# NOISE IMPACT ASSESSMENT PROTOCOL
**Bull Run Wind Farm**
**Clinton County, New York**

June 2016

## 1 Background
Invenergy affiliate Bull Run Energy LLC (BRE) is developing a wind energy facility of approximately 100-140 wind turbines to be installed in Clinton County, New York in the towns of Altona, Clinton, Ellenburg, and Mooers. This document describes BRE's plants for assessing the ambient noise environment and potential noise impacts of the proposed Project.

## 2 Noise-Sensitive Receptors
For purposes of this protocol, the following are considered noise-sensitive receptors:

- Year-round residences
- Schools
- Hospitals
- Houses of worship
- Outdoor public use areas

Attachment 1 maps the noise-sensitive receptors in the areas expected to be within one mile or less of proposed wind turbines or the project substation. Invenergy developers familiar with the local area identified these receptors by review of aerial photographs.

## 3 Ambient Noise Assessment
The ambient noise environment is the existing noise environment, prior to the introduction of a new noise source. The ambient noise environment includes a range of different noise, or sound, including background noise, short term noise, and noises that occur seasonally. The Project will create new noises not currently present in the ambient noise environment. [1]

To assess the ambient noise environment, BRE will hire an acoustical consultant with experience in community noise measurements (a "noise expert") who will tour the Study Area to identify the local land uses, observe existing sound sources and acoustic environments in the community, observe noise-sensitive receptors, and deploy equipment for continuous noise monitoring and storage.

[1] Technically, the ambient noise assessment would be more accurately called an ambient sound assessment, as "noise" is defined as a sound that causes a disturbance, and the assessment is measuring all sound in the existing environment, not just sounds that cause a disturbance. Similarly, the sound from wind turbines should not necessarily be referred to as noise, as it does not necessarily cause a disturbance. But this document generally uses the term "noise" in both instances, as this has become commonplace in such evaluations.

### 3.1 Data Collection Period

The noise expert will collect data during winter and summer months. For each season, at least two weeks of data will be collected. Specific monitoring periods are:

- Winter period. Starting week of 15 February 2016.
- Summer period. Starting sometime in the month of May, June, July, August, or September 2016.

### 3.2 Noise Monitoring Locations

The noise expert will select six community locations from where he/she will collect continuously-measured ambient data. The selected sites will be representative of noise sensitive receptors in the Project Area where wind turbine noise might be audible during project operation.

The overall Project Area includes large areas of wooded or lightly-used farm lands. Ambient noises in these areas should be fairly consistent. Noise levels are likely higher along the highway corridors along the southern portion of the Project Area. The noise expert selected locations to sample locations in the sparsely populated wooded areas, lightly used agricultural areas, and along the highway corridors. Locations were also selected to be geographically dispersed across the Project Area. There are no dramatic topographic features in the Project Area that would have a significant effect on ambient noise levels, thus topography was not a consideration in selecting monitoring sites.

The selected noise monitoring locations, listed below, are mapped in Attachment 2. Photos of the locations are provided as Attachment 3.

- NR1. Backyard of residence along US Route 11. Many of the residences in the project area are along Route 11, and this monitoring location should provide representative noise levels at locations along this major corridor.
- NR3. Side yard of residential property near a garage building on Brandy Brook Road.
- NR5. Side yard near residence and barn located on the SE corner of the intersection of Bull Run Road and Clinton Mills Road.
- NR6. Side yard near residence on Canaan Road.
- NR9. Backyard of residence on Military Turnpike (NYS Rt. 190).
- NR10. Rural property located on Clinton Mills Road, similar distance to road as nearby residence. This is a wooded area where many of the project wind turbines are proposed.

All sites are on land where the owner has agreed to participate in the Project and has been briefed on the purpose of the noise monitoring equipment and the importance of not disturbing the data collection.

