September 23, 2020

VIA ELECTRONIC MAIL

Ms. Pamela Monroe, Administrator
Site Evaluation Committee
21 South Fruit Street, Suite 10
Concord, NH 03301

RE: DOCKET NO. 2015-02, ANTRIM WIND SOUND MONITORING

Dear Ms. Monroe:

Attached please find a Sound Monitoring Report prepared by Rand Acoustics, LLC ('Rand') of Brunswick Maine (Exhibit A). The report summarizes the results of a four-day sound survey conducted at the Antrim Wind Energy facility ('Project') from February 19 to February 23, 2020. The survey involved the installation of two outdoor noise monitors at the Berwick property situated at 72 Reed Carr Road in Antrim.[1] During the survey period, Ms Berwick reported two noise complaints. Post-analysis confirmed that both complaints were from Antrim Wind turbine noise. This was corroborated by audio recordings. In each case the recorded Project noise levels exceeded the nighttime noise limit of 40-dBA Leq-0.125 second as defined in the Site Evaluation Committee ('Committee') rules.

This independent survey was conducted at the request of neighbors to the Project. Rand followed the sound monitoring method detailed in NH Site 301.18 and the applicable standards. Graphs shown on pages 6 and 7 of the report clearly show noise exceedances occurring when the Antrim turbines dominated the acoustic environment with pronounced whooshing and thumping typical of wind turbine amplitude modulation[2] ('AM'). Rand recorded repetitive AM ranging between 3 and 8 decibels (dB). Rand's findings are consistent with audio recordings submitted to the Committee by Ms. Berwick and others living near the Antrim turbines.[3]

Turbine amplitude modulation is obvious to the listener, well documented in the technical literature, and clearly recognizable in valid sound data. No competent acoustician who has dealt with wind turbine noise could say otherwise.

In fact, Michael Bahtiarian, Antrim's principle consultant for its winter 2020 monitoring, documented AM emitted from turbines sited in Falmouth, MA[4] and Kingston, MA.[5] In Kingston, Mr.

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[1] Turbines T1, T2, T3 are approximately 3670, 3800, and 5000 feet respectively from the Berwick home.
[2] Amplitude modulation is a well document characteristic of wind turbine noise. It is defined as periodic changes in amplitude or loudness of a signal and is associated with the rate of blade-pass frequency.
[3] Morrison, E, (20 July, 2020). Complaint from Erin Morrison 07/20/20. The audio submitted to the Committee is sufficient for demonstrating the characteristic AM in the Project turbine noise. Retrieved at https://drive.google.com/file/d/1iPND1w1dJzxZ6kK00N4-oXkuvNVFTKzL/view
[4] Bahtiarian, M. & Beaudry, A. (27 February, 2015) Infrasound measurements of Falmouth wind turbines

Bahtiarian explains how his data showed "*the acoustic characteristic produced by wind turbines (i.e. the "woosh-woosh" sound) known as Aerodynamic Amplitude Modulation (AAM)*." He goes on to explain that "*AAM is a striking characteristic or signature unique to wind turbines. Persistent evidence of AAM in a set of noise data is a reliable method for determining if a wind turbine is indeed the primary noise source.*"[6] Mr. Bahtiarian's explanation is consistent with Rand's findings at Antrim.

Mr. Bahtiarian and Acentech now claim that wind turbine noise is a 'steady sound source,' which is factually untrue and not supported by Mr. Bahtiarian's prior work or any literature addressing modern wind turbine noise.[7] Bahtiarian/Acentech use this claim to arbitrarily and incorrectly declare Project sound measurements where minimum and maximum levels differ by more than 3 dB as contaminated by 'non-turbine sounds' and exclude those measurements from their data set.[8]

None of these actions are supported by NH Site 301.18 or any of the relevant professional sound standards cited. Bahtiarian/Acentech misapply ANSI S12.9 Part 3 § 6.5(b)(1) when trying to claim the ANSI standard supports this action. It does not. The purpose of § 6.5 is to describe a quick and simplified method for *on-site* observers to measure steady (or intermittent) sounds under non-complex environmental conditions. Bahtiarian/Acentech conducted *unattended* and long-term monitoring under highly complex environmental conditions where the repetitive whoosh of the measured sound regularly exceeds 3 dB. Exhibit B contains the relevant language of ANSI S12.9 Part 3 § 6.4 and § 6.5 for the Committee's reference. Section 6.4 lists examples of steady sounds contemplated by the standard (cooling towers, electric power transformers, diesel generators). In short, Bahtiarian/Acentech cherry-picked a definition from the standard which is generally inapplicable to the type of monitoring conducted.[9] There is no basis under ANSI S12.9 Part 3 to support the discarding of valid turbine sound data as was done in this case.

