Wilton IV Wind Energy Center
Acoustic Assessment
Burleigh County, North Dakota

September 2014

Prepared for

Prepared by

160 Federal Street
Boston, MA 02110
617-443-7500

TABLE OF CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

AGL	above ground level
Applicant	NextEra Energy Resources, LLC
BIL	basic impulse level
CadnaA	Computer-Aided Noise Abatement Program
dB	decibel
dBA	A-weighted decibel
dBL	unweighted decibel
GE	General Electric
Hz	Hertz
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
kHz	kilohertz
kV	kilovolt
L_{dn}	day-night averaged sound level
L_{eq}	equivalent sound level
LFN	low frequency noise
L_{max}	maximum sound level
L_p	sound pressure level
L_w	sound power level
m/s	meters per second
mph	miles per hour
MVA	megavolt ampere
MW	megawatt
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
Project	Wilton IV 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 Wilton IV Wind Energy Center (Project) located in Burleigh County, North Dakota. A screening-level analysis was completed to evaluate the expected sound levels resulting from the Project wind turbine generator (WTGs) and substation. Although the Project also includes a transmission line, this component was not included within the scope of the acoustic assessment. The overall objectives of this study were to: (1) determine Project sound sources and site-specific sound propagation characteristics incorporating terrain effects; (2) predict Project sound levels using internationally accepted calculation standards; and (3) determine the feasibility of the Project to operate in compliance with applicable noise standards. The study also includes an assessment of sounds generated during Project construction and maintenance activities and an evaluation of the cumulative sound impacts of the Project in conjunction with existing wind energy development.

Wind turbine sound source data was obtained from General Electric (GE), the manufacturer of the GE 1.79 megawatt (MW)-100 WTGs as documented in the noise specification (GE 2013). Substation sound source data were obtained from NextEra Resources, LLC (NextEra) and were based on a 110 megavolt ampere (MVA) transformer specification (dated July 11, 2014). 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 4.4.145), 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 were compared to the North Dakota Public Service Commission (PSC) noise standards. Acoustic modeling results showed that the Project will not generate exceedances of the North Dakota PSC noise standards at any occupied receptor locations. Therefore, the Project is not expected to present an adverse noise impact to public welfare, health and safety.

1.0 INTRODUCTION

Wilton Wind IV, LLC, a subsidiary of NextEra Energy Resource, LLC, proposes to construct and operate the Wilton IV Wind Energy Center in Burleigh County, North Dakota. According to the WTG layout dated July 28, 2014, the Project consists of a total of 66 GE 1.79-100 MW WTGs which includes 8 alternate WTG locations. Each WTG is designed to have a rotor diameter (RD) of 328 feet (100 meters) and hub height of 262.5 feet (80 meters). The Project infrastructure also includes a collection substation to enable interconnection to the Central Electric Power Cooperative 230-kilovolt (kV) transmission line and the Western Area Power Administration's transmission system. Substation sound source data were obtained from NextEra and were based on a 110 MVA transformer specification (dated July 11, 2014). The Project transmission line was not included within the scope of the acoustic assessment. A cumulative assessment of sound resulting from the Project in conjunction with the adjacent operational Wilton I, Wilton II, and Baldwin Wind Energy Centers was also conducted. Tetra Tech performed the acoustic assessment, including analysis of expected future sound levels resulting from operation of all Project components, at existing potential noise-sensitive receptors (e.g., residential structures). The operational acoustic analysis was used to determine the feasibility of the Project to operate in compliance with the North Dakota PSC noise standards.

1.1 Project Area

The Wilton IV Project Area consists of approximately 32,134 acres (50.2 square miles). The Project Area is shown in Figure 1 and is located on privately owned lands in Burleigh County, 1.6 miles east of Regan, ND, 2.9 miles west of Wing, ND, and 13 miles east of Wilton, ND. The Project Boundary spans portions of seven townships including Canfield, Richmond, Ghylin, Rock Hill, Wing, Cromwell, and Trygg; however, there are no noise sensitive receptors identified within the Wing or Canfield townships. This region of North Dakota has topography that can be described as level to rolling plains with isolated sandstone buttes or badlands formations. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring and winter wheat, barley, sunflowers, corn, alfalfa, and interspersed with cattle grazing. Patches of trees and shrubs exist throughout the Project Area and are found primarily between agricultural fields, in drainages, and as shelter belts around homesteads.

Occupied and unoccupied structures are widely scattered throughout the Wilton IV Project Area. A total of 46 receptor locations were identified based on the receptor information dated March 6, 2014 provided by NextEra. Of these 46 receptors identified, only 34 are identified as occupied structures and 12 are unoccupied structures. Other infrastructure within the Project Area includes North Dakota Highway 36 and a railway running horizontally through the northeast portion of the Project Area. Figure 1 is a map of the Wilton IV Wind Energy Center Project Area, the locations of the proposed WTGs, noise-sensitive receptor locations, and the land status of the receptor locations incorporated in the acoustic assessment.

Figure 1. Project Layout

1.2 Existing Acoustic Environment

Northern Burleigh County would generally be considered a rural agricultural area. Existing ambient sound levels are expected to be relatively low, although sound levels may be sporadically elevated in localized areas due to roadway and railroad noise or periods of other human activity such as agricultural operations. Background sound levels vary both spatially and temporally depending on proximity to area sound sources such as roadways and natural sounds. Principal contributors to the existing acoustic environment include motor vehicle traffic, mobile farming equipment, farming activities such as plowing and irrigation, all-terrain vehicles, local roadways, railroad traffic, periodic aircraft flyovers, and natural sounds such as birds, insects, and leaf or vegetation rustle during elevated wind conditions in areas with established tree stands or established crops. Diurnal effects result in sound levels that are typically quieter during the night than during the daytime, except during periods when evening and nighttime insect noise may dominate 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 (µPa). 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 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 16 Hz (low) to 16,000 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 are 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.

An inherent property of the logarithmic decibel scale is that the sound pressure levels of two separate sources are not directly additive. For example, if a sound of 50 dBA is added to another sound of 50 dBA, the result is a 3-decibel increase (or 53 dBA), not an arithmetic doubling to 100 dBA. With respect to how the human ear perceives changes in sound pressure level relative to changes in “loudness”, scientific research demonstrates that the following general relationships hold between sound level and human perception for two sound levels with the same or very similar frequency characteristics:

- 1 dBA is the practical limit of accuracy for sound measurement systems and corresponds to an approximate 10 percent variation in the sound pressure level. A 1 dBA increase or decrease is a non-perceptible change in sound.

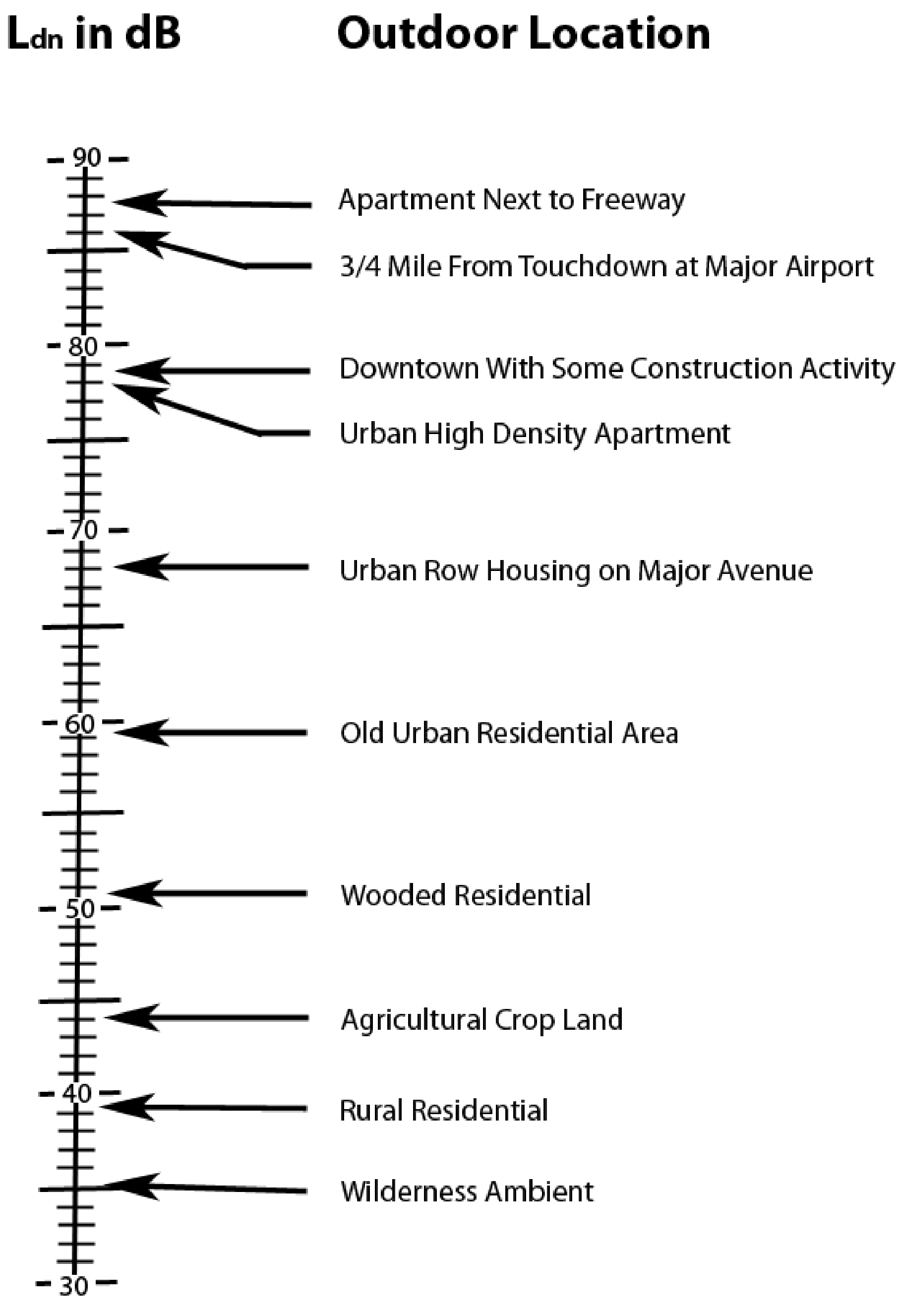
- 3 dBA increase or decrease is a doubling (or halving) of acoustic pressure level and it corresponds to the threshold of change in loudness perceptible in a laboratory environment. In practice, the average person is not able to distinguish a 3 dBA difference in environmental sound outdoors.

- 5 dBA increase or decrease is described as a perceptible change in sound level and is a discernible change in an outdoor environment.

- 10 dBA increase or decrease is a tenfold increase or decrease in acoustic pressure level but is perceived as a doubling or halving in loudness (i.e., the average person will judge a 10 dBA change in sound level to be twice or half as loud).

Sound can be measured, calculated, and presented in various formats, with a 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 environmental acoustic assessments. The L_{eq} is often further defined by the time period (T) it is measured over $L_{eq(T)}$, for instance L_{eq24} would indicate the equivalent sound level over a 24-hour period. Community sound levels are also often described in terms of the day-night averaged sound level (L_{dn}), which accounts for the increased potential for annoyance that comes with elevated sound levels at night. In addition, the maximum sound level (L_{max}) can be used to quantify the maximum instantaneous sound pressure level generated by a source. Estimates of noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented in Figure 2. Table 1 provides additional reference information on acoustic terminology.

Figure 2. Various Outdoor Sound Levels (L_{dn})



Notes:

μPa - Micropascals describe sound pressure levels (force/area).
dBA - A-weighted decibels describe sound pressure on a logarithmic scale referenced to 20 μPa.
Reference: USEPA, Protective Noise Levels. Condensed Version of EPA Levels Document. Publication EPA-550/9-79-100, November 1978.