### 3.3 Manual Measurements

In addition to the data collected by automatic equipment at the remote noise monitoring sites described in the previous section, the noise expert will also obtain hand-held sound measurements and observations of sound sources during the daytime and nighttime hours at up to four additional community locations. This information will supplement and support the automatic data. The noise expert will collect these data during the seasonal period when automatic data are also being collected.

Sites for manual measurements are:

- ST1. Side yard of residence at 2180 Plank Road.
- ST2. Side yard of residence on the northeast corner of the intersection of Drown Road and Stone Road.
- ST3. Front yard of in-town residence at 5597 US Rt. 11.
- ST4. Side yard of residence at 5940 US Rt. 11.

### 3.4 Low Frequency Measurements

The automatic monitors and manual instruments will collect low frequency (1/3-octave band with center frequency of 12.5 Hz and above) and overall A-weighted sound level data.

### 3.5 Noise Monitoring Equipment

The continuous and manual sound measurements will be made with instruments that meet the Type 1 provisions in ANSI S1.4 or IEC 651 and the provisions in ANSI S1.11 or IEC 225. Specific instruments to be used will include or be comparable to:

- Rion Model NL-52 sound level meter,
- Rion Model NA-28 sound level meter

All sound instruments are laboratory calibrated at least every two years and calibrated on-site before and checked after the measurement periods.

### 3.6 Ambient Data to Be Recorded

At every monitoring station, the following data will be collected:

- Leq, A-weighted, calculated for every 10-minute interval.
- L90, A-weighted, calculated for every 10-minute interval.
- L50, A-weighted, calculated for every 10-minute interval.
- L10, A-weighted, calculated for every 10-minute interval.
- L1, A-weighted, calculated for every 10-minute interval.
- A-weighted sound level for every one second interval.

- 1/3-octave band sound pressure levels for every one second interval (1/3-octave bands with center frequencies from 12.5 Hz to 10,000 Hz).
- In addition to the above-listed sound statistics, at several of the sound monitoring stations, the equipment will record the 10-minute average wind speed as recorded by a wind speed sensor installed in the vicinity of the noise monitoring station. The noise expert will compare the local wind data with the project met tower wind data and the local sound level data.

### 3.7 Equipment Checks

During the monitoring periods, the noise expert will visit the monitoring stations to check the equipment and to download the data.

### 3.8 Data Analysis

The noise expert will document the results of the ambient noise study in a report that will reference this protocol and specify the noise expert's credentials. The report will summarize the A-weighted sound levels measured at the various locations. It will also comment on any trends observed regarding noise levels during different seasons, during day and night, and varying with wind speed.

## 4 Applicable Regulations

### 4.1 Local Laws

The following local laws require that the L10 noise level from wind energy facilities not exceed 50 dBA at non-participating residences:

- Town of Altona, Local Law No 1 of 2006, Section 1226.A
- Town of Clinton, Local Law No 1 of 2005, Section 15.A
- Town of Ellenburg, Local Law No 4 of 2005, Section 16.A

### 4.2 NYSDEC Guidance

The New York State Department of Environmental Conservation (NYSDEC) Program Policy, "Assessing and Mitigating Noise Impacts" (DEP-00-1) provides direction for the evaluation of sound levels and characteristics (such as pitch and duration) generated from proposed or existing facilities. This guidance also serves to identify when noise levels may cause a significant environmental impact and gives methods for noise impact assessment, avoidance, and reduction measures. It states that for non-industrial settings, the sound level should probably not exceed the ambient sound level by more than 6 dBA at the receptor. The NYSDEC Policy also provides guidance about ambient sound levels for non-industrial settings: "For estimation purposes……. a quiet seemingly serene setting such as rural farmland will be at the lower end of the scale at about 45 dBA." The sound level of 45 dBA is understood to be an Leq value.

# 5 Assessment Methods – Construction Noise

## 5.1 Analysis Methods

Potential noise impacts during project construction will be estimated using the Cadna/A computer software and the following assumptions:

- Typical construction equipment is operating simultaneously at every turbine site, at the batch plant, and at the laydown yard. This will result in conservatively high noise levels, as construction will not be occurring at all sites simultaneously.
- Equipment noise levels will be based on values in NYSDEC Program Policy, "Assessing and Mitigating Noise Impacts" (DEP-00-1), and "ESEERCO Power Plant Construction Noise Guide," BBN Report No. 3321, May 1977.

