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May 31, 2012

Hon. Jaclyn A. Brilling
Secretary, New York State Public Service Commission
Three Empire State Plaza
Albany, New York 12223-1350

Re: Case 12-F-0036, In the Matter of the Rules and Regulations of the Board on Electric Generation Siting and the Environment, contained in 16 NYCRR, Chapter X, Certification of Major Electric Generating Facilities

Dear Secretary Brilling:

This office represents the Town of Malone (Franklin Co.) in the above-referenced matter. Please accept the following comments and enclosures regarding the regulation of noise impacts under 16 NYCRR, Chapter X. These comments focus exclusively on noise issues raised by siting utility-scale wind energy projects. I anticipate filing a subsequent comment letter with you by June 15.

In support of these comments and filed with this letter is a letter by acoustic engineer Richard James, including further supporting information. Mr. James has substantial experience measuring actual sound emissions from operating wind farms and reviewing wind project preconstruction noise assessments. Please consider Mr. James' letter and attachments incorporated by reference into this letter.

1. Introduction

The requirement found in the draft regulations to assess the "worst case" noise condition is commendable, and consistent with the only noise assessment guidance otherwise applicable in New York, issued by NYSDEC. *See* subsection 1001.19(f). However, other draft provisions are inconsistent with this policy and should be changed to achieve consistency.

2. Low frequency sound impacts should be specifically addressed

Low frequency noise is more intrusive than noise dominated by mid and high frequencies. This is because low frequency sound is substantially less attenuated over distance, and therefore travels farther, and more readily passes through walls and windows than mid and high frequency sound captured by A-weighted filtering (dBA). Substantial pulsation (amplitude modulation) in the noise makes the low frequency components even more noticeable. Chronic exposure to excessive low frequency noise results in sleep disturbance and adverse health effects, and "there is not a single published study showing a lack of adverse effects of wind turbine noise on sleep and health."[1] Noise assessments should therefore be required to determine whether a project will emit sound with substantial low frequency and pulsating components.

Sound emissions of modern wind turbines, for example, are predominantly low frequency, as demonstrated by the attached comments of Richard James. To assess low frequency noise impacts, at a minimum C-weighted filtering (dBC) must be utilized. Subsections 1001.19(c), (e) and (f) should therefore add dBC sound levels to those included as required subjects of any evaluation of future noise levels.

3. Assuming wind-induced background noise departs from the "worst case" policy.

Subsection 1001.19(d) requires that estimates of the future noise level of operations "assum[e] wind-induced background noise or stable atmospheric conditions, as appropriate . . ." This provides insufficient guidance such that siting reviews can be expected to get routinely bogged down over the question, which approach is appropriate?

Importantly, there is no scientific basis for assuming, for wind energy projects, wind-induced background noise will occur all or even most of the time during operations.

For wind projects, it is now well established that assuming wind-induced background noise fails to accurately estimate noise impacts under reasonable worst case conditions. Such conditions include wind shear which, when it occurs, results in operations of wind turbines during times when no significant wind-induced background noise is present at ground level. Independent peer-reviewed research shows that wind shear is a common occurrence at night everywhere in the temperate zone on earth, including New York.[2]

NYSDEC has commented consistently on wind project proposals that the method for determining baseline background sound levels in a community must identify the "worst case 10

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[1] C.D. Hanning and Alun Evans, "Re: wind turbine noise, Authors' reply" [to: Hanning and Evans, "Editorial: wind turbine noise," 344 *British Medical Journal* 1527 (2012)], available at <http://www.bmj.com/content/344/bmj.e1527?tab=responses>. Dr. Hanning is an expert in sleep medicine; Professor Evans is an expert in public health. The editorial in the *British Medical Journal* was peer-reviewed.

[2] G.P. van den Berg, *The sound of high winds: the effect of atmospheric stability on wind turbine sound and microphone noise*, Doctoral Dissertation (May 12, 2006), Groningen Univ. (Rotterdam), p. 104, available at <http://www.dissertations.ub.rug.nl/faculies/science/ 2006/g.p.van.den.berg/>. This study has been favorably reviewed by independent acoustic experts. *See* Acoustic Ecology Institute (Santa Fe, NM), *Wind Turbine Noise Impacts* (January 6, 2009), available at <http://www.acousticecology.org/srwind.html>.

minute sound pressure level," assuming no wind-induced noise.[3]

For these reasons, discussed in detail by Mr. James (attached), subsection 1001.19(d) should simply disallow the assumption of wind-induced background noise during operations, for highly elevated noise sources such as wind turbines.

4. The need for a performance standard for wind turbine noise

The draft regulations, if augmented to require accurate background sound studies and address the impacts of pulsating and low-frequency noise, will result in sufficient information to assess the potential of projects to have adverse noise impacts. However, without performance standards the regulations provide insufficient guidance to a Siting Board about how to evaluate the information. To provide sufficient guidance, the regulations should include performance standards and require applicants to provide a reasonable assurance that the standards will be met prior to certification.[4]

A research-based numerical sound level limit to avoid sleep disturbance has been issued by the World Health Organization (WHO). Inside the home where people sleep, WHO guidelines state that 30 dBA is sufficiently protective of public health, but if low frequencies dominate and A-weighted reporting of sound levels is utilized, a 6 dB penalty should be added to modeled project sound levels.[5] This independent standard is designed to prevent significant adverse health

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[3] See Rudyard Edick, NYSDEC, Letter to Town of Allegany Planning Board, April 30, 2010, at pp. 10-11; Rudyard Edick, NYSDEC, Letter to Town Board of the Town of Orangeville, May 20, 2010, pp. 13-14. Copies of these two letters are attached.

[4] Improper siting based on overly liberal noise performance standards and professionally indefensible sound study protocols is the primary impetus behind property value guarantees, which are increasingly being incorporated into local laws in New York and elsewhere. *See* Iberdrola Renewables, supplemental comments filed in this matter, dated May 29, 2012, p. 2. *Compare* Martin D. Heintzelman and Carrie M. Tuttle, "Values in the Wind: A Hedonic Analysis of Wind Power Facilities," Clarkson University, March 3, 2011, available at <http://clarkson.academia.edu/MartinHeintzelman/Papers/1155349/Values_in_the_Wind_A_Hedonic_Analysis_of_Wind_Power_Facilities>. Based on "data on 11,369 arms-length residential and agricultural property transactions between 2000 and 2009 in Clinton, Franklin, and Lewis Counties in Northern New York to explore the effects of relatively new wind facilities," homes 0.5 miles away from a wind turbine had 10.87%-17.77% declines in sales price, and at a distance of one mile declines in value of between 7.73% and 14.87%. *Id.*, at 9, 26. *See also* Greg Fladager, "Properties 'virtually unmarketable,'" *Casper Journal* (September 21, 2010), available at <http://www.casperjournal.com/article_113f34f7-c657-53b7-a042-3afafc2d2139.html>. Proper siting may obviate the need to apply property value guarantees.

[5] See discussion in attached James comments, and in my appendix excerpting the findings of the Minnesota Department of Health, Environmental Health Division, PUBLIC HEALTH IMPACTS OF WIND TURBINES (May 22, 2009), available at <http://www.health.state.mn.us/divs/ eh/hazardous/ topics/windturbines.pdf>.

effects of noise. The Article 10 regulations should adopt this standard as a default, imposing a heavy burden on an applicant for certification to show that exceeding this standard is appropriate under the circumstances.

Alternatively, the regulations should adopt NYSDEC's guidelines, which classify the level of annoyance of a noise by how much it exceeds the existing background sound.[6] "In non-industrial settings the SPL [sound pressure level] should probably not exceed ambient [pre-construction] noise by more than 6 dB(A) at the receptor."[7] Applying the guidelines, NYSDEC has commented on New York wind projects urging that generally accepted penalties for noise sources emitting modulating noise, low frequency noise, and night time noise be applied when assessing wind turbine operational noise.[8] Therefore, the regulations should limit wind turbine noise at sensitive receptors to no more than 6 dBA above the baseline ambient sound level, with appropriate penalties added to modeled operational sound levels.

5. Conclusions

New York and the Nation embarked on a policy to promote renewable energy without the benefit of adequate research on the environmental effects of wind farms. NYSDEC and U.S. Fish and Wildlife Service recently issued guidelines on siting wind farms that emphasize the need for additional data and understanding of the impacts on wildlife, recognizing the paucity of data in that area. Arguably, research into the effects of wind turbine noise is at least as advanced than is research into wildlife impacts. As noted herein, it can no longer be questioned, for example, that wind turbine noise is dominated by low frequencies; low frequency noise at night causes sleep disturbance; a significant fraction of those who live within two miles of a typical modern wind farm complain of sleep disturbance; and sleep disturbance is, by itself, a recognized adverse health effect.[9] Unlike wildlife impacts, however, an adequate mitigation for health impacts due to

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[6] NYSDEC, Program Policy DEP-00-1, ASSESSING AND MITIGATING NOISE IMPACTS (2001), available at <http://www.dec.ny.gov/docs/permits_ej_operations_pdf/noise2000.pdf>.

[7] *Id.*, 14.

[8] *See above*, footnote 3.

[9] These conclusions are to be distinguished from an explanation for "wind turbine syndrome" which links low-frequency and infrasound exposure to vestibular and other organic impairments. A growing body of medical research explores this hypothesis but has not reached the kind of scientific consensus that exists for the conclusions listed above. The Minnesota Health Department's 2009 survey of scientific literature on wind turbine noise complaints is focused on the question, whether low frequency noise by causing annoyance, results in sleep disturbance. The Department concludes it is, and therefore an assessment of low frequency sound effects on residents should be provided prior to approval. See appendix to this letter.

sleep disturbance is available: additional distance from sensitive receptors.[10] These distances will vary with topography and other siting details (and thus provide a superior regulatory tool compared to noise setbacks)[11] but cannot be accurately determined without requiring an assessment of low frequency sounds and vibrations, and careful attention to methods utilized to model project noise.

Thus, there can be little debate that, without scientifically defensible protocols for determining baseline background sound levels and modeled project sound levels, a fraction of the community hosting a wind farm will predictably suffer unacceptable nuisance and health impacts from wind turbine noise. Unlike other power projects, utility-scale wind projects generally require a project area of about 20 square miles. Incorporating such protocols into the regulations that will guide siting boards may therefore make siting wind projects a challenge. However, as Mr. James' and others' experience in New York and elsewhere shows, the alternative is to sacrifice the stability and well-being of proposed host communities for a technology that provides the State with few demonstrated net benefits. This does not seem to be a reasonable approach to siting.

I hope these comments are helpful in achieving a reasonable siting program by means of final regulations implementing Public Service Law, Article 10. Thank you for the opportunity to comment on the draft regulations.

Respectfully submitted,

/s/
Gary A. Abraham

gaa/encs. - (1) Appendix, Excerpts from Minnesota Department of Health, Environmental Health Division, PUBLIC HEALTH IMPACTS OF WIND TURBINES (May 22, 2009)
(2) Rudyard Edick, NYSDEC, Letter to Town of Allegany Planning Board, April 30, 2010, at pp. 8-11
(3) Rudyard Edick, NYSDEC, Letter to Town Board of the Town of Orangeville, May 20, 2010
(4) Comment letter by Richard R. James, with attachments

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[10] NYSDEC, ASSESSING AND MITIGATING NOISE IMPACTS, *op. cit.*, at 24.

[11] A 1,500-foot setback to protect sensitive receptors from unacceptable noise impacts may be appropriate, (as suggested by Iberdrola Renewables' May 29 comments, *op. cit.*, p. 3), for example where it can be shown that receptors are sheltered by topography from wind turbine noise. However, this should be the conclusion of a site specific sound study utilizing defensible protocols.

APPENDIX

EXCERPTS FROM:

Minnesota Department of Health, Environmental Health Division, PUBLIC HEALTH IMPACTS OF WIND TURBINES (May 22, 2009), available at <http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf>

The most problematic wind turbine noise is a broadband "whooshing" sound produced by interaction of turbine blades with the wind. Newer turbines have upwind rotor blades, minimizing low frequency "infrasound" (i.e., air pressure changes at frequencies below 20-100 Hz that are inaudible). However, the NRC [National Research Council] notes that during quiet conditions at night, low frequency modulation of higher [that is, audible] frequency sounds, such as are produced by turbine blades, is possible.[1]

. . . Rhythmic, low frequency pulsing of higher frequency noise (like the sound of an amplified heart beat) is one type of sound that can be caused by wind turbine blades under some conditions.[2]

. . . The World Health Organization (WHO, 1999) suggests that A-weighting noise that has a large low frequency component is not a reliable assessment of loudness.[3]

. . . Some people are more sensitive to low frequency noise. The difference, in dB, between soft (acceptable) and loud (annoying) noise is much less at low frequency (see Figure 4 audible range compression). Furthermore, during the daytime, and especially outdoors, annoying low frequency noise can be masked by high frequency noise.

The observation that "the noise was typically audible indoors and not outdoors" is not particularly intuitive. However, as noted in a previous section, low frequencies are not well attenuated when they pass through walls and windows. Higher frequencies (especially above 1000 Hz) can be efficiently attenuated by walls and windows. In addition, low frequency sounds may be amplified by resonance within rooms and halls of a building. Resonance is often characterized by a throbbing or a rumbling, which has also been associated with many low

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1 Minnesota Health Department, *Public Health Impacts of Wind Turbines*, p. 6.

2 Id., p. 9.

3 Id., p. 11.

frequency noise complaints. . . . As reviewed in Leventhall (2003), a study of industrial exposure to low frequency noise found that fluctuations in total noise averaged over 0.5, 1.0 and 2.0 seconds correlated with annoyance (Holmberg et al., 1997). This association was noted elsewhere and led (Broner and Leventhall, 1983) to propose a 3dB "penalty" be added to evaluations of annoyance in cases where low frequency noise fluctuated.[4]

. . . Kjellberg et al. (1997) looked at the ability of different full spectrum weighting schemes to predict annoyance caused by low frequency audio noise. They found that dB(A) is the worst predictor of annoyance of available scales. However, if 6 dB ("penalty") is added to dB(A) when dB(C) – dB(A) is greater than 15 dB, about 71% of the predictions of annoyance are correct. . . . The World Health Organization (WHO) recommends that if dB(C) is greater than 10 dB more than dB(A), the low frequency components of the noise may be important and should be evaluated separately. In addition, WHO says "[i]t should be noted that a large proportion of low-frequency components in noise may increase considerably the adverse effects on health." (WHO, 1999) . . . In their noise guidance, the WHO (1999) recommends 30 dB(A) as a limit for "a good night's sleep". However, they also suggest that guidance for noise with predominating low frequencies be less than 30 dB(A).[5]

. . . The most common complaint in various studies of wind turbine effects on people is annoyance or an impact on quality of life. Sleeplessness and headache are the most common health complaints and are highly correlated (but not perfectly correlated) with annoyance complaints. Complaints are more likely when turbines are visible or when shadow flicker occurs. Most available evidence suggests that reported health effects are related to audible low frequency noise. Complaints appear to rise with increasing outside noise levels above 35 dB(A). . . . Low frequency noise from a wind turbine is generally not easily perceived beyond 1/2 mile. However, if a turbine is subject to aerodynamic modulation because of shear caused by terrain (mountains, trees, buildings) or different wind conditions through the rotor plane, turbine noise may be heard at greater distances.[6]

. . . To assure informed decisions: . . . Isopleths for dB(C) - dB(A) greater than 10 dB should also be determined to evaluate the low frequency noise component.[7]

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4 Id., p. 16.

5 Id., pp. 21-22.

6 Id., p. 35.

7 Id., p. 36.

New York State Department of Environmental Conservation
Division of Environmental Permits, 4th Floor
625 Broadway, Albany, NY 12233-1750
Phone: (518) 402-9167 • Fax: (518) 402-9168
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Alexander B. Grannis
Commissioner

RECEIVED MAY - 3 2010

April 30, 2010

Town of Allegany Planning Board
Town Hall
52 West Main Street
Allegany, New York 14706

Re: State Environmental Quality Review (SEQR)
Allegany Wind Power Project
Town of Allegany, Cattaraugus County

Dear Town of Allegany Planning Board:

The New York State Department of Environmental Conservation (DEC) has reviewed the Draft Environmental Impact Statement (DEIS) for the proposed Allegany Wind Power Project, Town of Allegany, Cattaraugus County, New York, February 2010, prepared by Environmental Design and Research (EDR) P.C.

The project sponsor, Allegany Wind, LLC (a subsidiary of EverPower Renewables), proposes construction and operation of a maximum capacity 72.5 megawatt (MW) wind power project consisting of up to 29 Nordex N100 wind turbine (or equivalent), each with a rated capacity of 2.5 MW, over a project area of 9,119 acres. The project area includes two parallel ridges on either side of Chipmunk Road. Each WTG, though the manufacturer is yet to be finalized and will be subject to availability, will have total height of approximately 492 feet (including hub height and tip of rotor blade). In addition to the wind turbines, the project will involve construction of two permanent 80-meter meteorological towers, an operations and maintenance (O&M) facility up to 2.5 acre in size, 8.2 miles of access roads, approximately 10.7 miles of buried electrical interconnect lines, a collection station and an interconnection substation, a 6.4 mile long buried transmission line, and a staging area up to five acres in size. The applicant's intention is to construct the project in one continuous phase in the calendar year 2011.

The DEC comments will be presented in the following sections to include: 1) wetlands impacts; 2) surface water impacts; 3) spill prevention, control and countermeasures 4) wildlife impacts; and 5) noise impacts.

Wetlands.

General Issues.