The obvious effect of this novel device by Bahtiarian/Acentech is to exclude valid turbine noise measured at the Project, thereby *suppressing periods of turbine noise exceedances*.

As you are aware, numerous noise complaints have been filed with the Committee by residents living near the Project. The record is replete with correspondence on this issue. Antrim Level, LLC insists the Project is operating in compliance with the certificate. Its July 17[10] and August

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Wind #1 and Wind #2 (at 2). Retrieved at http://s3.amazonaws.com/windaction/attachments/2359/NCE-Report-of-February-27-2015.pdf

[5] Beaudry, A. & Bahtiarian, M. (23 April, 2013). O'Donnell wind turbines noise evaluation Kingston, MA. Retrieved at https://windwisema.files.wordpress.com/2013/05/2013-05-23-o_donnellwindturbineevaluation.pdf

[6] *Id.* at 8

[7] Oerlemans, S. (15 July, 2011) An explanation for enhanced amplitude modulation of wind turbine noise. Retrieved at https://cdn.ymaws.com/www.renewableuk.com/resource/collection/4E7CC744-FEF2-473B-AF2B-135FF2AA3A43/ruk_wind_turbine_amplitude_modulation_dec_2013_v2_(1).pdf

[8] Brush, E. & Bahtiarian, M. (12 May, 2020). Post construction sound monitoring report – Winter 2020 (at 19). Retrieved at https://www.nhsec.nh.gov/projects/2015-02/post-certificate-filings/2015-02_2020-05-13-20_awe_post_construction_sound_monitoring.pdf

[9] *Id.* at 19. Acentech states that measured sound data are excluded during periods where "LA10 and LA90 sound levels differed by more than 3 dBA." Acentech arbitrarily changed the ANSI definition of steady sound source by substituting LA10 for Lmax and LA90 for Lmin.

[10] Latour, J. (17 July, 2020). TransAlta response to comments received on post-construction sound monitoring report. Retrieved from https://www.nhsec.nh.gov/projects/2015-02/post-certificate-filings/2015-02_2020-07-17_transalta_response_linowes.pdf

11[11] letters tortuously labor to find foundation within the plain language of the SEC rules and supporting standards to justify its claim where no such foundation exists. The fact remains that the methods utilized by Mr. Bahtiarian, Acentech, and now Cavanaugh-Tocci[12] are not supported by the SEC rules and render any legitimate analysis and validation of their conclusions and regulatory compliance impossible.

We hope the attached report will prove a useful addition to the record. Now that Mr. Tocci has completed his peer-review of the Acentech winter sound monitoring report, we urge the Committee to schedule a tech session, an evidentiary hearing and a briefing schedule so that parties can respond appropriately.

Respectfully,

Lisa Linowes
for The Windaction Group

[11] Needleman, B. (8 August, 2020). Response to Comments of Lisa Linowes dated 08/11/20 https://www.nhsec.nh.gov/projects/2015-02/public-comments/2015-02_2020-08-11_resp_comments_l_linowes.PDF

[12] Cavanaugh-Tocci misapplied ANSI S12.9 Part 3 §6.5(b)(1). See Cavanaugh-Tocci (25 August, 2020). AWE wind farm sound measurement report (at 3 and Appendix A). Cavanaugh-Tocci 'voids' ***all*** Project sound data collected at the monitor and declares the turbines compliant with the certificate. Also See: CAVANAUGH TOCCI Peer Review (at 4).

EXHIBIT A – Rand Report Antrim Wind Facility

Robert W. Rand, ASA, INCE (Member Emeritus)
RAND ACOUSTICS, LLC
65 Mere Point Road
Brunswick, ME 04011
E-mail: rrand@randacoustics.com
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September 3, 2020

Ms. Lisa Linowes
The WindAction Group
286 Parker Hill Road
Lyman, NH 03585

Re: Complaint Response Noise Survey 2/19-2/23, 2020
Antrim Wind Facility, Antrim, NH

The New Hampshire SEC Rules for Noise Testing and Compliance are complaint-driven. Shortly after Antrim Wind began operation, two neighbors, one east and another west have complained about Antrim Wind noise.

Per your request, two outdoor noise monitors were installed near the Berwick home (east) in Antrim, NH from February 19 to February 23, 2020. During the four-day survey there were two noise complaints: first at 8:48 pm (21Feb2020) and a second at 12:36 am (22Feb2020). Post-analysis confirmed that both noise complaints were from Antrim Wind turbine noise, corroborated by audio recordings and dBA vs 100 millisecond time history graphs.