## 5.2 Results

Results of the construction noise analysis will be presented in a map showing construction activity areas, contours of expected maximum dBA noise levels, and noise-sensitive receptors.

# 6 Assessment Methods – Operation Noise

## 6.1 Computer Modelling

Potential noise impacts during project operation will be estimated using the Cadna/A computer software and the following assumptions:

- Maximum Turbine Sound Levels. All wind turbines will be assumed to be operating simultaneously at the sound power levels specified by the turbine manufacturer.
- Turbines as Point Sources. Turbines will be modelled as a point source located at the turbine hub, which is consistent with the method used to define the sound power level for the turbine through testing done in accordance with IEC 61400-11.
- Substation Noise. The transformer(s) in the Project substation will be modelled as sound point sources using a sound power level equal to or louder than the specification intended to be used during equipment procurement.
- Average Ground Absorption. The ability of the ground to reflect or absorb sound will affect the level of wind turbine noise that may be heard at receptors. Soft ground conditions, such as fresh snow or freshly plowed fields has a high ground absorption that tends to attenuate wind turbine sound and make it less noticeable. Harder ground conditions, such as asphalt or a frozen landscape has a lower ground absorption that tends to reflect sound and would make wind turbine sound more noticeable. In its noise modelling for the Project, BRE will assume a ground absorption value, G, of 0.5, which accounts for a mix of soft (sound absorptive) and hard (sound reflective) ground conditions.
- Typical Air Conditions. Air temperature will be assumed to be 50°F (10°C) with a relative humidity of 70%.

- Moderate Atmospheric Inversion. Temperature inversions, e.g., when air above ground level is higher temperature than air at ground level, can cause sound to be reflected downward toward receptors, increasing sound levels. In most areas such inversions are not regular occurrences, but are not uncommon. The ISO standard model that BRE will employ conservatively includes a moderate temperature inversion.[2]

- Downwind Conditions. Noises can be louder when hear downwind of the noise source. The ISO standard model that BRE will employ conservatively assumes all receptors are downwind of the wind turbines. As a result, it will overestimate sound levels for any receptors that might be "upwind" of a wind turbine.

- Weather Variations. Short term weather variations such as thunderstorms, falling snow, and weather fronts can attenuate sound travel and will make noise from wind turbines less noticeable. BRE's noise modelling will not take credit for any attenuation due to such weather conditions.

- Vegetation. Trees and other vegetation attenuate sound and make noise from turbines less noticeable. BRE's noise modelling will conservatively assume a "bare earth landscape" with no attenuation from trees or other vegetation.

- Wind Shadowing. Just as downwind conditions can increase sound travel, conditions that block wind from a receptor can also serve to attenuate sound travel to the receptor. BRE's noise modelling will not include any attenuation affects from such "wind shadowing."

- Daytime Air Turbulence. Ground level activities, heat absorption or other effects can create turbulence and heat pockets at the ground level that will reflect sound upward and away from noise receptors. BRE's noise modelling will not include any attenuation affects from such daytime air turbulence.

### 6.2 Noise Impact Assessment Report

The noise expert will prepare a noise impact assessment report summarizing methods and results of the construction and operations noise assessments.

The report will present results from the project sound model that employs the standard Cadna/A configuration. In addition, the report will discuss results from a model that employs the CONCAWE configuration and compared with those of the standard model.

The reporting of modelling results for operating conditions will include:

- A map showing project noise sources, contours of expected upper noise levels (dBA) of the Project, and noise-sensitive receptors.

- Tables of noise statistics for the following locations:

[2] ISO standard 9613 on community noise modelling includes an assumption of a moderate temperature inversion.

