166322      |               | 50                    | Brady I              | 816     | 34                                   | 43                     | 44                                     |  |
| 610149      | Occupied            | Non-participant             | 674773                                     | 5165354      |               | 52                    | Brady II             | 1,050   | 34                                   | 44                     | 45                                     |  |
| 610155      | Unoccupied          | Non-participant             | 669944                                     | 5164888      |               | 28                    | Brady II             | 653     | 34                                   | 46                     | 47                                     |  |
| 610164      | Unoccupied          | Non-participant             | 669993                                     | 5164876      |               | 28                    | Brady II             | 693     | 34                                   | 46                     | 47                                     |  |
| 610170      | Occupied            | Participant                 | 667574                                     | 5164565      |               | 26                    | Brady II             | 1,627   | 28                                   | 39                     | 41                                     |  |
| 610181      | Occupied            | Participant                 | 670466                                     | 5167264      |               | 36                    | Brady I              | 729     | 36                                   | 44                     | 44                                     |  |
| 610185      | Occupied            | Participant                 | 670516                                     | 5167245      |               | 36                    | Brady I              | 696     | 37                                   | 44                     | 44                                     |  |
| 610188      | Unoccupied          | Non-participant             | 668519                                     | 5166787      |               | 24                    | Brady II             | 925     | 31                                   | 41                     | 43                                     |  |
| 610190      | Unoccupied          | Non-participant             | 668913                                     | 5167829      |               | 25                    | Brady II             | 1,737   | 30                                   | 38                     | 40                                     |  |
| 610194      | Unoccupied          | Non-participant             | 669326                                     | 5167878      |               | 33                    | Brady I              | 1,747   | 30                                   | 38                     | 40                                     |  |
| 610197      | Unoccupied          | Non-participant             | 673253                                     | 5168730      |               | 35                    | Brady I              | 407     | 40                                   | 47                     | 47                                     |  |
| 610203      | Unoccupied          | Non-participant             | 670759                                     | 5168861      |               | 33                    | Brady I              | 605     | 37                                   | 44                     | 45                                     |  |
| 706192      | Unoccupied          | Non-participant             | 656694                                     | 5166353      |               | 1                     | Brady I              | 704     | 36                                   | 43                     | 44                                     |  |
| 800268      | Unoccupied          | Non-participant             | 670007                                     | 5160023      |               | 46                    | Brady II             | 1,142   | 29                                   | 40                     | 41                                     |  |
| 800288      | Unoccupied          | Non-participant             | 664145                                     | 5164372      |               | 17                    | Brady II             | 1,003   | 31                                   | 43                     | 44                                     |  |
| 800292      | Unoccupied          | Non-participant             | 664102                                     | 5164281      |               | 17                    | Brady II             | 1,090   | 31                                   | 43                     | 44                                     |  |
| 800304      | Unoccupied          | Non-participant             | 670346                                     | 5166290      |               | 25                    | Brady II             | 837     | 34                                   | 43                     | 44                                     |  |
| 800308      | Occupied            | Participant                 | 667354                                     | 5158391      |               | 36                    | Brady II             | 861     | 30                                   | 42                     | 43                                     |  |
| 800311      | Occupied            | Participant                 | 667332                                     | 5158349      |               | 36                    | Brady II             | 903     | 28                                   | 41                     | 41                                     |  |
| 800317      | Occupied            | Non-participant             | 662260                                     | 5158285      |               | 36                    | Brady II             | 5,195   | 15                                   | 26                     | 28                                     |  |
| 800342      | Unoccupied          | Non-participant             | 670035                                     | 5161380      |               | 40                    | Brady II             | 993     | 30                                   | 41                     | 43                                     |  |
| 800364      | Unoccupied          | Non-participant             | 669001                                     | 5162054      |               | 40                    | Brady II             | 279     | 39                                   | 52                     | 52                                     |  |
| 811069      | Unoccupied          | Non-participant             | 682736                                     | 5175254      |               | 74                    | Brady I              | 404     | 42                                   | 49                     | 49                                     |  |
| 811201      | Occupied            | Non-participant             | 680019                                     | 5177169      |               | 77                    | Brady I              | 2,577   | 25                                   | 32                     | 34                                     |  |
| 811205      | Occupied            | Non-participant             | 679691                                     | 5178020      |               | 77                    | Brady I              | 3,127   | 21                                   | 28                     | 30                                     |  |
| 811210      | Occupied            | Non-participant             | 680887                                     | 5178421      |               | 77                    | Brady I              | 2,338   | 24                                   | 31                     | 33                                     |  |
| 811214      | Unoccupied          | Non-participant             | 680759                                     | 5178424      |               | 77                    | Brady I              | 2,433   | 24                                   | 31                     | 33                                     |  |
| 811217      | Unoccupied          | Non-participant             | 680753                                     | 5178482      |               | 77                    | Brady I              | 2,477   | 24                                   | 31                     | 33                                     |  |
| 811224      | Unoccupied          | Non-participant             | 680747                                     | 5178483      |               | 77                    | Brady I              | 2,482   | 24                                   | 31                     | 33                                     |  |
| 811228      | Unoccupied          | Non-participant             | 682023                                     | 5174120      |               | 72                    | Brady I              | 187     | 48                                   | 55                     | 55                                     |  |
| 811231      | Unoccupied          | Non-participant             | 682042                                     | 5174165      |               | 72                    | Brady I              | 139     | 50                                   | 57                     | 57                                     |  |