I respectfully submit this complaint response technical report summarizing the Antrim Wind noise monitoring and post-analysis. Antrim Wind turbine noise levels exceed the 40-dBA, Leq-0.125-second site noise limit at the Berwick home.

Methodology

By NH SEC Rules, Leq-0.125-second noise levels shall not exceed 40 dBA at night and measurements during field sound surveys investigating noise complaints shall be taken at 1/8-second intervals using Fast response and Leq metrics:

> *NH Site 301.14(f)(2)a: With respect to sound standards, the A-weighted equivalent[1] sound levels produced by the applicant's energy facility during operations shall not exceed the greater of 45 dBA or 5 dBA above background levels, measured at the L-90 sound level, between the hours of 8:00 a.m. and 8:00 p.m. each day, and the greater of 40 dBA or 5 dBA above background levels, measured at the L-90 sound level, at all other times during each day, as measured using microphone placement at least 7.5 meters from any surface where reflections may influence measured sound pressure levels, on property that is used in whole or in part for permanent or temporary residential purposes, at a location between the nearest building on the property used for such purposes and the closest wind turbine, and the measurements shall be performed at night with winds above 4.5 meters per second at hub height and less than 3 meters per second at ground level; and*
>
> *NH Site 301.18(e)(6): All sound measurements during post-construction monitoring shall be taken at 0.125-second intervals measuring both fast response and Leq metrics; and*
>
> *NH Site 301.18(i): Validation of noise complaints submitted to the committee shall*

1) Equivalent sound level measurements are defined as Leq, 0.125-second, Fast response in NH Site 301.18(e)(6): "*All sound measurements during post-construction monitoring shall be taken at 0.125-second intervals measuring both fast response and Leq metrics*".

require field sound surveys, except as determined by the administrator to be unwarranted, which field studies shall be conducted under the same meteorological conditions as occurred at the time of the alleged exceedance that is the subject of the complaint.

Noise measurements were acquired using recommended survey methods which are consistent with ANSI S12.9 and requirements in the Site 301.18(a)(4) Sound Study Methodology, sections of which are listed below:

Sound measurements shall be omitted when the wind velocity is greater than 4 meters per second at the microphone position, when there is rain, or with temperatures below instrumentation minima; and,

a. Microphones shall be placed 1 to 2 meters above ground level, and at least 7.5 meters from any reflective surface; and

b. A windscreen of the type recommended by the monitoring instrument's manufacturer must be used for all data collection;

c. Microphones should be field-calibrated before and after measurements; and

d. An anemometer shall be located within close proximity to each microphone.

Facility noise levels were acquired at 1/10-second intervals which is consistent with and exceeds the 1/8-second interval requirements of the NH SEC Rules for Noise Testing and Compliance. Measurements using longer averaging than 1/8-second (examples, 1-second, 10-second, 10-minute, 1-hour) fail to track the Fast response as the ear hears (complaints).

Noise monitoring during this complaint response survey represents the meteorological conditions for noise complaints as the measurements were conducted during complaints. Hub height operating conditions during the survey are unknown without SCADA logs.

It must be noted from decades of professional noise survey practice: When the noise source under investigation dominates the acoustic environment, rural background sound levels 10 or more dB lower are insignificant and "corrections" to measured sound levels are not warranted.

Facility overview

The Antrim Wind facility consists of nine Siemens SWT-3.2-113 Direct Drive turbines each with a nameplate generating capacity of 3.2 MW. The turbines run approximately two miles along the Tuttle Hill ridgeline toward nearby Willard Mountain as shown on Figure 1. Excluding turbine blades, 8 of the turbines are 92.5 meters tall (303.5 feet) and 1 turbine is 79.5 meters tall (260.9 feet). Including turbine blades, 8 of the turbines are 488.8 feet tall and turbine 9 is 446.2 feet tall. The Tuttle Hill ridgeline elevation ranges between 1760 and 1830 feet, a rise of 610 to 680 feet above the valley floor. The three nearest turbines to the Berwick property, T1, T2, and T3 are line-of-sight and respectively approximately 3670, 3800, and 5000 feet from the Berwick home. Turbine T1 is visible and audible through trees. Turbine T2 (see Figure 3 of this report) has a total elevation to blade tip of approximately 1000 feet above the Berwick home. The T3 hub and blades are visible above the treeline (see Figure 3).