Table 1. Acoustic Terms and Definitions

Term	Definition
Noise	Unwanted sound dependent on level, character, frequency or pitch, time of day, and sensitivity and perception of the listener. 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_P)	Pressure fluctuations in a medium. Sound pressure is measured in decibels referenced to 20 micropascals, the approximate threshold of human perception to sound at 1000 Hz.
Sound Power Level (L_W)	The total acoustic power of a noise source measured in decibels referenced to picowatts (one trillionth of a watt). Equipment 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.
Frequency (Hz)	The rate of oscillation of a sound, measured in units of Hertz (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. For comparative purposes, the lowest note on a full range piano is approximately 32 Hz and middle C is 261 Hz.
A-Weighted Decibel (dBA)	Environmental sound is typically composed of acoustic energy across all frequencies (Hz). 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.
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 Hertz and is typically divided into octave band center frequencies (Hz) ranging from 31 to 8,000 Hz.
Broadband Sound	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.
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.
Low Frequency Noise (LFN)	The frequency range of 20 to 200 Hz is typically defined as low frequency noise. Studies have shown that low frequency sound from modern wind turbines is generally below the threshold of human perception at standard setback distances.
Infrasound	The frequency range of infrasound is normally defined as below 20 Hz. Infrasound from wind turbines are significantly below recognized thresholds for both human perceptibility and standardized health.

Note: Compiled by Tetra Tech from multiple technical and engineering resources.

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 or local environmental noise requirements specific to this Project but at the state level, the North Dakota PSC has established standards applicable to wind energy facilities.

2.1 State of North Dakota Public Service Commission Noise Standards

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 standard is absolute and independent of the existing acoustic environment; therefore, a baseline sound survey is not required to assess conformity.

3.0 ACOUSTIC MODELING METHODOLOGY

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 GE1.79-100 WTG 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 conventional energy projects, 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 maximum rotational wind speed the assumed maximum sound power level will be reached, occurring at approximately 7 to 10 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 likely increase as well, resulting in acoustic masking effects. The net result is that during periods of elevated wind when higher WTG sound emissions occur, the sound produced from a WTG operating at maximum rotational speed may well 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, acoustic masking effects may be limited during periods of unusually high wind shear or at receiver locations that are particularly sheltered from prevailing winds.

3.1 Acoustic Modeling Software and Calculation Methods

The operational acoustic assessment was performed using the Project WTG layout dated July 28, 2014 consisting of 66 proposed WTG locations, eight of which are alternate WTG locations. The Project WTG model is the GE 1.79 MW-100 with a RD of 328 feet (100 meters) and hub height of 262.5 feet (80 meters). The Project also requires a collection substation to connect to the Central Electric Power Cooperative 230-kV transmission line and the Western Area Power Administration's transmission system. WTG sound source data were obtained from GE (GE 2013) and substation transformer sound source data were obtained from NextEra, dated July 11, 2014. It is expected that the sound power levels of the Project components 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.

The acoustic modeling analysis employed the most recent version of DataKustic GmbH's CadnaA, the computer-aided noise abatement program (v 4.4.145). 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 ignored.

Sound attenuation by the atmosphere is not strongly dependent on temperature and humidity; however, the temperature of 10^{o}Celsius (50^{o}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, such as commonly occurs at nighttime and during early morning hours, and wind gradients which can bend sound downwards, which may occur any time depending on weather conditions. Per ISO 9613-2, the effects of meteorological conditions on sound propagation are small for short distances, and also small for longer distances at greater source and receptor heights. Over extended distances when the influences of wind or temperature gradients are most prevalent, atmospheric effects may cause fluctuations in received sound levels, but will typically attenuate noise to levels below those predicted. Levels significantly above those predicted are defined as exceptional events under the ISO 9613-2 standard. Propagation for anomalous meteorological conditions are presented to show, that for comparatively short periods of time, received sound levels may be higher than the mean.

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. Table 2 presents a summary of sound power data during normal operations correlated to 10 meter height integer wind speeds with a stated roughness length of 0.05 meters, which is representative of level grass-covered terrain (GE 2013). The roughness length describes the vertical wind profile per IEC specification in a neutral atmosphere with the wind profile following a logarithmic curve.

The specification for the GE 1.79-100 WTG includes an expected warranty confidence interval of k=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 2. Broadband Sound Power Levels (dBA) Correlated with Wind Speed

10-meter AGL Wind Speed	**WTG L_{max} Sound Power Level (L_W) at Reference Wind Speed**							
	11.2 mph (5 m/s)	12.3 mph (5.5 m/s)	13.4 mph (6 m/s)	14.5 mph (6.5 m/s)	15.9 mph (7 m/s)	17.9 mph (8 m/s)	20.1 mph (9 m/s)	22.4 mph (10 m/s)
GE 1.79-100	98.6	101.0	103.2	105.5	107.2	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 the acoustic model development. A summary of sound power data for the GE 1.79-100 WTG by octave band center frequency are presented in Table 3 (1/1 octave band frequency data provided with stated intended use limited for informational purposes only).

Table 3. Sound Power Level by Octave Band Center Frequency

Frequency (Hz)	**Octave Band Sound Power Level (dB)**								**Broadband (dBA)**
	63	125	250	500	1000	2000	4000	8000	
GE 1.79-100	90.8	96.0	97.9	100.8	103.4	99.9	90.0	70.3	107.5

4.0 PROJECT OPERATING NOISE LEVELS

Operational received sound levels (dBA) were calculated assuming that all WTGs and the substation transformer are operating concurrently at the maximum manufacturer-rated sound level.

4.1 Results

Acoustic modeling for the Project layout was completed for WTG cut-in and maximum rotational operating conditions, thereby describing sound pressure levels over the entire operational range of the Project. In addition, sound energy contribution from the Project substation was included in the acoustic modeling analysis. Table 4 presents the results of the Wilton IV Wind Energy Center acoustic modeling analysis and includes the ID, status, Universal Transverse Mercator (UTM) coordinates, receptor status and the received sound levels at each receptor. The receptor status is based on the Farmstead Report provided by NextEra on August 1, 2014.

Sound contour plots displaying Project operational sound levels in color-coded isopleths are provided in Figures 3 through 5 and are rounded to the nearest whole decimal for consistency with the State of North Dakota noise limit absolute value of 50 dBA. Therefore, the range of "45 – 50 dBA" includes values up to 50.0 and the range of ">50 dBA" includes all values over 50.0. The tabulated results and contour plots are independent of the existing acoustic environment and are representative of expected Project sound levels only. Figure 3 is a map of the operational sound levels under low-level wind speeds sufficient for the WTGs to operate at initial cut-in rotational speeds. Figure 4 is a map of the operational sound levels at wind speeds sufficient to sustain WTG operation at maximum rotational speeds for moderate downwind propagation. Figure 5 is a map of the operational sound levels at wind speeds sufficient to sustain WTG operation at maximum rotational speeds under anomalous meteorological conditions. A 100-foot buffer was included around the receptors, corresponding to the point of compliance identified in the PSC noise standard.

Table 4. Summary of Acoustic Modeling Results

Receptor ID	Receptor Status*	UTM Coordinates (m)		Received Sound Levels (dBA L_{eq})**		
		Easting (X)	Northing (Y)	Cut-in Wind Speed	Maximum Wind Speed	Anomalous Meteorological Conditions
610031	Unoccupied	389212	5217228	42.6	51.5	52.0
6003	Occupied*	388428	5218681	40.0	48.8	49.6
530133	Occupied	386633	5219482	40.2	48.3	49.4
610173	Occupied*	394482	5222622	40.0	48.9	49.2
610075	Unoccupied	387358	5221173	40.4	46.6	48.3
610024	Unoccupied*	388298	5217306	38.4	47.3	48.3
530105	Occupied	383345	5217711	38.5	47.4	48.0
530093	Unoccupied	383270	5217511	37.6	46.5	47.3
540139	Occupied	394590	5221990	37.5	46.4	47.1
530107	Occupied*	384110	5218969	37.2	46.0	47.0
530141	Occupied	386513	5218237	36.3	45.1	46.8
530173	Occupied*	385063	5217268	35.8	44.6	46.4
610424	Unoccupied*	385003	5217307	36.0	44.9	46.4

Table 4. Summary of Acoustic Modeling Results

Receptor ID	Receptor Status*	UTM Coordinates (m)		Received Sound Levels (dBA L_{eq})**		
		Easting (X)	Northing (Y)	Cut-in Wind Speed	Maximum Wind Speed	Anomalous Meteorological Conditions
530121	Occupied*	386637	5220374	36.9	42.6	45.7
610010	Occupied*	387929	5217074	34.6	43.4	45.5
610113	Occupied*	394482	5221250	35.3	44.2	45.3
610084	Occupied*	391245	5219577	34.6	43.4	45.2
530160	Occupied*	386944	5216909	33.6	42.5	44.8
6001	Occupied*	397123	5225096	34.7	43.6	44.6
6000	Occupied	397461	5225086	34.3	43.2	44.1
530117	Occupied	383241	5219439	32.8	41.7	43.9
530040	Occupied*	381894	5217518	33.1	42.0	43.6
530062	Occupied*	383364	5216276	32.2	41.1	42.5
540127	Occupied*	389725	5222595	30.5	39.2	42.1
610340	Occupied*	388148	5214284	30.5	39.3	42.1
6012	Occupied	390291	5217195	30.6	39.4	42.0
6006	Unoccupied*	391342	5222050	29.7	38.5	41.5
530036	Unoccupied*	381502	5217191	29.6	38.5	41.2
610221	Unoccupied	386210	5222113	29.5	37.3	40.8
610219	Unoccupied	386190	5222151	29.4	37.3	40.7
530020	Occupied	380646	5217791	28.9	37.8	40.2
6007	Occupied	386732	5222971	28.3	36.5	40.0
530076	Occupied*	384588	5214106	28.1	36.9	40.0
6008	Occupied	386723	5212548	28.7	37.6	40.0
540110	Occupied*	392363	5223481	28.0	36.8	39.7
6005	Unoccupied	393969	5219077	27.2	36.0	39.6
610416	Unoccupied	390710	5215947	27.4	36.2	39.5
610314	Occupied*	387773	5213084	27.7	36.6	39.3
610310	Occupied*	387887	5213068	26.8	35.7	38.6
6004	Occupied	385613	5221925	26.9	34.4	38.1
6002	Unoccupied*	384640	5212570	25.5	34.4	37.7
540151	Occupied	398442	5228176	24.7	33.6	36.7
610386	Occupied	389374	5212240	22.2	31.1	35.2
6011	Occupied	391510	5213971	21.4	30.2	34.3
6009	Occupied	387776	5210601	19.6	28.5	32.6
6010	Occupied	387884	5210414	17.9	26.8	30.9

* = Project participants
** = Modeling results are presented to one decimal place for comparative purposes only.

The acoustic modeling results demonstrate that received sound levels are all below the 50 dBA State noise standard at occupied receptors. One unoccupied receptor location (Receptor ID 610031) may potentially exceed the State noise limit at maximum rotational wind speed under moderate downwind and anomalous meteorological conditions; however, since this receptor was identified as unoccupied, it would not be considered noise-sensitive and the Project would be in compliance with the State noise standard.

Figure 3. Received Sound Levels - Wind Turbines at Cut-in Rotational Wind Speed

Figure 4. Received Sound Levels - Wind Turbines at Maximum Rotational Wind Speed

Figure 5. Received Sound Levels - Wind Turbines at Maximum Rotational Wind Speed, Anomalous Meteorological Conditions

5.0 OTHER SOUND CONSIDERATIONS

5.1 Cumulative Wind Energy Effects

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 Wilton I, II, and Baldwin Wind Energy Centers, adjacent to and generally north-northwest of the Wilton IV Project Area. The Wilton I, II, and Baldwin Wind Energy Centers have are currently generating electricity and consist of a total of 130 WTGs:

- **Wilton I Wind Energy Center**: 33 GE 1.5 MW sle WTGs; hub height 80 m (262.5 ft), rotor diameter of 77 m (253 feet), and total nameplate capacity of 49.5 MW;
- **Wilton II Wind Energy Center**: 33 GE 1.5 xle MW WTGs; hub height 80 m (262.5 ft), rotor diameter of 82.5 m (270 feet), and total nameplate capacity of 49.5 MW; and
- **Baldwin Wind Energy Center**: 64 GE 1.6 xle MW WTGs; hub height 80 m (262.5 ft), rotor diameter of 82.5 m (270 feet), and total nameplate capacity of 102.4 MW.