Table 10. Summary of Acoustic Modeling Results - Cumulative

| Receptor ID | Receptor Status     |                             | UTM Coordinates (NAD83 UTM Zone 13 meters) |              | Nearest Wind Turbine | Project  | Distance to Nearest Wind Turbine (m) | Cut-in Rotation (dBA) | Maximum Rotation (dBA) | Maximum Rotation under Anomalous (dBA) |
|-------------|---------------------|-----------------------------|--|--------------|----------------------|----------|--------------------------------------|-----------------------|------------------------|--|
|             | Occupied/Unoccupied | Participant/Non-participant | Easting (m)                                | Northing (m) |                      |          |                                      |                       |                        |  |
| 811236      | Unoccupied          | Non-participant             | 682274                                     | 5174639      | 72                   | Brady I  | 398                                  | 43                    | 49                     | 50                                     |
| 811237      | Unoccupied          | Non-participant             | 679990                                     | 5178775      | 77                   | Brady I  | 3,250                                | 21                    | 27                     | 30                                     |
| 811285      | Unoccupied          | Non-participant             | 657284                                     | 5168323      | 4                    | Brady I  | 1,712                                | 30                    | 37                     | 39                                     |
| 811287      | Occupied            | Non-participant             | 655467                                     | 5168218      | 1                    | Brady I  | 1,630                                | 23                    | 30                     | 32                                     |
| 811290      | Occupied            | Non-participant             | 650090                                     | 5167200      | 1                    | Brady I  | 6,518                                | 10                    | 18                     | 21                                     |
| 880001      | Occupied            | Non-participant             | 680270                                     | 5173773      | 68                   | Brady I  | 649                                  | 40                    | 47                     | 47                                     |
| 900002      | Occupied            | Participant                 | 661988                                     | 5161930      | 11                   | Brady II | 2,051                                | 24                    | 36                     | 38                                     |
| 900007      | Occupied            | Participant                 | 662323                                     | 5161469      | 11                   | Brady II | 2,621                                | 23                    | 34                     | 36                                     |
| 900011      | Occupied            | Non-participant             | 662065                                     | 5161089      | 11                   | Brady II | 2,810                                | 21                    | 33                     | 35                                     |
| 900015      | Occupied            | Non-participant             | 658130                                     | 5161120      | 1                    | Brady II | 3,339                                | 22                    | 32                     | 34                                     |
| 900019      | Occupied            | Non-participant             | 658166                                     | 5161105      | 1                    | Brady II | 3,340                                | 22                    | 32                     | 34                                     |
| 900025      | Unoccupied          | Non-participant             | 666717                                     | 5161478      | 31                   | Brady II | 754                                  | 32                    | 44                     | 45                                     |
| 900027      | Occupied            | Non-participant             | 664500                                     | 5161670      | 30                   | Brady II | 2,813                                | 24                    | 36                     | 38                                     |
| 900031      | Occupied            | Non-participant             | 665522                                     | 5158935      | 36                   | Brady II | 1,869                                | 24                    | 36                     | 38                                     |
| 900035      | Occupied            | Non-participant*            | 665494                                     | 5158171      | 36                   | Brady II | 1,872                                | 24                    | 36                     | 38                                     |
| 900039      | Occupied            | Non-participant*            | 665496                                     | 5158110      | 36                   | Brady II | 1,873                                | 25                    | 36                     | 38                                     |
| 900042      | Unoccupied          | Non-participant             | 666233                                     | 5158189      | 36                   | Brady II | 1,552                                | 25                    | 37                     | 39                                     |
| 900047      | Occupied            | Non-participant             | 663971                                     | 5160025      | 37                   | Brady II | 3,418                                | 18                    | 29                     | 32                                     |
| 900053      | Occupied            | Non-participant             | 664011                                     | 5160036      | 37                   | Brady II | 3,379                                | 20                    | 31                     | 34                                     |
| 900056      | Unoccupied          | Non-participant             | 664009                                     | 5160071      | 37                   | Brady II | 3,386                                | 20                    | 32                     | 34                                     |
| 900059      | Occupied            | Non-participant             | 665090                                     | 5160153      | 37                   | Brady II | 2,331                                | 24                    | 36                     | 38                                     |
| 900063      | Unoccupied          | Non-participant             | 665463                                     | 5160848      | 31                   | Brady II | 1,838                                | 25                    | 37                     | 39                                     |
| 900068      | Unoccupied          | Non-participant             | 665093                                     | 5160747      | 31                   | Brady II | 2,217                                | 23                    | 35                     | 37                                     |
| 900070      | Occupied            | Non-participant             | 679567                                     | 5171280      | 82                   | Brady I  | 663                                  | 39                    | 46                     | 46                                     |
| 900537      | Unoccupied          | Non-participant             | 662248                                     | 5160947      | 11                   | Brady II | 3,021                                | 21                    | 32                     | 35                                     |
| 900539      | Unoccupied          | Non-participant             | 659745                                     | 5159757      | 11                   | Brady II | 3,971                                | 17                    | 27                     | 30                                     |
| 900542      | Occupied            | Non-participant             | 664710                                     | 5156553      | 36                   | Brady II | 3,785                                | 12                    | 23                     | 27                                     |
| 900543      | Unoccupied          | Non-participant             | 664547                                     | 5156573      | 36                   | Brady II | 3,887                                | 14                    | 25                     | 27                                     |
| 900546      | Occupied            | Non-participant             | 664516                                     | 5156546      | 36                   | Brady II | 3,929                                | 12                    | 23                     | 27                                     |
| 900547      | Occupied            | Non-participant             | 665655                                     | 5157082      | 36                   | Brady II | 2,762                                | 18                    | 29                     | 32                                     |
| 900548      | Occupied            | Non-participant             | 665667                                     | 5156254      | 49                   | Brady II | 3,165                                | 7                     | 16                     | 21                                     |
| 900549      | Unoccupied          | Non-participant             | 667277                                     | 5158374      | 49                   | Brady II | 1,900                                | 8                     | 18                     | 23                                     |

\* Denotes receptors categorized as Non-Participating because the receptor is located on land that is not covered by an easement. However, the landowners at these receptors are participants of the Project on property located elsewhere in the Project Area. Note: The cumulative noise assessment was analyzed using Brady Wind Energy Center and Brady II Wind Energy Center site layouts dated November 6, 2015, and April 22, 2016, respectively. If either facility site layout is modified, potential noise impacts will be reanalyzed to ensure consistency with the PSC's noise requirement.

**4.2 Substation Noise**

Substations have switching, protection and control equipment and typically one or more transformers, which generate the sound generally described as a low humming. There are three main sound sources associated with a transformer: core noise, load noise and noise generated by the operation of the cooling equipment. The core vibrational noise is the principal noise source and does not vary significantly with electrical load. Transformers are designed and catalogued by MVA ratings. Just as horsepower ratings designate the power capacity of an electric motor, a transformer’s MVA rating indicates its maximum power output capacity. The National Electrical Manufacturers Association (NEMA) published NEMA Standards TR1-1993 (R2000), which establish the maximum noise level allowed for transformers, voltage regulators, and shunt reactors based on the equipment’s method of cooling its dielectric fluid (air-cooled vs. oil-cooled) and the electric power rating.

Transformer noise is generated and will attenuate with distance at different rates depending on the transformer dimensions, voltage rating, and design. The noise produced by substation transformers is primarily caused by the load current in the transformer’s conducting coils (or windings) and consequently the main frequency of this sound is twice the supply frequency. The characteristic humming sound consists of tonal components generated at harmonics of 120 Hz. Most of the acoustical energy resides in the fundamental tone (120 Hz) and the first 3 or 4 harmonics (240, 360, 480, 600 Hz). In addition to core vibration noise, transformer cooling fans may generate broadband noise, limited to periods when high heat loads require additional cooling capacity. The resulting audible sound is a combination of core noise and the broadband fan noise. Circuit-breaker operations may also cause audible noise, particularly the operation of air-blast breakers which is characterized as an impulsive sound event of very short duration. This is expected to occur only a few times throughout the year, and was therefore not considered in this analysis.