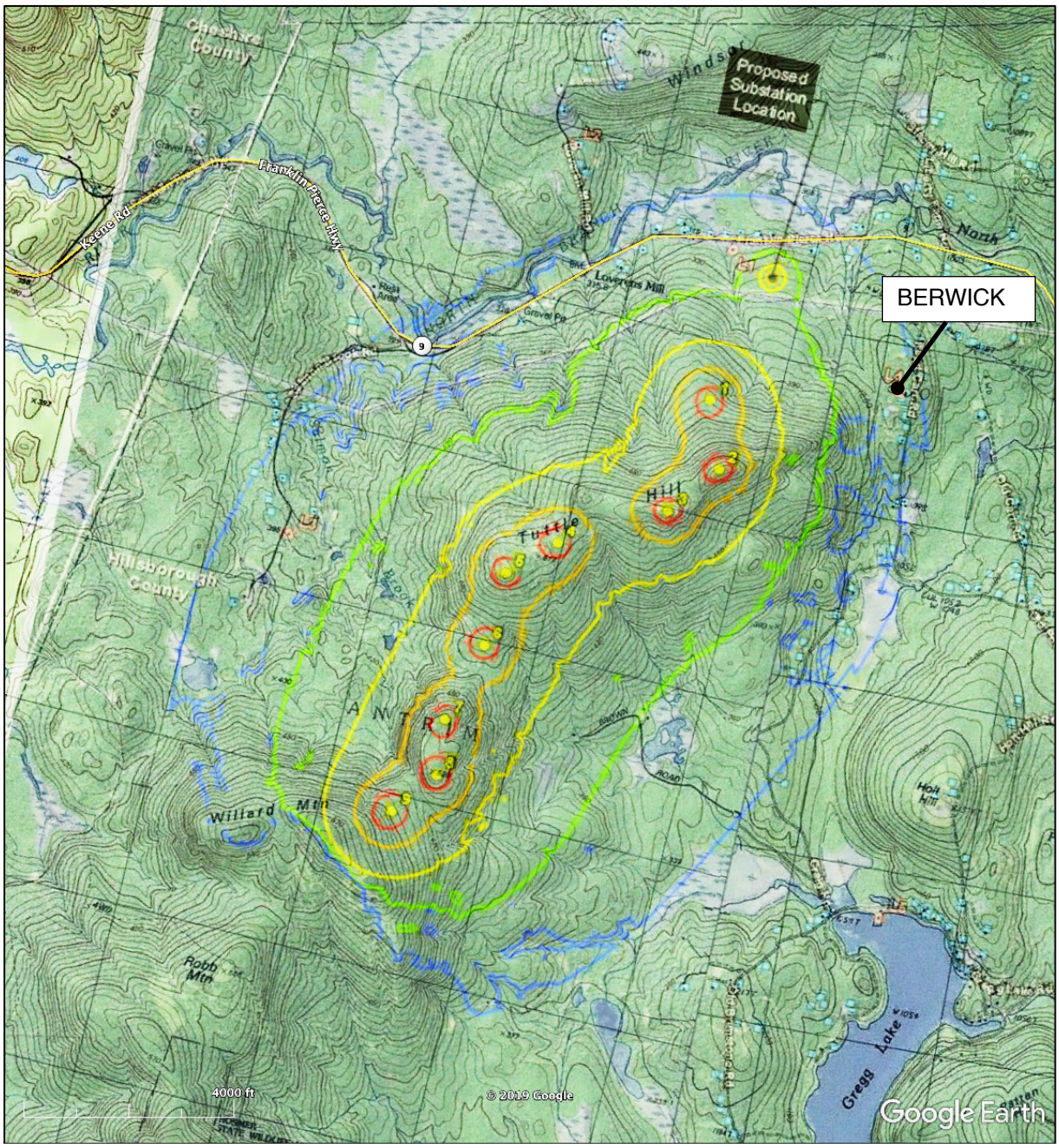


Figure 1. Turbine locations with 2016 predicted long term average noise levels (yellow, 45 dBA; green, 40 dBA; blue, 35 dBA). This survey location is at 72 Reed Carr Road (BERWICK).

Survey setup and instrumentation

The Berwick home was visited by this author during the midday on 2/19/20. The weather was mild and sunny with light winds. The Berwicks were home during the visit and agreed to the noise survey. The yard layout was reviewed, and locations selected for instrumentation.

The survey was conducted from approximately noon on 2/19/20 to noon on 2/23/20. Primary and backup survey microphones (NM1 and NM2) were installed in the yard approximately 40

and 37 feet (12 and 11 meters) diagonal to and southwest of the home, in the clear yard area away from trees. Per NH Site rules, the distances from microphones to the home exceed the minimum requirements of 7.5 meters and, as required, the microphone locations fall between the home and turbine locations. A datalogging wind speed anemometer (WM) was installed near the survey microphones to assess for wind speeds at microphones. The microphones and anemometer were installed at a height of approximately 1.2 meters, within the required 1 to 2 meters.