- Residences and Receptors, Typical. One or more noise-sensitive receptors in the Project Area representing a range of impacts expected;
- Non-Participating Parcel, Typical. One or more points in the Project Area on the edge of a parcel not participating in the Project and with Project components in relatively close proximity compared to other parcels;
- Non-Participating Parcel, Greatest Impact. The noise-sensitive receptor on a non-participating parcel where the highest project noise levels are expected to occur.

For each of the above locations, the tables shall provide the following noise statistics and results:

- Ambient noise levels:
  - Leq ambient noise levels, based on the ambient noise assessment, for daytime and nighttime conditions in summer and winter.[3]
  - L90 background noise levels, based on the ambient noise assessment, for daytime and nighttime conditions in summer and winter.
- Predicted Project noise levels during operation, from computer modelling:
  - L10 project noise levels, the level that noise from the project will exceed 10% of the hours of the year, based on on-site wind data.
  - L50 project noise levels, the level that noise from the project will exceed 50% of the hours of the year, based on on-site wind data.
- Predicted noise levels combining ambient values and estimated Project noise levels:
  - Worst case noise levels for daytime and nighttime periods in summer and winter, calculated by combining the L90 background noise levels for the periods and the L10 project noise levels.
  - Typical noise levels for daytime periods in summer and winter, calculated by combining the Leq ambient noise levels and the L50 project noise level.

In addition to the data described above, the noise impact assessment report will also address:

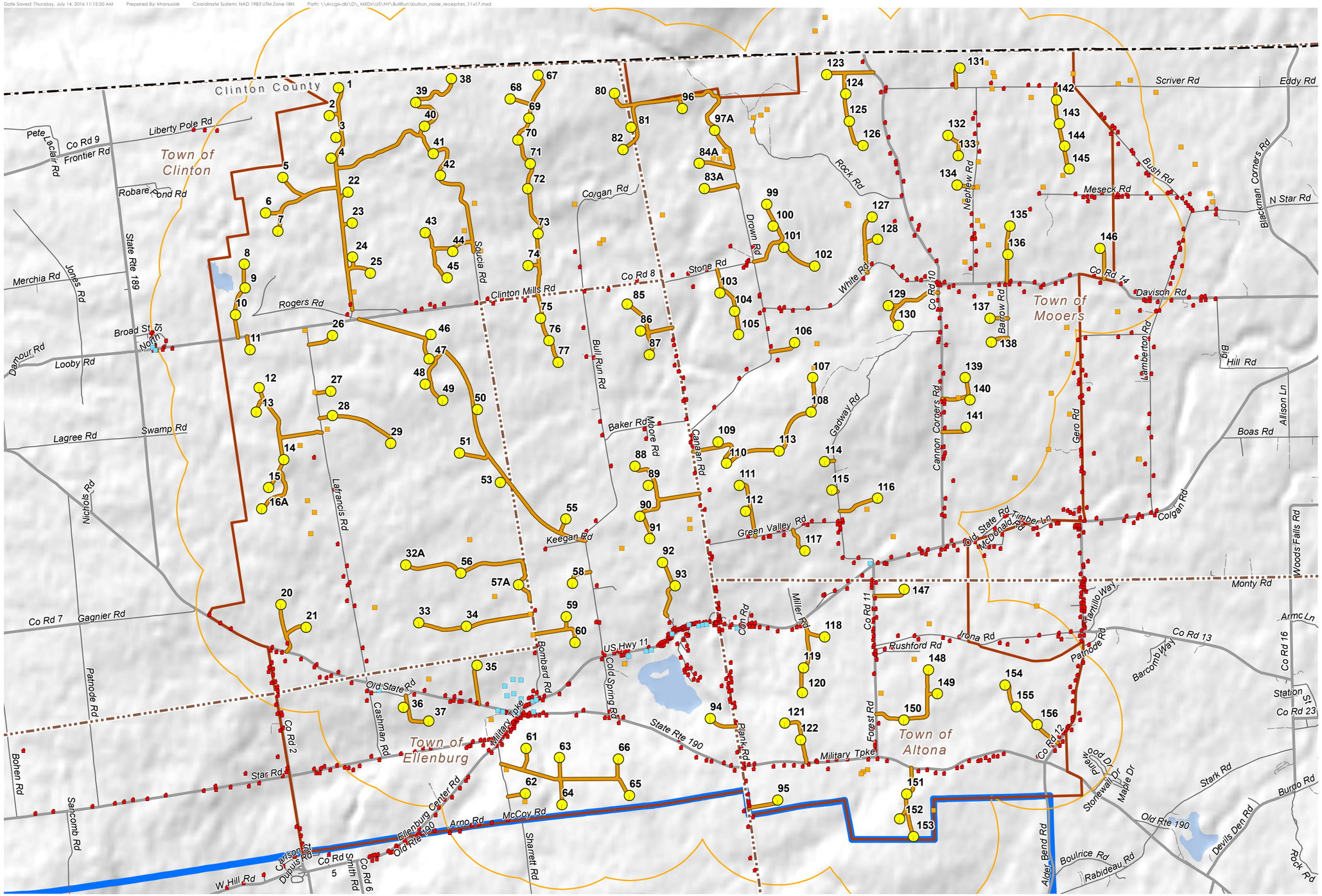
- Compliance with Local Laws. Whether studies indicate the Project is in compliance with the applicable local law at this point.
- Low Frequency Noise. As discussed in Section 3 of this protocol, the noise expert will collect ambient sound for 1/3-octave bands with center frequencies of 12.5 Hz and above. The modelling of turbine operating sound will use sound power date from the turbine vendor, which typically include 1/3-octave band data for 25 Hz and above. The report will discuss the contribution of low frequency sound to the overall sound levels in the community during turbine operation.