Table 5 provides a summary of sound power data for the GE 1.5 MW sle WTG (GE 2004) used for Wilton I correlated by wind speed at a height of 10 meters (32.8 ft). A confidence interval of k=2 dB was incorporated into the acoustic modeling analysis per the manufacturer specification.

Table 5. GE1.5 MW sle Broadband Sound Power Levels (dBA) Correlated with Wind Speed

	WTG L_{max} Sound Power Level (L_W) at Reference Wind Speed						
10-meter AGL Wind Speed	9 mph (4 m/s)	11.2 mph (5 m/s)	13.4 mph (6 m/s)	15.9 mph (7 m/s)	17.9 mph (8 m/s)	20.1 mph (9 m/s)	22.4 mph (10 m/s)
GE 1.5 MW sle	<96	99.1	103	<104.0	<104.0	<104.0	<104.0

A summary of sound power data for the GE 1.5 MW sle by octave band center frequency is presented in Table 6.

Table 6. GE 1.5 MW sle Sound Power Level by Octave Band Center Frequency

	Octave Band Sound Power Level (dBA)								Broadband (dBA)
Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	
GE 1.5 MW sle	85.1	94	97.2	98.6	97.9	94.5	87.3	78.1	104.0

Table 7 provides a summary of sound power data for the GE 1.5 MW xle WTG (GE 2009) used for Wilton II correlated by wind speed at a height of 10 meters (32.8 ft). A confidence interval of k=2 dB was incorporated into the acoustic modeling analysis per the manufacturer specification.

Table 7. GE1.5 MW xle Broadband Sound Power Levels (dBA) Correlated with Wind Speed

	WTG L_{max} Sound Power Level (L_W) at Reference Wind Speed						
10-meter AGL Wind Speed	9 mph (4 m/s)	11.2 mph (5 m/s)	13.4 mph (6 m/s)	15.9 mph (7 m/s)	17.9 mph (8 m/s)	20.1 mph (9 m/s)	22.4 mph (10 m/s)
GE 1.5 MW xle	<96	<96	98.8	102.3	<104.0	<104.0	<104.0

A summary of sound power data for the GE 1.5 MW xle by octave band center frequency is presented in Table 8.

Table 8. GE 1.5 MW xle Sound Power Level by Octave Band Center Frequency

	Octave Band Sound Power Level (dBA)								Broadband
Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	**(dBA)**
GE 1.5 MW xle	83.4	92.2	97.8	99.4	97.7	93.4	86.6	84.8	104.0

Table 9 provides a summary of sound power data for the GE 1.6 MW xle WTG (GE 2009) used for Baldwin correlated by wind speed at a height of 10 meters (32.8 ft). A confidence interval of k=2 dB was incorporated into the acoustic modeling analysis per the manufacturer specification.

Table 9. GE 1.6 MW xle Broadband Sound Power Levels (dBA) Correlated with Wind Speed

	WTG L_{max} Sound Power Level (L_W) at Reference Wind Speed						
10-meter AGL Wind Speed	9 mph (4 m/s)	11.2 mph (5 m/s)	13.4 mph (6 m/s)	15.9 mph (7 m/s)	17.9 mph (8 m/s)	20.1 mph (9 m/s)	22.4 mph (10 m/s)
GE 1.6 MW xle	<96	<96	<99	<102	<104	≤106	≤106

A summary of sound power data for the GE 1.6 MW xle by octave band center frequency is presented in Table 10.

Table 10. GE 1.6 MW xle Sound Power Level by Octave Band Center Frequency

	Octave Band Sound Power Level (dB)								Broadband
Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	**(dBA)**
GE 1.6 MW xle	84.8	93.6	99.2	100.8	100.1	97.3	89.1	86.2	106.0

The existing Wilton I, II, Baldwin, and proposed Wilton IV wind energy projects would sometimes operate concurrently; therefore a cumulative wind energy noise impact assessment was completed.

Cumulative effects were assessed for all WTGs in conjunction with operation of four on-site substations servicing each of the facilities.

Acoustic modeling for all four projects was completed for concurrent WTG cut-in and maximum rotational operating conditions. Table 11 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 NextEra. Sound contour plots displaying Project operational sound levels in color-coded isopleths are provided in Figures 6 through 8 and are also rounded to the nearest whole decimal for consistency with the State of North Dakota noise limit absolute value of 50 dBA. Furthermore, Figures 6 through 8 are presented at two figures (e.g., Figures 6a and 6b), to more easily display the western and eastern portions of the project areas. 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.

Table 11. Summary of Acoustic Modeling Results

Receptor ID	Receptor Status*	UTM Coordinates (m)		Received Sound Levels (dBA)**		
		Easting (X)	Northing (Y)	Cut-in Wind Speed	Maximum Wind Speed	Anomalous Meteorological Conditions
2027	Unoccupied*	369737	5218420	47.8	55.8	56.2
610031	Unoccupied	389212	5217228	42.6	51.5	52.0
2025a	Unoccupied*	370431	5218318	42.6	49.6	51.0
41014a	Unoccupied	368950	5226845	40.4	50.2	50.4
41013a	Unoccupied	368951	5226825	40.2	50.0	50.2
2050	Unoccupied	368883	5216631	39.9	49.6	50.0
6003	Occupied*	388428	5218681	40.0	48.8	49.6
530133	Occupied	386633	5219482	40.2	48.3	49.4
610173	Occupied*	394482	5222622	40.0	48.9	49.2
2020	Unoccupied	369311	5219083	41.1	47.3	49.2
2024	Occupied*	369232	5219059	40.9	47.4	49.1
530136	Occupied*	386712	5219476	39.8	48.0	49.0
530138	Occupied*	386729	5219476	39.8	47.9	49.0
40039	Occupied	373837	5227612	37.9	47.9	48.4
610075	Unoccupied	387358	5221173	40.4	46.6	48.3
610024	Unoccupied*	388298	5217306	38.4	47.3	48.3
530106	Occupied*	383443	5217713	38.7	47.6	48.2
530101	Occupied*	383431	5217704	38.6	47.5	48.2
40074a	Unoccupied*	370668	5225623	37.6	47.5	48.2
530105	Occupied	383345	5217711	38.6	47.4	48.1
40069	Occupied	372228	5226802	37.3	47.2	47.9
40070a	Unoccupied*	372259	5227439	37.3	47.3	47.9
40134a	Unoccupied	371186	5223960	37.4	47.1	47.9

Table 11. Summary of Acoustic Modeling Results

Receptor ID	Receptor Status*	UTM Coordinates (m)		Received Sound Levels (dBA)**		
		Easting (X)	Northing (Y)	Cut-in Wind Speed	Maximum Wind Speed	Anomalous Meteorological Conditions
2019	Occupied*	367510	5219031	38.8	46.7	47.8
2063	Occupied	372614	5220687	38.6	46.2	47.7
40135	Occupied	371067	5223960	37.1	46.8	47.7
2014	Unoccupied*	379983	5218952	39.3	47.1	47.5
40066	Occupied	372315	5225695	36.8	46.6	47.5
2028	Unoccupied*	371097	5217187	37.3	46.0	47.5
2018	Occupied*	368373	5219341	38.4	45.7	47.5
2063	Occupied	373529	5211684	38.3	45.9	47.5
530093	Unoccupied	383270	5217511	37.7	46.6	47.5
530107	Occupied*	384110	5218969	37.4	46.2	47.2
530154	Occupied	386459	5218300	37.0	45.7	47.2
390002	Occupied	372431	5226918	36.3	46.2	47.1
6100a	Occupied	372687	5220626	37.8	45.4	47.1
540139	Occupied	394590	5221990	37.5	46.4	47.1
530156	Occupied	386441	5218203	36.6	45.4	47.0
530152	Unoccupied*	386517	5218266	36.5	45.3	46.9
530148	Occupied*	386530	5218264	36.5	45.2	46.9
530145	Occupied*	386543	5218265	36.5	45.2	46.8
2047	Occupied*	370195	5216578	36.4	45.3	46.8
530114	Occupied*	384101	5219042	36.7	45.5	46.8
530141	Occupied	386513	5218237	36.3	45.1	46.8
40112	Occupied	371312	5222602	36.6	45.6	46.8
2045	Occupied*	370218	5216534	36.0	45.0	46.6
530183	Occupied	385152	5217332	36.1	45.0	46.6
530179	Occupied	385119	5217313	36.0	44.9	46.6
530175	Occupied	385108	5217318	36.0	44.9	46.5
2016	Occupied*	372755	5218312	36.1	44.6	46.5
530167	Occupied	385135	5217281	35.9	44.8	46.5
40125a	Unoccupied	372393	5227947	35.7	45.7	46.5
530173	Occupied*	385063	5217268	35.8	44.7	46.4
610424	Unoccupied*	385003	5217307	36.0	44.9	46.4
530170	Occupied	385142	5217255	35.8	44.6	46.4
2013	Occupied*	380100	5218948	37.7	45.8	46.3
40342	Occupied	370909	5226405	35.0	44.8	46.0
530120	Occupied*	383255	5219446	36.3	44.7	46.0
2011	Occupied*	383232	5219483	36.4	44.8	45.9
530117	Occupied	383241	5219439	36.3	44.7	45.9
530125	Occupied*	386702	5220354	37.3	42.9	45.9

Table 11. Summary of Acoustic Modeling Results

Receptor ID	Receptor Status*	UTM Coordinates (m)		Received Sound Levels (dBA)**		
		Easting (X)	Northing (Y)	Cut-in Wind Speed	Maximum Wind Speed	Anomalous Meteorological Conditions
40097	Occupied	368972	5227351	35.3	45.2	45.8
530121	Occupied*	386637	5220374	36.9	42.7	45.7
40060	Occupied	372120	5223886	34.9	44.4	45.7
530129	Occupied*	386654	5220336	36.9	42.7	45.7
610010	Occupied*	387929	5217074	34.6	43.5	45.5
40037a	Unoccupied*	373984	5228148	34.7	44.7	45.5
6099	Occupied	366688	5218078	35.6	44.0	45.5
40063a	Unoccupied*	372312	5224843	34.0	43.7	45.4
40089	Occupied	367924	5226018	35.0	44.8	45.4
610113	Occupied*	394482	5221250	35.3	44.2	45.3
40086	Occupied	368967	5226144	34.6	44.4	45.2
2036	Occupied*	372317	5216000	34.1	43.2	45.2
610084	Occupied*	391245	5219577	34.6	43.4	45.2
40093a	Occupied*	367907	5226008	34.6	44.5	45.1
6096	Occupied	366619	5217768	34.7	43.5	45.0
40076a	Unoccupied*	370151	5225694	33.6	43.3	45.0
40055a	Unoccupied*	372334	5224178	33.8	43.3	44.9
40077	Occupied	370102	5225602	33.7	43.4	44.9
530160	Occupied*	386944	5216909	33.7	42.5	44.9
530164	Occupied	386967	5216938	33.6	42.5	44.8
40139a	Unoccupied	369726	5224097	33.5	42.8	44.6
6001	Occupied*	397123	5225096	34.7	43.6	44.6
2062	Occupied	372289	5222275	33.9	41.9	44.5
60016	Occupied	372159	5214610	33.7	43.3	44.5
40033	Occupied	373882	5225842	33.0	42.7	44.4
530049	Unoccupied*	381954	5217605	34.1	43.0	44.3
530048	Unoccupied*	381980	5217604	34.2	43.0	44.3
530053	Unoccupied*	381934	5217608	34.1	42.9	44.3
6000	Occupied	397461	5225086	34.3	43.2	44.1
40028a	Unoccupied*	375368	5229059	33.5	43.5	44.1
530055	Unoccupied*	381903	5217610	33.9	42.7	44.1
530044	Occupied	381955	5217498	33.5	42.3	44.0
530040	Occupied*	381894	5217518	33.5	42.3	44.0
40081	Occupied	369701	5225578	32.1	41.7	44.0
530059	Occupied*	381901	5217584	33.7	42.5	44.0
2058	Occupied*	375404	5220251	34.0	41.8	43.9
2041	Occupied*	371025	5215602	32.6	41.5	43.8
2060a	Unoccupied*	368839	5215450	32.4	41.3	43.3