The NM1 system was comprised of a Svantek SV 277 PRO Outdoor Monitor System (SV 977: sn 46468) with Type 1 Environmental Microphone System with manufacturer's environmental windscreen and bird-spikes, powered via AC power cable from the house. Calibration was checked before and after the survey with a Svantek Acoustic Calibrator (SV33A: sn 46144) operating within its calibration period. The NM1 was set up to acquire Fast Response LAeq (A-weighted), LCeq (C-weighted), and LZeq (Linear) sound levels 10 times per second, meeting and exceeding the 8 samples per second requirements of the NH SEC Rules.

The NM2 backup system was comprised of a GRAS 40AN Type 1 Precision microphone (sn 73461) and GRAS Type 26AI low frequency 200V preamplifier (sn 283409) connected via 100-meter Norsonic LEMO7 cable to a SINUS Messtechnik GmbH Model Apollo Box 4-channel Acoustic Analyzer (sn 7800) operated with Sinus Samurai software version 2.8.3 on a Windows 10 laptop located in the house basement. System end-to-end calibration was performed with a Bruel & Kjaer Type 4230 Acoustic Calibrator (sn 1103065) operating within its calibration period. The NM2 microphone was equipped with a 7-inch ACO windscreen covered with nylon coated with ScotchGard and topped with bird spikes. Five parallel Samurai Class 1 sound level meters meeting IEC 60561, 60804, and 61672 were set up on the NM2 signal with an audio sampling rate of 12800 Hz at 24 bits and configured to acquire 0.05, 0.125 (matching NH SEC Rules), 1, 60 and 600 second time records including simultaneous LAeq, LCeq, and LZeq sound levels for each time period. TeamViewer software was utilized to observe and listen to Samurai data acquisition remotely during the survey. Recordings were reviewed during post analysis. Extraneous ground loop noise was found in the recording but didn't interfere with listening. The NM2 data were not used in this analysis.

The two calibrators' outputs provided consistent system calibration within 0.5 dB.

The WM wind speed logger was a Madgetech Wind101A (sn N66334) cup anemometer set up to record average wind speed in 10-second periods. The Madgetech was configured to start automatically on 2/19/20 and was stopped and downloaded on 2/23/20.

Survey instrumentation locations (NM1, NM2, WM) are shown in Figures 2 and 3 below.

Figure 2. Mic (NM1, NM2) and anemometer (WM) locations.