The proposed collection substation would be located approximately 600 feet (183 meters) south of 52nd Street SW and immediately adjacent to 109th Avenue SW. The transformer at this substation location was modeled using the latest version of CadnaA implementing ISO 9613-2. Transformer sound source levels were provided based on a 170 MVA transformer similar to the HICO 170 MVA transformer in use at other NEER energy facilities. Table 11 presents the transformer sound source data by octave band center frequency calculated based on the estimated transformer NEMA and MVA ratings using standardized engineering guidelines.

**Table 11. Transformer Sound Power Level**

| Frequency (Hz)      | Octave Band Sound Power Level (dB) |     |     |     |      |      |      |      | Broadband (dBA) |
|---------------------|------------------------------------|-----|-----|-----|------|------|------|------|-----------------|
|                     | 63                                 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |                 |
| 170 MVA Transformer | 93                                 | 99  | 101 | 94  | 90   | 85   | 80   | 73   | 97              |

Transformers the size of the one proposed for the Project can present a noise concern if the separation distance is less than a few hundred feet between the transformer and noise-sensitive

receptors. The proposed transformer location is approximately 1,050 feet (320 meters) from the nearest noise sensitive receptor and poses little concern from a noise perspective. That being said, transformer noise may be periodically audible at nearby receptors on occasions when background sound levels are very low.

### 4.3 Construction Noise

The development of Brady II Wind Energy Center will involve construction to establish access roads, excavate and form WTG foundations, prepare the site for crane-lifting and assemble and commission the WTGs. Work on large-scale wind projects such as Brady II Wind Energy Center is generally divided into four phases consisting of the following:

1. *Site Clearing*: The initial site mobilization phase includes the establishment of temporary site offices, workshops, stores, and other on-site facilities. Installation of erosion and sedimentation control measures will be completed as well as the preparation of initial haulage routes.
2. *Grading*: This phase would begin with the grading and formation of access roads and preparation of laydown areas. Excavation for the concrete turbine foundations would also be completed.
3. *Foundation Work*: Construction of the reinforced concrete turbine foundations would take place in addition to installation of the internal transmission network.
4. *WTG Installation*: Delivery of the turbine components would occur followed by their installation and commissioning.

Work on these construction activities is expected to overlap. It is likely that the WTGs will be erected in small groupings. Each grouping may undergo periodic testing and commissioning prior to commencement of full commercial operation. Other construction activities include those for the supporting infrastructure such as the substation, maintenance building, and the overhead transmission line.

The construction of the Project may cause short-term but unavoidable noise impacts. The sound levels resulting from construction activities vary significantly depending on several factors such as the type and age of equipment, the specific equipment manufacturer and model, the operations being performed, and the overall condition of the equipment and exhaust system mufflers. The list of construction equipment that may be used on the Project and estimates of near and far sound source levels are presented in Table 12.

**Table 12. Estimated L<sub>max</sub> Sound Pressure Levels from Construction Equipment**

| Equipment*    | Estimated Sound Pressure Level at 50 feet (dBA) | Estimated Sound Pressure Level at 2000 feet (dBA) |
|---------------|---|---|
| Crane         | 85  | 53  |
| Forklift      | 80  | 48  |
| Backhoe       | 80  | 48  |
| Grader        | 85  | 53  |
| Man basket    | 85  | 53  |
| Dozer         | 83–88   | 51–56   |
| Loader        | 83–88   | 51–56   |
| Scissor Lift  | 85  | 53  |
| Truck         | 84  | 52  |
| Welder        | 73  | 41  |
| Compressor    | 80  | 48  |
| Concrete Pump | 77  | 45  |

Source: FHWA 2006; Bolt et al. 1977

Sounds generated by construction activities are typically exempt from state and local noise oversight provided that they occur within weekday, daytime periods as may be specified under local zoning or legal codes. All reasonable efforts will be made to minimize the impact of noise resulting from construction activities. As the design of the Project progresses and construction scheduling is finalized, the construction engineer normally notifies the community via public notice or alternative method of the expected Project construction commencement and duration to help minimize the effects of construction noise. In addition, the location of stationary equipment and the siting of construction laydown areas will be carefully selected to be as far removed from existing noise-sensitive receptors as is practical. Candidate construction noise mitigation measures include scheduling louder construction activities during daytime hours and equipping internal combustion engines with appropriate sized muffler systems to minimize noise excessive emissions.

Construction activity will generate traffic having potential noise effects, such as trucks travelling to and from the site on public roads. At the early stage of the construction phase, equipment and materials will be delivered to the site, such as hydraulic excavators and associated spreading and compacting equipment needed to form access roads and foundation platforms for each turbine. Once the access roads are constructed, equipment for lifting the towers and turbine components will arrive. Traffic noise is categorized into two categories: (1) the noise that will occur during the initial temporary traffic movements related to turbine delivery, haulage of components and remaining construction; and (2) maintenance and ongoing traffic from staff and contractors, which is expected to be minor.

## 5.0 CONCLUSIONS

Project operational sound has been calculated and compared to the 50 dBA PSC noise limit. Acoustic modeling analysis per ISO 9613-2 and inclusive of a number of conservative assumptions under operational conditions demonstrates the Project will not generate exceedances of the PSC noise limit at any occupied receptor location under either "With Alternates" or with "No Alternates". In addition, predicted noise impacts of the Project "With Alternates" should be considered conservative since only 72 WTGs will actually be built as part of the Project.

It is expected that received sound levels at noise-sensitive receptors will be consistent with sound generated at similar wind energy projects successfully sited throughout the state of North Dakota employing the same or similar criteria. However, while the Project has demonstrated compliance with the requirements, the Project may result in periodically audible sound within adjacent areas under certain operational and meteorological conditions.