Table 11. Summary of Acoustic Modeling Results

Receptor ID	Receptor Status*	UTM Coordinates (m)		Received Sound Levels (dBA)**		
		Easting (X)	Northing (Y)	Cut-in Wind Speed	Maximum Wind Speed	Anomalous Meteorological Conditions
40116a	Unoccupied	372859	5222443	32.2	40.1	43.3
530073	Occupied*	383476	5216269	32.7	41.6	43.2
2020w	Occupied*	365973	5217765	32.3	40.6	43.0
2053	Occupied*	367280	5216355	31.8	40.6	43.0
530062	Occupied*	383364	5216276	32.3	41.2	42.7
40130a	Unoccupied	375933	5228266	31.5	41.5	42.7
2061	Occupied*	373618	5222265	31.4	39.2	42.5
530070	Occupied*	383458	5216176	31.7	40.6	42.4
530067	Occupied*	383410	5216196	31.8	40.6	42.4
2030	Unoccupied*	374516	5216892	30.6	39.2	42.3
40120	Occupied	373474	5222500	31.0	38.8	42.3
2057	Occupied*	375513	5220742	31.5	39.2	42.2
540127	Occupied*	389725	5222595	30.5	39.2	42.1
610340	Occupied*	388148	5214284	30.5	39.3	42.1
530023	Occupied	380703	5217814	30.8	39.4	42.0
6012	Occupied	390291	5217195	30.6	39.4	42.0
530028	Occupied	380723	5217783	30.7	39.4	42.0
530020	Occupied	380646	5217791	30.6	39.2	41.9
530036	Unoccupied*	381502	5217191	30.2	39.0	41.8
2064	Occupied	366589	5221003	31.1	38.4	41.7
530029	Occupied	380656	5217756	30.4	39.0	41.7
2012	Unoccupied*	380630	5217738	30.3	38.9	41.7
40336a	Unoccupied	373387	5228862	28.7	38.7	41.6
2060	Occupied*	374367	5222200	30.5	38.1	41.5
6006	Unoccupied*	391342	5222050	29.7	38.5	41.5
40343	Occupied	370818	5228021	29.0	39.0	41.5
40142	Occupied	367963	5222567	32.0	37.6	41.5
2059	Occupied*	374606	5221973	30.6	38.2	41.5
530033	Occupied	380645	5217720	30.0	38.7	41.4
2065	Occupied	366333	5220865	30.6	37.9	41.3
2057a	Unoccupied*	367248	5215913	29.7	38.1	41.2
2066a	Unoccupied*	365765	5216992	29.9	38.3	41.1
2066	Occupied	366175	5220821	30.2	37.5	41.0
40128	Occupied	372293	5228874	28.3	38.2	41.0
40049	Occupied	373825	5224083	28.6	37.2	41.0
40031	Occupied	375434	5226226	28.0	37.9	40.9
610221	Unoccupied	386210	5222113	29.6	37.4	40.9
610219	Unoccupied	386190	5222151	29.5	37.4	40.8

Table 11. Summary of Acoustic Modeling Results

Receptor ID	Receptor Status*	UTM Coordinates (m)		Received Sound Levels (dBA)**		
		Easting (X)	Northing (Y)	Cut-in Wind Speed	Maximum Wind Speed	Anomalous Meteorological Conditions
40051	Occupied	373899	5223691	28.7	37.0	40.8
40140a	Unoccupied	368909	5223606	29.0	37.1	40.6
40124	Occupied	374934	5222439	28.8	36.4	40.2
530080	Occupied*	384604	5214158	28.1	37.0	40.1
6007	Occupied	386732	5222971	28.4	36.6	40.1
530083	Occupied*	384590	5214155	28.1	37.0	40.1
60010	Occupied	372930	5213255	28.2	37.4	40.0
530085	Occupied*	384572	5214136	28.0	36.9	40.0
530076	Occupied*	384588	5214106	28.1	36.9	40.0
6008	Occupied	386723	5212548	28.7	37.6	40.0
530087	Occupied*	384573	5214100	28.0	36.9	39.9
530090	Occupied*	384573	5214091	28.0	36.9	39.9
2068	Occupied	364110	5219367	30.7	37.2	39.9
2015	Occupied*	376198	5217497	28.7	36.5	39.9
540110	Occupied*	392363	5223481	28.0	36.8	39.7
40105a	Occupied	367270	5227370	27.3	37.2	39.6
6005	Unoccupied	393969	5219077	27.2	36.0	39.6
610416	Unoccupied	390710	5215947	27.4	36.2	39.5
2067	Occupied	366079	5220821	29.1	36.1	39.5
40021a	Unoccupied*	376428	5227682	26.6	36.6	39.4
610314	Occupied*	387773	5213084	27.7	36.6	39.3
530003	Occupied	380700	5216823	27.1	35.8	39.3
40149a	Unoccupied	367475	5223178	28.0	35.3	39.3
53007	Occupied	380724	5216793	27.1	35.7	39.3
2056	Occupied*	375960	5222198	27.6	35.2	39.2
530014	Occupied	380655	5216754	26.9	35.5	39.2
530010	Occupied	380677	5216753	26.8	35.5	39.1
5000000	Occupied	378668	5221147	27.2	35.5	38.9
60002	Occupied	375153	5214163	26.8	35.7	38.8
40100	Occupied	367556	5227926	26.0	36.0	38.7
40018a	Unoccupied*	375524	5224880	26.0	34.8	38.7
610310	Occupied*	387887	5213068	26.8	35.7	38.6
2055	Occupied*	376380	5222201	26.9	34.5	38.5
2053e	Unoccupied*	379196	5221219	26.6	34.9	38.5
2054	Occupied*	376457	5222208	26.7	34.3	38.3
6004	Occupied	385613	5221925	27.0	34.5	38.2
40011a	Unoccupied*	375671	5223949	25.9	34.0	38.1
40196	Occupied	365654	5221719	27.2	34.1	38.1

Table 11. Summary of Acoustic Modeling Results

Receptor ID	Receptor Status*	UTM Coordinates (m)		Received Sound Levels (dBA)**		
		Easting (X)	Northing (Y)	Cut-in Wind Speed	Maximum Wind Speed	Anomalous Meteorological Conditions
40198	Occupied	365596	5221731	27.1	34.1	38.1
40025	Occupied	375732	5229916	24.8	34.7	37.8
2052	Occupied*	378705	5221297	25.9	34.2	37.7
6002	Unoccupied*	384640	5212570	25.5	34.4	37.7
40044	Occupied	375953	5224137	25.4	33.5	37.7
40099	Occupied	367401	5228151	24.6	34.5	37.6
2051	Occupied*	378621	5221835	25.1	33.4	37.3
40193	Occupied	365836	5222281	26.4	33.2	37.2
60012	Occupied	371907	5212797	25.2	33.6	37.2
40155a	Unoccupied	366297	5223595	25.5	32.6	36.8
540151	Occupied	398442	5228176	24.7	33.6	36.7
60005	Occupied	372854	5212708	24.7	33.2	36.5
40001a	Unoccupied*	376933	5223953	23.4	31.9	36.2
40323	Occupied	365791	5225833	26.6	31.9	36.1
40152a	Unoccupied	365746	5223799	24.2	31.0	35.3
610386	Occupied	389374	5212240	22.2	31.1	35.2
40324	Occupied	365832	5226445	21.4	31.0	34.9
60018	Occupied	371925	5212263	23.0	30.9	34.7
40326	Occupied	365834	5226625	21.0	30.7	34.5
6011	Occupied	391510	5213971	21.4	30.2	34.3
60080	Occupied*	369521	5212432	22.7	29.9	34.1
40107a	Occupied	365871	5224958	22.6	29.8	33.9
40110b	Occupied	366065	5224523	22.8	29.6	33.7
60076	Occupied*	376259	5212642	19.3	28.8	32.9
6009	Occupied	387776	5210601	19.6	28.5	32.6
60020	Occupied*	372273	5211194	18.4	28.3	32.4
60083	Occupied	368784	5212014	21.2	27.8	32.2
390019	Occupied	369543	5212867	22.1	27.7	31.9
390019	Occupied	369543	5212867	22.1	27.7	31.9
40333a	Unoccupied	365619	5228487	17.7	27.7	31.7
60070	Occupied*	376194	5212140	17.8	27.3	31.5
60085	Occupied	368667	5211618	20.3	26.5	30.9
6010	Occupied	387884	5210414	17.9	26.8	30.9
40329	Occupied	364837	5227355	16.7	26.6	30.7
60090	Occupied	368701	5211608	19.9	25.7	30.1
60092	Occupied	368592	5211213	15.6	25.4	29.7
60066	Occupied*	375965	5211018	13.7	23.7	27.9
60062	Occupied*	376003	5210859	13.4	23.4	27.6

Table 11. Summary of Acoustic Modeling Results

Receptor ID	Receptor Status*	UTM Coordinates (m)		Received Sound Levels (dBA)**		
		Easting (X)	Northing (Y)	Cut-in Wind Speed	Maximum Wind Speed	Anomalous Meteorological Conditions
60065	Occupied*	375996	5211041	13.4	23.4	27.6
60058	Occupied*	376239	5210903	13.0	23.0	27.3
60052	Occupied*	376701	5210591	11.9	21.9	26.2
60024	Occupied*	372285	5209130	11.8	21.8	26.1
60027	Occupied*	373830	5209328	11.8	21.8	26.1
60028	Occupied*	374001	5209320	11.7	21.7	26.1
60028	Occupied*	374001	5209320	11.7	21.7	26.1
60048	Occupied*	376427	5210435	11.7	21.7	25.9
60035	Occupied*	374298	5209331	11.5	21.5	25.8
60040	Occupied*	375109	5209360	10.8	20.8	25.2
60054	Occupied*	376545	5211062	10.5	20.5	24.8
60042	Occupied*	375350	5209336	9.7	19.7	24.1
60044	Occupied*	375800	5209460	8.8	18.8	23.1

***** = Project participants
** = Modeling results are presented to one decimal place for comparative purposes only.

Results presented in Table 11 indicate that received sound levels at receptors are all below the 50 dBA. State noise standard at occupied receptor locations. Three unoccupied receptor locations (Receptor IDs 2027, 610031, and 41014a) may potentially exceed the limit at maximum rotational wind speed under moderate downwind meteorological conditions and an additional three receptor locations (Receptor IDs 2025a, 41013a, and 2050) potentially exceed the limit at maximum rotational wind speed under anomalous meteorological conditions. However, since all three of these receptors have been identified as unoccupied, they would not be considered noise-sensitive and the Project would be in compliance with the State noise standard.

Figure 6a. Cumulative Effects - Received Sound Levels: Wind Turbines at Cut-In Rotational Wind Speed, West

Figure 6b. Cumulative Effects - Received Sound Levels: Wind Turbines at Cut-In Rotational Wind Speed, East

Figure 7a. Cumulative Effects - Received Sound Levels: Wind Turbines at Maximum Rotational Wind Speed, West

Figure 7b. Cumulative Effects - Received Sound Levels: Wind Turbines at Maximum Rotational Wind Speed, East

Figure 8a. Cumulative Effects - Received Sound Levels: Wind Turbines at Maximum Rotational Wind Speed, Anomalous Meteorological Conditions, West

Figure 8b. Cumulative Effects - Received Sound Levels: Wind Turbines at Maximum Rotational Wind Speed, Anomalous Meteorological Conditions, East

5.2 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 Wilton IV electrical substation and as-built substations servicing the Wilton I, II, and Baldwin Wind Energy Centers were modeled using the latest version of CadnaA implementing ISO 9613-2. The Wilton I, II, and Baldwin substations are located adjacent to one another in the northwest section of the Project Area. The existing Wilton I and II substations are located at the northwest corner of 279th Avenue NE and 52nd Street NE. The existing Baldwin substation is located in close proximity to the Wilton I and II substations, immediately south of 279th Avenue NE. The Wilton IV substation will be located within the center portion of the refined Wilton IV project boundary. Transformer sound source levels for the Wilton IV substation were provided by NextEra, based on a 110 MVA rating. The existing substation transformer sound source levels were estimated using a NEMA sound rating of 83 dBA. Table 12 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 12. Transformer Sound Power Level

	Octave Band Sound Power Level (dB)								Broadband
Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	(dBA)
Wilton I, II, Baldwin (NEMA 83)	94.2	96.2	91.2	91.2	85.2	80.2	75.2	68.2	100.2
Wilton IV (MVA 110)	68.6	80.6	83.1	88.5	85.8	82.0	76.7	67.6	92.1

Substations with transformer sizes of 10 to 150 MVA can present a noise concern if the separation distance is less than a few hundred feet between the transformer and noise-sensitive receptors. However, the proposed Wilton IV transformer location is approximately 700 m (2,297 feet) or ten times the stated distance. That being said, transformer noise may be periodically audible at nearby receptors on occasions when background sound levels are very low.

