



5422-AuroraWind-Epsilon-Review-190222.docx

PRINCIPALS

February 22, 2019

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Dr. Brandon Storm, Ph.D.
 Senior Meteorologist
 Tradewind Energy, Inc.
 Via email at BStorm@tradewindenergy.com

**Subject: Sound Level Analysis Review
 Proposed Aurora Wind Project – Williams County, North Dakota**

Dear Dr. Storm:

Epsilon Associates, Inc. (Epsilon) has reviewed the sound level modeling analysis conducted by Tradewind Energy, Inc. (Tradewind) for the proposed Aurora Wind Project (Project) to be located in Williams County, North Dakota. The Aurora Wind Project consists of 130 proposed wind turbine locations with five (5) wind turbine scenarios being considered.

ASSOCIATES

- Richard M. Lampeter, INCE
- Geoff Starsiak, LEED AP BD+C
- Marc Bergeron, PWS, CWS

Sound level modeling was conducted for the proposed wind energy facility using WindPRO and was summarized in a report provided by Tradewind. Epsilon reviewed the sound modeling report which included figures and the model output in order to determine whether the methodology used to calculate project sound levels is consistent with the modeling methodology used by Epsilon for wind energy facilities and is consistent with an analysis specific to North Dakota.

Summary

The methods described in the report to predict sound pressure levels from wind energy facilities are generally consistent with Epsilon’s sound modeling practices. Sound modeling for the Project adheres to the ISO 9613-2 international standard for sound propagation (Acoustics – Attenuation of sound during propagation outdoors – Part 2: General Method of Calculation) and uses a ground absorption factor of G= 0.5 (mixed ground). The manufacturer’s sound power level documents were not provided, however, the sound power levels presented in the WindPRO sound reports are similar to those Epsilon has encountered for other wind turbines. A

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 Sound analysis report
 Aurora Wind Project, LLC

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+2dB k-factor has been added to the sound levels, which is also consistent with Epsilon's modeling approach.

Although the modeling details presented in the report are conservative and aligned with Epsilon's modeling methods, there are several aspects of the modeling and regulatory evaluation which require further explanation. Specific comments on those items are found below.

Terrain

Terrain can have a significant impact on sound levels, therefore it is important to include terrain for all outdoor acoustic modeling. There is no mention of terrain in the Tradewind report. However, based upon the Z-values shown in the WindPRO output, Epsilon assumes that terrain was used for sound modeling. This has been confirmed through personal communication with Tradewind.

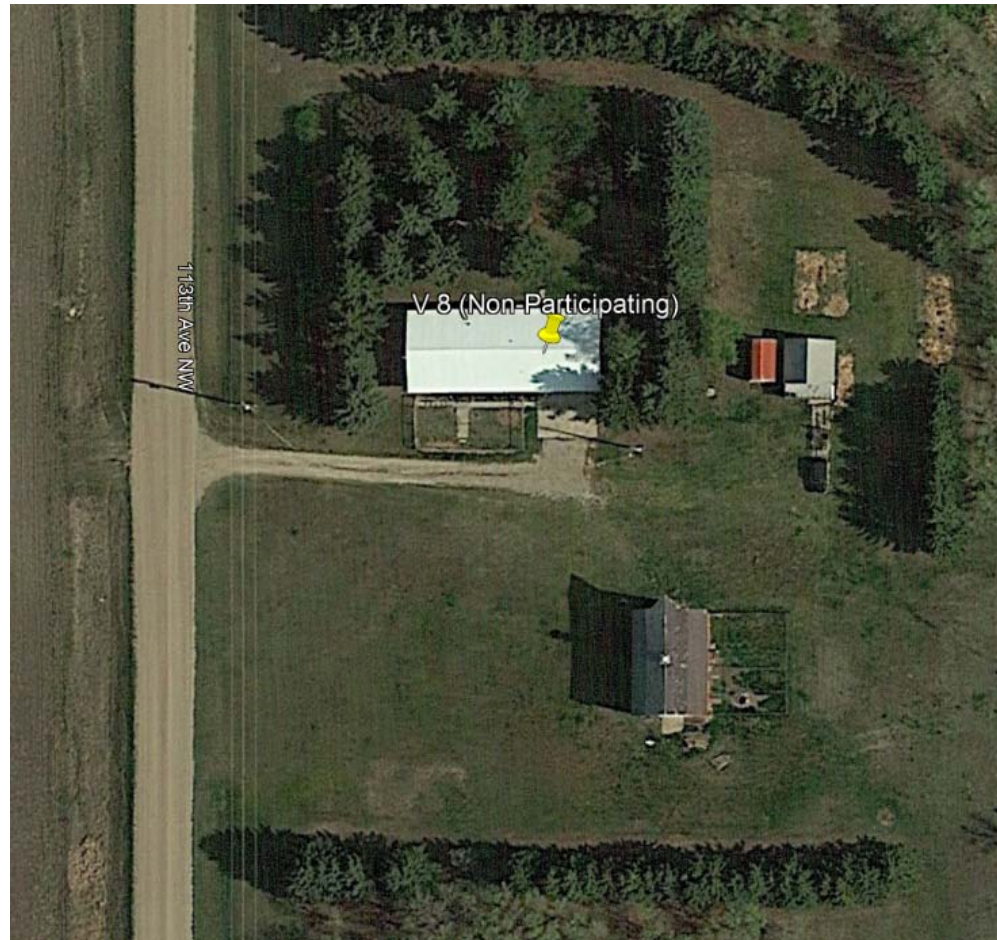
Receptors

Although in the Sound Analysis section of the report it states that the Commission has a wind turbine sound level limit of 50 dBA within 100 feet of an inhabited residence or community building, only center points of structures have been modeled. A detailed review of all receptor locations was not conducted, but Google Earth imagery for one receptor point (labeled as "V 8") is shown on the following page. Of the structures shown, the modeled location is likely a home although "Street View" was not available for this location to confirm this assumption.