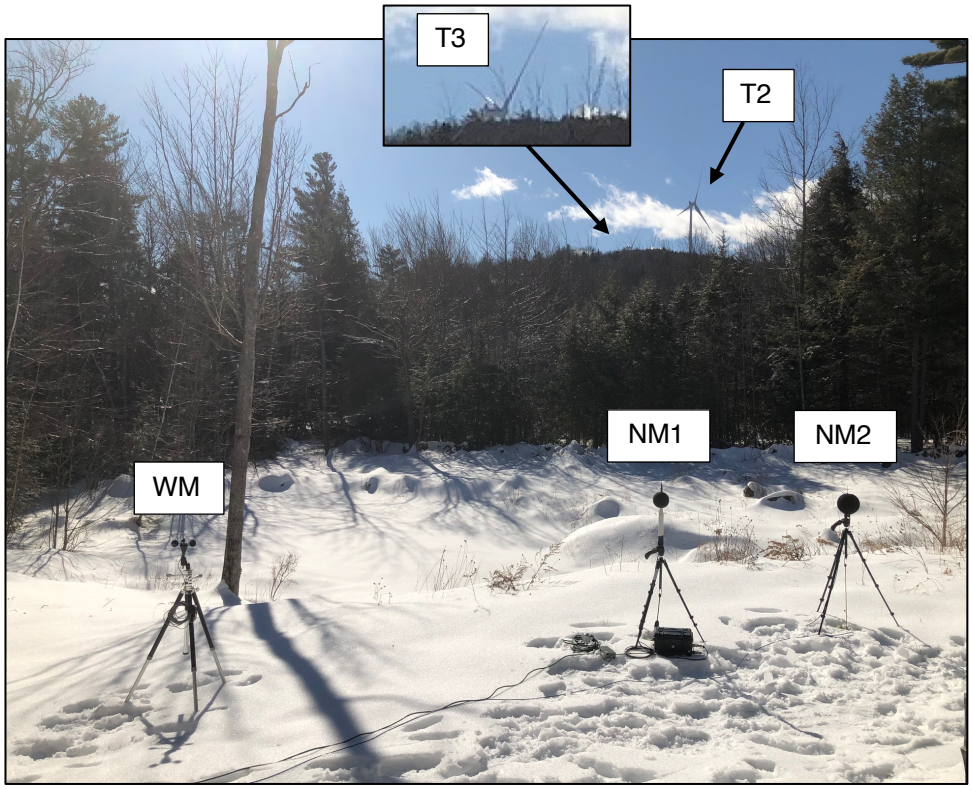


Figure 3. Looking West, left to right, anemometer WM, primary system NM1, and backup system microphone NM2. Turbines 2 and 3 are visible direct line-of-sight on Tuttle Hill in top right portion of photograph (T3 nacelle is just above ridgeline).

Complaint Noise Analysis

2/21/20 8:48 PM: Sound occurring during the Berwick noise complaint for February 21, 2020 8:48 pm was reviewed in the backup record and plotted from the primary system NM1. The Antrim Wind turbines dominated the acoustic environment with pronounced low frequency whooshing-thumping. There was very low variable wind (slight to none) at the Berwick home, under 3 m/s and no wind induced noise in the microphone recording. The local temperature was 21F and humidity 51% [2]. The 1/10-second A-weighted Leq noise level exceeded the facility not-to-exceed night noise limit of 40 dBA by several dBA numerous times. Deep repetitive amplitude modulations, adding together from multiple turbines, and exceeding 3 dB up to 7 dB depth, were observed occurring at wind turbine blade pass rates. See Figure 4 trend chart below showing A-weighted sound level versus time.

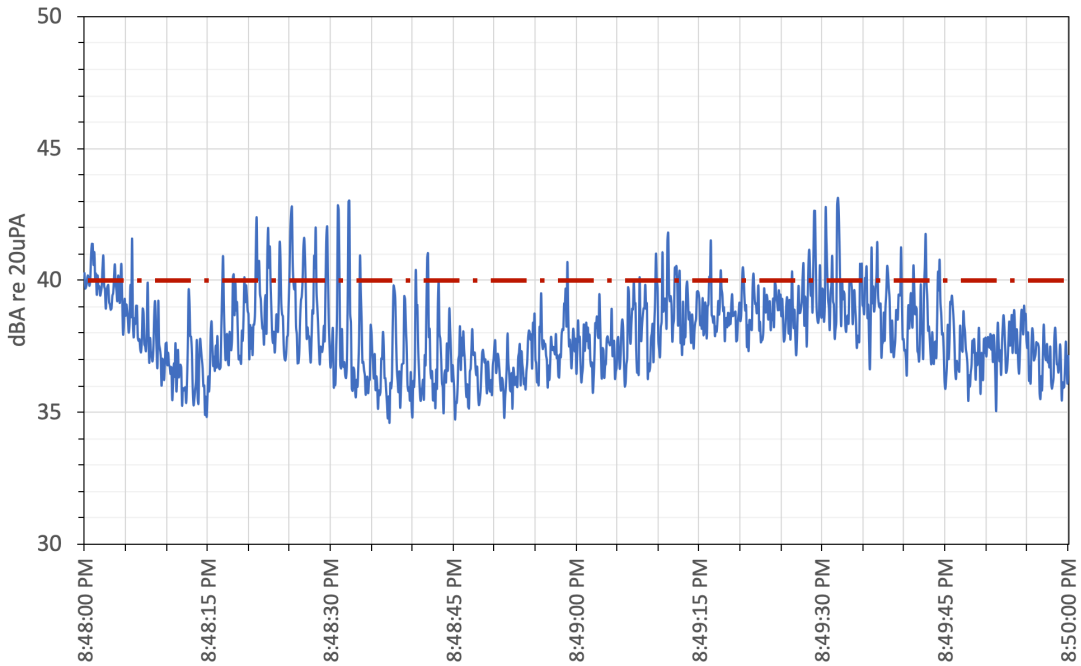


Figure 4. 2/21/20 8:48 PM, 1/10-second LAeq, turbines dominating the acoustic environment. The NH shall-not-exceed 40-dBA night noise limit is shown in red.

2/22/20 12:36 AM: Sound occurring during the Berwick noise complaint for February 22, 2020 12:36 am was reviewed in the backup record and plotted from the primary system NM1. The Antrim Wind turbines dominated the acoustic environment with pronounced low frequency whooshing and thumping. There was no wind at the Berwick home and no wind induced noise in the microphone recording. The local temperature was 20F and humidity 52%. The 1/10-second A-weighted Leq noise level exceeded the facility not-to-exceed night noise limit of 40 dBA by several dBA numerous times. Deep repetitive amplitude modulations, adding together from multiple turbines, exceeding 3 dB up to 8 dB depth were observed occurring at wind turbine blade pass rates. See Figure 5 trend chart below showing

2 https://www.wunderground.com/dashboard/pws/KNHANTRI9/ accessed March 1, 2020.