Projects that propose to disturb regulated wetland areas, buffer areas and protected streams require permits from DEC and the U.S. Army Corps of Engineers (USACE). DEC wetland permit regulations at 6 NYCRR 663.2(z) define a "regulated activity" as any form of draining, dredging, excavation, or mining, either directly or indirectly; any form of dumping, clear cutting or filling, either directly or indirectly; erecting any structures, constructing roads, driving pilings, or placing any other obstructions whether or not changing the ebb and flow of the water; any form of pollution, including but not limited to installing a septic tank, running a sewer outfall, discharging sewage treatment effluent or other liquefied wastes into or so as to drain into a wetland; or any other activity which substantially impairs any of the several functions or benefits of wetlands which are set forth in section 24-0105 of the (Freshwater Wetlands) Act. These activities are subject to regulation whether or not they occur upon the wetland itself, if they impinge upon or otherwise substantially affect the wetland and are located within the adjacent area.

Before DEC can consider a permit application, wetland delineations prepared for the project must be verified by agency staff. DEC jurisdiction and resulting acreage impacts may vary based on DEC verification of wetland delineations. It is DEC policy that wetland impacts are not permitted, even with mitigation, until other alternatives have been explored, including avoidance, minimization or reduction of impacts. Generally applicants are required to: 1) Examine alternative project designs that avoid and reduce impacts to wetlands; 2) Develop plans to create or improve wetlands or wetland functions to compensate for unavoidable impacts to wetlands; 3) Demonstrate overriding economic and social needs for the project that outweigh the environmental costs of impacts on the wetlands.

The DEC guidance document, *Freshwater Wetlands Regulation Guidelines on Compensatory Mitigation,* October 26, 1993, states that "Temporary disturbances, where pre-construction conditions are essentially restored, for example when laying a pipeline, do not require *compensatory* mitigation since there is no permanent loss. However, impacts to the wetland still must be first avoided and then minimized as with any other project, and efforts to reduce disturbances during construction, such as erosion control, will still be required." USACE defines "permanent" impacts as the loss of waters of the United States, and includes the area where fill is placed plus areas that are adversely affected by flooding, excavation or drainage as a result of a project. Where the project area is restored to pre-construction contours and elevation, it is not included in the calculation of permanent loss of waters (permanent impacts). This includes temporary construction mats (e.g. timber, steel, geotextile) used during construction activities and removed upon the completion of the work. However, where certain functions and values of waters of the United States are permanently adversely affected (such as the conversion of a forested wetland to an herbaceous one in a permanently maintained utility right-of-way), USACE requires mitigation to reduce the adverse affects of the project to the minimal level. The wetlands analysis in the DEIS should be refined to apply the full range of potential impact criteria to the proposed construction activity in the determination of total area of permanent impact; not just those areas proposed for permanent placement of fill. This is necessary to quantify the total affected area for permitting and requirements for mitigation.

Simple re-grading to pre-construction contours following excavation in a wetland area may not be enough to restore the full function of the existing wetland area. Any clearing or grading that disturbs wetland soils can result in permanent impacts to wetlands. Grading a wetland or adjacent area can substantially alter surface water drainage and flow patterns, may temporarily increase erosion, and may eliminate fish and wildlife habitat. Clear-cutting removes the vegetative cover of wetlands and may reduce their ability to absorb water and serve as habitat, and can also cause soil erosion. Dredging or excavation may increase water depth and remove wetland vegetation, thus altering the basic characteristics of, and perhaps destroying, wetlands. Fish and wildlife feeding or reproductive capacities may be altered, as may cover types, turbidity, sediment deposition, and erosion patterns. Clearing vegetation and any form of soil disturbance can lead to the introduction of invasive plants. Any of these activities can cause the permanent loss of benefits provided by wetlands and may, in fact, destroy wetlands entirely.

Specific Issues

Freshwater Wetlands

Section 3.2.1.2.1 states that "Review of NYSDEC mapping indicates that while there are no wetlands or adjacent areas (wetland buffers) within the Project Site (generating site or along the transmission line), there are several wetlands located within the river valleys in the vicinity of the Project Site that are regulated under Article 24 of the Environmental Conservation Law."

NYSDEC review concurs that there are no mapped State-regulated wetlands or their associated 100-foot adjacent areas directly impacted by this proposed project. In the event that the project area is modified, this would have to be re-evaluated.

The state regulated wetlands in the vicinity of the Project Site are not expected to be directly impacted based on the information provided, as long as there is adequate erosion and sedimentation control.

Clarification is needed on page 54 where stated "Based upon the current Project layout, it is anticipated that there will be no permanent impacts to wetlands/streams, including NYSDEC regulated wetlands, within the generating site or along the buried transmission route. **All wetland impacts along the buried transmission line will be temporary and upon completion of construction, impacted areas will be restored and allowed to regenerate naturally.** (emphasis added)." DEC may require seeding of a cover crop in disturbed wetland areas to prevent establishment of invasives. It is previously stated that there are no impacts to State regulated wetlands or adjacent areas, but this statement implies that the impacts along the transmission route may include State wetland impacts. Please clarify whether this is intended to mean impacts to Federally regulated wetlands only.

Page 3: There is no mention of wetlands in the environmental impacts table, nor forest fragmentation specifically.

Page 4: Reference to 1.7 acres of temporary wetland disturbance, but no details are given. It should be explicitly stated that this is regarding wetlands under Federal jurisdiction only.

Page 34: Table 3 should include NYSDEC Article 24 Permit is for impacts to wetlands <u>and</u> 100-foot adjacent area

Page 46: States no mapped wetlands. However, wetlands of greater than 12.4 acres may be unmapped but still present on the project site. Were any unmapped wetlands found on the site? Was there a search for such wetlands?

Page 47: Impacts from buried 115kV line. Again, please verify this is only impacts to Federally regulated wetlands.

Page 54: Transmission line is 100 foot wide. If route needs to be maintained by periodically cutting vegetation to prevent woody growth, then it is a permanent disturbance resulting from wetland conversion rather than a temporary impact.

Page 56: No permanent impacts = no mitigation. Not entirely true. As stated above we may require mitigative measures to prevent introduction of invasives and assure wetland vegetation re-establishment. But, such changes may have permanent impacts as noted in the comment above.

Forest Fragmentation

Forest fragmentation is a major concern. While effort has been made to use existing logging and oil/gas well roads and other existing fragmentations, there is still a great deal of forest that will be cleared (and thus further fragmented) as a result of this project. In fact, it appears that as many as one-third to one-half of the turbines will result in additional forest fragmentation. The impacts on wildlife habitat, forest health, etc. should be minimized by a project design that would result in as little forest clearing as feasible.

Invasive Species

As stated in the SEQR letter dated October 6, 2008, "The control of invasive species to minimize the spread of invasive propagules throughout the project development area, and particularly in regulated wetland and stream areas, should be discussed in the DEIS. The discussion should include measures to ensure no net increase in the areal coverage of invasive species in the project development area. Post-construction monitoring and periodic management, including invasives control and re-planting of preferred indigenous species to ensure survival should also be included in the discussion. A satisfactory Invasive Species Control Plan will be a requirement of any permits issued by DEC."

While the concern for invasive species is mentioned in the DEIS, there does not appear to be any thorough discussion of how invasive species management will be carried out, either to prevent establishment, monitor for introductions and/or spread, or control if discovered. An Invasive Species Control Plan must be developed and more detail must be given as to how invasive species impacts will be minimized or prevented.

Surface Water

The following guidance pertains to work involving the crossing of water bodies and work in close proximity to regulated streams as well as culvert design.

1) If work occurs within 50' of the top of a bank of a DEC classified C(t) or C(ts) stream, erosion control planning will be necessary. This should be part of the storm water management plan for the site.

2) All underground collection lines and culvert crossings shall be done in the dry.

3) All work is prohibited in a protected trout stream from 15 October through 31 May.

4) Siltation prevention measures shall be installed and maintained during the project to prevent movement of silt and turbid waters from the project site and into any watercourse, stream, water body or wetland.

5) Before trenching through stream banks, upland sections of the trench shall be backfilled or plugged to prevent drainage of possible trench water into the stream.

6) Underground collection lines and culvert installations shall be done in one operation without any delay between construction phases.

7) All permanent culverts crossings shall be entrenched a minimum of 1 foot below bed elevation.

8) All permanent culvert crossings shall be designed to meet a 25 year flood event. This can be accomplished either by conveying the flood entirely through the culvert or w/ an overflow spillway that directs the water immediately back to the stream.

9) All permanent culverts and culverts in longer than 60 days shall have a rocked headwall and a downstream splash apron extending 3 times the culvert diameter to prevent erosion. Rock size should be of an even mix from 6 to 18 inches in diameter.

10) Care must be taken to design and build culverts correctly – particularly when it involves crossing a navigable water body or a state regulated stream. Please see our website for an overview on proper culvert design: http://www.dec.ny.gov/permits/49060.html. The particular details of culvert design must be worked out in consultation with the DEC and must address concerns such as 25 year flood event design, maintaining channel geometry, proper use of rip rap, cofferdam specifications, work in the dry, culvert slope, etc.

Necessary Plans for Development

Spill Prevention, Control, and Countermeasures Plan (SPCC).

Due to possible construction impacts from heavy equipment use (such as large cranes) and the need to move much soil and concrete over rugged terrain, hydraulic and diesel fuel spills are a distinct possibility. And during operation, spills are also a possibility due to the number of wind turbine generators and large electrical transformers. A Spill Prevention, Control and Countermeasures Plan will be required for any permit issued by the DEC. Measures to prevent, contain, and cleanup spills should be discussed in the Final Environmental Impact Assessment Statement.

Wildlife Impacts

Potential Impacts Section 3.3.2

In Section 3.3.2.1.1 "Construction-Vegetation", the DEC noted the following concerns. An invasive species management plan should be developed to describe measures the project sponsor will take to minimize the introduction, spread, and establishment of invasive species within the project area. A table similar to Table 8 should be included describing the amount of each habitat type within the project area that will be lost and altered on a temporary and permanent basis as a result of construction, operation, and maintenance of the project.

In Section 3.3.2.2.1 "Operation-Vegetation", the DEC noted the following issues. Although the DEIS discusses some of the impacts to forested habitat, and the shrub/scrub or grassland areas that may result from forest clearing that could be utilized by species dependent on those habitat types, DEC considers the conversion of forest cover to another type of habitat as a loss of forest habitat. Even if the forest is "allowed to regenerate naturally", it would not become mature forest for decades, and therefore the disturbed area would not be utilized by forest-dependent species during the life of the project, and should be considered a permanent loss of forested habitat. An estimate of total forest acreage permanently lost should include all areas of forest disturbed or cleared for construction of project components, and the area of forest converted to another habitat type.

3.3.3 Proposed Mitigation

Section 3.3.3.2 "Fish and Wildlife" discusses aspects of the project designed to minimize impacts to birds, and states that "the Project is not anticipated to have an undue adverse impact on birds or bats, and therefore no mitigation is required." A post-construction bird and bat monitoring study will be required which includes mortality searches, bias correction testing, bat monitoring, and potential mitigation options. Upon reviewing the results of such studies, DEC may recommend mitigation for impacts to birds and bats that could include operational changes (altering the turbine cut-in speed, changes in daily or seasonal timing of operation, etc.), easement purchase/management, and/or removal or relocation of various offending project components.

Breeding Bird Surveys, 2007 and 2008

It is stated in the discussion of both the 2007 and 2008 reports that, other than one cerulean warbler in 2007, "no other species of concern were observed during surveys, which may indicate that the disturbed nature of the Project area does not provide quality habitat for forest interior species." However, 3 of the species observed in the greatest numbers and with the highest relative abundance and frequencies (ovenbird, black-throated green warbler, and red-eyed vireo) are all dependent on intact forest interior habitat. Though not listed as species of concern, the presence of these birds throughout the project area during both years of survey suggests that quality forest interior habitat does indeed exist within the project area. The degree to which these and other forest-dependent species will be displaced or otherwise impacted by forest clearing, noise, movement, collision, and other associated effects of turbines is currently unknown.

The entire western part of the project is within the Allegany Forest Tract IBA, including proposed turbines 1W-11W. The IBA boundary was expanded in 2008 to include a portion of the project area. Some species not typically found in New York were detected during the 2007 and 2008 surveys, including blue grosbeak and summer tanager. It was not stated in the reports whether these birds were observed west of Chipmunk Creek (within the IBA), or to the east of the creek (outside the IBA). The DEIS should include a map indicating the current IBA boundary relative to the proposed project area and turbine locations.

The project sponsor should coordinate with DEC to develop an appropriate protocol for post-construction surveys that include mortality searches, acoustical bat monitoring, and breeding bird surveys.

Endangered and Threatened Species.

The DEC's Natural Heritage Inventory Program reveals no listed animal species within the proposed project area. One plant species, Appalachian Shoestring Fern (Vittaria Appalachiana), is present. Impacts on this species need to be discussed further with our technical staff.

Although not indicated on the Natural Heritage Inventory maps there is some information available on the possible breeding of a listed "special concern" bird species within the project area. This species Cerulean Warbler, (Dendroica cerulea) was detected by the Allegany Wind Project consultants during a June, 2007 breeding bird survey of the project area. In addition the Second Atlas of Breeding Birds in New York State indicates that Cerulean Warbler was a possible breeder in BBA Block 1966C which is a block immediately west of the project. This species is a bird of large intact forests and is very sensitive to forest fragmentation. If it is present on the project site the increased forest fragmentation resulting from the construction of the towers and connection lines would likely have negative impacts on Cerulean Warblers using the project area as habitat. The Allegany State Park and Vicinity Population of Cerulean Warblers is one of the most significant populations of this species in New York. The number of blocks reporting Cerulean Warblers within the Appalachian Plateau declined by 17% from the first atlas to the second and most recent atlas.

Although no other endangered, threatened or listed animal species are shown in the Natural Heritage Inventory new information on the presence of such species may become available in the future and possibly during the planning and construction of the Allegany Wind Power Project. At such time protection of such species and their associated habitats may be required by this Department

Noise

On Proper Determination of Ambient Levels.

The NYS DEC policy document, "Assessing and Mitigating Noise Impacts" places stress on reducing impacts above background levels. And this is emphasized in the DEIS. Moreover, the applicant employs the more conservative L90 metric in the analysis which is to be commended. As determining the impact of the proposed wind farm on the local community depends on accurately determining existing background levels, an analysis should carefully justify the number of chosen background sampling points, their specific location, and any factors which may have an influence on the respective result.

Number and Location of Background Sampling Points

As the project area spans over 9,000 acres, the background analysis should include a justification for the number of sampling locations chosen based on statistical analysis of what would be representative of such a large area. In a rough fashion, the clusters of home possibly effected by the wind project in terms of noise would include, clockwise from the north: 1) homes along Upper Birch Road; 2) homes in the proximity of Boulder Ridge Road; 3) homes along Geiger Hollow Road; 4) homes near the intersection of Bucher Hollow Road; 5) homes near the intersection of Knapp Creek Road; 6) homes in Nichols Run; 7) homes in Harrisburg; 8) homes in the west along Nichols Run near the intersection of Quinn Road; 9) homes in the proximity of Chipmunk. Of these, 2), 3), 5), 6), 7), and 8) would appear to be closest (though topography needs to be considered and proximity may not be perfectly indicative of effect). Moreover, homes in the vicinity of Geiger Hollow Road and west along Nichols Run near the intersection of Quinn Road have no representation in background analysis. For a project spanning such a large area, the background analysis should include discussion of the following question – do we have enough data to characterize the background in the area of each cluster of homes? Moreover, additional background analysis points may be called for given the nearly 20 dBA divergence between readings that occasionally occurred at the same time between background points. Also, it may be advised to analyze each identifiable cluster of homes which could be affected and present the respective existing background levels along with potential impacts from the wind project. While Plot 1 does make considerable steps towards addressing this question, a closer look at the home clusters within the anticipated 40dBA line or in close proximity to it would be helpful in better characterizing potential community impacts.

Potential Confounding Factors Influencing Background Levels

The DEC recommends a more detailed discussion of any factors that may cause a given location to be influenced towards a less conservative ambient level. Such factors could include work or hobbies conducted nearby (such as tractor or ATV use), traffic on nearby roads, higher wind levels (due to elevation and exposure), and quite a few other possibilities including brook noise as discussed by the applicant. Background levels are, of course, influenced by such factors as road noise and wind, but it is important that the applicant explain the choice of locations with care to show that the results could not be unduly biased towards higher readings by non-representative events.

Given that the majority of the background sampling points were in close proximity to roads, more so then nearby homes, some discussion of this influence, as well as other activities in the nearby area, should be discussed. For example, do nearby residents use tractors or ATVs? How heavy is the car and truck traffic on the nearby road? While stream noise is natural in the vicinity of many of the homes, the fact that the work was done in the Spring during greatest flow may raise some questions of how representative the background would be over the course of the entire year.

Moreover, while pictures were provided from two perspectives, it would be preferable to have photos to cover a 360 degree view, or at least multiple vantage points. Furthermore, it should be kept in mind that some (possibly many) residences may be in relatively wind sheltered locations while still being within a reasonable distance of the turbines. If this is the case, and background survey locations do not reflect this, the difference between background and wind turbine generator sound levels may be greater then anticipated.