## 6.0 TECHNICAL REFERENCES

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# **APPENDIX A**

## **Figures**

NEXTERA ENERGY  
RESOURCES, LLC  
BRADY II WIND PROJECT  
HETTINGER COUNTY  
NORTH DAKOTA

FIGURE 1  
PROJECT LAYOUT  
MAY 2016

Brady II Proposed Turbine Array (4/22/2016)

- GE Xle 2.1-116 Turbine
- GE Xle 2.1-116 Turbine (Alt)
- GE Xle 1.79-100 Turbine

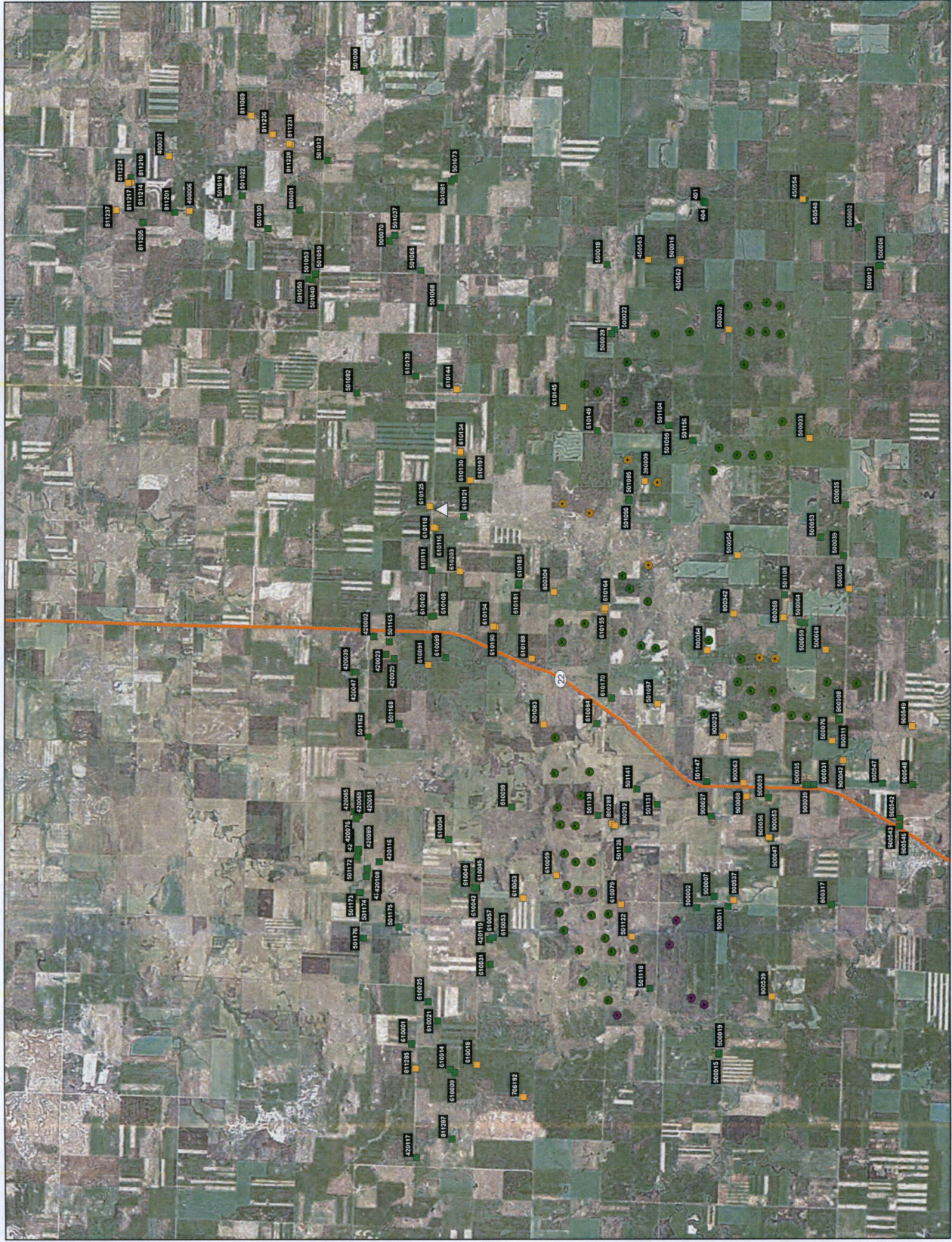
Receptors

- Occupied
- Not Occupied
- △ Substation
- Major Road



0 0.5 1 1.5 2 MILES

REFERENCE MAP



NEXTERA ENERGY  
 RESOURCES, LLC  
 BRADY II WIND PROJECT  
 HETTINGER COUNTY  
 NORTH DAKOTA

FIGURE 2  
 WITH ALTERNATES:  
 RECEIVED SOUND LEVELS -  
 WIND TURBINES AT CUT-IN  
 WIND SPEED

MAY 2016

Brady II Proposed Turbine Array (4/22/2016)

- GE Xle 2.1-116 Turbine
- GE Xle 2.1-116 Turbine (Alt)
- GE Xle 1.79-100 Turbine

Receptors

- Occupied
- Not Occupied
- △ Substation

Sound Level Contour Ranges (dBA)