A-weighted sound level versus time.

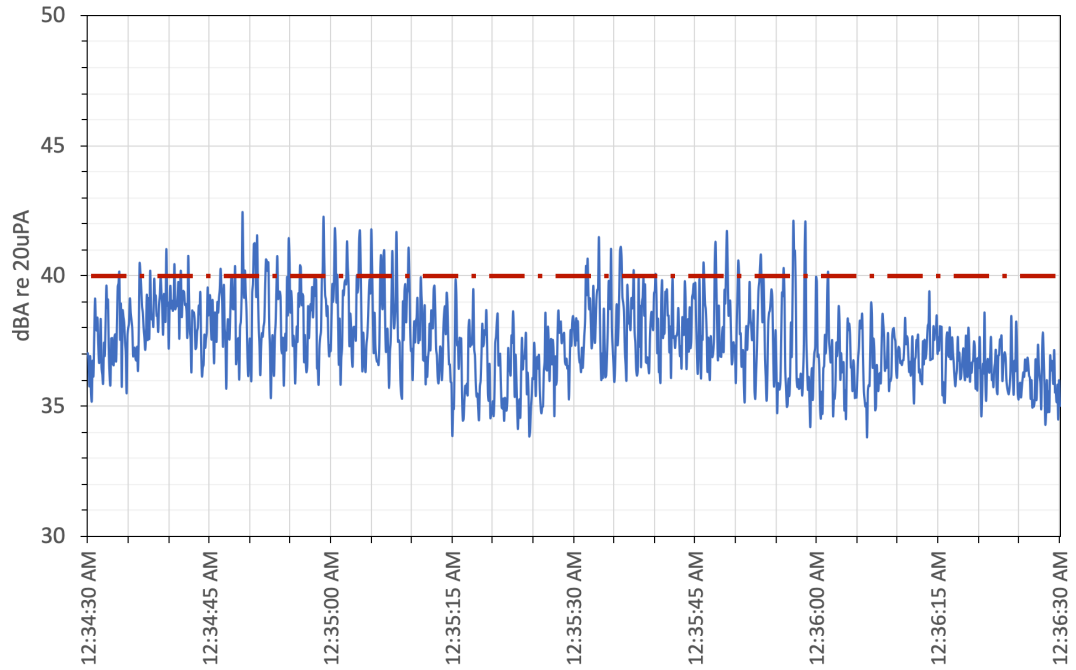


Figure 5. 2/22/20 12:36 AM, 1/10-second LAeq, turbines dominating the acoustic environment. The NH shall-not-exceed 40-dBA night noise limit is shown in red.

Wind speed at microphones during complaint times

Wind speeds at microphones as measured by the WM anemometer were below 4 m/s during the complaint times of 2/21 8:48 pm and 2/22 12:36 am.

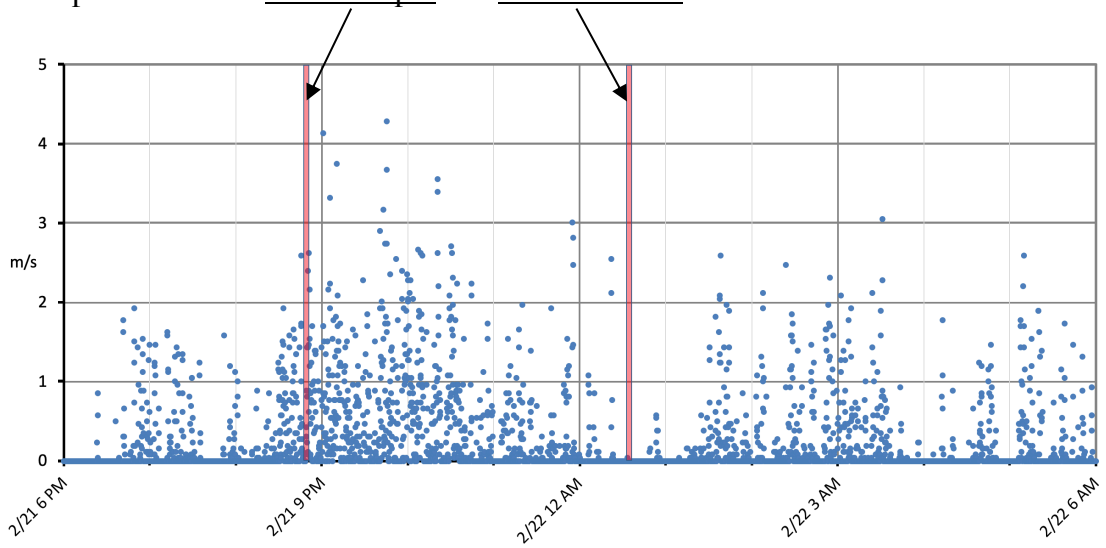


Figure 6. Wind speeds at microphone locations with complaint times shown.