5.3 Construction Noise

The development of Wilton IV 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 Wilton IV 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. *Excavation*: This phase would begin with the excavation 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. *Wind Turbine 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 13.

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.

Table 13. Estimated L_{max} 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

Data compiled in part from the following sources:

Federal Highway Administration, “Roadway Construction Noise Model User’s Guide,” Report FHWA-HEP-05-054 / DOT-VNTSC-FHWA-05-01, January 2006.

Power Plant Construction Noise Guide, Bolt Beranek and Newman, Inc. 1977.

Federal Highway Administration, “Procedures for Abatement of Highway Traffic Noise and Construction Noise.” Code of Federal Regulations, Title 23, Part 772, 1992.

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.

6.0 CONCLUSIONS

Project operational sound has been calculated and compared to the 50 dBA North Dakota PSC noise standard. Acoustic modeling analysis per ISO 9613-2 and inclusive of a number of conservative assumptions under both cumulative and non-cumulative normal operational conditions, demonstrates the Project will not generate exceedances of the PSC noise standard at any occupied receptor locations. Therefore, the Project is not expected to present an adverse noise impact with respect to public welfare, health and safety. In addition, 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 similar criteria.

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. Furthermore, individual response to low-level WTG sound is largely subjective and therefore not easily predictable and may depend on several technical and non-technical factors such as predetermined perceptions of the Project and wind energy in general, individual and community economic incentives, existing background sound levels, and the proximity of the listener to a single or grouping of WTGs. Due to their support of Project development, Project participants have been found to be less likely to become concerned about low-level WTG sound than non-participants. Non-participants that consider the development of renewable energy sources, and wind energy projects specifically, as beneficial will also be more likely to deem the low-level environmental noise as generally acceptable. Nonetheless, complaints about noise from wind energy projects may occur, even when fixed standards or limits relative to existing ambient conditions are proposed and met. Inaudibility under all operating conditions is an unrealistic expectation, and one that is not required under any other industrial, commercial, or agricultural activity in the state of North Dakota.

7.0 TECHNICAL REFERENCES

Burleigh County Farmstead Location Report, Swenson, Hagen & Co P.C, August 4, 2010.

Bolt, Beranek and Newman, Inc., Power Plant Construction Noise Guide, prepared for the Empire State Electric Energy Research Corporation, Report No. 3321, 1977.

David Bies, Collin Hansen. "Engineering Noise Control: Theory and Practice", Pages 554-555, Published by Taylor & Francis, 2003.

DataKustik GmbH. 2014. Computer-Aided Noise Abatement Model CadnaA, Version 4.4.145 Munich, Germany.

Elliott, T. et al. Standard handbook of power plant engineering. McGraw-Hill: 1998, New York.

Federal Highway Administration, FHWA Roadway Construction Noise Model User's Guide, FHWA-HEP-05-054, January 2006.

Federal Highway Administration, "Procedures for Abatement of Highway Traffic Noise and Construction Noise". Code of Federal Regulations, Title 23, Part 772, 1992.

IEC (International Electromechanical Commission). 61400-11:2002(E) Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques, Second Edition 2002-12.

ISO (International Organization for Standardization). 1989. Standard ISO 9613-2 Acoustics – Attenuation of Sound During Propagation Outdoors. Part 2 General Method of Calculation. Geneva, Switzerland.

Rogers, Anthony, James Manwell, Sally Wright. 2006. "Wind Turbine Noise – A White Paper," Renewable Energy Research Laboratory, University of Massachusetts at Amherst, June 2002, Amended January 2006.

Technical Documentation: Wind Turbine Generator Systems GE 1.5 sle – 50Hz and 60Hz, Noise emission characteristics Normal operation according to IEC, GE Wind Energy GmbH, 2004.

Technical Documentation: Wind Turbine Generator Systems GE 1.5 xle – 50Hz and 60Hz, Noise emission characteristics Normal operation according to IEC, GE Wind Energy GmbH, 2007.

Technical Documentation: Wind Turbine Generator Systems GE 1.6-100 – 50Hz and 60Hz, Noise emission characteristics Normal operation according to IEC, GE Wind Energy GmbH, 2011.

Technical Documentation: Wind Turbine Generator Systems GE 1.79-100 – 50Hz and 60Hz, Noise emission characteristics Normal operation according to IEC, GE Wind Energy GmbH, 2013.

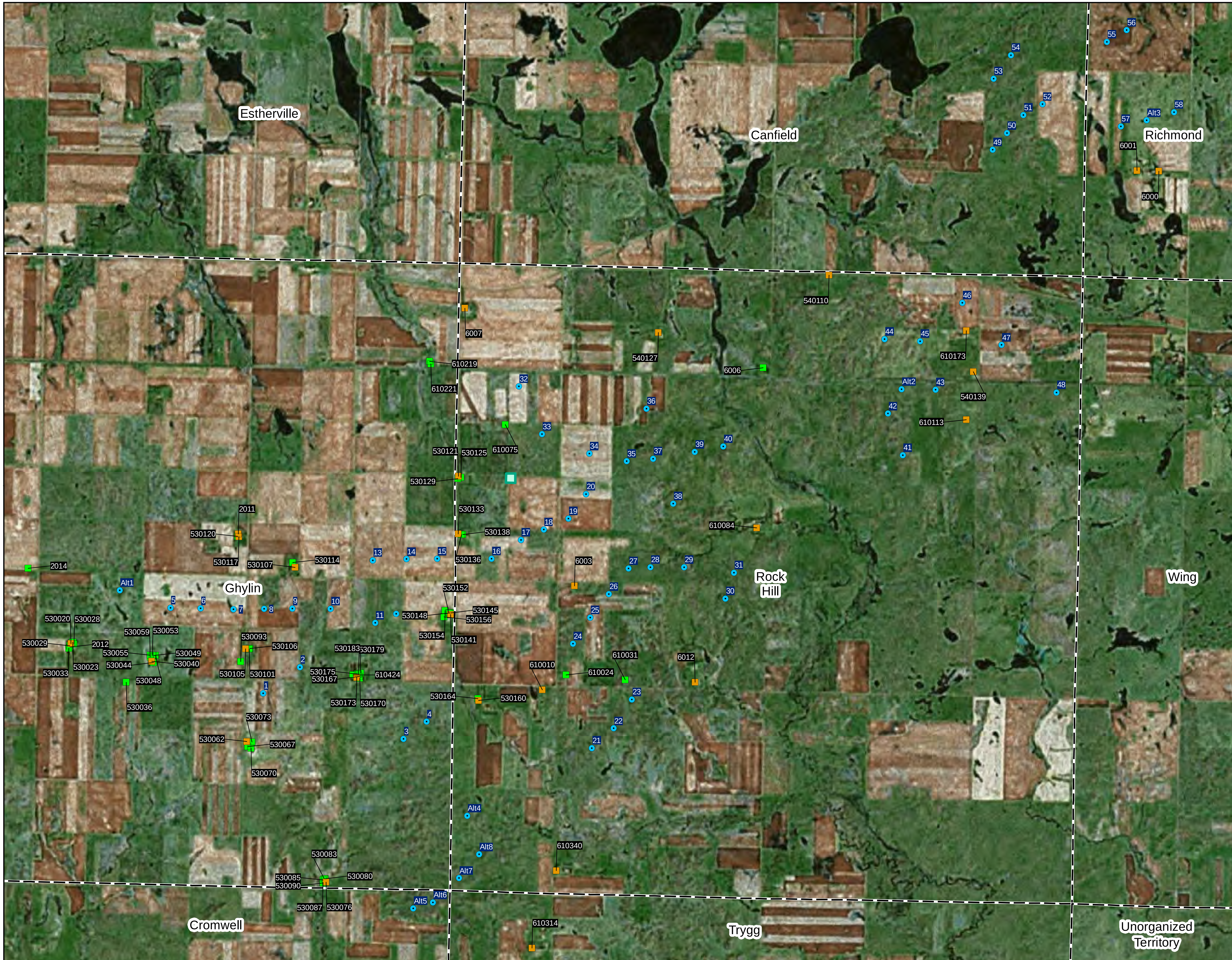
USEPA. 1978. Protective Noise Levels. Condensed Version of EPA Levels Document. Publication EPA-550/9-79-100, November.

Wagner, S., Bareib, R. and Guidati, G. 1996. Wind Turbine Noise, Springer, Berlin.

WILTON WIND IV, LLC
WILTON IV WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 1
PROJECT LAYOUT

AUGUST 2014



Legend

- Wilton IV WTG (GE 1.79)
- Receptor - Occupied
- Receptor - Unoccupied
- Substation
- Civil Township

0 0.5 1 Miles

N E S W

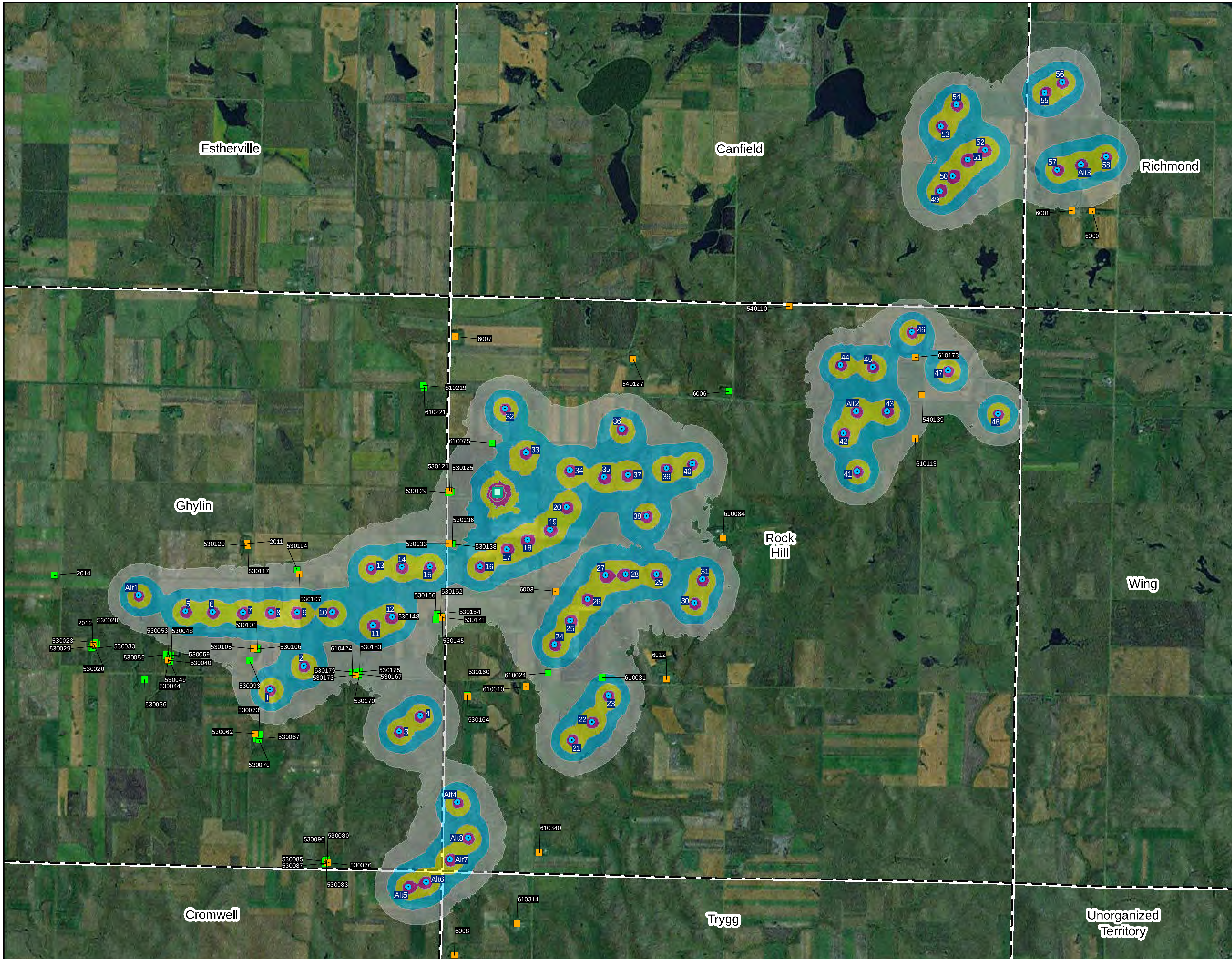
REFERENCE MAP

Document Path: P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\Noise\Fig1_ProjectLayout.mxd