On the Nature of Sound Characteristic of Wind Turbines

Appendix N, Environmental Sound Survey, discusses that sound from wind turbines as unsteady and variable and periodic thus can be discerned at larger distances then if it were continuous (page 26). The characteristic of the sound generated is important in considering its impact on the public (as discussed in our guidelines). As wind turbine generator noise is characterized by amplitude modulation (whooshing, for example), this should be considered in the analysis as some studies have shown amplitude modulation as an annoyance factor for the public. In this light, per the "Factors to Consider" section (under "Evaluation of Sound Characteristics") of the DEC guidelines, it may be advisable to add a calculated number of dBA to the generated sound in an attempt to compensate for this characteristic.

On Need to Consider Nighttime Impacts.

As our guidelines discuss (below), given situations which involve night-time noise (such as that generated by wind projects), a discussion of impacts on residents should consider possible disruption during the night. As mentioned below in the quote from our Guidelines, weighting night-time noise more heavily, such as the Ldn, may be appropriate as an supplemental means to assess possible effects on local residents. As stated in our guidelines:

> "….Equivalent Sound Level (Leq) …. can be combined with other types of noise analyses such as Composite Noise Rating, Community Noise Equivalent Level and daynight noise levels characterized by Ldn where an Leq(24) is measured and 10 dBA is added to all noise levels measured between 10 pm and 7 am. These different types of noise analyses basically combine noise measurements into measures of cumulative noise exposure and may weight noise occurring at different times by adding decibels to the actual decibel level. Some of these analyses require more complex noise analysis than is mentioned in this guidance."

However, care should be taken that this approach not substitute for analysis involving short term worse case analysis – such as worse case 10 minute nighttime sound pressure level.

Moreover, while the analysis does assume atmospheric stability according to Mr. Hessler, a Swedish study does indicate ("Human Response to Wind Turbine Noise", Eja Pedersen, Goteborgs Universitet, 2007) that an additional complicating factor may be at play: wind velocity may be nearly double that anticipated at hub height during nighttime stable atmospheric conditions. Thus resultant sound levels might be much higher than anticipated relative to background. In any case, whether this proves to be an issue or not, care should be taken to compare likely lower background noise levels at night and consequent possible higher spreads between background and wind turbine generated sound at a time when annoyance may be the greatest. Stable atmospheric conditions at night when the difference between ground level wind and hub height wind speeds may be most pronounced should be carefully examined.

On Need to More Closely Examine Point Source Assumption and In Phase Generation.

The sound study provided by the applicant assumes that wind turbine generators (WTG) will act as a point source in generating sound. However, as WTG are commonly configured in a line, noise may not drop off as quickly as possibly assumed. It is not clear if this consideration is examined.

Furthermore, particularly at night, wind speeds may be relatively uniform and thus a synchronicity in the sound from various WTGs may result in an unexpected additive effect from an "in phase" generation of sound from the various WTGs. This is particularly the case since WTG blades are at most 60 degrees out of phase.

On Need to Consider Error Margins.

Error is a component of any study. Some discussion is encouraged to focus on the likely degree of measurement and model error. An analysis should be included in the Final Environmental Impact Assessment to ensure that the results are not in danger of underestimating possible impacts. One possible source of error to discuss is the fact that sampling represented only several days and this may not represent atmospheric conditions common over the course of a year.

Cultural Resources.

Per New York State Office of Parks, Recreation, and Historic Preservation the proposed windpark will have an adverse impact on culture resources within the Area of Potential Impact surveyed. Consequently, the project sponsor must work in consultation with OPRHP to pursue feasible and prudent plans that avoid or mitigate the adverse impacts. The DEIS includes a discussion of cultural resources in the project area and the Area of Potential Effect (APE) for visual impacts to historic resources as well as possible mitigation actions.

According to correspondence this month with OPRHP, they have not received any submissions from Allegany Wind LLC or its representatives since 2008. Please ensure OPRHP is in receipt of your recent work.

In conclusion, DEC appreciates the opportunity to comment on the DEIS for this project. We look forward to continuing to work with the Town of Allegany as Lead Agency throughout the remainder of the SEQR and permit review processes. If you have any questions or comments, please contact me at (518) 402.9150.

Sincerely,

Rudyard G Edick

Rudyard G. Edick
Project Manager

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Alexander B. Grannis
Commissioner

May 20, 2010

Town Board of Town of Orangeville
Orangeville Town Hall
4082 Route 20A
Warsaw, New York 14569

Re: State Environmental Quality Review (SEQR)
Stony Creek Wind Farm
Town of Orangeville, Wyoming County

Dear Town of Orangeville Town Board:

The New York State Department of Environmental Conservation (DEC) has reviewed the Draft Environmental Impact Statement (DEIS) for the proposed Stony Creek Wind Farm, Town of Orangeville, Wyoming County, New York, February 2010, prepared by Stony Creek Energy LLC.

The project sponsor, Stony Creek Energy LLC (a subsidiary of Invenergy LLC), proposes construction and operation of a maximum capacity 94.4 megawatt (MW) wind power project consisting of up to 59 1.5 MW or 1.6 MW wind turbine generator (WTG) over a project area of 14,500 acres. The WTG would be either the General Electric 1.5xle or 1.6xle and both have the same dimensions with a total blade tip height of 398 feet. The project area is bounded by the Attica-Orangeville town line to the north; Warsaw-Orangeville town line to the east; Almeter Road and Wilder Road to the south; and Syler Road and a line 3000 feet west of Gassman Road to the west. In addition to the wind turbines, the project will involve construction of one permanent 80-meter meteorological towers, an operations and maintenance (O&M) facility, 15 miles of access roads, approximately 28 miles of buried electrical interconnect lines, a collection station and an interconnection substation on Center Road, and a temporary staging area. The applicant's intention is to construct the project in one continuous phase in the calendar year 2011.

values of waters of the United States are permanently adversely affected (such as the conversion of a forested wetland to an herbaceous one in a permanently maintained utility right-of-way), USACE requires mitigation to reduce the adverse affects of the project to the minimal level. The wetlands analysis in the DEIS should be refined to apply the full range of potential impact criteria to the proposed construction activity in the determination of total area of permanent impact; not just those areas proposed for permanent placement of fill. This is necessary to quantify the total affected area for permitting and requirements for mitigation.

Simple re-grading to pre-construction contours following excavation in a wetland area may not be enough to restore the full function of the existing wetland area. Any clearing or grading that disturbs wetland soils can result in permanent impacts to wetlands. Grading a wetland or adjacent area can substantially alter surface water drainage and flow patterns, may temporarily increase erosion, and may eliminate fish and wildlife habitat. Clear-cutting removes the vegetative cover of wetlands and may reduce their ability to absorb water and serve as habitat, and can also cause soil erosion. Dredging or excavation may increase water depth and remove wetland vegetation, thus altering the basic characteristics of, and perhaps destroying, wetlands. Fish and wildlife feeding or reproductive capacities may be altered, as may cover types, turbidity, sediment deposition, and erosion patterns. Clearing vegetation and any form of soil disturbance can lead to the introduction of invasive plants. Any of these activities can cause the permanent loss of benefits provided by wetlands and may, in fact, destroy wetlands entirely.

Specific Issues

Freshwater Wetlands (Section 3.4.2)

The following comments focus primarily on freshwater wetlands within the proposed Stony Creek Wind Park project area.

Based on a preliminary review of GIS resource maps as well as the preliminary wetland location maps prepared by the applicant, approximately 20 unmapped freshwater wetlands (i.e., wetlands exceeding 12.4 acres in size that are not currently mapped as state-regulated wetlands) are likely present within the project area. The areas in question include the immediate vicinity of the following project features:

Proposed Turbines T-01, T-02, T-04, T-09, T-16, T-27, T-32, T-33, T-37, T-38, T-43, T-

T-44, T-45, T-51, T-53, T-54, T-56, T-57, T-58

Access Road & ECS Collection Line Between T-01 & T-02

ECS Collection Line East of T-01 & T-02

Access Road & ECS Collection Line West of T-04

ECS Collection Line North of T-09

ECS Collection Line West of T-09

infestations of invasive species, where feasible, could potentially be used to meet part of the mitigation requirements.

A final Invasive Species Control Plan will be a requirement of any permits issued by DEC. The DEC requires a ten year monitoring period for Invasive Species.

Surface Water (Section 3.4.1)

A tributary to Crow Creek, crossed by the transmission line between T-8 and T-13, does not appear on the DEIS map. Its WIN is ONT-158-12-46-6A. It is a class A stream, but will be upgraded to A(ts) as it is a tributary to a wild brook trout stream, upper Crow Creek. In addition, some class A tributaries of Tonawanda Creek are being crossed in the western part of the project and any crossings there should have the general fishery permit conditions as listed below for the wind projects. While those streams may not have high quality sport fishery value, most do support fish life and measures will be necessary to protect them.

The following guidance pertains to work involving the crossing of water bodies and work in close proximity to regulated streams as well as culvert design.

1) If work occurs within 50' of the top of a bank of a DEC classified C(t) or C(ts) stream, erosion control planning will be necessary. This should be part of the storm water management plan for the site.

2) All underground collection lines and culvert crossings shall be done in the dry.

3) All work is prohibited in a protected trout stream from 15 October through 31 May. If wild brook trout are present, closure date should be 1 October. For example, since the tributary of Crow Creek is a brook trout stream, 1 October would apply as brook trout spawn earlier than brown trout.

4) Siltation prevention measures shall be installed and maintained during the project to prevent movement of silt and turbid waters from the project site and into any watercourse, stream, water body or wetland.

5) Before trenching through stream banks, upland sections of the trench shall be backfilled or plugged to prevent drainage of possible trench water into the stream.

6) Underground collection lines and culvert installations shall be done in one operation without any delay between construction phases.

7) All permanent culverts crossings shall be entrenched a minimum of 1 foot below bed elevation.

8) All permanent culvert crossings shall be designed to meet a 25 year flood event. This can be accomplished either by conveying the flood entirely through the culvert or w/ an

Management Design Manual.

However, the draft plan refers to SPDES General Permit GP-0-08-001 which was the appropriate Permit when the plan was written in 2009. The SPDES General Permit for Stormwater Discharges from Construction activities has since been updated; therefore the final plan must be developed in accordance with the new permit GP-0-10-001.

In addition to proper erosion and sediment control, the final Stormwater Pollution Prevention Plan (SWPPP) must provide design specifications for water quality and quantity controls that conform to the *New York State Stormwater Management Design Manual.* The Design Manual is currently undergoing revision; therefore it will be the responsibility of the applicant to ensure that the SWPPP is developed in accordance with the most recent version. And any deviations from the Design Manual will be subject to a 60 day review and approval process by the Division of Water.

For your assistance, listed below are the links to the "Construction Stormwater Information" page on the DEC website. The New York Standards and Specifications for Erosion and Sediment Controls aka the "Blue Book", contains the erosion and sediment control practices which are approved by the Department. The "Blue Book" also contains details on the practices, sizing and installation guidelines, phasing recommendations, and other useful guidance for sites which require erosion and sediment controls. This is an essential resource for planning a construction project.

The New York State Stormwater Management Design Manual provides guidance on post-construction control structures which are endorsed by the Department. These structures are designed to control water quality and quantity.

GP-0-10-001 is the most current version of the SPDES General Permit for Stormwater Discharges from Construction Activity. The following links will give you access to each of these documents, as well as other forms which enable a project to apply for permit coverage:

GP-0-10-001

http://www.dec.ny.gov/chemical/43133.html

NYS Standards and Specifications for Erosion and Sediment Controls ("Blue Book") & NYS Stormwater Management Design Manual:

http://www.dec.ny.gov/chemical/8694.html

Wildlife Impacts

Compliant with the DEC's reqest, these locations were surveyed by Stony Creek Wind LLC's consultant in April to determine if wetlands or vernal pool breeding sites exist there which may be impacted by construction of the project. The DEC has not received the report of work and looks forward to reviewing the data. If such breeding sites are found, they should be avoided and not filled. And wherever possible, clearing of vegetation should not occur within 100 feet of the wetland or pool edge to provide an adequate wooded envelope around the pool for use by this species. If any additional work is necessary, surveys of potential breeding sites for this species can be reasonably performed during the months of July and August when the developing larvae can be observed.

State Listed Endangered, Threatened or Protected Birds (Section 3.5.3 Birds)

Bald Eagle, listed as threatened in New York, has been reported numerous times at the Attica Reservoir located one-half mile away from the Project components. The Region 9 Wildlife Office has eight recorded sightings of Bald Eagle at this reservoir from 1999 and 2008. There is one winter record of a pair of adult eagles there on January 10, 2008. Seven spring and summer records exist from April 19 to August 3 of mostly adult pairs with only one juvenile sighting record. This evidence has prompted regional biologists to conduct aerial searches for a nest at the reservoir in past years. Such a nest, not yet identified, may be located in other forested habitat in the general vicinity of the Reservoir. It is probable that Bald Eagles observed at the Reservoir also utilize nearby Bantam Swamp located to the southeast. Region 9 Wildlife Staff have not completed any searches of that extensive wetland area for a nest or eagle use to date, but will attempt to make observations there in 2010.

Proposed wind turbines T-07, T-08 and T-20 through T-28 located north of Old Buffalo Road are within or just over one mile of the Reservoir and can pose collision risk to Bald Eagles utilizing that area or flying to adjacent Bantam Swamp. Turbines T-20, T-21, T-22, T-26, T-27 and T-28 are located between the reservoir and Bantam Swamp and could pose special risk.

Surveys were conducted to find Short-Eared Owls within the project area. Although appropriate habitat is present in the area, this species is not known to winter in large numbers within the project area and large impacts are not expected to occur to this species at the Stony Creek project.

Forest raptors such as Cooper's hawk and sharp-shinned hawk are resident breeders within and around the project area, and several of the proposed turbine locations are in the wooded areas where these birds nest. The chance that a resident raptor encounters a turbine is greater than for a migrant raptor that spends no more than a few days in the project area each year. Very few or no studies have specifically looked at the impact of wind projects on forest-nesting raptors, and at this time it is unknown if resident raptors are at greater risk of collision than migrants. However, to reduce the potential for disturbance and negative impacts to forest-dependant species, the placement of turbines, access roads, collection lines and other project components in forested habitat should be minimized to the extent possible.

abundance/diversity in the project area. Transects would be surveyed during the same time frame and under the same conditions as BBS-style point counts, and can be used instead of or in addition to point count surveys. The project sponsor should consult with DEC to develop the methods and to discuss other aspects of this study.

Post-Construction Monitoring Plan should specify that final reports should be submitted no later than January 31 of the year following the end of a survey year. A March submittal date would not provide the resource agencies enough time to review reports, meet with the project sponsor, make any necessary changes to the protocol, and finalize a work plan satisfactory to all parties prior to the next season beginning in April. The final report should also include information on the date, turbine number, species, and gender (if determinable) of every carcass found.

The proposed adjustments to the monitoring plan do not include consideration for impacts to state and federally listed species, large mortality events occurring in one night or involving one species or group of species, or other unexpected impacts from the operation of the project. Ground searches are likely to be recommended for the second year of monitoring, which would include searching for and recording carcasses of both bats and birds, regardless of the first year's estimated per turbine impact for each group. DEC is willing to discuss alterations to the timing, search frequency, and duration of ground searches, upon review of the first year's results.

Noise (Appendix D)

On Proper Determination of Ambient/Background Levels.

The NYS DEC policy document, "Assessing and Mitigating Noise Impacts" places stress on reducing impacts above ambient/background levels. As determining the impact of the proposed wind farm on the local community depends on accurately determining existing background levels, an analysis should carefully justify the number of chosen background sampling points, their specific location, and any factors which may have an influence on the respective result.

Number and Location of Ambient/Background Sampling Points

As the project area spans over 14,500 acres, the background analysis should include a justification for the number of sampling locations chosen based on statistical analysis of what would be representative of such a large area. Ten (10) short term measurements were taken to assess variation, with only four (4) locations chosen for long term analysis, but there is no discussion as to why the reader should believe that these four locations were sufficient for analyzing ambient/background levels for a 14,500 acre area. The justification should preferably be based on a statistical analysis which would consider the variation in ambient/background levels, an acceptable confidence in result (plus or minus a certain dBA), and the consequent number of sampling locations thus required.

four locations chosen appear to be either near relatively busy roads or at high windy elevations.

The survey equipment used for the analysis should be presented along with its calibration data. Also, supplemental equipment such as wind screens should be described in greater detail.

Use of L90 as a Metric

L90 is an important metric in understanding existing sound pressure levels in a community. Providing a similar table for L90 as provided for Leq on page 104 of the DEIS would be useful for understanding the potential impacts. Modeling of sound pressure level impacts of the wind turbines in terms of L90 would provide additional insight on potential impacts.

On the Nature of Sound Characteristic of Wind Turbines

The sound from wind turbines is variable and periodic thus can be more annoying to the public then a continuous noise of the same average amplitude. The characteristic of the sound generated is important in considering its impact on the public (as discussed in our guidelines). As wind turbine generator noise is characterized by amplitude modulation (whooshing, for example), this should be considered in the analysis as some studies have shown amplitude modulation as an annoyance factor for the public (e.g, "Noise Annoyance from Wind Turbines – A Review", Eja Pedersen, Swedish Environmental Protection Agency, Report 5308, August 2003). In this light, per the "Factors to Consider" section (under "Evaluation of Sound Characteristics") of the DEC guidelines, it may be advisable to add a calculated number of dBA to the generated sound in an attempt to compensate for this characteristic.

On Need to Consider Nighttime Impacts.