Due to the modeling receptor location, sound levels within 100 feet of inhabited residences in the direction of the wind closest wind turbine would likely be slightly higher than what is presented in the WindPRO output. Although discrete points 100 feet from the homes were not modeled, compliance with respect to 50 dBA at this distance was evaluated by Tradewind. Table 2 of the Sound Analysis presents the distance from the receptor (assumed approximate center point of the home) to 50 dBA for the worst-case scenario (GE 2.5-127). The minimum distance presented is 253 feet. This distance (in meters) is directly output by WindPRO as shown in the provided outputs labeled as "Distance to noise demand". 253 feet (77 meters) is greater than the distance from the center point of the home to the façade of the home plus 100 feet; therefore, this location is in compliance with the sound level limit. Although this approach differs from Epsilon's typical approach for evaluating

this type of limit, the modeling analysis demonstrates compliance with the 50 dBA limit 100 feet from an inhabited residence for all turbine models presented.

Screenshot from Google Earth of Receptor V 8:



Meteorological Conditions

In the Main Result pages of the WindPRO generated output, a Meteorological coefficient (C0) is equal to 0.0 dB. It is unclear what temperature and humidity the model uses to calculate sound levels. Epsilon's standard assumptions are a relative humidity of 70% and a temperature of 10°C (50°F) in order to minimize the atmospheric attenuation in the 500 Hz and 1 kHz octave bands where the human ear is most sensitive. The use of 70% and 10°C (50°F) in this analysis has been confirmed through personal communication with Tradewind.

Wind Turbine Sound Power Levels

In the Main Result pages for the Gamesa SG132-3.465 in the Noise data column, the “Loudest Octave + 2dB” is indicated to be a sound power level of 106.1+2, however in the LwA,ref column, the total sound power level is listed as 108.0 dBA. It is unclear why this value is not 108.1 dBA; all other scenarios are accurate to the tenth of a decibel. This difference in the sound power level would result in an insignificant change to the receptors. In addition, this scenario results in modeled sound levels significantly less than other wind turbine scenarios modeled for this Project and would have no impact on this wind turbine model being compliant with the requirements.

Wind Turbine Hub Heights

The statement is made in the Tradewind report that the shortest hub height for a given wind turbine model was utilized to present worst-case sound results. Although this is true for the closest receptors, more distant receptors may have slightly higher modeled sound levels under a higher hub height. The approach selected by Tradewind does not negatively impact the sound level compliance evaluation for this Project as the approach results in higher sound levels at closer receptors which are the critical receptors for evaluating compliance.

Substation

A substation is not identified in the Sound Analysis. Based on personal communication with Tradewind a substation is a component of this Project. Tradewind has indicated that the substation will be beyond one mile from the closest inhabited residence. Therefore, the sound levels associated with transformer(s) at the substation will not result in an exceedance of the 50 dBA limit at inhabited residences.

Local Regulations

A discussion of county regulations is not presented in the report. Based on personal communication with Tradewind there are no applicable county or township wind energy regulations with respect to sound.

Conclusions

Epsilon has completed a review of the sound level modeling analysis conducted by Tradewind for the proposed Aurora Wind Project. The details of the modeling used

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Tradewind Energy, Inc.
February 22, 2019

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to predict sound pressure levels in the Project area as presented in the report are generally consistent with Epsilon's methodology. Although the analysis does not include discrete receptors 100 feet from inhabited structures, the limit at this distance is evaluated and demonstrates compliance. Items not clearly identified in the submitted report have been addressed through follow-up communication with Tradewind as identified in this letter and documented in the attached Exhibit A.

Based on the review of the sound level analysis conducted and my experience in this field of study, I conclude to a reasonable degree of scientific certainty that the Tradewind Sound Analysis can be relied upon for evaluating compliance with the North Dakota State Regulations with respect to sound from wind energy conversion facilities.

Sincerely,

EPSILON ASSOCIATES, INC.



Richard Lampeter, INCE
Associate

Attachment: Exhibit A - Tradewind letter to Epsilon dated February 21, 2019



EXHIBIT A

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February 21, 2019

Richard Lampeter, INCE
Associate
Epsilon Associates, Inc.
Via email at rlampeter@epsilonassociates.com

Subject: Confirming sound modeling assumptions and information

Dear Mr. Lampeter,

This communication is to confirm assumptions and modeling techniques Tradewind Energy applied in the Aurora Wind Project ("Project") sound analysis, as well as provide other requested information.

Terrain within WindPRO was represented in the sound analysis by ten foot height contour lines created from a ten meter digital elevation model.

The atmospheric absorption within WindPRO used reflects those applicable to a 10°C and relative humidity of 70%.

With respect to the planned Project substation, the substation will be located more than one mile from any existing occupied residences or community buildings.

There are no county or township regulations regarding sound from wind energy facilities.

If you need any further information, please let me know.

Sincerely,

/s/ Brandon Storm

Brandon Storm
Senior Meteorologist
Tradewind Energy