MEMO

TO:	Jeremy Duehr, Esq. (Fredrikson & Byron)
FROM:	Eddie Duncan, INCE Bd. Cert.
CC:	Mark Wengierski (Scout Clean Energy)
DATE:	January 17, 2020
SUBJECT:	Three Waters Wind Farm Sound Propagation Model Update Summary

This memorandum was prepared as a follow up to the meeting between Three Waters Wind Farm, LLC and Minnesota Department of Commerce (Commerce) representatives which was held to review noise modeling results submitted with the Site Permit Application for the Project. The sound propagation model for Three Waters Wind Farm has been updated to reduce turbine-only sound levels to not more than 47 dBA at area residences. Modeling turbine-only sound levels to not more than 47 dBA in conjunction with a conservative addition of 2 dB to the manufacturer's apparent sound power level of turbines in the model helps to ensure the project's compliance with the MPCAs sound regulations.

The updated model uses the same modeling parameters that were used in the Preliminary Noise Compliance Assessment (Preliminary Assessment) for the Project dated October 3, 2019. Specifically, a receiver height of 4 meters and a ground factor of G=0.7 is used. This memorandum provides a summary of the mitigation that has been incorporated into the model, a brief summary of the model results, and brief discussion on the choice of modeling parameters.

Mitigation and Model Results

As in the Preliminary Assessment, a total of 128 turbines (79 in Minnesota and 49 in Iowa) are modeled in the same locations as previously reported, which includes both primary and alternate turbines. To reduce projected sound levels to 47 dBA or less, two forms of mitigation were applied to select turbines: Low Noise Trailing Edge Blades (LNTE) and various levels of Noise Reduced Operations (NRO). GE offers NRO modes for the GE 2.82-127 in 1 dB increment reductions. **[NONPUBLIC DATA HAS BEEN EXCISED]**.

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In the updated model, there are a total of 54 standard GE 2.82-127 turbines that do not need LNTE or NRO in order to achieve a sound level of 47 dBA or less at residences. Turbines with mitigation applied include:

- 31 turbines with LNTE & no NRO (17 in MN & 14 in IA), and
- 43 turbines with LNTE & NRO (30 in MN and 13 in IA).

With this mitigation incorporated into the model, a summary of the projected turbine-only sound levels (L_{50}) at residences by participation status and location is provided in Table 1.

TABLE 1: SUMMARY OF MITIGATED MODEL RESULTS

RECEPTOR		AVERAGE PROJECTED TURBINE-ONLY SOUND LEVEL (L_{50}, dBA)	MAXIMUM PROJECTED TURBINE-ONLY SOUND LEVEL (L_{50}, dBA)
Minnesota	Non-Participating	36	47
	Participating	44	47
Iowa	Non-Participating	45	47
	Participating	46	47

Modeling Parameters

The selection of modeling parameters is dependent upon the sound level metric that needs to be modeled, and the sound level metric that needs to be modeled is dependent upon the applicable regulation. Pursuant to Minn. R. Ch. 7030, Minnesota regulates the hourly median sound level, $L_{50,\ 1\text{-hour}}$. To model the L_{50} due to turbines both accurately and conservatively, we used:

- the manufacturer's reported apparent sound power level plus 2 dB,
- a ground factor of G=0.7, and
- a receiver height of 4 meters.

Receiver Height

Some other site permit applications[1] before the MN Public Utilities Commission (PUC) have used receiver heights of 1.5 meters as opposed to 4 meters. However, using a receiver height of 4 meters is more conservative and results in a projected sound level that is 1.6 dB higher, on average, than the results projected at a height of 1.5 meters. Use of 4 meter receiver height is also supported by post-construction monitoring at a number of projects[2], and by the Institute of Acoustics' Good Practice Guide on Wind Turbine Acoustics Noise (2013), "as it has the effect of reducing the potential oversensitivity of the calculation to the receiver region ground factor compared to lower receiver heights."

[1] See Minnesota DOC Docket Nos. 17-307, 18-179, and 19-394 for example.
[2] Kaliski, et. al., Regulating and predicting wind turbine sound in the U.S., Inter-Noise 2018.

Ground Factor

A ground factor is used in the model to represent the impact the ground surface will have on sound propagation. A ground factor of 0.5 is more commonly used in the United States when the noise standard is based on L_{eq} (i.e., the pressure-weighted mean level). In Minnesota, the noise standard is based on the L_{50} (i.e., the median level). Based on data from the Mass CEC wind turbine research study[3], the L_{50} from wind turbines is typically 0.7 to 1.0 dB lower than the L_{eq}. For Three Waters to account for the difference between L_{eq} and L_{50} in its model and create an accurate projection of L_{50}, an adjustment of the ground factor from 0.5 to 0.7 will lower the sound level projection of the model by 0.7 dB, on average. Using a ground factor of 0.7 to model L_{50} is really a way of applying an adjustment or correction factor to shift from an L_{eq}-based model to an L_{50}-based model to adhere to the Minnesota L_{50} noise standard.

Conclusions

This combination of modeling parameters has been used in other projects in Minnesota that have received permits from the PUC (Docket Nos. 16-215 & 17-700) and result in projected sound levels that are, on average, 0.9 dB higher (e.g. more conservative) than other projects[1] in the State.

We hope this memorandum helps to address some of Commerce's questions and concerns. If Commerce has any questions or comments, or would like other information concerning this matter, they can contact either a Three Waters Wind representative or myself. My contact information is provided below:

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[3] RSG, et. al. "Massachusetts Study on Wind Turbine Acoustics", Massachusetts Clean Energy Center and Department of Environmental Projection, 2016.