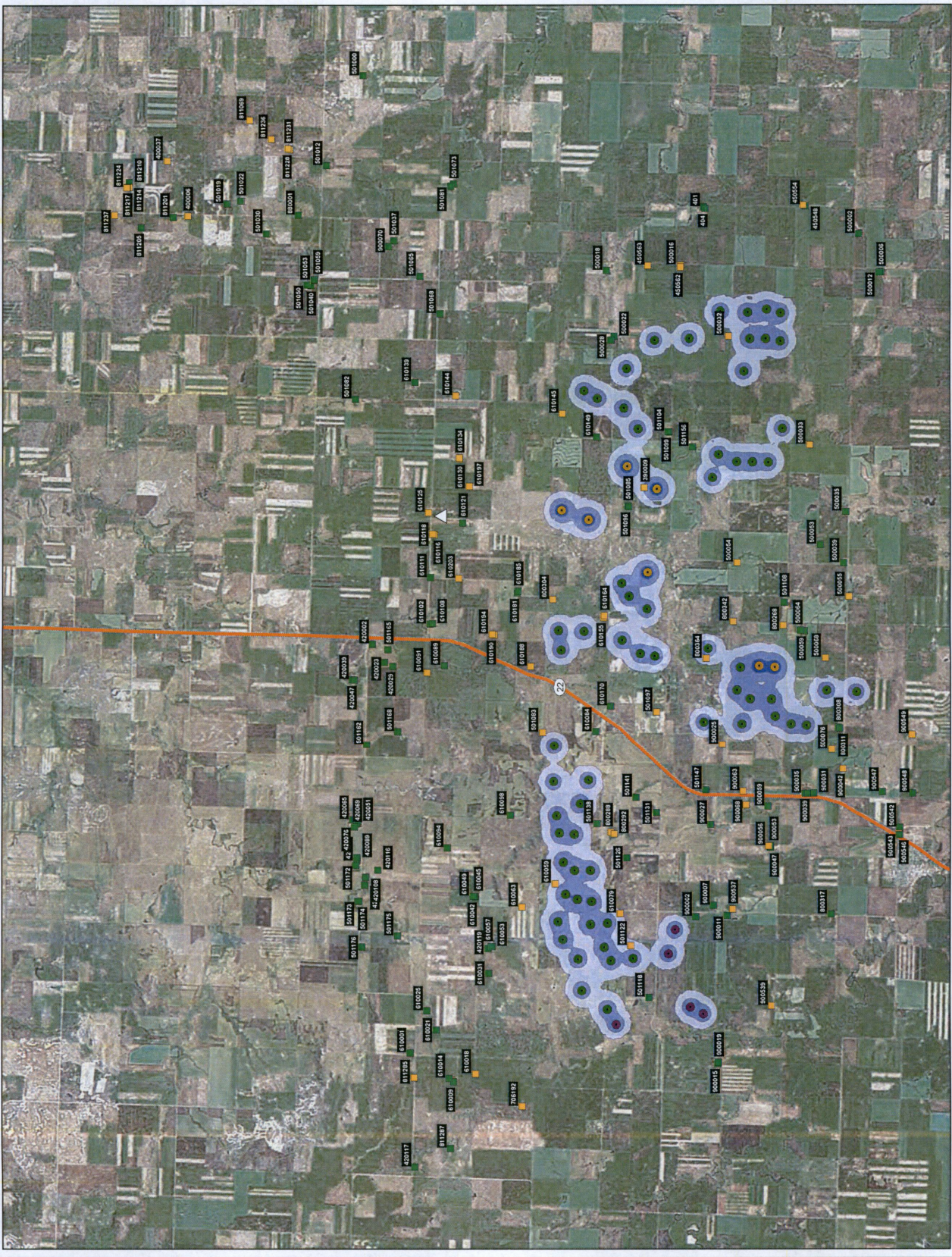
- 35-40
- >40-45
- >45-50
- >50

- Interstate Highway
- Major Road



0 0.5 1 1.5 2 MILES

REFERENCE MAP



NEXTERA ENERGY  
 RESOURCES, LLC  
 BRADY II WIND PROJECT  
 HETTINGER COUNTY  
 NORTH DAKOTA

FIGURE 3  
 NO ALTERNATES:  
 RECEIVED SOUND LEVELS-  
 WIND TURBINES AT CUT-IN  
 WIND SPEED  
 MAY 2016

Brady II Proposed Turbine Array (4/22/2016)

- GE Xle 2.1-116 Turbine
- GE Xle 1.79-100 Turbine

Receptors

- Occupied
- Not Occupied
- △ Substation

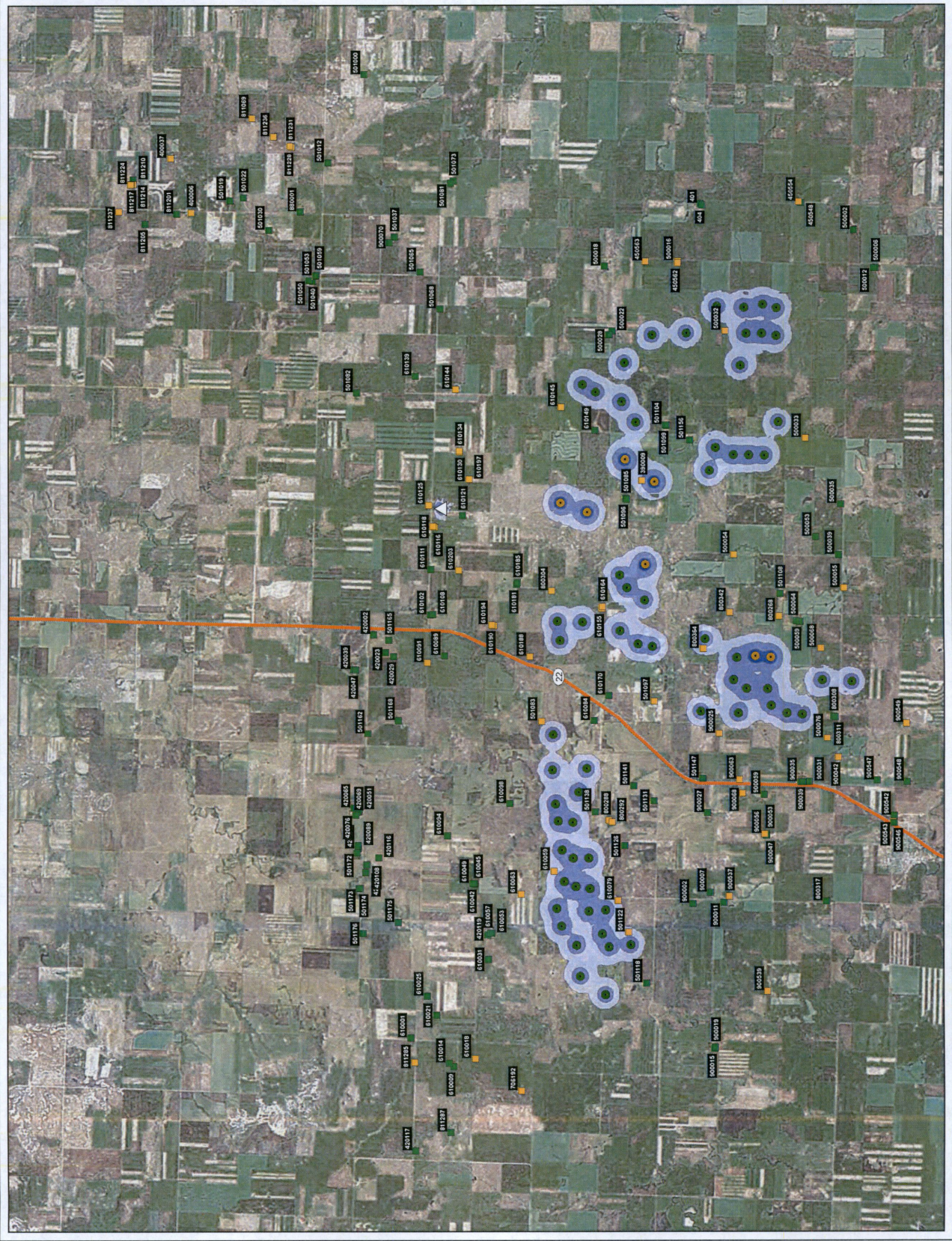
Sound Level Contour Ranges (dBA)