As our guidelines discuss (below), given situations which involve night-time noise (such as that generated by wind projects), a discussion of impacts on residents should consider possible disruption during the night. As mentioned below in the quote from our Guidelines, weighting night-time noise more heavily, such as the Ldn, may be appropriate as an supplemental means to assess possible effects on local residents. As stated in our guidelines:

> "….Equivalent Sound Level (Leq) …. can be combined with other types of noise analyses such as Composite Noise Rating, Community Noise Equivalent Level and daynight noise levels characterized by Ldn where an Leq(24) is measured and 10 dBA is added to all noise levels measured between 10 pm and 7 am. These different types of noise analyses basically combine noise measurements into measures of cumulative noise exposure and may weight noise occurring at different times by adding decibels to the actual decibel level. Some of these analyses require more complex noise analysis than is mentioned in this guidance."

bird and bat impacts. On page xxxv, the DEIS states, "For example, wind farms are a common sight in this area, thus the negative aspects of the visual impact are limited as the local skyline already includes numerous similar intrusions." This statement is not consistent with the need to view the additive effect of a new project among already existing projects.

Cultural Resources.

Per New York State Office of Parks, Recreation, and Historic Preservation the proposed windpark will have an adverse impact on culture resources within the Area of Potential Impact surveyed. Consequently, the project sponsor must work in consultation with OPRHP to pursue feasible and prudent plans that avoid or mitigate the adverse impacts. The DEIS includes a discussion of cultural resources in the project area and the Area of Potential Effect (APE) for visual impacts to historic resources as well as possible mitigation actions. Please ensure OPRHP is in receipt of your recent work.

In conclusion, DEC appreciates the opportunity to comment on the DEIS for this project. We look forward to continuing to work with the Town of Orangeville as Lead Agency throughout the remainder of the SEQR and permit review processes. If you have any questions or comments, please contact me at (518) 402.9150.

Sincerely,

Rudyard G Edick

Rudyard G. Edick
Project Manager

cc: Stony Creek Energy LLC
A. Davis, DPS
M. Brower, Ag. & Mkts.
J. Peterson, NYSERDA
J. Bonafide, OPRHP
S. Metevier, USACE
T. Sullivan, USFWS
S. Doleski, DEC Reg 9
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RICHARD R. JAMES
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Comments On Exhibit 19, Case 12-F-0036

Rules and Regulations of the Board on Electric Generation Siting and the Environment

16 NYCRR, Chapter X, Certification of Major Electric Generating Facilities

May 31, 2012

INTRODUCTION

Thank you for the opportunity to provide comments on the proposed noise criteria. I am responding to a request by Mr. Gary Abraham to speak to these issues.

My comments focus on competing considerations underlying Draft Exhibit 19, which endeavors to regulate the noise impacts of power plants. Specifically, these comments support the following considerations that appear to already inform this section of the Draft Regulations, relevant to wind energy facilities:

1. The need to include low frequency sound in the measurement of pre-existing background sound levels, the prediction of operational sound immissions, monitoring of operating sound immissions and complaint follow-up.

These comments also support modifications of the Draft Regulations that address the following considerations:

2. The need to focus sound propagation models on reasonable worst case conditions of operations during nighttime stable atmosphere.
3. The need for performance criteria in the regulations.

QUALIFICATIONS

I am the Owner and Principal Consultant for E-Coustic Solutions, of Okemos, Michigan (P.O. Box 1129, Okemos MI 48805). I have been a practicing acoustical engineer for 40 years. Attached is a summary demonstrating my experience in addressing a broad range of problems for my clients. I have been actively involved with the Institute of Noise Control Engineers (INCE) since I started my career in the early 1970s. I have Full Member status in INCE. My clients include many large manufacturing firms, such as, General Motors, Ford, Goodyear Tire & Rubber, and others who have operations involving both community noise and worker noise exposure. In addition, I have worked for many small companies and private individuals. My academic credentials include appointments as Adjunct Professor and Instructor to the Speech and Communication Science Departments at Michigan State University and Central Michigan University. Specific to wind turbine noise, I have worked for clients in over 60 different communities. I have provided written and oral testimony in approximately 30 of those cases. I have authored or co-authored four papers covering topics from how to set criteria to protect public health, demonstrating that wind turbine sound immissions are predominantly comprised of infra and low frequency sound, and conducted a historical review of other types of noise sources with similar sound emission characteristics that have known adverse health effects on people exposed to their sound.

An appendix with my resume provides additional details on my qualifications.

INTRODUCTION

It is with some disappointment that I offer my comments because the penultimate pre-draft version of the Article 10 regulations required an assessment of low frequency noise, but the current draft does not. Much was lost when the earlier version's requirements were dropped. Yet, the rationale of the stakeholders representing the wind developers who requested this change is specious. Please accept the following as support for the concepts included in the pre-draft version and an explanation of why the developer's rationale should be disregarded.

THE COSTS AND UTILITY OF ASSESSING LOW FREQUENCY SOUND

The preamble to the Draft Regulations on noise states:

> "Many stakeholders representing wind developers opposed requiring the incorporation of C-weighted/dBC sound levels as an unnecessary expense because they believe that issues related to low frequency noise or infrasound can be analyzed adequately without such expenditure." *(p.19)*

However, there is no scientific basis for asserting that a requirement to assess low frequency noise impacts is either unnecessary or a significant expense.

Commercially available sound propagation models currently utilized by wind industry's acoustical consultants, such as Cadna/A, are fully capable of being programmed with octave band level sound power levels provided by the manufacturer from tests conducted using the standard IEC61400-11 test procedure. Any properly programmed model would include the octave band level of detail. No extra cost is involved by adding a requirement for C-weighted analysis since no more than a program change made through the software's user interface is needed to instruct the software to provide a report of over-all dBC or unweighted octave band sound pressure levels. With respect to requirements to measure low frequency sound (whether as dBC or in 1/1 or 1/3 octave bands) conventional measurement devices currently utilized by wind energy project consultants already include these capabilities. Modern professional grade acoustical measurement instruments are more than adequate to measure sound in the lower frequency ranges.

The auditory response to infra and very low frequency sounds is well understood only for single steady pure tones. When sounds are more complex, as is the case with wind turbine immissions, the auditory thresholds are lower. Bray and James (2011) [1]; Swinbanks (2011). How much lower is not known, but it is safe to say that wind turbine infra and low frequency emissions in the range of 60 to 80 dB as measured using a standard 1/3 octave band analyzer are likely to be audible to the more sensitive members of the population. This is consistent with the well-documented fact that people find noise with dominant low frequency content more annoying than mid and high frequency noise at the same decibel level. People who report "hearing" wind turbine rumble or vibration are likely to be in this more sensitive group. Recent research published in peer reviewed medical journals by Dr. Alec Salt and colleagues has demonstrated that there are non-auditory perceptions of the acoustic energy in the lowest frequency ranges (below 100 Hz) that have a threshold at approximately 60 dB for a 10 Hz sound. These perceptions are mediated by the cochlea's vestibular organs and the nerve impulses associated with detection above that threshold are sent to a part of the brain not related to processing speech or other sounds. A new paper to be presented by Dr. Salt later this summer at the New York InterNoise 2012 Conference will discuss how the perceived strength of the infra and low frequency stimulation is increased if the listening environment does not include much mid or high frequency sound. It is worth noting that this is the situation in most homes at night, especially bedrooms.

In my work I often see noise studies submitted as part of an application for permits that include low frequency in the analysis. I have reviewed noise assessments for wind projects where frequencies from 16 Hz to 4kHz or higher were evaluated and many others where dBC and dBA are both presented. These sound propagation prediction models were developed using standard commercial

1 Bray, W., James, R. " Dynamic measurement of WT noise considering time and frequency of human perception," Noise-Con 2011, Portland, Oregon.

software, such as Cadna/A, and were programmed using readily available wind turbine manufacturer's sound power level test data spanning the range from the 31.5 Hz octave band to the 4k or 8k Hz octave band. Even if the model is only used to report dBA sound levels it is still necessary to program the model using octave band sound power levels across the frequency range of at least the 31.5 Hz to 4k Hz octave bands. Spanning that frequency range includes part of the acoustic energy in the lower frequency bands in the analysis and permits evaluation of frequency dependent factors that influence sound propagation.

Extending that analysis down to the 16 Hz octave band or even the 8 Hz octave band adds in the acoustic energy related to the lowest frequencies and part of the infrasound range. It is these lowest octave bands that include the acoustic energy we associate with "rumble" where the sound pressure levels are the highest. Not including the energy in the lowest frequency ranges will result in predictions that understate over-all dBC sound levels; the characteristic of wind turbine sound immissions most likely to cause indoor noise complaints. This error will be greatest for the newer larger wind turbines that emit the most infra and low frequency sound.

Many communities require consideration of low frequency sound in one way or another. For example, projects in the state of Illinois must meet the Illinois IPCB octave band sound criteria and the models constructed for these projects must report the specific sound pressure level in each octave band. In other cases, the overall dBA and dBC sound levels are required. Even when there are no such requirements dBC models have been quickly produced. I have attended hearings in communities where a dBC model is requested of a wind energy facility developer. The developer often provides that data within a day or so of the request. This shows doing so is not a major expense and that other permitting agencies require information about low frequency sounds from wind turbines. When the need for reporting frequency specific information is known ahead of time, costs will be lower than if the request for such information is made after the fact.

Opposition to measuring and assessing low frequency noise may have less to do with additional costs or the utility of dBA sound levels for anticipating low-frequency problems than it does with the need to divert attention away from a significant negative aspect of wind turbine noise.

Wind turbine sound energy from modern upwind industrial scale wind turbines of the types being installed in New York peaks in the region below 10Hz. Just as is seen for large fans used in the heating and cooling systems of office spaces (HVAC), the frequency of highest acoustic energy is at the blade passage frequency (BPF). For a 20 rpm three bladed wind turbine this will be 1 Hz. Because sound propagation is frequency dependent, to properly assess the distance wind turbine noise will propagate, analysis must include the sound power levels for the lowest frequency bands, 16 Hz and preferably even below.

Relying on measurements and models that only consider A-weighted sound levels will underestimate wind project noise and lead to improper siting. The A-weighting filter attenuates any acoustic energy at 16 Hz by 56 dB and the acoustic energy at 8 Hz by 77 dB. At the blade passage frequency of 1Hz the dBA scale attenuates the energy by 148 dB. It is absurd to claim that evaluation of a prospective wind turbine project using only dBA information can offer any meaningful insights into the impact of the lower frequency acoustic energy when that energy is suppressed by 56 to 148 dB.

<u>The final regulations should therefore restore the requirement to analyze C-weighted sound levels. However, this must be part of a coherent low frequency noise assessment method appropriate for wind energy projects.</u>

FOCUS ON REASONABLE WORST CASE CONDITIONS

The preamble to the Draft Regulations on noise also notes:

> "Because of the lack of technical consensus on the issue [of wind shear], the draft regulations do not resolve the issue and require the application to assume wind-induced background noise or stable atmospheric conditions, as appropriate."

The issue, from my point of view, is not that there is a lack of scientific consensus on the effect of wind shear on background sound levels, especially with regards to how it affects wind induced background noise during periods with stable atmospheric conditions. It is more a result of the confusion that has developed because of a belief that wind induced noise will somehow mask the sounds of wind turbines. This is sometimes expressed as: "*wind turbines only produce noise when the wind is blowing*." This belief depends on an incorrect assumption that the winds at the surface of the earth are always related or "connected" to the winds at the height of the turbine's blades. This is only true for a limited set of atmospheric conditions. This is not true for what is called a "stable atmosphere."

A stable atmosphere is such a common occurrence that acousticians routinely make use of it when evaluating outdoor noise sources and background sound levels. It is a very common during warm season nights. For many common noise sources that are ground-based, or at least are not located at more than 30 meters above the ground, a stable atmosphere results in predictable sound propagation and optimum noise measurement conditions. This is primarily because, for ground based noise sources, the noise is emitted from an elevation below the stable atmosphere's temperature inversion boundary layer, in the region of calm air. Sound propagation from such sources is generally well behaved and predictable.

One aspect of stable atmospheric conditions is there is little or no surface wind (ground level) to produce wind induced background noise. This allows the analysis of the noise source to be conducted with less concern that the measurements may be contaminated by wind related noises. That contamination includes pseudo-noise produced by the interaction of air moving over the microphone's diaphragm and/or the audible wind induced noise from leaf rustle and air movement around buildings and structures.

What makes nighttime stable atmospheric conditions an issue for wind turbine noise is that the wind turbine blades operate above the temperature inversion boundary. At that elevation, the wind speed, shear and turbulence are high. Near the ground there is little or no surface wind to produce wind noise while at the height of the rotor the wind is sufficient to operate the turbines at nominal to optimum power production levels but, due to the high wind shear and turbulence above the boundary layer, often with higher sound emissions than reported by the manufacturer.

The combination of very quiet background sound levels during a period when the noise produced by the wind turbines is at or near the maximum is a recipe for complaints. The background sound level in a rural community may be 25 dBA (L_{A90}) or lower when the wind turbines are not operating; while the noise from operating wind turbines located 1500 feet away may be 40 to 50 dBA depending on the wind speed, shear, and turbulence at the height of the turbine's blades. The wind turbines raise the pre-existing conditions by 15 to 25 dBA. As stated in Table B from the NYSDEC Guidelines a 15 to 20 dB increase is "Objectionable" and an increase of over 20 dB is "Very objectionable to intolerable."

Table B

HUMAN REACTION TO INCREASES IN SOUND PRESSURE LEVEL

Increase in Sound Pressure (dB)	Human Reaction
Under 5	Unnoticed to tolerable
5 - 10	Intrusive
10 - 15	Very noticeable
15 - 20	Objectionable
Over 20	Very objectionable to intolerable

(Down and Stocks - 1978)

Figure 1-Table B from NYSDEC, Assessing an Mitigating Noise Impacts (2000)

Some might argue that the sounds emitted by a wind turbine during other types of atmospheric conditions may be higher or that the turbine noise must be compared to the wind induced noise to address annoyance during other weather conditions. However, based on personal experience and review of the reports of others, there is no evidence that wind turbine noise is masked by wind induced noise from surface or ground level winds. The characteristics of the sounds of the wind turbines are too distinct for wind induced noise to provide any useful masking. Further, as low level winds increase in intensity people tend to seek shelter. The sounds of the wind interacting with one's ears causes distortion of other sounds and other types of discomfort. As surface winds increase to speeds of 10 mph or more outdoor activities are affected. What "masking" may be provided is of little value if the people are not outside.

Nighttime conditions of a stable atmosphere offer the most potential for interfering with community activities. This is the time when people use the outdoors for amenity and enjoyment. This is the time when people like to sleep with their windows open. Under these conditions there is no wind induced noise to "mask" wind turbine noise.

If one is interested in protecting the periods when outdoor activities are likely, the focus of the review process should be on nighttime periods with a stable atmosphere leading to little or no surface winds with high winds and turbulence above the temperature inversion boundary such that the turbine's noise emissions are at a maximum. <u>Because this situation is generally associated with complaints, it should be considered the reasonable worst case condition. To avoid unnecessary measurements and analysis it is appropriate to assume stable atmospheric conditions as the reasonable worst case condition.</u>

THE WIND INDUSTRY'S POSITION

It is important to understand that wind energy project sponsors have taken a consistent approach to assessing the noise effects of their projects that is not based on generally accepted acoustical measurement and prediction procedures. In the opinion of some independent acousticians the methods promoted by the wind industry and its trade associations for siting wind turbines are not just "novel" but constitute junk science. The procedures have their roots in a document prepared by a British wind industry sponsored committee titled: "*The Assessment And Rating Of Noise From Wind Farms: The Working Group on Noise from Wind Turbines*" or ETSU-R-97.[2] This document was the genesis of many of the flawed concepts regarding wind turbine noise that have become the talking points of the industry trade associations. It was heavily promoted by the wind industry and its trade associations. As a result it was adopted as, or heavily influenced, regulations not only in the

2 regmedia.co.uk/2011/08/02/etsu_r_97.pdf

U.K. but also in many former British colonies, such as New Zealand, Australia, and Canada. There are many papers and presentations that debunk the premises of this document should there be an interest in the details. However, it is possible to summarize the primary flaws as follows:

1. The procedures elevate the baseline background sound level in the community against which a new noise should be assessed, by theorizing that wind-induced noise will always accompany wind turbine operations. Thus, the allowed sound emissions from wind turbines will change depending on the wind induced noise.
2. The ETSU-R-97 procedures for predicting operational sound levels at sensitive receptors inappropriately apply parts of the ISO 9613-2 sound propagation formulas. Some parts of the procedure are not appropriate for elevated noise sources like turbine blades. One example is attenuation of sound levels by ground absorption. ISO 9613-2 states that its propagation formulas are not accurate for noise sources that are more than 30 meters higher than the receiver. Use of inappropriate formulas results in lower modeled sound levels at receiving properties.
3. The data used to represent the wind turbine's sound emissions are taken from manufacturer's tests conducted according to IEC61400 "*Wind turbine generator systems - Part 11: Acoustic noise measurement techniques.*"[3]. The IEC measurement standard is not designed as a stress test for the wind turbines, but instead assumes standardized weather and operating conditions. The weather needed for testing is a neutral atmosphere with low wind shear and no turbulence. This type of weather is often associated with a warm sunny afternoon. Even though the tests report the turbine's sound power levels for a range of wind speeds these results do not reflect the highest sounds that are produced by wind turbines when operating in-situ. The required test conditions call for the air-stream entering the plane of the blade rotation to be steady, predictable, and free of up-drafts, cross-drafts, and gusts. Under these conditions the sound emissions from a wind turbine are at their minimum and there is little if any audible blade swish. However, these conditions are not representative of wind conditions at night above the temperature inversion boundary layer. At night, there is high wind shear, unpredictable wind speed increases between the elevation of the blade's tip at the bottom of the plane of rotation to the top, and consequently, high levels of turbulence. These conditions increase the wind turbine's sound power levels, increase the low frequency content, and introduce modulation or blade swish or thumps. None of this acoustic energy is accounted for in the IEC 61400-11 test results the consultants use for model inputs. The result is that the model predictions reflect the quieter daytime noise immissions, not the nighttime noise immissions most often associated with complaints.
4. Low frequency noise is ignored and results report only dBA sound levels.

