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January 8, 2020

Jessica M. Damon
Eastern Maine Regional Office
Department of Environmental Protection
106 Hogan Road, Suite 6
Bangor, ME 04401

Re: Peer Review of Silver Maple Wind Sound Assessment

Dear Jessica:

Tech Environmental, Inc. (TE) has completed an independent peer review of the acoustic impacts of the 20-MW Silver Maple Wind Project in the Town of Clifton with regard to Maine Site Location of Development (SLOD) Regulations. The applicant is proposing to install five Vestas V136-4.0 STE[1] wind turbines on either 105-meter or 117-meter hubs. The project will be located adjacent to, and west of, the existing 9-MW Pisgah Mountain Wind Project. The documents I received for this review include:

- Section 5 of the SLOD Application, which includes the report by RSG, Inc. "Noise Impact Assessment, Silver Maple Wind," July 16, 2019 ("RSG Report").

- Section 1 of the SLOD Application, Silver Maple Wind Project, "Project Description," November 2019.

Review Standard and Receptors

The purpose of this peer review is to determine if the acoustic studies submitted with the Application are reasonable and technically correct according to standard engineering practices and if the proposed project will comply with the Town of Clifton sound limits.

For non-participating land parcels, the Town of Clifton Land Use Ordinance Article 14 sets sound limits of 35 dBA (10-minute L_{90}) within 100 feet of a Sensitive Receptor and 45 dBA (10-minute L_{90}) at the property line. While the Ordinance mentions Short Duration Repetitive Sound (SDRS), it does not impose a 5-decibel penalty like Department regulations.

RSG used over 140 receptors, placed at the location of residences, and the acoustic modeling results show maximum predicted sound levels no higher than 35 dBA at those residences. For assessment of property line sound levels, the RSG Report relies on two decibel contour maps (Figures 27 and 28), and

[1] Serrated Trailing Edge (STE) blades.

concludes on page 28 that "modeled sound levels all along the project boundary are 45 dBA or less." The report needs to include an outline of the proposed compliance testing program for Silver Maple Wind, showing it would satisfy requirements in the Clifton Ordinance and the SDRS requirements in the Department's regulations.

Sound Power Levels Assumed for the Turbines

The sound power level (L_w) on a decibel scale[2] is determined by the manufacturer through a series of prescribed field measurements using the International Standard IEC 61400-11 test method.[3] The IEC-reported sound power level for a given hub-height wind speed is an average value, meaning there is a scatter of values about the average and the actual sound power level emitted in the field may either be lower or higher. To quantify that variability in values of L_w, the IEC provides a method for assessing L_w measurement uncertainty and unit-to-unit turbine production uncertainty, combining both into a total uncertainty "K" factor (IEC Technical Specification 61400-14)[4]. The IEC method defines the "Declared Sound Power Level" as L_w + K, and the sum represents an upper-bound sound power level that, under the stated wind speed conditions, will not be exceeded 95% of the time. The Declared Sound Power Level should be used in acoustic modeling to ensure the predicted sound pressure levels are conservative estimates and reasonably account for known uncertainties. Department regulations (Section 375.10(I)(7)(c)(8) state that "The predictive model … shall include, at a minimum, the following … an uncertainty factor adjustment to the maximum rated output of the sound sources based on the manufacturer's recommendation."

It is not clear whether the applicant's consultant RSG followed this procedure, or not, in modeling sound power levels. The text states on page 27 that "the maximum overall sound power was modeled for each turbine type" and Appendix C (page 363) lists the modeled sound power level as 103.9 dBA for four of the five turbines. With no manufacturer's L_w data provided in the report, the phrase "maximum sound power" could mean several different things. A noise impact assessment for a similar project[5] in Alberta, Canada using the V136-4.0 STE turbine includes the manufacturer's table of 1/3-octave band and A-weighted L_w values, at hub height (HH) wind speeds from 3 m/s to 20 m/s. Vestas' table shows the maximum rated L_w value of 103.9 dBA is achieved at HH wind speeds of 9 m/s and above, a value matching that listed in the RSG Report. This suggests RSG did not include the required K uncertainty factor, which is typically 2 dBA. Correcting this error adds 2 dBA to the modeling results.

[2] The sound power level is defined as $10*\log_{10}(W/W_o)$, where W is the sound power of the source in Watts and W_o is the reference power of 10^{-12} Watts. The sound power level (energy density) and sound pressure level (what we hear) are not the same, yet both are reported using a decibel levels scale. An acoustic model uses the sound power level of a wind turbine along with other assumptions to calculate the sound pressure level heard at a receiver located a certain distance from the wind turbine.

[3] International Electrotechnical Commission, International Standard IEC 61400-11 Edition 2.1, "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques," Geneva, 2006.

[4] International Electrotechnical Commission, Technical Specification TS 61400-14,"Wind turbines – Part 14: Declaration of apparent sound power level and tonality values," Geneva, 2005.

[5] GL Garrad Hassan, Inc., "Noise Impact Assessment for the Windy Point Wind Park," October 13, 2017.