- 35-40
- >40-45
- >45-50
- >50

- Interstate Highway
- Major Road



0 0.5 1 1.5 2 MILES



NEXTERA ENERGY  
 RESOURCES, LLC  
 BRADY II WIND PROJECT  
 HETTINGER COUNTY  
 NORTH DAKOTA

FIGURE 4  
 WITH ALTERNATES:  
 RECEIVED SOUND LEVELS -  
 WIND TURBINES AT MAXIMUM  
 ROTATIONAL WIND SPEED

MAY 2016

Brady II Proposed Turbine Array (4/22/2016)

- GE Xle 2.1-116 Turbine
- GE Xle 2.1-116 Turbine (Alt)
- GE Xle 1.79-100 Turbine

Receptors

- Occupied
- Not Occupied
- △ Substation

Sound Level Contour Ranges (dBA)

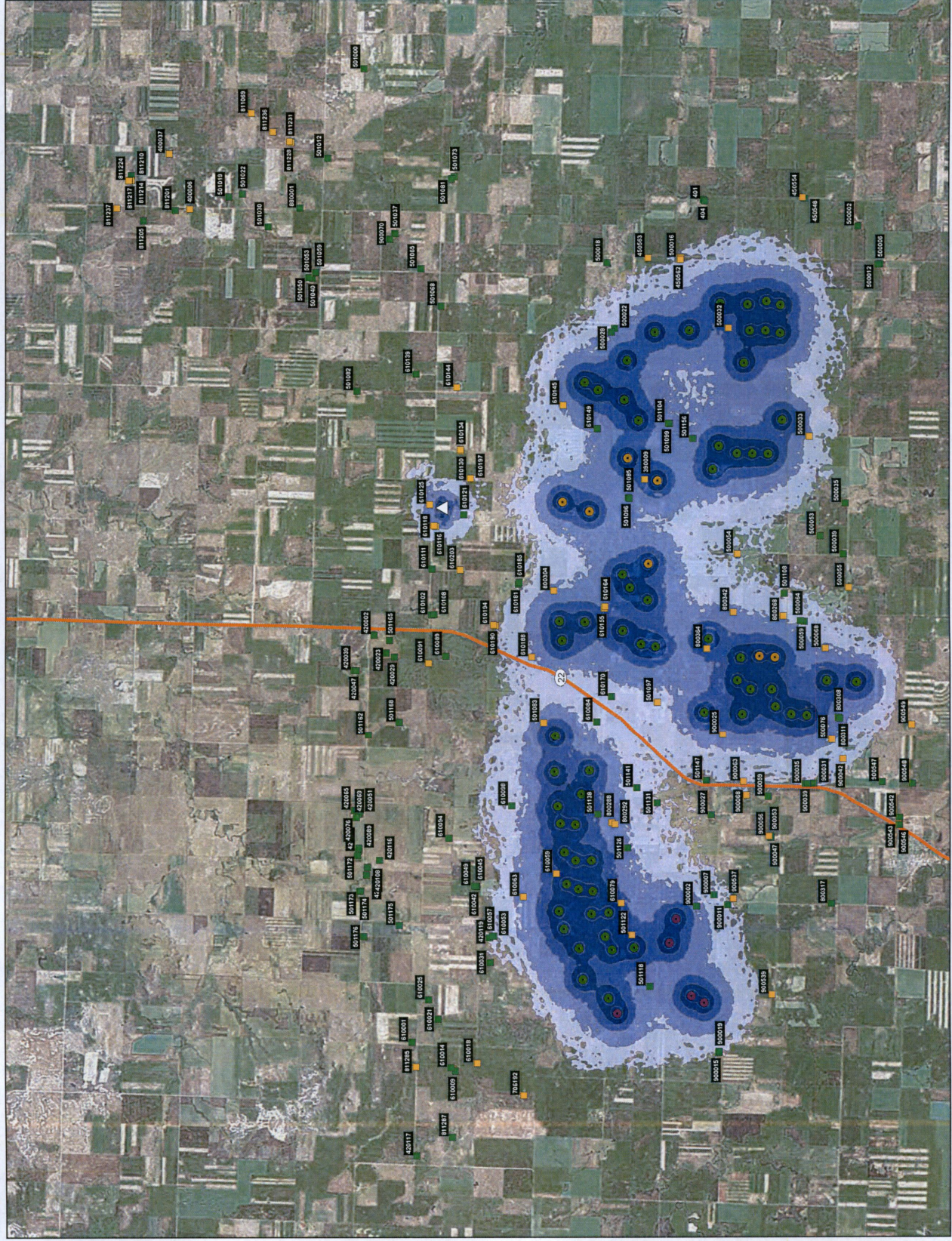
- 35-40
- >40-45
- >45-50
- >50

- Interstate Highway
- Major Road



0 0.5 1 1.5 2 MILES

REFERENCE MAP



NEXTERA ENERGY  
 RESOURCES, LLC  
 BRADY II WIND PROJECT  
 HETTINGER COUNTY  
 NORTH DAKOTA

FIGURE 5  
 NO ALTERNATES:  
 RECEIVED SOUND LEVELS -  
 WIND TURBINES AT MAXIMUM  
 ROTATIONAL WIND SPEED  