The ETSU and similar procedures produce an inflated appraisal of background sound levels, an unrealistically low estimate of nighttime noise (expressed in dBA), and no consideration for the effects of low frequency noise emissions. The wind industry sometimes refers to these procedures as "Best Practices" and will point to the many governments that have adopted their use without admitting that in each of those countries independent acoustical consultants have found the procedures to be flawed. It is the substitution of these novel and "junk science" procedures for the generally accepted procedures codified in ANSI and ISO standards that explains why projects that appear to be compatible with a community during the review process produce complaints of noise annoyance, sleep disturbance and other adverse health effects once they are operational.

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3 http://webstore.iec.ch/preview/info_iec61400-11%7Bed2.0%7Den.pdf

Adverse health effects in people living near or within the footprint of utility scale wind turbines are being reported by researchers and medical professionals from countries around the world. These reports reinforce the self-reported descriptions from people who reside near wind turbine projects with which I am familiar. Based on published reports and my own experience, people living near wind turbines commonly report high levels of annoyance and sleep disturbance. In some cases the reports are of other adverse health effects. In response to these reports, the wind industry uniformly disclaims any responsibility. Instead, the problems are deemed to be a result of sublimated fear and anxiety; disapproval of the "visual" impact; concern about property value loss; or other issues that cause the symptoms. It is never the sound from the wind turbines that might be the cause.

The conflict between the promises of compatibility with host communities and wide spread complaints has lead to many independent acoustical and medical experts conducting their own studies. The independent professional research into this subject is not a trendy or opportunistic short term reaction to the complaints. Much of it is built upon the work of other acousticians whose work is now almost 30 years old.

The potential for modern industrial scale wind turbines to cause problems for the communities that host them has been known since the early 1980's. Research conducted during the 1980s by NASA and the U.S Department of Energy found that the type of wind turbines that we now call "upwind horizontal axis wind turbines" (HAWT) produced unacceptable noise that propagated further than other common noise sources and that low frequency noise produced by the turbines would likely give rise to complaints, especially for people indoors. The final report of these NASA/DOE studies was published in 1990 in the report "Wind Turbine Acoustics." Hubbard and Shepherd (1990). Yet, for the last fifteen or so years (from the time of the ETSU-R-97 document) the wind industry has claimed that industrial scale wind turbines are safe near people's homes and that they will not even be heard over the other community sounds and wind noise. To some, it appears that the industry and its trade associations have been engaged in a multifaceted disinformation campaign conducted through trade association funded "siting guidelines," white papers on health effects, conference papers and testimony at hearings from its experts. These efforts have been productive. Industrial scale wind turbines are frequently thought of as benign by both the public and the governmental agencies that regulate wind turbine utilities. However, upon closer examination, one can find no peer-reviewed scientific research that would support the industry's premise that wind turbines located near homes will not cause adverse health effects for some of the residents.

Reports of high levels of annoyance, sleep disturbance, and other health effects continue to be received from people around the world living within two or more kilometers (1.25 miles), and sometimes at greater distances. The veracity of these reports is confirmed by 1) acoustical consultants not affiliated with wind developers; 2) by a growing body of peer-reviewed scientific acoustic, atmospheric and health research; 3) from individuals who are willing to travel to national and international conferences on wind turbine noise to report their personal situations; and, more recently, 4) from public health departments in communities where utility-scale wind projects are operating.

A SPECIFIC CASE EXAMPLE

Brown County, Wisconsin has an eight-turbine wind project called Shirley Wind to the southeast of Green Bay that has attracted considerable national attention. Shirley Wind was purchased by Duke Energy after it started operation in 2011. This project utilizes 2.5 MW Nordex N100 turbines, but in terms of the impact on the community they could have been from any manufacturer that has a 2.5 MW turbine with similar characteristics.[4] Studies comparing the sound emissions from wind

4 The situation described at the Shirley Wind project is not specific to the manufacturer of any particular wind turbine. It is associated with the larger, multi-megawatt wind turbines offered by all wind turbine suppliers. Noise is

turbines show a high degree of similarity between the various makes and models within each power output range. Moeller and Pedersen (2011).

This project was subject to only local township noise limits and the local town adopted criteria that had been originally proposed to the state by a committee that was heavily dominated by wind industry supporters or staff. It should be noted that since that time the Wisconsin PSC has promulgated new requirements that are slightly more stringent that the town's regulations. The town's criteria set the upper limit for noise at 50 dBA (24/7) while the revised PSC rules include a provision that the reduces the nighttime limit to 45 dBA.

Shortly after Shirley Wind started operation residents living near or within the footprint of the project began to voice complaints about sleep disturbance because of the noise at night. One family left their farm and home after only a few months of turbine operation. The nearest turbine was 3100 feet from the home. That turbine is part of a cluster of turbines putting the home downwind on a frequent basis. This family left their home in the spring of 2011 and has been living in a recreational vehicle or staying with other family members since that time. By the fall of 2011 there were seven families reporting adverse health effects, two of which had abandoned their homes. A report prepared for the Brown County Board of Public Health as a result of complaints included a list of the symptoms being experienced by these families. They include:

• Anxiety	• Appetite Loss	• Blurred Vision	• Chest Vibration
• Difficulty Concentrating	• Depression	• Disequilibrium	• Desire to "Get Out"
• Ear Pressure, Pain, Popping and Infections	• Fatigue	• Headaches	• Heart Palpitations
• Insomnia	• Nausea	• Vertigo	•

The Brown County Board of Health conducted a review of the situation, including a review of current literature and the history of the noise regulatory process in the state. Based on its review the Board drafted and submitted a resolution to the State titled: "*Brown County Board of Health Resolution Requesting Emergency State Aid for Families Suffering Around Industrial Wind Turbines*." This resolution states:

> "WHEREAS Shirley Wind LLC has created an environment that has resulted in the very same "undue hardships" that the JCRAR suspension of 'PSC 128' sought to prevent. These "undue hardships" have forced two families to vacate their homes to regain their health and continue to force at least two other families to suffer adverse health effects significant enough that they seek refuge away from their homes but do not have the financial ability to temporarily relocate.
>
> WHEREAS the Brown County Board of Health has attached recent (2009 and newer) references (many peer-reviewed) to this resolution, organized by year of publication, accurately describing the cause, conditions, and adverse health effects being experienced by Brown County families."

And,

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expected to increase as the turbine's blades are increased in size and the towers on which the nacelles are mounted increase in height pushing the blades into increasingly turbulent winds. As turbine sizes increase the associated low frequency sounds increase and shift downward in the frequency spectrum. Because of this downward shift some larger wind turbines have lower dBA ratings than their smaller siblings. This has led to the incorrect conclusion that larger turbines are quieter. See Moeller and Pedersen (2011)

> "THEREFORE, BE IT RESOLVED that the Brown County Board of Health formally requests temporary emergency financial relocation assistance from the State of Wisconsin for those Brown County families that are suffering adverse health effects and undue hardships caused by the irresponsible placement of industrial wind turbines around their homes and property. The State of Wisconsin emergency financial assistance is requested until the conditions that have caused these undue hardships are studied and resolved, allowing these families to once again return safely to their homes and property."

A copy of the resolution and its list of supporting references is attached to my comments.

OTHER MEDICAL PROFESSIONALS SPEAK OUT

The concern of the Brown County Board of Health is not an isolated situation. A peer-reviewed editorial titled:"*Wind Turbine Noise*" in the British Medical Journal reported:

> "A large body of evidence now exists to suggest that wind turbines disturb sleep and impair health at distances and external noise levels that are permitted in most jurisdictions, including the United Kingdom. Sleep disturbance may be a particular problem in children, and it may have important implications for public health. When seeking to generate renewable energy through wind, governments must ensure that the public will not suffer implications for public health. When seeking to generate renewable energy through wind, governments must ensure that the public will not suffer harm from additional ambient noise. Robust independent research into the health effects of existing wind farms is long overdue, as is an independent review of existing evidence and guidance on acceptable noise levels. [Hanning and Evans (2012)]

A recent peer-reviewed paper by the epidemiologist, Dr. Carl Phillips, points out that:

> "There is overwhelming evidence that wind turbines cause serious health problems in nearby residents, usually stress-disorder type diseases, at a nontrivial rate. The bulk of the evidence takes the form of thousands of adverse event reports. There is also a small amount of systematically gathered data. The adverse event reports provide compelling evidence of the seriousness of the problems and of causation in this case because of their volume, the ease of observing exposure and outcome incidence, and case-crossover data. Proponents of turbines have sought to deny these problems by making a collection of contradictory claims including that the evidence does not "count," the outcomes are not "real" diseases, the outcomes are the victims' own fault, and that acoustical models cannot explain why there are health problems so the problems must not exist. These claims appeared to have swayed many non-expert observers, though they are easily debunked. Moreover, though the failure of models to explain the observed problems does not deny the problems, it does mean that we do not know what, other than kilometers of distance, could sufficiently mitigate the effects. There has been no policy analysis that justifies imposing these effects on local residents. The attempts to deny the evidence cannot be seen as honest scientific disagreement and represent either gross incompetence or intentional bias." [Phillips (2011)]

On March 1, 2011 it was announced that forty Canadian physicians had signed a *"Petition for Health: Industrial Turbines in Populated Areas"* stating:

> "The Québec government, in its energy development plan, calls for the building of numerous industrial wind turbines in rural, inhabited Québec.
>
> The fact is, more and more scientific research is showing the negative impacts on health and quality of life among people living near industrial wind turbines.

> CONSIDERING that no measures of assessment and control are currently applied on the level of social acceptability and level of psycho-social impacts associated with such industrial wind projects;
>
> WHEREAS the unit of measurement currently used in Québec for impact studies (98-01 of instruction note MDDEP) is recognized by the Department of Public Health and MDDEP as inadequate to assess the specific types of noise emitted by industrial wind turbines, and consequently their real nuisance for people;
>
> WHEREAS, increasingly, research confirms the evidence of several other negative impacts on health and quality of life of people living near industrial wind turbines;
>
> WHEREAS much remains unknown and much research remains to be done to better define the extent of these impacts and their real consequences, particularly in view of audible sound and infrasound;
>
> CONSIDERING that more and more researchers recommend a minimum setback of 2 km from residential and industrial turbines, to reduce risks to human health. Moreover, this criterion is being increasingly accepted elsewhere in the world;
>
> We, the following physicians, in light of the risks discussed above and the potential negative effects of industrial wind turbines on the health of people living nearby, ask the Québec government for a moratorium on future or current projects being built close to human habitation, until the research is sufficiently advanced to allow public health authorities to establish, beyond doubt, a safe setback from people's homes. This follows the spirit of the law regarding sustainable development in Québec (LRQcd_8.1.1), and in particular the Precautionary Principle."

Massachusetts has its own version of the same situation. The state denies there are any risks from either audible or inaudible low frequency sound, while local public health boards are doing the field work and finding that people are at risk. In January-2012, Massachusetts sponsored a report from a review panel that concluded: "*There is insufficient evidence that the noise from wind turbines is directly (i.e., independent from an effect on annoyance or sleep) causing health problems or disease*." Massachusetts Department of Environmental Protection and Massachusetts Department of Public Health (2012), p. ES-6.

The basis of this report is a review of approximately 100 papers on the issues of wind turbine noise and health, although only a few (less than 5) were actually used for its conclusions. Many of the references draw conclusions or present information that are contrary to the panel's findings. The report caused a flurry of negative reactions from outside experts since many of the panel members had ties to the wind industry, or to the government whose pro-wind agenda was well known. For example, one of the panelists, Dr. Dora Mills had issued a similar statement while she was the director of Maine's Center for Disease Control. Her report was a restatement of wind industry trade association talking points reflecting no interaction with any of the families at the Mars Hill or Vinalhaven communities. Complaints about wind turbine noise from those two towns resulted in the Maine Medical Association's request for a moratorium on further wind energy projects until a proper health study could be conducted.

In Massachusetts, this failure to seek out evidence and confirmation bias in weighting the available evidence was repeated by the panelists. In spite of the availability of people who were claiming adverse health effects, not a single person or any of their medical doctors were interviewed by the panel. This is not the place to do a full critique of the paper, but it had major failings both in the constitution of the panel and method of analysis used to make their conclusion.

Many so-called health studies prepared by either the wind industry, such as the 2009 CAN/AWEA "*Wind Turbine Sound and Health Effects: An Expert Panel Review*,"[5] or by government agencies or panels, like the 2010 report from the Ontario, Canada, Chief Medical Officer of Health (CMOH) Report: "The Potential Health Impact of Wind Turbines,"[6] have similar methodological flaws and biases. For example, the body and references of the CAN/AWEA whitepaper do not support the paper's conclusion that 45 dBA outside homes at night does not pose health risks to the occupants. Several of its authors have undergone cross examination in siting proceedings since the whitepaper was published. One has admitted that he would not support the conclusions and would limit wind turbines to no more than 35 to 40 dBA at his property line if it was his home and family that was at risk (McCunney, Lowell Mountain Vermont hearing before VPSC); while another has admitted that people who live in homes subjected to sound levels of 40 dBA or higher at night are likely to show adverse health effects (Leventhall, Kent Breeze, Ontario hearing before Ontario Environmental Tribunal). Yet, this whitepaper is still distributed by the wind industry trade associations as though it carried the authority of independent peer reviewed science.

While "independent panels" were concluding that there were no health risks associated with wind turbine noise in Massachusetts, the Board of Health in Falmouth was dealing with the complaints of sleep disturbance and adverse health effects from low frequency sound by people living near two industrial scale wind turbines. In March of 2012, less than a month after the Massachusetts report was issued, the Falmouth Board of Health sent a letter to the state's Department of Environmental Protection. It stated:

- "As a preventative measure, it would be appreciated if the Mass. DEP quickly reformulated current nuisance noise specifications and measurement techniques to specifically address the impact the wind turbines and other sources of impulsive and low-frequency sound on sleep. Implementation of a full study of the effects of wind turbines on annoyance and sleep will take some time, especially if the study is scientifically valid. Interim regulatory criteria would provide some guidance to local Boards of Health that are the actual regulatory enforcement bodies.

- Mass. DEP should give spectral quality sound guidance specific to amplitude modulated and low-frequency sound. We agree with the State Panel's suggestion that the difference between A-weighted and C-weighted sound should be part of the noise specifications. Current noise pollution measurement guidelines do not address this. Additional consideration needs to be applied to amplitude modulated noise that may be discounted by current measurement guidelines (i.e. averaging L_{90} over a 10 minute period).

- Although noise guidelines focused on protecting sleep measured as an absolute dB(A/C) are the most scientifically validated, a more useful regulatory measure would address the potential increase in sound levels (dB(A/C)) over ambient conditions. A wide range of ambient noise as possible, in general regulatory guidelines addressing the increase above ambient are also relevant to the regulation of wind turbine sound immissions."[7]

SIMILAR PROBLEMS IN NEW YORK

This commenter's experience with wind projects in New York began with a visit in March of 2009 to First Wind's Cohocton and Dutch Hill Wind projects in Cohocton, NY. The visit was in response to complaints about excessive noise and vibration in one resident's home.

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[5] http://www.awea.org/policy/regulatory_policy/documents/AWEA_and_CanWEA_Sound_White_Paper.pdf
[6] http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.pdf
[7] http://www.falmouthmass.us/energy/board of health request to DEP.pdf

Subsequent to that field trip there were additional requests for help in documenting complaint conditions related to people living near operating utilities in Bliss and Varysburg, NY. In each case, measurements demonstrated that there were two types of noise problems related to the complaints. First, fluctuating sounds of blade swish were a source of audible sounds that were identified as disturbing sleep. Second, complaints of rumble, vibration, and other low frequency noise effects were reported by many of the same people who had reported the problems with blade swish.