WILTON WIND IV, LLC
WILTON IV WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 3
RECEIVED SOUND LEVELS:
WIND TURBINES AT CUT-IN
ROTATIONAL WIND SPEED

AUGUST 2014



Legend

- Wilton IV WTG (GE 1.79)
- Receptor - Occupied
- Receptor - Unoccupied
- Substation
- Civil Township

Sound Level Contour Ranges (dBA)

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

0 0.5 1 Miles

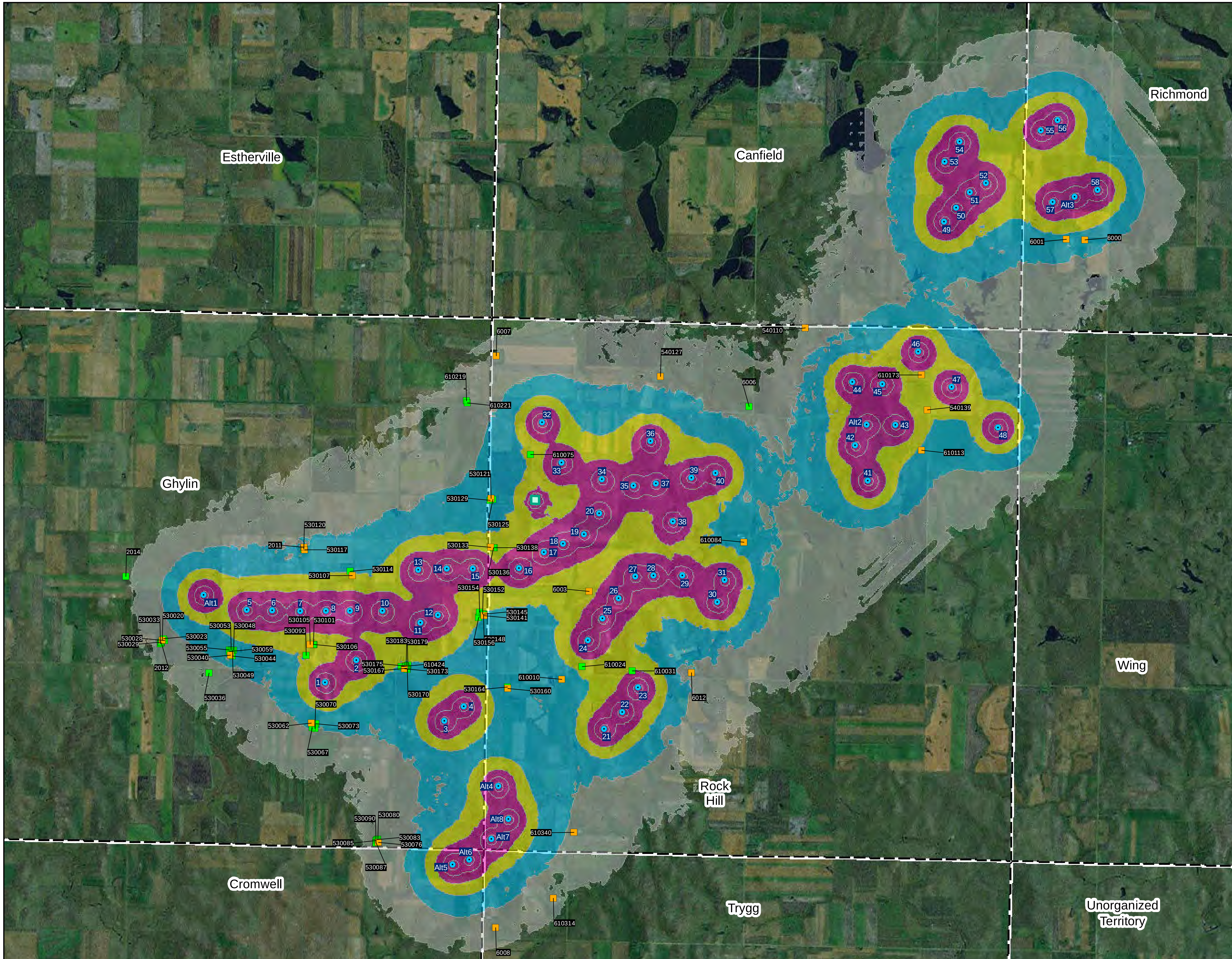
REFERENCE MAP

Document Path: P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\Noise\Fig2_WTG_Cut-In.mxd

WILTON WIND IV, LLC
WILTON IV WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

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

AUGUST 2014



Legend

- Wilton IV WTG (GE 1.79)
- Receptor - Occupied
- Receptor - Unoccupied
- Substation
- Civil Township

Sound Level Contour Ranges (dBA)

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

N W E S

0 0.5 1 Miles

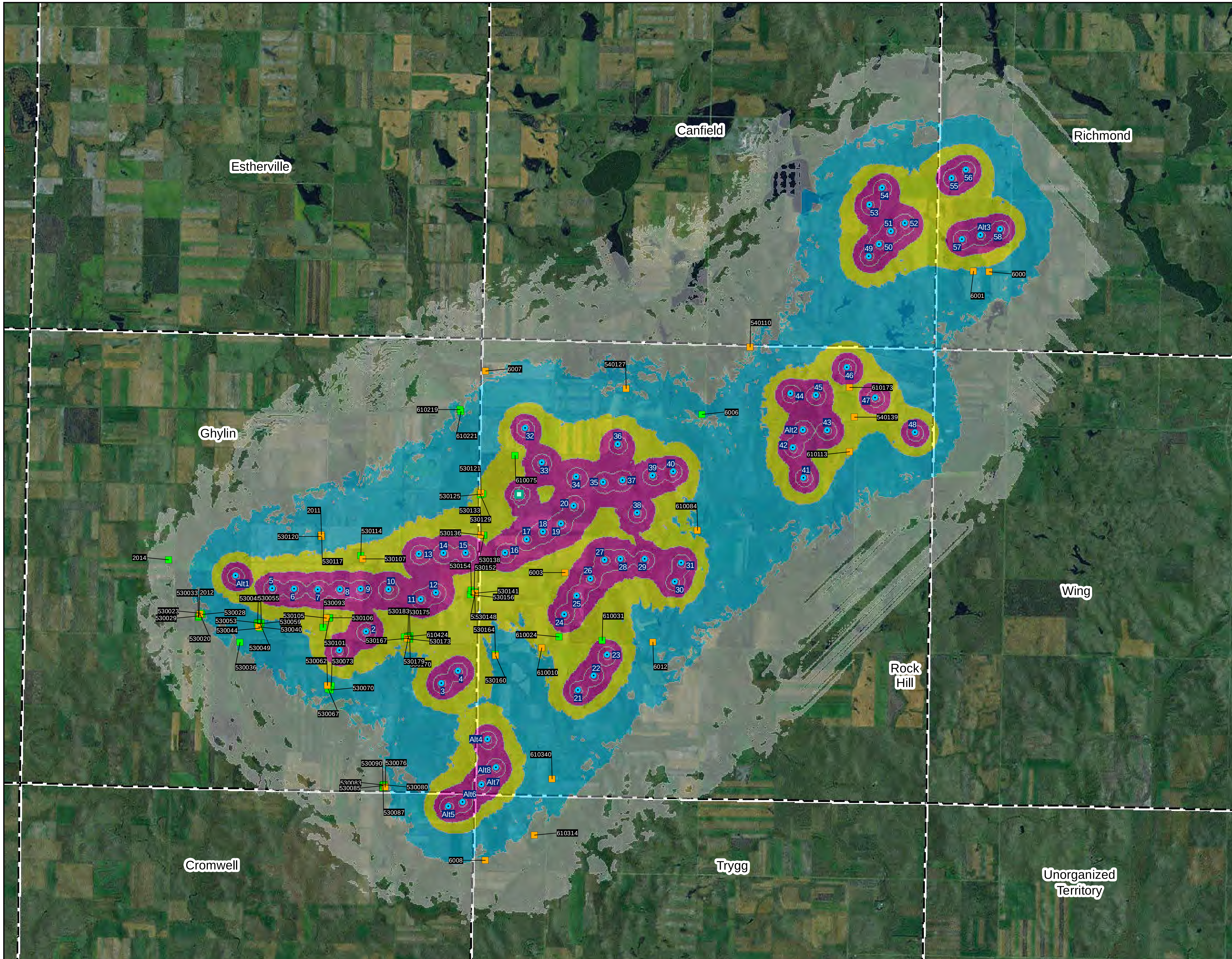
REFERENCE MAP

Document Path: P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\Noise\Fig3_WTG_MaxRot.mxd

WILTON WIND IV, LLC
WILTON IV WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 5
RECEIVED SOUND LEVELS:
WIND TURBINES AT MAXIMUM
ROTATIONAL WIND SPEED,
ANOMALOUS METEOROLOGICAL
CONDITIONS

AUGUST 2014



Legend

- Wilton IV WTG (GE 1.79)
- Receptor - Occupied
- Receptor - Unoccupied
- Substation
- Civil Township

Sound Level Contour Ranges (dBA)

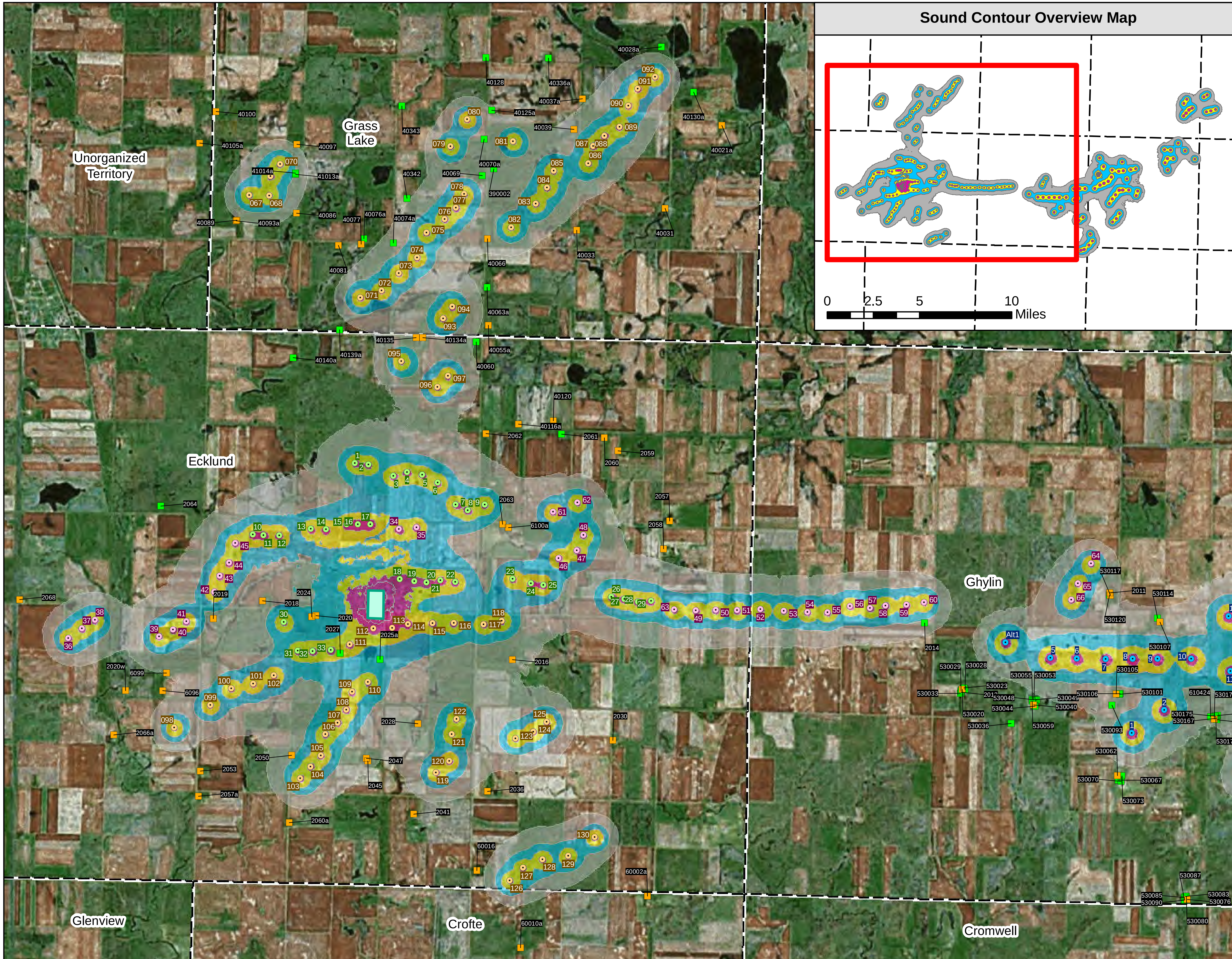
- 35 - 40
- 40 - 45
- 45 - 50
- > 50

0 0.5 1 Miles

N S E W

REFERENCE MAP

Document Path: P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\Noise\Fig4_WTG_AnomMet.mxd