 MAY 2016

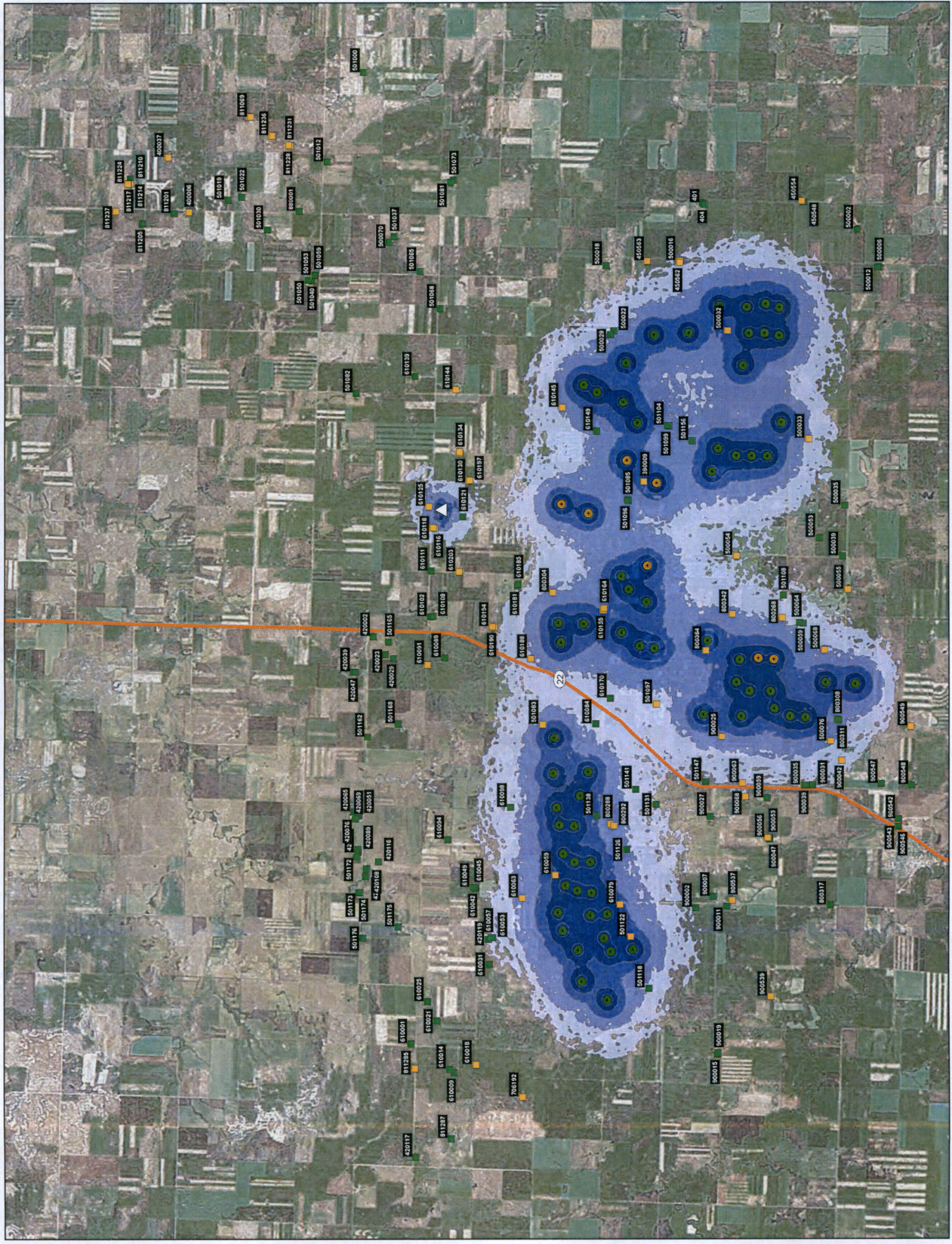
Brady II Proposed Turbine Array (4/22/2016)

- GE Xle 2.1-116 Turbine
- GE Xle 1.79-100 Turbine
- Receptors**
- Occupied
- Not Occupied
- △ Substation
- Sound Level Contour Ranges (dBA)**
- 35-40
- >40-45
- >45-50
- >50
- Interstate Highway
- Major Road



0 0.5 1 1.5 2 MILES

REFERENCE MAP



NEXTERA ENERGY  
 RESOURCES, LLC  
 BRADY II WIND PROJECT  
 HETTINGER COUNTY  
 NORTH DAKOTA

**FIGURE 6**  
 WITH ALTERNATES:  
 RECEIVED SOUND LEVELS -  
 WIND TURBINES AT MAXIMUM  
 ROTATIONAL WIND SPEED  
 ANOMALOUS METEOROLOGICAL  
 CONDITIONS

MAY 2016

Brady II Proposed Turbine Array (4/22/2016)

- GE Xle 2.1-116 Turbine
- GE Xle 2.1-116 Turbine (Alt)
- GE Xle 1.79-100 Turbine

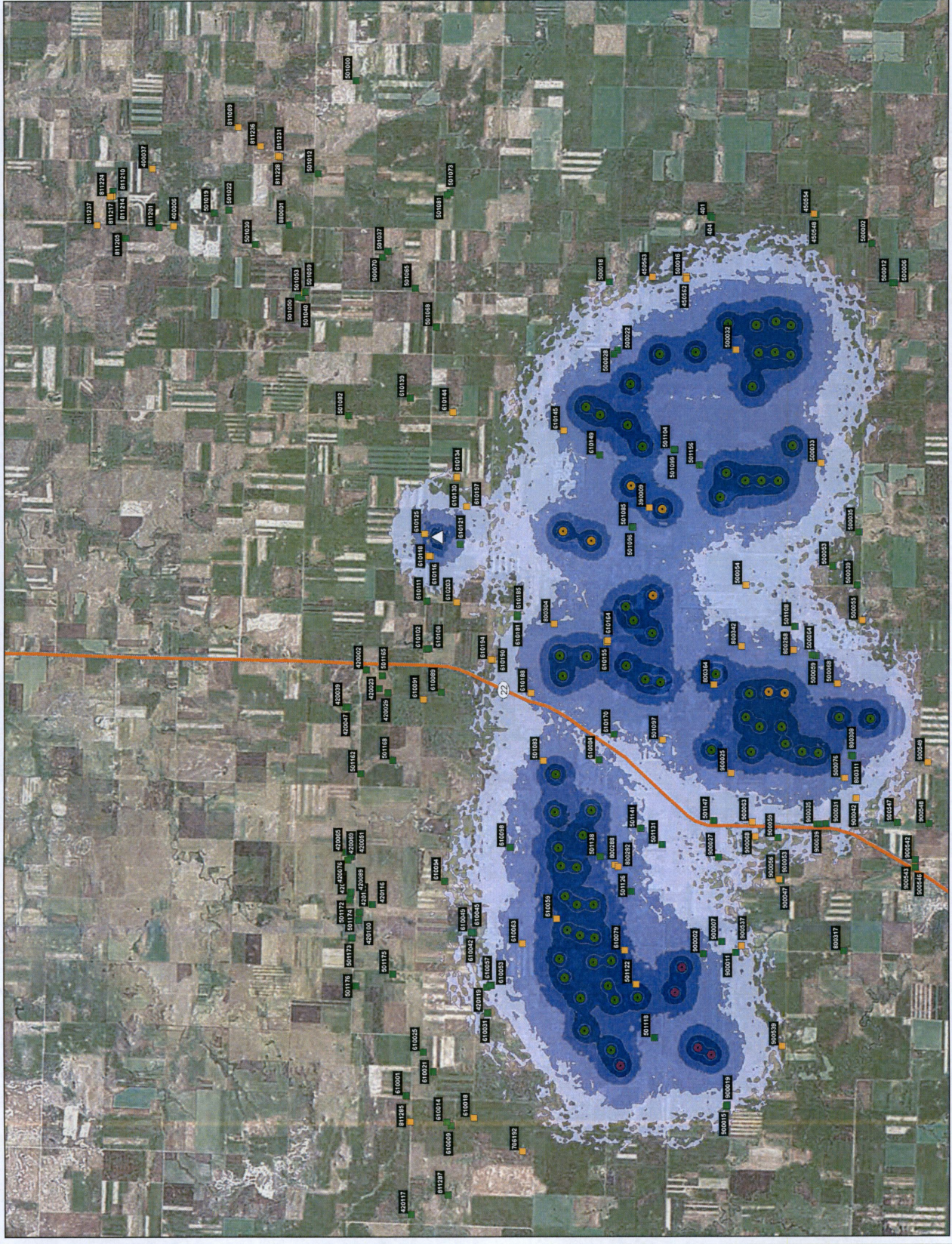
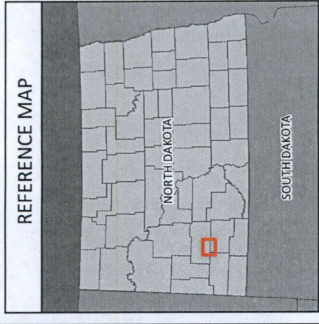
- Receptors
- Occupied
  - Not Occupied
  - △ Substation