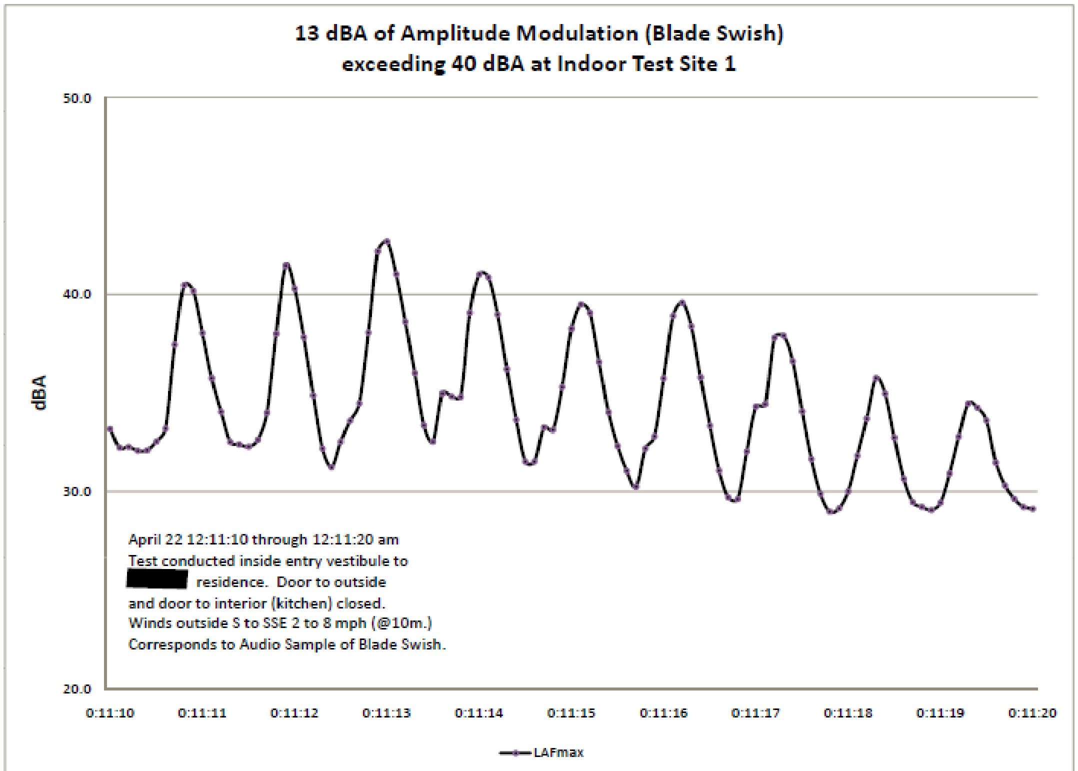

Figure 2-Example of 10-13 dBA Blade Swish inside a home in Bliss/Eagle, NY from turbines 1500 feet or more upwind

Measurements were taken inside and outside the residences and other structures that showed the presence of both the audible blade swish (which was easily observed in the fluctuations of the dBA sound levels) and also the presence of high levels of infra and low frequency sound inside the homes and structures. The difference between the dBC and dBA overall sound levels was always more than 15 and often more than 20 dB outside the homes where there were other sources of mid and high frequency sound from community activity. At night, inside the homes the deltas were higher because the building structure blocks much of the outdoor mid and high frequency sound.

The fluctuating sounds of blade swish were documented in one late night measurement taken inside the home of a resident of Bliss, NY. Figure 2 shows a short 12 second excerpt from the measurement that varied by 13 dBA above the valleys between each swish. The turbines were 1.5 MW models located about 1500 to 2000 feet downwind. The example in Figure 2 was measured using the dBA scale with fast response taken inside the home's entry vestibule with doors and windows closed. Frequency analysis of this noise sample shows the blade swish modulation falls in the frequency range under 200 Hz. Even with the de-emphasis of low frequency sound by the A-weighting filter there is enough energy to produce clearly audible blade swish that is distinct when plotted as dBA sound level (fast response) against time. This shows that the low frequency energy in wind turbine noise is also associated with amplitude modulation. A modulating sound is more annoying than a steady sound. This is one reason that modulation of both frequency and amplitude are commonly used for warning signals and emergency sirens.

Consideration of low frequency sound energy and the modulation of the sounds is appropriate because the influence of complex sounds on humans is more adverse than that estimated from averaged A-weighted measurements. Swinbanks (2011). Also see Minnesota Department of Public Health (2009). Infra and low frequency sound pressure levels inside a home during periods when nearby turbines are operating not only includes sounds of blade swish but also includes short pulsations (under 100 milliseconds in duration) in the frequency range under 20 Hz. These pulsations exceed 70 to 80 dB with some short bursts of sound exceeding 90 and 100 dB and may or may not be audible to the listener. Fluctuations in the infrasound frequency range were rapid and of short duration with peak to valley differences of 20 to 30 dB.,[8] Similar findings would be expected if the measurements taken at the other two properties were subjected to the same analysis.

It is important to note that sound propagation models can only report the average sound pressure level and are not able to predict or report the range of sound pressure levels due to modulations in the sound. Whether the fluctuating sounds are the once per second blade swishes or thumps or the short, rapid pulsations of under 100 milliseconds in the lowest infrasonic frequency ranges, the models cannot be used to assess them. An equivalent sound power level (as L_{eq}) reported with such models provides no information about what the maximum (L_{max}), minimum (L_{min}) or statistical distribution of sound levels (L_{10}, L_{50}, L_{90}) will be at the receiving property. Further, the reported L_{eq} sound pressure levels, whether in dBA, dBC, or octave band detail, will substantially underestimate the peak sound pressure levels people will actually hear. Bray and James (2011).

SEPARATING FACTS FROM MISINFORMATION, MISDIRECTION, TALKING POINTS, AND DENIAL

Last summer, a crack in the wall of silence surrounding wind turbine low frequency noise emissions occurred as a result of the Danish EPA rule making process to add low frequency criteria to their wind turbine noise regulations. A letter dated June 29, 2011 from CEO of Vestas Wind Systems A/S to the Minister of Environment for Denmark's Department of Environment (DoE) sheds some light on why the wind industry directs permitting authorities away from regulations requiring low frequency or C-weighted analysis.[9] Denmark's DoE had been undergoing the steps of the regulatory process to include a requirement limiting low frequency sound from wind turbines. This requirement is the same one that Denmark uses for general industry and is a well conceived and tested method although it does not utilize the dBC scale. The Danish government had concluded that larger utility scale wind turbines shift sound energy downward and increase the potential effect of low frequency noise on people inside their homes. See Moeller (2011). This is consistent with the Vestas letter, which acknowledges that it will take some time to make the design changes needed to reduce the low frequency sound emissions. It states:

> "In fact according to our analyses the most economical turbines, the 3 MW category, are the ones that will be strongly affected by the new rules. This applies to open terrain in particular, where in future low frequency noise will dictate and increase the distance requirements to neighbors for close to half of the projects that we are already aware of over the next 2 to 3 years."

And,

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[8] This may not seem like a significant sound pressure level, but the data was measured using a Type 1, 1/3 octave band analyzer which understates the true peak of sounds in the lower frequency range because the impulse response time is much longer than the duration of the fluctuating sounds being measured. See Bray and James (2011). Thus, had this data been analyzed using the tools applied in the Bray/James paper the peaks would have been 10 to 15 dB higher, the valleys even lower, and the durations would have been in the under 100 millisecond range.

[9] A translation of this letter has been posted on National Wind Watch's website: http://wind-watch.org/doc/?p=2792

> "At this point you may have asked yourself why it is that Vestas does not make changes to the wind turbines so that they produce less noise? The simple answer is that at the moment it is not technically possible to do so, and it requires time and resources because presently we are at the forefront what is technically possible for large wind turbines, and they are the most efficient of all."

In a recent report prepared for the City of Maastricht, Netherlands, Dr. Henrik Moller (2012) shows that utilization of dBC analysis shows large areas of the surrounding community will be immersed in significant low frequency sound levels from wind turbines, while utilization of only dBA analysis results in a prediction of insignificant low frequency immissions.

Concern about indoor environments with strong low frequency noise is not new. In its "Night Noise Guidelines for Europe," the World Health Organization (WHO) states that, to protect the most vulnerable among the public from adverse health effects, regulatory authorities should limit night noise to 40 dB outside the home. See WHO (2009).[10] In 1999, WHO applied a conventional rule acoustic engineers apply to determine whether a noise source emits sound dominated by low frequencies. They cautioned that when the difference between the dBC and dBA sound levels is greater than 10 dB low frequency analysis is required because of potential health effects from the low frequency sounds. WHO (2009), pp. xii-xiii. The need for such a rule is WHO's finding that sound dominated by low frequencies may be more disturbing than sound at the same decibel level not dominated by low frequencies. Id. This fact is well documented. See Bradley (1994); Krahè (2008); Minnesota Department of Public Health (2009).

WHO acknowledged that low frequency noise may be obscured by reporting A-weighted equivalent sound level (L_{Aeq}):

> "A noise measure based only on energy summation and expressed as the conventional equivalent measure, LAeq, is not enough to characterize most noise environments. . . . If the noise includes a large proportion of low-frequency components, still lower values than the guideline values below will be needed. When prominent low-frequency components are present, noise measures based on A-weighting are inappropriate. The difference between dB(C) and dB(A) will give crude information about the presence of low-frequency components in noise, but if the difference is more than 10 dB, it is recommended that a frequency analysis of the noise be performed. It should be noted that a large proportion of low-frequency components in noise may increase considerably the adverse effects on health." WHO (1999), pp. xii-xiii.

As discussed previously, ten years prior to the WHO's cautionary statements about low frequency noise inside homes and other occupied structures, the NASA/DOE studies of wind turbines, including the upwind HAWT designs now being installed, concluded that wind turbines were likely to be more of an indoor problem than an outdoor one because of the interaction between the low frequency sounds and the structures of homes and other buildings. Hubbard and Shepherd (1990).

The need for addressing the increased noise during nighttime stable atmospheric conditions to assess complaint potential has been known since the early 2000's from the early work of Dr. G. P. (Frits) Van den Berg. His numerous conference papers and thesis: "*The Sounds of High Winds: the effect of atmospheric stability on wind turbine sound and microphone noise*" documents the

10 WHO identifies sleep disturbance as an adverse health impact. See Shepherd (2011), at 390. See also Gohlke et al. (2008) ("*Wind energy will undoubtedly create noise, which increases stress, which in turn increases the risk of cardiovascular disease and cancer.*"); Hanning and Evans (2012) ("*experts contend that the quantity, consistency, and ubiquity of the complaints [about wind turbine noise] constitute epidemiological evidence of a strong link between wind turbine noise, ill health, and disruption of sleep. A large body of evidence now exists to suggest that wind turbines disturb sleep and impair health at distances and external noise levels that are permitted in most jurisdictions*").

difference between day and night time noise emissions. Van den Berg (2006) In this commenter's opinion, it should have been a red flag to the industry and its experts that there were risks of higher than expected sounds outside and inside the homes of people living near the projects. However, instead of disclosing these risks to permitting agencies and incorporating the new knowledge about the nighttime noise from wind turbines into the noise reports and studies prepared for their client's use in applications, the work of Van den Berg was dismissed by wind industry proponents as only applying to the one project used for his study. The wind industry proponents' reports and studies continued to understate or misdirect permitting authorities about risks by avoiding any discussion of variability in wind turbine noise emissions that can occur within common weather and wind conditions. They continue to present reports and contour maps ignoring low frequency sound and showing predicted sound levels for the adjacent communities based on computer models that use daytime sound power levels (as measured under the IEC61400-11 protocol) to represent wind turbine sound propagation and its dBA level at receiving properties.

The typical wind project sponsor's model reports daytime noise which is lower and often with little or no blade swish. The model is not inaccurate, it just reflects the daytime sound emissions. I have reviewed a number of studies by wind industry acousticians that compared model predictions to operational sound level. Many have shown good correlations, but that is because the operational sound levels were sampled during the same daytime conditions as the model was designed to represent.

Many people who have observed wind turbines in operation during a typical warm weather day conclude the turbines do not seem to be producing enough noise to support the complaints. What is being reported are observations of the conditions used for the permit application; those of daytime operation. The residents who made the complaints would respond that to understand why wind turbine noise can cause the complaints one needs to spend some nights in their homes. There is considerable truth in that statement.

That is not to say that other night time weather conditions cannot also lead to high wind turbine noise emissions or that there are no noisy periods during the day. They do. However, during the daytime, community activities lead to higher background sound levels and people are relatively less sensitive to noise in general because of their own activities. During periods with unstable atmospheric conditions, such as during stormy weather, the turbines can be very noisy, but this is not the time when people are concerned about noise. The winds howl, the lighting and thunder cracks and the sounds of wind turbines, while still distinctive and easily separated from these other sounds, are just one more annoyance that people tolerate during bad weather. All of these other conditions aside, if the project is designed for the condition of a stable nighttime atmosphere the project will be more likely to be acceptable to the community. It is during such periods that people are accustomed to the peace and tranquility of the rural area.

In summary, we know that the primary complaints about wind turbine noise occur as a result of nights when a stable ground-level atmosphere is accompanied by a temperature inversion at an altitude near or above the lowest point of blade rotation, and above that boundary the wind shear is high (0.4 or higher) and turbulence is also high.[11] During the warm season, nighttime stable atmospheric conditions occur about a third to just under half of the time. (Schneider 2010; Van den Berg 2006.) This is about half of the time wind turbines operate. The unpredictability of the winds entering the plane of blade rotation results in in-flow, cross-wind and/or up-draft turbulences as blades cross from one wind speed region to another within the rotor-swept area. Van den Berg (2006); Schneider (2009). See also James (2010), at pp. 7ff. Had project proponents in Bliss, Sheldon, Cohocton, Lowville and other New York towns hosting wind projects been required to meet appropriate dBA and dBC criteria based on models that represent nighttime noise conditions,

[11] IEC 61400-11 requires wind turbine test conditions have a wind shear of 0.2 or lower.

turbine to home distances would have been increased and the potential for complaints of adverse health effects would be reduced.

CONCLUSIONS AND RECOMMENDATIONS

The foregoing discussion support the following considerations for changes to the current draft of Exhibit 19:

1. Low frequency sound must be a specific element of the analysis including the measurement of pre-existing background sound levels, the prediction of operational sound immissions, monitoring of operating sound immissions, and complaint follow-up. Both measurements and project noise predictions should utilize dBC or spectral/octave band analysis or both.
2. Sound propagation models should focus on representing the reasonable worst case conditions of operations during nighttime stable atmosphere and reflect the most current understanding of how low frequency sound propagates under these conditions.
3. Performance criteria are an essential part of the regulations, if only to avoid project to project disparities and to expedite the process. The criteria be the $L_{(90)}$ background + 6 dBA/dBC with upper limits of 35 dBA and 50 dBC ($L_{eq\ 1hr}$) set as not to exceed limits until more is known about the risks of adverse health effects.

In addition, it must be recognized that the IEC 61400-11 input data for project noise modeling do not reflect real world conditions. Model outputs using such input data must be penalized to reflect the higher sound emissions that occur during the nighttime stable atmospheric conditions at near-ground level (e.g. calm), a temperature inversion at or near the blades and the increased wind shear and turbulence that occurs above the temperature inversion boundary. Without such adjustments, project noise will routinely fail to reflect the reasonable worst case condition.

Sincerely,
E-Coustic Solutions

Richard R. James, INCE

RRJ/encs:
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JUDY FRIEDERICHS, R.N., B.S.N.
DIRECTOR

January 18, 2012

On January 10, 2012, the Brown County Board of Health adopted the enclosed resolution requesting emergency State aid for families suffering around industrial wind turbines; and supported Wisconsin Citizens Safe Wind Siting guidelines (PSC Ref#157326).

We urge your consideration and support of these issues.

Sincerely,

Audrey S. Murphy

Audrey S. Murphy, BSN
Chairman
Brown County Board of Health

Jay J. Tibbetts, MD

Jay J. Tibbetts, MD
Vice-Chairman
Brown County Board of Health

Turning Brown County Green

<u>Brown County Board of Health Resolution Requesting Emergency State Aid for Families Suffering Around Industrial Wind Turbines</u>

WHEREAS the Public Service Commission of Wisconsin's wind siting rules ('PSC 128') were created without oversight of a medical professional *"...who is a University of Wisconsin System faculty member with expertise regarding the health impacts of wind energy systems.*" as mandated in 2009 WISCONSIN ACT 40. Jevon D. McFadden, MD, MPH (the Medical Doctor appointed to this role) publically acknowledged that he did not meet these criteria.

WHEREAS in the May 25, 2010 presentation made by Jevon D. McFadden, MD, MPH to the Brown County Board of Health, on behalf of the Wisconsin Department of Health Services - Division of Public Health, the State recognized and acknowledged that "*Gaps remain in our knowledge of the impact that wind energy may have on human health...*" but has failed to take any action to fill these gaps.

WHEREAS the Public Service Commission of Wisconsin's wind siting rules ('PSC 128') were suspended on March 1, 2011 by the Joint Committee for Review of Administrative Rules (JCRAR) stating that its contents *"...create an emergency relating to public health, safety, or welfare; are arbitrary and capricious; and impose an undue hardship on landowners and residents adjacent to wind turbine sites.*"

WHEREAS the State of Wisconsin has failed to remedy this "*emergency relating to public health, safety, or welfare*" by carrying out the mandate of 2009 WISCONSIN ACT 40 which requires the State to enact wind siting standards that *"...include setback requirements that provide reasonable protection from any health effects, including health effects from noise and shadow flicker, associated with wind energy systems...*"

WHEREAS the State's inaction to enact wind siting rules that protect human health and safety has allowed development of the industrial wind project known as Shirley Wind LLC to be constructed in the Town of Glenmore, Brown County, Wisconsin (dedicated November 2010).

WHEREAS Shirley Wind LLC has created an environment that has resulted in the very same "*undue hardships*" that the JCRAR suspension of 'PSC 128' sought to prevent. These "*undue hardships*" have forced two families to vacate their homes to regain their health and continue to force at least two other families to suffer adverse health effects significant enough that they seek refuge away from their homes but do not have the financial ability to temporarily relocate.

WHEREAS the Brown County Board of Health has attached recent (2009 and newer) references (many peer-reviewed) to this resolution, organized by year of publication, accurately describing the cause, conditions, and adverse health effects being experienced by Brown County families.

WHEREAS the Brown County Board of Health has in the past, and continues to, advocate for the health and safety of Brown County families.

THEREFORE, BE IT RESOLVED that the Brown County Board of Health formally requests temporary emergency financial relocation assistance from the State of Wisconsin for those Brown County families that are suffering adverse health effects and undue hardships caused by the irresponsible placement of industrial wind turbines around their homes and property. The State of Wisconsin emergency financial assistance is requested until the conditions that have caused these undue hardships are studied and resolved, allowing these families to once again return safely to their homes and property.