Acoustic Model and Assumptions

Sound levels from the wind turbines were predicted using the Cadna\A acoustic model, the International Standard ISO 9613-2 sound propagation method, and a ground absorption factor of G=0 for a hard ground surface. Page 363 of the RSG Report lists some of the model assumptions, and found there is the choice of "Reflection = None". This means no sound wave reflection was assumed, which is not standard practice in acoustic modeling. Noise impact assessments submitted to the Department typically have the Cadna\A model assuming 2 or 3 reflections. By assuming "None," RSG may have under-predicted noise impacts at the receptors and property lines. All other model assumptions were correctly selected in regard to standard engineering practice.

Noise Reduced Operations (NRO)

In order to achieve the 35 dBA limit at the residence located at 96 Woodchuck Hill Road, the RSG Report (page 31) states that NRO has to be assumed for Turbine 1 (T1), the turbine closest to that residence, under certain wind conditions. That NRO reduces the modeled sound power level from 103.9 dBA to 97 dBA. RSG states that NRO on T1 is only needed when hub-height (HH) winds are 8 m/s or greater and from the south-east direction +/- 22.5°.

The manufacturer's sound power level table for the V136-4.0 STE turbine lists L_w values at HH wind speeds of 5, 6, 7 and 8 m/s of 92.9 dBA, 96.1 dBA, 99.7 dBA and 103.0 dBA, respectively. Thus, when the HH wind speed is 7 m/s, RSG would not recommend applying NRO on T1, yet the un-mitigated L_w level of 99.7 dBA is higher than the 97 dBA they assumed in the modeling. At a minimum, the NRO application rule needs to extend down to HH wind speeds of 7 m/s or greater, and if the modeled sound power level should have been 2 dBA higher, as discussed above, then the NRO application rule needs to extend down to HH wind speeds of 5 m/s or greater.

The wind sector criterion of a +/-22.5° sector centered on the south-east wind is also too narrowly defined. My experience has been that directions 30° to 40° off the direct downwind vector can produce sound impacts equivalent to those of the direct downwind condition. This is consistent with the definition of "downwind propagation" in the International Standard ISO 9613-2[6] that underlies the Cadna\A model:

> "wind direction within an angle of +/- 45° of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region, with the wind blowing from source to receiver."

Thus, NRO on T1 is needed when hub-height (HH) winds are 5 m/s or greater and from the south-east direction +/- 45°.

[6] International Organization for Standardization, ISO 9613-2, "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation," Geneva, Switzerland.

Acoustic Modeling Results

With its chosen modeling approach, the RSG Report predicts maximum sound levels of 35 dBA at one receptor (residence) and 34 dBA at four other receptors. These results are right at the Clifton sound limit of 35 dBA. As discussed above, model predictions appear to be underestimated by 2 dBA.

Tonal Sounds

An analysis of the sound power level spectrum for the Vestas V136-4.0 STE turbine reveals no potential for creating a "tonal sound".

Short Duration Repetitive Sound (SDRS)

The definition of SDRS in the section of the Maine Noise Regulations that pertains to Wind Energy Developments is an impulse sound that is 5 dBA or greater "on the fast meter response above the sound level observed immediately before and after the event." Typically this modulation of the turbine mid-frequency sound (the audible "swish-swish") has an amplitude range of 2 to 5 dBA, with infrequent 6 dBA peaks. The 5-dBA penalty for SDRS is applied to each 10-minute period in which more than five SDRS events occur. The applicant has not discussed the possible effect of SDRS on compliance with the sound limits.

Post-Construction Sound Level Testing

To ensure that the sound level predictions submitted by the applicant are accurate for the wind turbines actually installed, and to ensure compliance with the Town of Clifton Ordinance and the SDRS requirements in the Department's regulations, the Department should require post-construction sound monitoring for the project. Testing should be done at a test location that represents 96 Woodchuck Hill Road.

Summary and Recommendations

A peer review was done of the RSG Report for the Silver Maple Wind Project. The report is incomplete as discussed above. The following additional information is needed in order to conclude the acoustic study is reasonable and technically correct according to standard engineering practices, and if the proposed project will comply with the Clifton sound limits:

1. An outline of the proposed compliance testing program for Silver Maple Wind, showing it would satisfy requirements in the Clifton Ordinance and the SDRS requirements in the Department's regulations.

2. Current Vestas (manufacturer's) data showing that 103.9 dBA is the sound power level with the uncertainty factor included [L_w + K], for the V136-4.0 STE, OR revised acoustic modeling using a sound power level of 103.9 + 2.0 = 105.9 dBA.

3. A demonstration that Reflections = None in the Cadna\A model did not underestimate prediction sound pressure levels, or revised acoustic modeling using Reflections = 2.

4. Revised NRO criteria consistent with the comments in the above section on NRO.

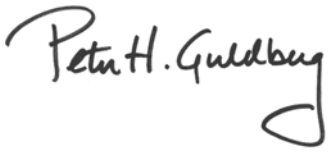
Thank you for the opportunity to provide an independent peer review of the Silver Maple Wind Project application.

Sincerely yours,

TECH ENVIRONMENTAL, INC.

Michael T. Lannan, P.E.
President

TECH ENVIRONMENTAL, INC.



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