Sound Contour Overview Map

0 2.5 5 10 Miles

WILTON WIND IV, LLC
WILTON IV WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 6A
CUMULATIVE EFFECTS -
RECEIVED SOUND LEVELS:
WIND TURBINES AT CUT-IN
ROTATIONAL WIND SPEED

WEST

AUGUST 2014

Legend

- Wilton IV WTG (GE 1.79)
- Wilton I WTG (Existing)
- Wilton II WTG (Existing)
- Baldwin WTG (Existing)
- Receptor - Occupied
- Receptor - Unoccupied
- Substation
- Civil Township

Sound Level Contour Ranges (dBA)

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

N W E S

0 0.5 1 2 Miles

REFERENCE MAP

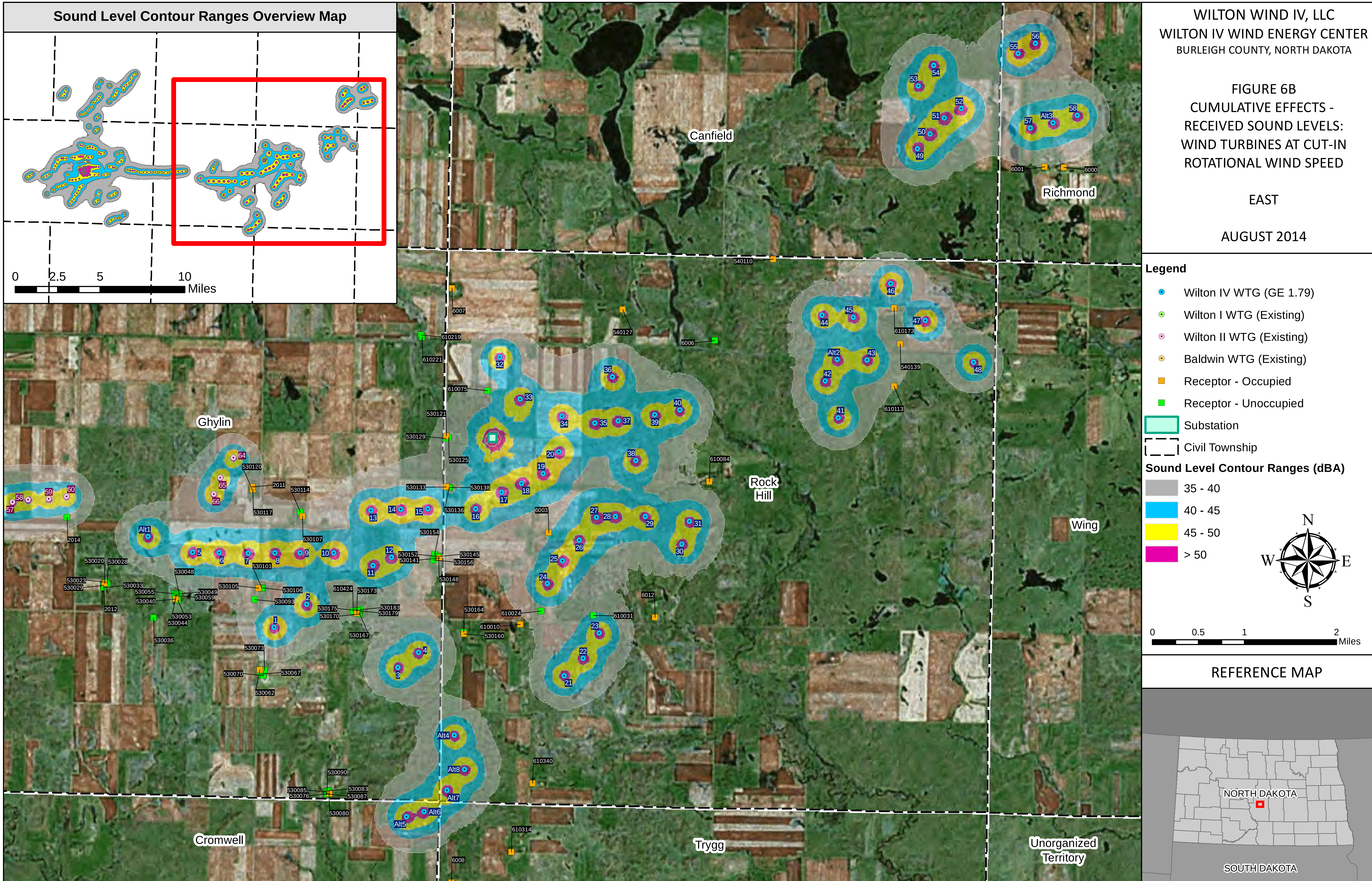
Path: P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\Noise\Fig5a_Cumulative_WTG_Cut-In_West.mxd

WILTON WIND IV, LLC
WILTON IV WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

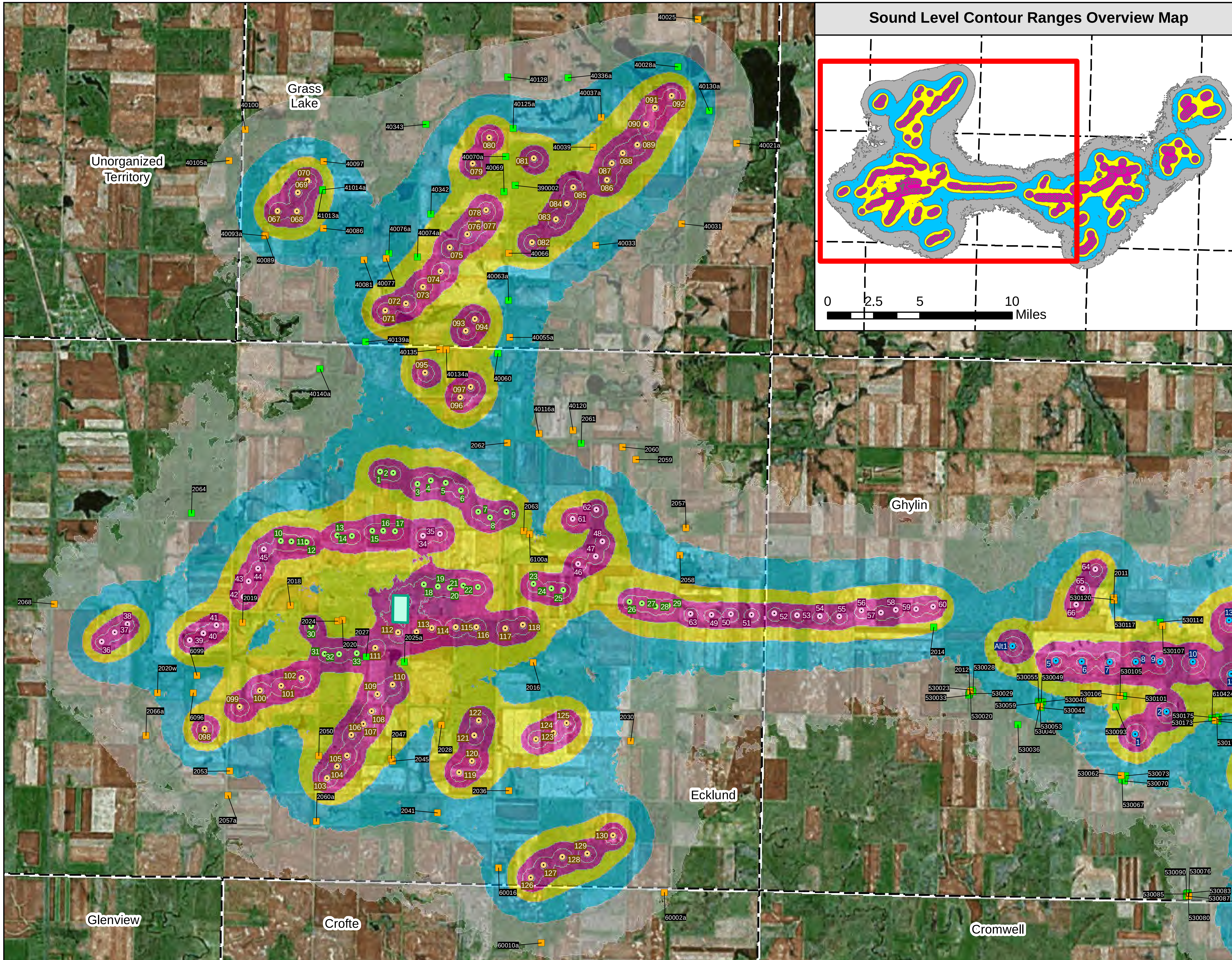
FIGURE 6B
CUMULATIVE EFFECTS - RECEIVED SOUND LEVELS: WIND TURBINES AT CUT-IN ROTATIONAL WIND SPEED

EAST

AUGUST 2014



Path: P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\Noise\Fig5b_Cumulative_WTG_Cut-In_East.mxd



WILTON WIND IV, LLC
WILTON IV WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 7A
CUMULATIVE EFFECTS -
RECEIVED SOUND LEVELS:
WIND TURBINES AT MAXIMUM
ROTATIONAL WIND SPEED