Sound Level Contour Ranges (dBA)

- 35-40
- >40-45
- >45-50
- >50

- Interstate Highway
- Major Road

0 0.5 1 1.5 2 MILES



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 NORTH DAKOTA

FIGURE 7  
 NO ALTERNATES  
 RECEIVED SOUND LEVELS -  
 WIND TURBINES AT MAXIMUM  
 ROTATIONAL WIND SPEED  
 ANOMALOUS METEOROLOGICAL  
 CONDITIONS

MAY 2016

Brady II Proposed Turbine Array (4/22/2016)

- GE Xle 2.1-116 Turbine
- GE Xle 1.79-100 Turbine

Receptors

- Occupied
- Not Occupied
- △ Substation

Sound Level Contour Ranges (dBA)

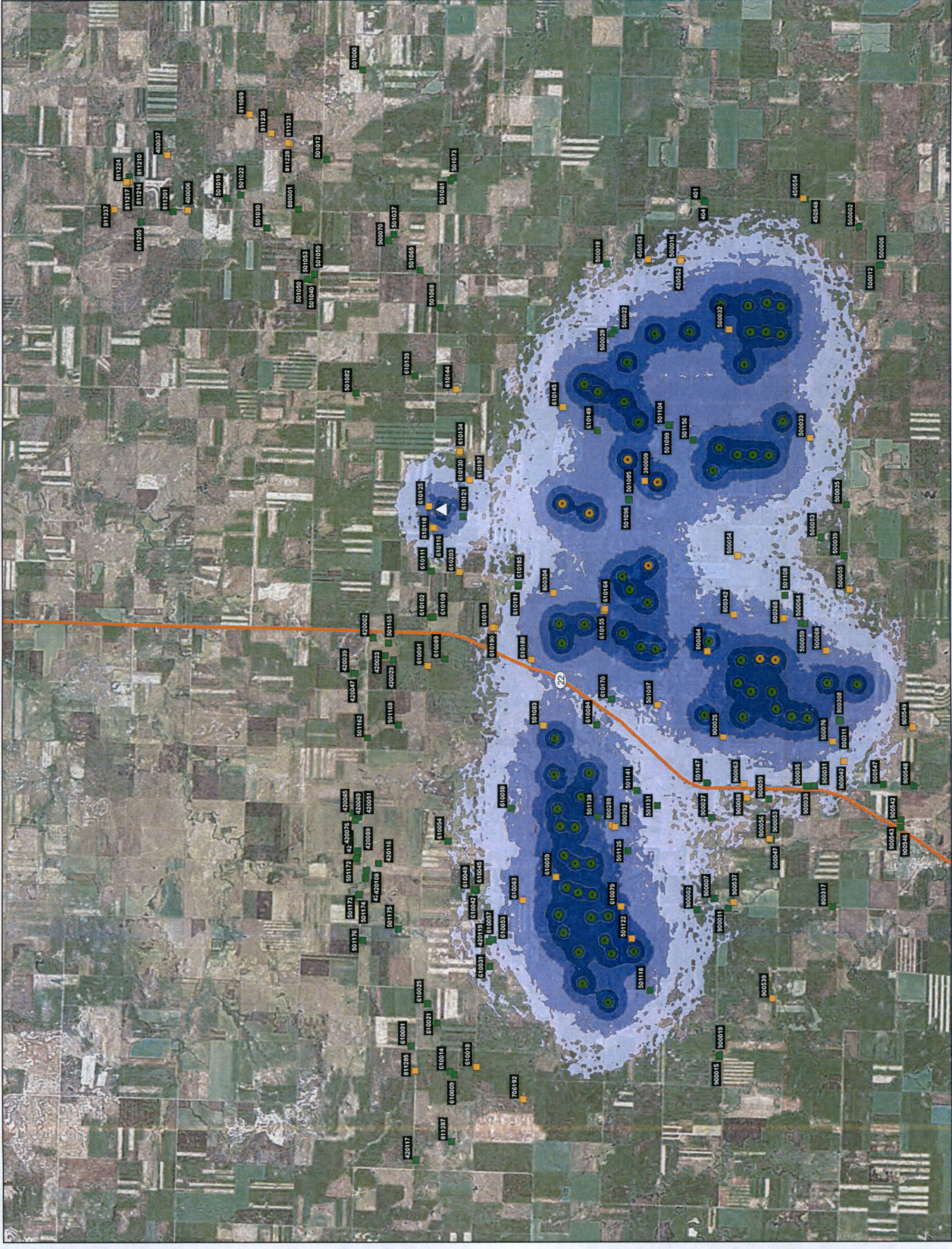
- 35-40
- >40-45
- >45-50
- >50

- Interstate Highway
- Major Road



0 0.5 1 1.5 2 MILES

REFERENCE MAP







NEXTERA ENERGY  
 RESOURCES, LLC  
 BRADY II WIND PROJECT  
 HETTINGER COUNTY  
 NORTH DAKOTA

FIGURE 10  
 CUMULATIVE EFFECTS (NO ALTS):  
 RECEIVED SOUND LEVELS -  
 WIND TURBINES AT MAXIMUM  
 ROTATIONAL WIND SPEED  
 ANOMALOUS METEOROLOGICAL  
 CONDITIONS

MAY 2016

- Brady I Proposed Turbine Array (11/6/2015)
- GE 1.7 MW Turbine
  - GE 1.79 MW Turbine
- Brady II Proposed Turbine Array (4/22/2016)
- GE Xle 2.1-116 Turbine
  - GE Xle 1.79-100 Turbine

Receptors

- Occupied
- Not Occupied
- △ Substation

Sound Level Contour Ranges (dBA)

- 35-40
- >40-45
- >45-50
- >50

- Interstate Highway
- Major Road



0 0.5 1 1.5 2 MILES

REFERENCE MAP