[3] Daytime will be considered the hours between 7am – 10pm, nighttime will be considered the hours between 10pm – 7am

- Prominent Tones. The report will discuss the potential for prominent tones in the community during turbine operation.
- Amplitude Modulated Sound. The report will discuss the potential for amplitude modulated sound associated with turbine operation based on published information.

# Attachment 1
# Map of Noise-Sensitive Receptors

Date Saved: Thursday, July 14, 2016 11:15:30 AM  Prepared By: khanusiak  Coordinate System: NAD 1983 UTM Zone 18N  Path: \\Arcgis-db\D_MXDs\US\NY\BullRun\bullrun_noise_receptors_11x17.mxd




3,600 0 3,600
Feet

## Legend

- Residence
- Public Place
- Cabin
- Turbine
- Area Outside 1mi from Turbine
- Access Road
- Adirondack Park Boundary

**Road Classification**

- US/State Route/County Road
- Local Road
- Dirt/Unpaved Road
- Project Area
- County Boundary
- Town

# Noise Receptor Summary

Bull Run Wind Project, Clinton County, New York

Rev. 00
July 14, 2016

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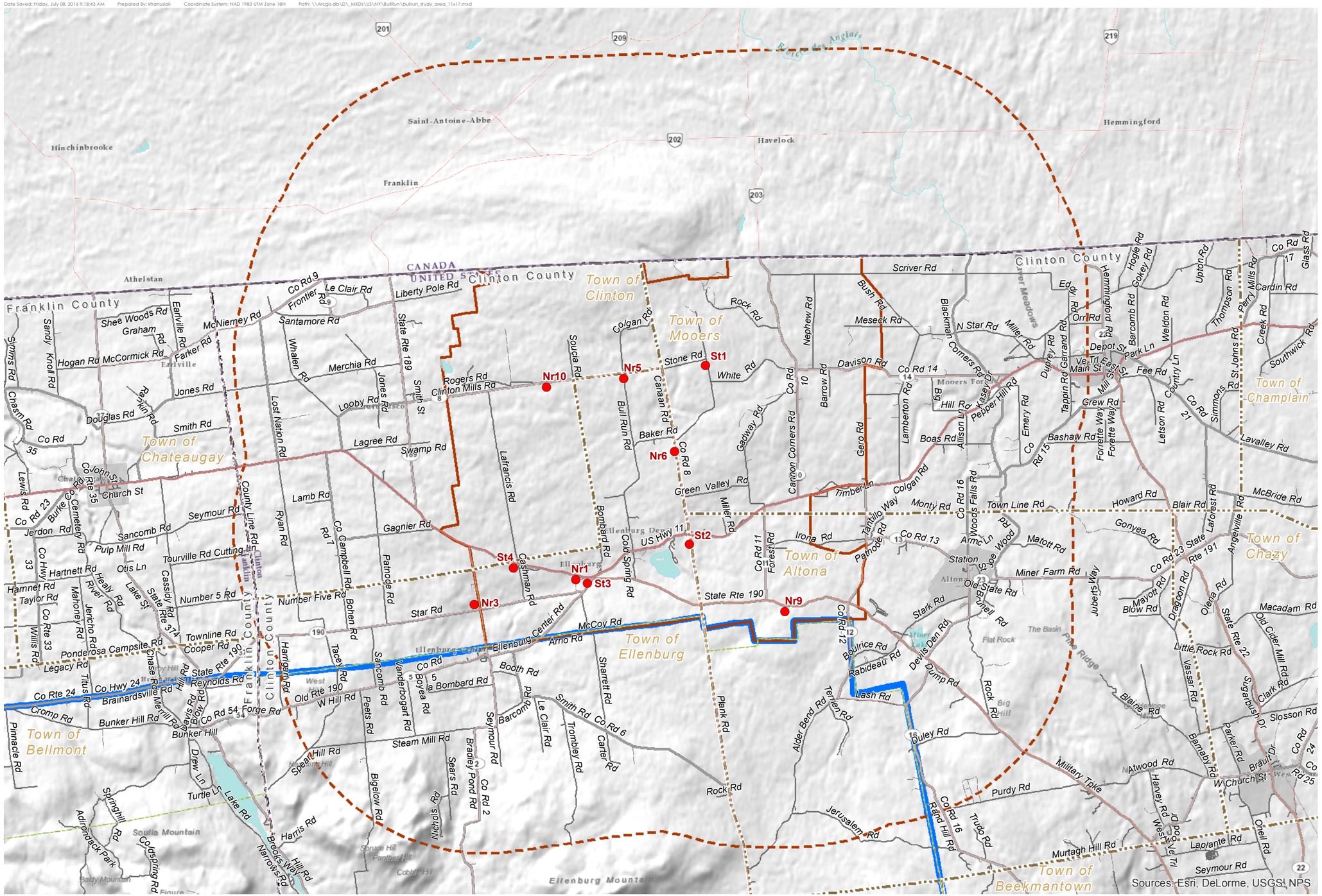
# Attachment 2
# Map of Noise Monitoring Locations

Date Saved: Friday, July 08, 2016 9:18:43 AM  Prepared By: khanusiak  Coordinate System: NAD 1983 UTM Zone 18N  Path: \\Arcgis-db\D_MXDs\US\NY\BullRun\bullrun_study_area_11x17.mxd




7,500 0 7,500
Feet

## Legend

- Noise Monitoring Location
- Municipal Area
- Adirondack Park Boundary

**Road Classification**

- US/State Route/County Road
- Local Road
- Dirt/Unpaved Road
- Study Area
- Project Area
- County Boundary
- Town

# Noise Monitoring Locations

Bull Run Wind Project, Clinton County, New York

Rev. 00
July 08, 2016

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# Attachment 3
# Photographs of Noise Monitoring Locations

**Noise Monitoring Location NR1, Bull Run Wind Project**

**Noise Monitoring Location NR3, Bull Run Wind Project**

**Noise Monitoring Location NR5, Bull Run Wind Project**

**Noise Monitoring Location NR6, Bull Run Wind Project**

**Noise Monitoring Location NR9, Bull Run Wind Project**

**Noise Monitoring Location NR10, Bull Run Wind Project**