Ground-level wind speeds at the Berwick home were light, variable and under 3 m/s at 2/21 8:48 pm and negligible (no wind) at 2/22 12:36 am. The data are consistent with observations that the Antrim Wind turbines dominated the acoustic environment at the time of complaints and "wind in trees" sounds were not significant contributors to the measured sound levels.

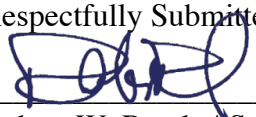
Conclusions

1. The complaint response noise survey at the Berwick home February 19-23, 2020 documented Antrim Wind exceeding the do-not-exceed 40-dBA night noise limit at complaint times.
2. Antrim Wind turbine noise dominated the acoustic environment at the complaint times with repetitive modulations with 1/10-second LAeq exceeding 40 dBA numerous times.
3. The noise survey was conducted during light wind conditions suggesting partial power conditions. During stronger winds aloft the turbines could be louder.
4. Complaints investigated during the noise survey occurred in the nighttime period. Complaint times and notes provided the most efficient basis for monitoring scheduling.
5. Noise survey results confirmed that excessive noise can be documented using recorded unattended monitoring when analysis corresponds with neighbor complaints.
6. Sensitive home activities such as sleeping and restoration in quiet conditions occur primarily between 8 pm and 8 am (night). It may be more efficient to focus on nighttime noise monitoring than daytime.
7. Valley topographic isolation below ridge with winds hundreds of feet aloft moving through turbine blade envelopes can result in low or no winds at the valley home with Antrim Wind turbine noise illuminating and dominating the valley acoustic environment.

Much appreciation is extended to the Berwicks for hosting the survey at their home, and to Mr. Stephen E. Ambrose, INCE (Board Cert. Member Emeritus) for instrumentation and analysis review.

Thank you for your consideration of this report. If you have any questions, please contact me.

Respectfully Submitted,



Robert W. Rand, ASA, INCE (Member Emeritus)

EXHIBIT B - ANSI/ASA S12.9-2013/Part 3

6.4 Initial data collection

(a) The duration of the basic measurement, together with any conditions related to the time of day, day of week, and season for the measurement, shall be established prior to the beginning of measurements.

(b) The characteristics of the source(s) and type of operation shall be examined to determine if:

(1) the sound pressure level of the source is essentially steady with time (e.g., cooling tower, electric power transformer, or diesel generator), or

(2) the sound pressure level of the source varies with time (e.g., cycling window air-conditioner, steam over-pressure valves, jet engine test cell, construction cranes, bulldozers, and forklift trucks).

6.5 Simplified procedure 1 for the accelerated measurement of equivalent-continuous sound pressure level

(a) Simplified data collection procedure 1 may be used to reduce the on-site measurement time when the following conditions are met:

(1) The measurements are being obtained with a standard frequency weighting (e.g., A-weighting) or are frequency filtered in a defined manner to yield only one sound pressure level;

(2) The source(s) sound pressure level is essentially steady with time and the source can be turned on and off; or

(3) The source is intermittent, consisting of definite on and off cycles and the sound pressure level during each "source-on" period is virtually constant.

(b) The following is the method of simplified procedure 1:

(1) Set the sound level meter to measure approximately 0.1 s time-average or *fast* time-weighted sound pressure levels. Observe the changes in indicated level when the source(s) of a steady sound are turned on or off, or when the source(s) of an intermittent sound are on or off, and determine if each source constitutes a dominant sound.

- *For a steady sound,* observe the indicated sound level for a 5-min period with the source(s) in operation and determine the frequency-weighted or frequency-filtered sound pressure level. For the sound to be essentially steady, the difference between the maximum sound pressure level and the minimum sound pressure level measured during the 5-min observation period shall be less than or equal to 3 dB. If there are transient background sounds that cause the indicated sound pressure level to rise by 3 dB or more, discard the sound pressure level measurements and repeat the 5-min observation. If interruptions persist, use the methods of 6.7.2 or 6.7.3 to eliminate the contribution of transient background sounds from the measurements of sound pressure levels as measured in the field.