Brown County Board of Health
Industrial Wind Turbine Health Impact Supporting References

The following recent (2009 and newer) references (many peer-reviewed), organized by year of publication, accurately describe the cause, conditions, and adverse health effects being experienced by Brown County families.

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- George Kamperman, PE, President, Kamperman Associates, Inc., Board-Certified Member of Institute of Noise Control Engineers, Fellow Member of Acoustical Society of America, Member of National Council of Acoustical Consultants,
- F. Owen Black, MD, Fellow of the American College of Surgeons, Board-Certified Otolaryngologist, Senior Scientist, Director of Neurotology Research Balance & Hearing Center North West, Legacy Health System
- Joel F. Lehrer, MD, Fellow of the American College of Surgeons, Board-Certified Otolaryngologist and Head and Neck Surgeon, Served on Hearing and Equilibrium Subcommittee of the American Academy of Otolaryngology and Head and Neck Surgery, Clinical Professor of Otolaryngology, University of Medicine & Dentistry of NJ,
- Stanley M. Shapiro, MD, Fellow of the American College of Cardiology, Board-Certified Internal Medicine, Cardiovascular Diseases, and Nuclear Cardiology, Champlain Valley Cardiovascular Associates,

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REVIEW OF NOISE STUDIES AND RELATED MATERIAL SUBMITTED REGARDING KENT BREEZE WIND

Date: January 17, 2011

Introduction

This review was conducted on behalf of the Appellant for their Appeal for Renewable Energy Approval issued to Kent Breeze Corp. and MacLeod Windmill Project Inc.. The EBR Registry Number is: 011-1039

The review will address a number of topics. Those topics include:

- An Overview summarizing deficiencies in the Noise Assessment Report by Hatch
- Description of wind turbine noise as a source of environmental noise exposure for humans
- Specific issues with the Noise Assessment report produced regarding Kent Breeze Wind
- Evidence that the Kent Breeze Wind farm noise will exceed the permitted levels
- Comments on the Ontario Chief Medical Officer of Health Report (attached) specifically regarding comments about wind turbine noise and sound.

Overview

This review identified a number of deficiencies in the report and information presented by Hatch regarding the potential for excessive noise exposure on adjoining properties. Most are concerned with the assumptions and methodology Hatch used in constructing the computer model of sound propagation. They fall into the following three categories.

First, the Hatch model included the tolerances for instrumentation error of the IEC 61400-11 test procedures of 0.9 dB but did not include the tolerances for the ISO 9613-2 modeling procedure of ± 3 dB. If the Hatch model had included this tolerance the results shown on the contour maps and tables of their report would be 3 dB higher than stated.

A second, and equally significant fault is that the predicted sound levels underestimate the sound levels that will be received on the properties and at homes adjacent to the wind turbine utility under nighttime stable atmospheric conditions. The Sound Power data used in the sound propagation models does not represent the noise produced by wind turbines during nighttime operations with high wind shear and stable atmospheric conditions. The IEC 61400.11 test standard collects data under neutral atmospheric conditions that do not cause these louder "thumping" or "whooshing" type of noise emissions.

MOE's 2008 Noise Guidelines for Wind Farms requires in section 6.2.3 Adjustment to Wind Turbine Generator Acoustic Emissions for Wind Speed Profile that:

> "The wind speed profile on site of the Wind Farm may have an effect on the manufacturer's wind turbine acoustic emission data and, consequently, on the sound levels predicted at a Point of Reception<u>. Therefore, the wind turbine generator acoustic emission levels must be consistent with the wind speed profile of the project area</u>." (emphasis added)
>
> "To address this issue, the assessment <u>must use manufacturer's acoustic emission data adjusted for the average summer night time wind speed profile</u>, representative of the site." (emphasis added)

In "Effects of the wind profile at night on wind turbine sound" G.P. van den Berg states:

> "....measurements show that the wind speed at hub height at night is up to 2.6 times higher than expected, causing a higher rotational speed of the wind turbines and consequentially up to 15 dB higher sound levels, relative to the same reference wind speed in daytime. Moreover, especially at high rotational speeds the turbines produce a 'thumping', impulsive sound, increasing annoyance further. It is concluded that prediction of noise immission at night from (tall) wind turbines is underestimated when measurement data are used (implicitly) assuming a wind profile valid in daytime."[1]

The "thumping" referred to in the Van den Berg paper occurs in synchronization with blade rotation (about one "thump" or "whoosh" per second assuming the hub is rotating at 20 rpm). "Thumping" does not referring to the blade "swish" of 1-3 dBA present when the turbine is operating in a neutral atmosphere. This "swish" is included as part of the wind turbine sound power ratings provided by the manufacturer. MOE does not permit a penalty for this type of swish. Since the noise from the swish is accounted for in the IEC 61400-11 sound power levels that may be a reasonable decision. The "thumping" of concern is the much louder noise that is not accounted for in the manufacturer's test data. This occurs typically at night under a stable atmosphere where there is high wind shear. This "thumping" can modulate by 5 to 10 dBA or more and is a result of increased sound power emissions from the wind turbine's blades.

Based on this reviewer's experience the nighttime noise is increased by at least 5 dBA over what is observed for similar hub level wind speeds during the day under a neutral atmosphere. If the increased sound power caused by the nighttime atmospheric conditions had been added to the manufacturer's sound power for neutral atmospheric conditions the predicted values would be 5 dBA or more higher than what is shown in the Hatch report tables and contour map.

Third, the sound propagation modeling software used for the sound models is a general purpose model designed for modeling noise from common urban noise sources like industrial plants, roads, and railways. The ISO Standard limits use of the methods to noise sources that are no more than 30 meters above the receiving locations. A wind turbine with a hub height of 80 meters exceeds this ISO limitation by 50 meters. The Hatch report did not disclose this limitation or make any effort to account for the errors that may accrue from the noise source exceeding the source height limits. Cadna/A is based on the ISO standard and thus limitations to the standard apply equally to the Cadna/A model.

The result of these three failings is that the Hatch model does not address the types of audible noise from wind turbines that occurs as a result of the summer night time wind speed profile. The model does not represent the nighttime high wind shear conditions that people find most objectionable. If the model had correctly addressed tolerances and the need to increase the IEC61400-11 sound power levels to account for increased sound emissions at night the contour map and tables would be at least eight (8) dBA higher. This increase would have expanded the boundary of the 40 dBA threshold to include many of the homes around the perimeter of the Kent Breeze project. As a rule of thumb, assuming that the increased sound power for nighttime operation results in a 5 dBA increase and the 3 dB ISO tolerances are included, all receiving properties that have sound level projections between 32 and 40 dBA will exceed 40 dBA. Properly modeled this project would not comply with MOE's 40 dBA limit at receiving properties.

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[1] Van den Berg, G.P., "Effects of the wind profile at night on wind turbine sound" Journal of Sound and Vibration, 2003

Description of wind turbine noise

It is common for people to look at wind turbines as a separate type of noise source. However, some of the problems associated with them are easier to understand if we view wind turbines as a special case of very large exposed-blade industrial fan. For example, if we take a look at the spectrum from a fan, as shown in Figure 1, there are certain characteristics that all fans have in common. There is maximum energy at the blade passage frequency, tones above the blade passage frequency, and broadband noise. The harmonics of that tone have somewhat lower energy content. The broadband spectrum starts above the range where the tones no longer dominate. The energy is highest at the blade passage frequency and drops off as frequency increases.

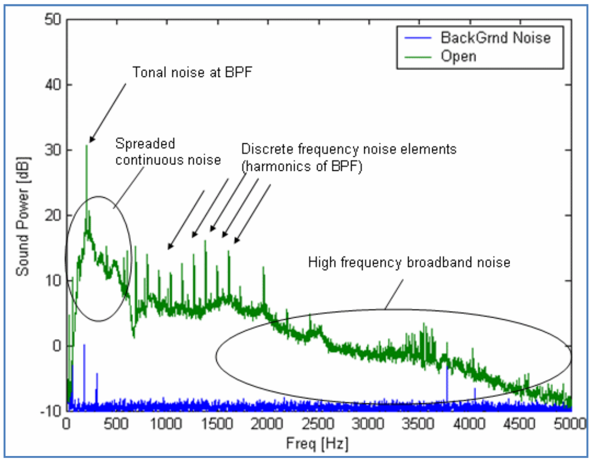

Figure 1-Typical Fan Noise Spectrum

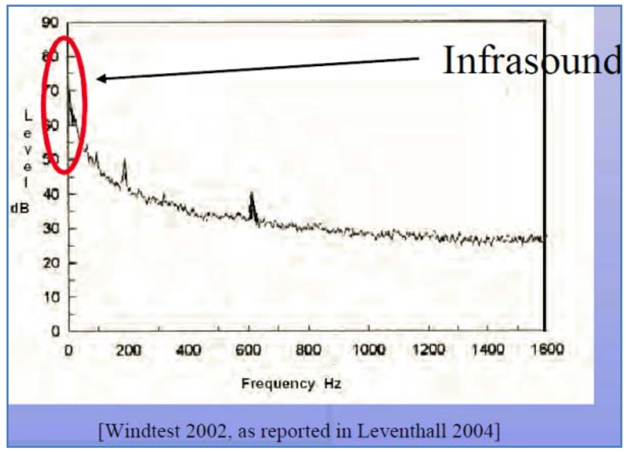

Figure 2-Vestas V-52 Spectrum (From NREL)

In Figure 2, the wind turbine spectrum for a Vestas V-52 shows some of the same spectral characteristics. It does not show the tones and harmonics at the blade passage frequency (BPF) because for industrial scale upwind turbines this is usually between 1 and 2 Hz and the harmonics occur below 10 Hz. Because this is a difficult range of frequencies to measure, especially in field test situations, most information about the spectral characteristics do not show the infrasound range (0-20Hz) sound pressure levels (SPL). This is further obscured by the practice of wind industry acoustical consultants to present data using of A-weighting (dBA). The practice masks the spectrum shape by creating a visual impression of minimal low-frequency sound content. Even when octave band (1/1 or 1/3) SPLs are presented the reports normally ignore frequencies below 31.5 or 63 Hz. The wind industry and its consultants often conclude that there is little or no infra or low frequency content. If that is true, then the customary reporting practices are understandable. But, if those assumptions are not accurate, then these practices mask a potential source of significant problems.

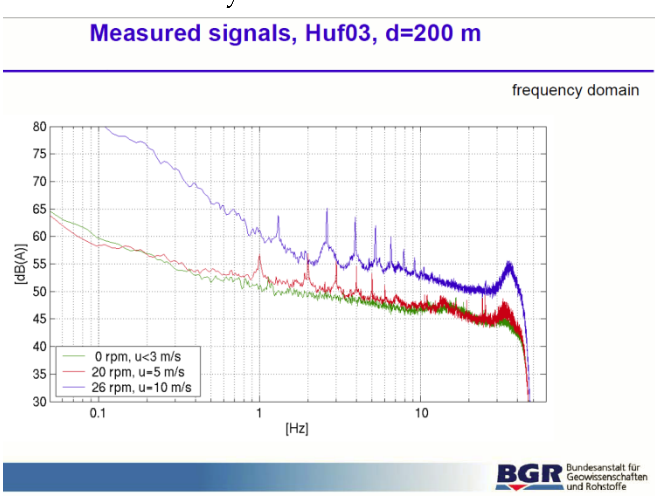

Figure 3-Wind Turbine Infrasound

The graphic to the left (Figure 3) is expanded in the lower frequency range to show a wind turbine's spectrum for the frequency range of 0-10 Hz. Now the tones and harmonics are clearer. Also, note the correlation of the frequency of the tones to rotational speed. This graph is from a study conducted by the Federal Institute for Geosciences and Natural

Resources, Hannover, Germany, titled: "The Inaudible Noise of Wind Turbines" presented at the Infrasound work shop in 2005 (Tahiti).

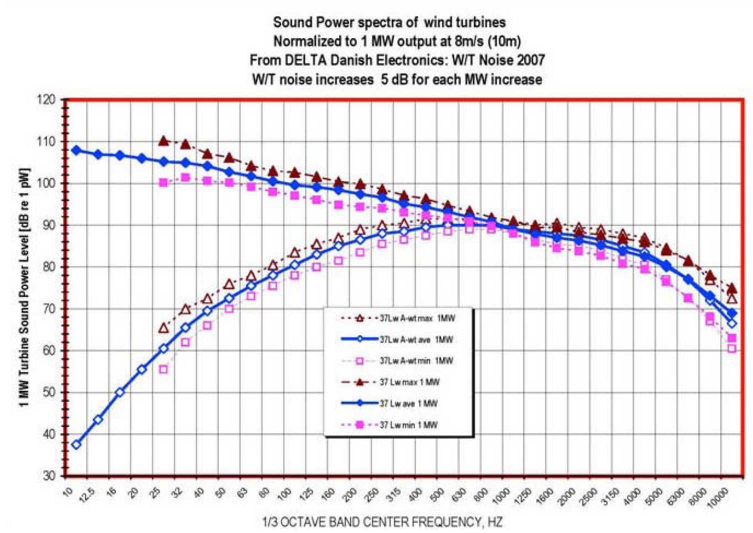

Figure 4-Sound Power Level of 37 Turbines Normalized to 1MW

Are the sound emission characteristics similar or different for different models and makes of wind turbines? Figure 4 shows the general spectrum shape of 37 modern upwind turbines representing the type and sizes being located in the Kent Breeze Wind Project. This graph shows the sound power data after normalizing the data for each turbine to 1 MW of power output.[2] It is clear that there is little deviation in spectral shape between any of the various models that is not related to power produced. However, as seen in the A-weighted curves of the same data, the use of A-weighting masks the low frequency energy content. All modern upwind industrial scale wind turbines have similar high sound pressure levels and tones in these lowest frequencies.

Wind turbine noise is distinctively annoying

There have been several studies, primarily conducted in European countries with a long history of wind turbines, showing that at the same sound pressure (decibel) level or less, wind turbine noise is experienced as more annoying than airport, truck traffic or railroad noise[3,4]. There are several reasons why people respond more negatively to wind turbine noise that are directly a result of the dynamic modulations of the noise, both audible and inaudible, more than the absolute level of the sounds received.

Amplitude Modulation (Audible Blade Swish)

It is not clear which characteristic of wind turbines makes them more annoying than other common sounds in the community. Whether it is the distinctive rhythmic, impulsive or modulating character of wind turbine noise (all synonyms for "thump" or "whoosh" or "beating" sounds); its characteristic low frequency energy (both audible and inaudible, and also impulsive); the adverse health effects of chronic exposure to wind turbine noise (especially at night); in-phase modulation among several turbines in a wind farm (this can triple the impulse sound level when impulses of three or more turbines become synchronized); or some combination of all of these factors that best explains the increased annoyance is not fully understood. One or more of these characteristics are

[2] DELTA, Danish Electronics, Light & Acoustics, "EFP-06 Project, Low Frequency Noise from Large Wind Turbines, Summary and Conclusions on Measurements and Methods," April 30, 2008

[3] E. Pedersen and K. Persson Waye, "Perception and annoyance due to wind turbine noise: a dose–response relationship," J. Acoust. Soc. Am. 116, 3460–3470 (2004).

[4] Vandenberg, G., Pedersen, E., Bouma. J., Bakker, R. "WINDFARMperception Visual and acoustic impact of wind turbine farms on residents" Final Report, June 3, 2008.

likely present depending on atmospheric and topographic conditions, (especially at night)[5] as is the individual susceptibility of each person to them.

Nevertheless, reports based on surveys of those living near wind farms consistently find that, compared to surveys of those living near other sources of industrial noise, annoyance is significantly higher for comparable sound levels among wind utility footprint residents. In most cases, where relationships between sound level and annoyance have been determined, annoyance starts at sound levels 10 dBA or more below the sound level that would cause equivalent annoyance from the other common community noise sources. Whereas one would expect that people would be annoyed by 45 dBA nighttime sound levels outside their homes in an urban area, rural residents are equally annoyed by wind turbines when the sound levels are 35 dBA. Given that wind turbine utilities are often permitted to cause sound levels of 40 or higher at the outside of homes adjacent to or inside the footprint of wind utilities the negative reactions to wind turbines from many of those people is understandable. Their reactions provide objective evidence from currently operating wind utilities that a substantial number of people who live near the Kent Breeze project will complain that the noise level they experience is both causing nighttime sleep disturbance and creating other problems once operation commences.[6 7]

Although there remain differences in opinions about what causes the amplitude modulation of audible wind turbine noise most of the explanations involve high wind shears and/or turbulence as it moves into turbine's blades[8]. There are a number of explanations that have been presented to explain this noise. For example, eddies in the wind, high wind shear gradients (e.g. different wind speeds at the higher reach of the blades compared to the lower reach), slightly different wind directions across the plane of the blades, and interaction among turbines, have each been identified as causes of modulating wind turbine noise from modern upwind turbines.[9]

Consultants for wind utility developers often claim that wind turbine sound immissions inside and adjacent to the project footprint estimated by the sound propagation model's represent "worst-case" conditions. The IEC 61400-11 test procedures used to derive this data states that the turbine's reported sound power levels represent the turbine's sound emissions at or above its nominal operating wind speeds under standardized weather and wind conditions. These weather conditions require a neutral atmosphere where the wind shear fits the assumptions of the power law for winds at 10 meters and the hub level. This condition is often associated with a warm, sunny afternoon. That is reasonable given that the purpose of these tests is to produce standardized data to permit a prospective buyer of turbines to compare the sound emissions from various makes and models. This needs to be understood as being similar to the standardized gasoline mileage tests for new vehicles. One does not get the mileage posted on the vehicle sticker since each person's driving habits are different. The same is true for wind turbines and the environments in which they operate. The IEC test data does not account for the increased noise from turbulence or other weather conditions that cause higher sound emissions. A review of the IEC 61400-11, Wind Turbine

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[5] G.P. Van den Berg, "The beat is getting stronger: The effect of atmospheric stability on low frequency modulated sound on wind turbines," Noise notes 4(4), 15-40 (2005) and "The sound of high winds: the effect of atmospheric stability on wind turbine sound and microphone noise" Thesis (2006)

[6] Kamperman and James (2008); James (2009b); Minnesota Department of Health (2009), pp. 19-20.