WEST

AUGUST 2014

Legend

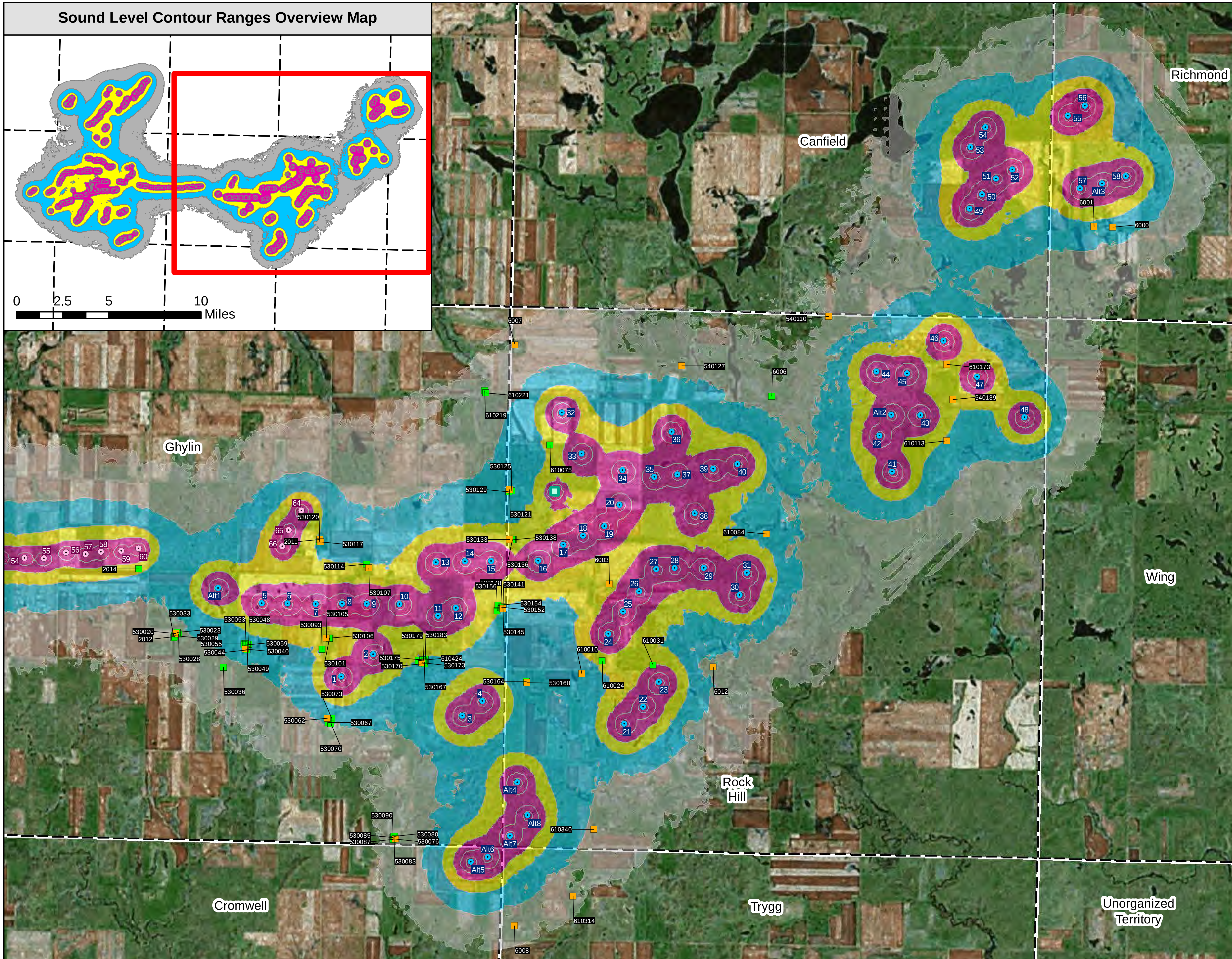
- Wilton IV WTG (GE 1.79)
- Wilton I WTG (Existing)
- Wilton II WTG (Existing)
- Baldwin WTG (Existing)
- Receptor - Occupied
- Receptor - Unoccupied
- Substation
- Civil Township

Sound Level Contour Ranges (dBA)

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

REFERENCE MAP

Path: P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\Noise\Fig6a_Cumulative_WTG_MaxRot_West.mxd



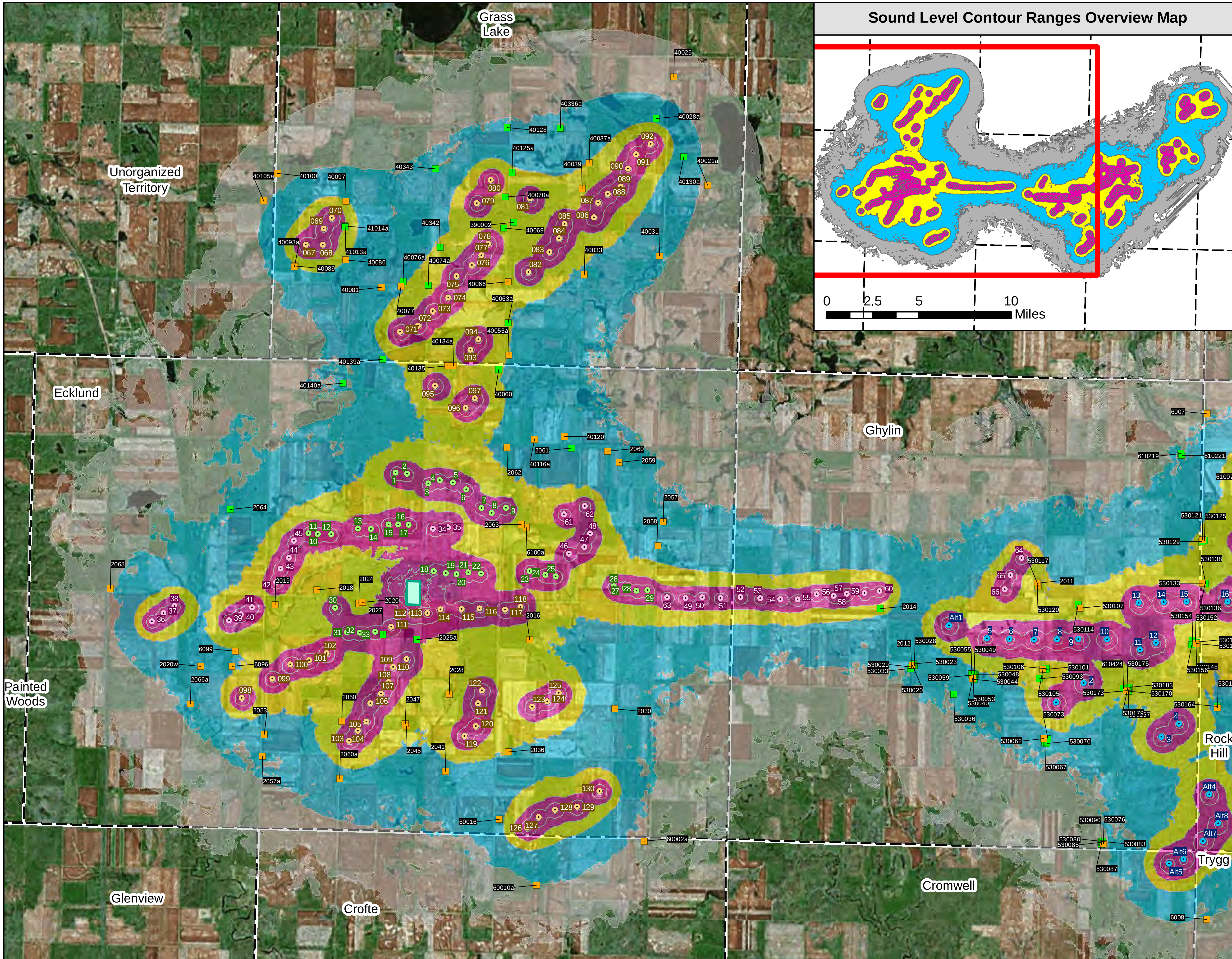
WILTON WIND IV, LLC
WILTON IV WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 7B
CUMULATIVE EFFECTS - RECEIVED SOUND LEVELS: WIND TURBINES AT MAXIMUM ROTATIONAL WIND SPEED

EAST

AUGUST 2014

Path: P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\Noise\Fig6b_Cumulative_WTG_MaxRot_East.mxd



WILTON WIND IV, LLC
WILTON IV WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 8A
CUMULATIVE EFFECTS -
RECEIVED SOUND LEVELS:
WIND TURBINES AT MAXIMUM
ROTATIONAL WIND SPEED,
ANOMALOUS METEOROLOGICAL
CONDITIONS

WEST

AUGUST 2014

Legend

- Wilton IV WTG (GE 1.79)
- Wilton I WTG (Existing)
- Wilton II WTG (Existing)
- Baldwin WTG (Existing)
- Receptor - Occupied
- Receptor - Unoccupied
- Substation
- Civil Township

Sound Level Contour Ranges (dBA)

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

N
W
E
S

0 0.5 1 2 Miles

REFERENCE MAP

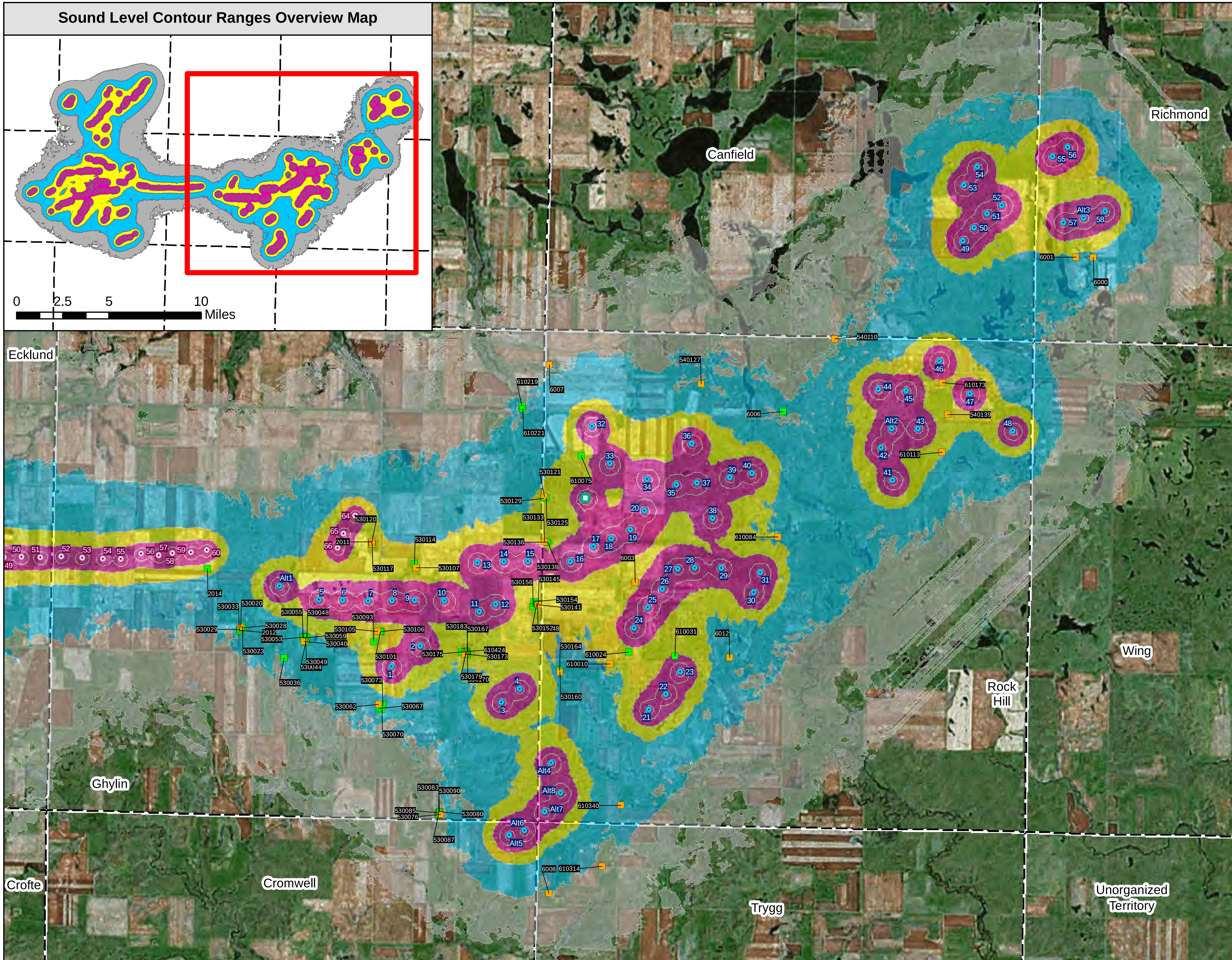
Path: P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\Noise\Fig7a_Cumulative_WTG_AnomMet_West.mxd

WILTON WIND IV, LLC
WILTON IV WIND ENERGY CENTER
BURLEIGH COUNTY, NORTH DAKOTA

FIGURE 8B
CUMULATIVE EFFECTS - RECEIVED SOUND LEVELS: WIND TURBINES AT MAXIMUM ROTATIONAL WIND SPEED, ANOMALOUS METEOROLOGICAL CONDITIONS

EAST

AUGUST 2014



Legend

- Wilton IV WTG (GE 1.79)
- Wilton I WTG (Existing)
- Wilton II WTG (Existing)
- Baldwin WTG (Existing)
- Receptor - Occupied
- Receptor - Unoccupied
- Substation
- Civil Township

Sound Level Contour Ranges (dBA)

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

N S E W

0 0.5 1 2 Miles

REFERENCE MAP

Path: P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\Noise\Fig7b_Cumulative_WTG_AnomMet_East.mxd