[7] Bajdek, Christopher J. (2007). *Communicating the Noise Effects of Wind Farms to Stakeholders*, Proceedings of NOISE-CON (Reno, Nevada), available at http://www.hmmh.com/cmsdocuments/ Bajdek_NC07.pdf

[8] Van den Berg (2006, pp. 35-36); Oerlemans/Schepers (2009).

[9] Bowdler, "Why Turbine Noise Annoys – Amplitude Modulation and other things," Where Now with Wind Turbines, Environmental Protection U.K. Conference, Sept. 9, 2010 Birmingham, U.K.

Systems-Part 11: Acoustic Noise Measurement Techniques' assumptions in the body and appendices (esp. Appendix A) show that the IEC test data reported to turbine manufacturers is not 'worst case' for real world operations. Weather can introduce additional deviations from model results along its propagation path. ANSI standards for outdoor noise caution that turbulence in the air can increase the downwind sound levels by several decibels. It should be clear that any assertions by the acoustical modeler that the models represent "worst case" sound level estimates rely on careful phrasing or ignorance of the underlying standards and methods.

Impulsive sound was considered more problematic for older turbines that had rotors mounted downwind from the tower[10]. The sound was reduced by mounting the rotor upwind of the tower, common now on all modern turbines[11]. Initially, many presumed that the change from downwind to upwind turbine blades would eliminate amplitude modulated sounds (whooshes and thumps) being received on adjacent properties. However, in a landmark study by G. P. van den Berg[12], it was shown that the impulsive swishing sound increases with size because larger modern turbines have blades located at higher elevations where they are subject to higher levels of wind shear during times of ground level "atmospheric stability." This results in sound fluctuating 5 dBA or more between beats under moderate conditions and 10 dBA or more during periods of higher turbulence or wind shear[13].

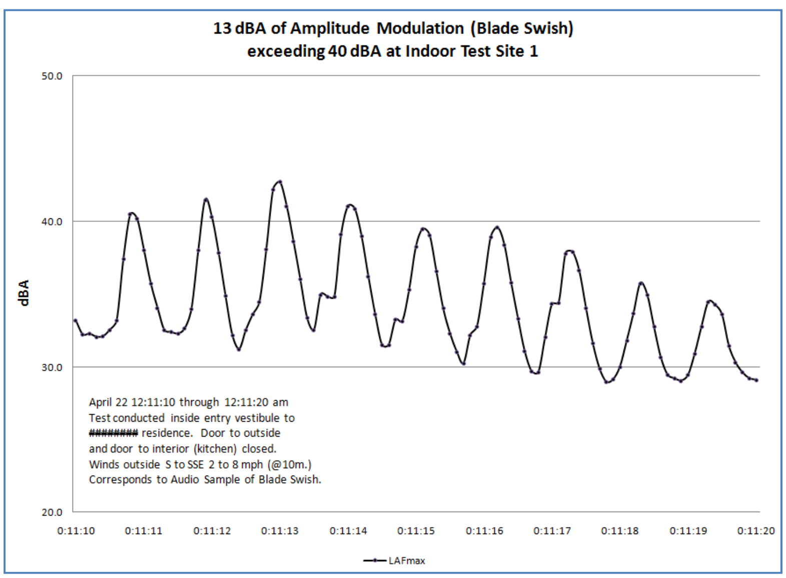

Figure 5-Audible Blade Swish inside home from New York Wind Utility

This author has confirmed night time amplitude modulation (blade thumping) at every wind project he has investigated. During periods of high turbulence or wind shear levels the sound levels produced by blade "thump" have been as high as 10-13 dBA. Figure 5's graph shows the rise and fall of the A-weighted sound levels from blade swish measured inside a closed entry vestibule to a home. This test site is approximately 1500 feet from two (2) turbines with sound emission characteristics similar to the turbines proposed for the Kent Breeze Wind project. It should be noted that other tests measured sound levels exceeding 40 dBA inside the home in the rooms facing the turbines with a window partly open.

To compensate for the added annoyance of fluctuating or impulsive sound, the sound power levels of the turbine must be increased above what is reported for neutral atmospheric conditions under IEC 61400-11. The impact of this increased annoyance from short term fluctuations in sound levels

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10 Rogers (2006, p. 10)
11 *Id.*, pp. 13, 16; Van den Berg (2006), p. 36.
12 Van den Berg (2006, p. 36)
13 *Id.*,

is cited in the Minnesota Department of Public Health report of 2009.[14] The evidence collected by this reviewer as demonstrated in Figure 5 shows that this increase in noise emissions is generally applicable. It is the days and nights when the amplitude modulation is at its worst that cause complaints. It is not the 1-3 dB swishes of a summer afternoon, but the 6-9 dB whooshes of a late evening or the 10 -14 dB thumps during warm season night time weather with high turbulence or wind shear that matter. These conditions are common in warm weather months and at any time when significant vertical and horizontal turbulence and wind shear may occur.

Frequency of Conditions that Cause Blade Swish

The phenomenon of wind shear coupled with ground level atmospheric stability refers to the boundary that forms between calm air at ground level and winds above the boundary at a higher altitude. "*A high wind shear at night is very common and must be regarded a standard feature of the night time atmosphere in the temperate zone and over land.*"[15] A paper presented at the 2009 Institute of Noise Control Engineers, Noise-Con 2009 conference in Ottawa, Canada on background noise assessment in New York's rural areas noted: "*Stable conditions occurred in 67% of nights and in 30% of those nights, wind velocities represented worst-case conditions where ground level winds were less than 2 m/s and hub-height winds were greater than wind turbine cut-in speed, 4 m/s.*"[16]

Based on a full year of measurements every half-hour at a wind farm in Germany, Van den Berg found:

> "*the wind velocity at 10 m[eters] follows the popular notion that wind picks up after sunrise and abates after sundown. This is obviously a 'near-ground' notion as the reverse is true at altitudes above 80 m. . . . after sunrise low altitude winds are coupled to high altitude winds due to the vertical air movements caused by the developing thermal turbulence. As a result low altitude winds are accelerated by high altitude winds that in turn are slowed down. At sunset this process is reversed.*[17]"

In other words, when ground-level wind speed calms after sunset, wind speed at typical hub height for large wind turbines (80 meters, or 262 feet) commonly increases or at least stays the same. As a result, turbines can be expected to produce noise while there is no masking effect from wind-related noise at the ground where people live. "*The contrast between wind turbine and ambient sound levels is therefore at night more pronounced*.[18]" The blade angle is calculated for the average wind speed (at the hub) but the wind speeds at the top and bottom can require different settings to avoid producing noise. As the turbine's blades sweep from top to bottom under such conditions the blade encounters different wind velocities that do not match the blade's angle of attack resulting in rhythmic swishing noise from the parts of the rotation where blade angle mismatches occur[19]. Such calm or stable atmosphere at near-ground altitude accompanied by wind shear near turbine hub height occurred in the Van den Berg measurements 47% of the time over the course a year on average, and most

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[14] Van den Berg (2006), p. 106; Minnesota Department of Public Health (2009), p. 21. *See also* Pedersen, "Wind turbine noise, annoyance and self-reported health and well being in different living environments," 2007, p. 24)

[15] Van den Berg (2006, p. 104). *See also* Cummings (2009)

[16] Schneider, C. "Measuring background noise with an attended, mobile survey during nights with stable atmospheric conditions" Noise-Con 2009

[17] (Van den Berg 2006, p. 90)

[18] *Id.*, p. 60

[19] *Id.*, p. 61. *Cf. also* Minnesota Department of Public Health (2009), pp. 12-13 and Fig. 5.

often at night[20].

Infra and Low Frequency Sounds

The level of annoyance produced by wind turbine noise also increases substantially for **low frequency sound,** once it exceeds a person's threshold of perception. Annoyance increases more rapidly than the more readily audible mid-frequency sounds. Sound measured as dBA is biased toward 1,000 Hz, the center of the most audible frequency range of sound pressure. Low frequency sound is in the range below 200 Hz and is more appropriately measured as dBC or using instrumentation that can provide 1/3 octave band resolution of the spectrum sound pressure levels. Sound below 20 Hz, termed infrasound, is generally presumed to not be audible to most people. *See* Leventhall (2003, pp. 31-37); Minnesota Department of Public Health (2009, p. 10); Kamperman and James (2008, pp. 23-24). However, if these criteria are applied to the most sensitive people, the thresholds drop approximately 6-12 dB. Since the wind turbine sounds are a complex mix of tones, all within the same critical band, they will be audible at levels lower than what is required for a single pure tone. The combination of people with extra sensitivity and the presence of a complex set of tones in the range from 0 to 20 Hz puts the infrasound sound pressure levels measured on receiving properties and inside homes within the threshold of perception for a subset of the population.

For many years it has been presumed that only infra and low frequency sounds that reached the threshold of audibility for people posed any health risks. Many acoustical engineers were taught that <u>if you cannot hear a sound, it cannot harm you</u>. Recent research has shown that the human body is more sensitive to infra and low frequency noise (ILFN) and that the organs of balance (vestibular systems) respond at levels of sound significantly lower than the thresholds of audibility.[21]

Dr. Nina Pierpont has conducted a peer reviewed study of the effects of infra and low frequency sound on the organs of balance that establishes the causal link between wind turbine ILFN and medical pathologies. The new research is not from the traditional fields that have provided guidance for acoustical engineers and others when assessing compatibility of new noise sources and existing communities. A recent peer reviewed paper by Dr. Alec Salt, reported that the cochlea responds to infrasound at levels 40 dB below the threshold of audibility.[22] These studies show how the body responds to extremely low levels of energy not as an auditory response, but instead as a vestibular response.

In a personal communication, this reviewer asked Dr. Salt the question: "Does infrasound from wind turbines affect the inner ear?" Dr. Salt responded:

> "There is controversy whether prolonged exposure to the sounds generated by wind turbines adversely affects human health. The un-weighted spectrum of wind turbine noise slowly rises with decreasing frequency, with greatest output in the 1-2 Hz range. As human hearing is insensitive to infrasound (needing over 120 dB SPL to detect 2 Hz) it is claimed that infrasound generated by wind turbines is below threshold and therefore cannot affect people. The inner hair cells (IHC) of the cochlea, through which hearing is mediated, are velocity-sensitive

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[20] Van den Berg 2006, p. 96

[21] Alves-Pereira, Marianna and Nuno A. A. Branco (2007a). *Vibroacoustic disease: Biological effects of infrasound and low-frequency noise explained by mechanotransduction cellular signalling*, 93 PROGRESS IN BIOPHYSICS AND MOLECULAR BIOLOGY 256–279, available at http://www.ncbi.nlm.nih.gov/ pubmed/17014895><
and, Alves-Pereira, Marianna and Nuno A. A. Branco (2007b). *Public health and noise exposure: the importance of low frequency noise*, Institute of Acoustics, Proceedings of INTER-NOISE 2007,

[22] Salt, Alec, "Responses of the ear to low frequency sounds, infrasound and wind turbines", Hearing Research, 2010. This work was supported by research grant RO1 DC01368 from NIDCD/NIH

> and insensitive to low frequency sounds. The outer hair cells (OHC), in contrast, are displacement-sensitive and respond to infrasonic frequencies at levels up to 40 dB below those that are heard."
>
> "A review found the G-weighted noise levels generated by wind turbines with upwind rotors to be approximately 70 dBG. This is substantially below the threshold for hearing infrasound which is 95 dB G but is above the calculated level for OHC stimulation of 60 dB G. This suggests that most wind turbines will be producing an unheard stimulation of OHC. Whether this is conveyed to the brain by type II afferent fibers or influences other aspects of sound perception is not known. Listeners find the so-called amplitude modulation of higher frequency sounds (described as blade "swish" or "thump") highly annoying. This could represent either a modulation of audible sounds (as detected by a sound level meter) or a biological modulation caused by variation of OHC gain as operating point is biased by the infrasound. Cochlear responses to infrasound also depend on audible input, with audible tones suppressing cochlear microphonic responses to infrasound in animals. These findings demonstrate that the response of the inner ear to infrasound is complex and needs to be understood in more detail before it can be concluded that the ear cannot be affected by wind turbine noise."

During the summer of 2009, this reviewer conducted a study of homes in Ontario where people had reported adverse health effects that they associated with the operation of wind turbines in their communities[23]. The study involved collecting sound level data at the homes and properties of these people, many of who had abandoned their homes due to their problems. This study found that sound levels in the 1/3 octave bands below 20 Hz were often above 60 dB and in many cases above 70 dB. Since the shape of the spectrum for wind turbine sound emissions is greatest at the blade passage frequency which was below the threshold for the instruments used it can be assumed that the sound pressure levels in the range of 0 to 10 Hz exceeded 70 dBA. Given the statement by Dr. Salt that vestibular responses would start at levels of 60 dBG or higher this data supports the supposition that there is a link between the dynamically modulated infra sound and reported adverse health effects. These examples demonstrate that there is evidence to suspect a link between the presence of modulated wind turbine infra and low frequency noise (ILFN) and the reported adverse health effects.

Problems related to inaudible low frequency and infra sound have been encountered before. Acoustical engineers in the Heating, Cooling and Air Conditioning (ASHRAE) field have suspected since the 1980's and confirmed in the late 1990's that dynamically modulated, but inaudible, low frequency sound from poor HVAC designs or installations can cause a host of symptoms in workers in large open offices[24]. The ASHRAE handbook devotes considerable attention to the design of systems to avoid these problems and has developed methods to rate building interiors (RC Mark II) to assess them for these low frequency problems[25]. The report on Ontario by this reviewer includes an Appendix that provides more detail on this aspect of how inaudible infra and low frequency sound can cause adverse health effects.

When infra and low frequency sound is in the less-audible or inaudible range, it is often <u>felt</u> rather than <u>heard</u>. Unlike the A-weighted component, the low-frequency component of wind turbine noise "*can penetrate the home's walls and roof with very little low frequency noise reduction*.[26]" Further, as discussed in the 1990 NASA study the inside of homes receiving this energy can resonate and cause an increase of the low frequency energy over and above what was outside the home. Acoustic

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23 James, R. R., "Comments Related to EBR-010-6708 and -010-6516" Comment ID 123842, 2009

24 Persson Waye, Kirsten, Rylander, R., Benton, S., Leventhall, H. G., Effects of Performance and Work Quality Due to Low Frequency Ventilation Noise, Journal of Sound and Vibration, (1997) 2005(4), 467-474.

25 The study also showed that NC curves are not able to predict rumble. This use of NC curves was disproved in the 1997 Persson Waye, Leventhall study. Use of the RC Mark II procedures is more appropriate for this use.

26 Kamperman and James (2008), p. 3.

modeling for low frequency sound emissions of ten 2.5 MW turbines indicated "*that the one mile low frequency results are only 6.3 dB below the 1,000 foot one turbine example.*[27]" This makes the infra and low frequency sound immissions from wind turbines a potential problem over an even larger area than the audible sounds, such as blade swish and other wind turbine noises in the mid to high frequency range.

The acoustical consultant that does not practice in that field may not be as aware of the problems of amplitude modulated, in-audible low frequency sound identified by the ASHRAE engineers. Many have not integrated these new understandings of how infra and low frequency sound can affect the vestibular organs into their work on community noise. These levels were only a few years ago considered too low to cause <u>any</u> physical response.

Specific Issues with the Hatch Noise Assessment Report

<u>Problems with Cadna/A (Limitations on Use of ISO 9613-2 Algorithms)</u>

As discussed earlier in this review the sound propagation modeling presented by Hatch and used as the basis for conclusions about the impact of the Kent Breeze Wind project on nearby properties and residences underestimates the sound levels that will be received on the properties and homes adjacent to the wind turbine utility. The sound propagation modeling software used for the sound models (Cadna/A and others) are general-purpose commercial packages for use in modeling noise from noise sources like industrial plants, roads, and railways, not wind turbines. Although this does not completely preclude the use of the Cadna/A software package, it does call into question the implied assertion by Hatch in representing the sound levels to a tenth of a decimal precision that the predicted values can be assumed to be precise. We need to apply reasonable safety factors and give consideration to the known tolerances and limits to the accuracy of the procedures in our conclusions. Further, it must be understood that there are other computational methods and algorithms that can be used to model wind turbines other than the ISO method that produce different results.

Hatch included the 0.9 decibel tolerance associated with instrumentation error from the IEC 61400 – 11 test protocol for measuring the sound power produced by wind turbines. However, Hatch does not include the three (3) dB tolerance associated with errors when applying the ISO-methodology (See Table 5 from the ISO standard on previous page).

Table 5 — Estimated accuracy for broadband noise of L_{AT}(DW) calculated using equations (1) to (10)

Height, h *)	Distance, d *)	
	0 < d < 100 m	100 m < d < 1 000 m
0 < h < 5 m	± 3 dB	± 3 dB
5 m < h < 30 m	± 1 dB	± 3 dB

*) h is the mean height of the source and receiver.
d is the distance between the source and receiver.

NOTE — These estimates have been made from situations where there are no effects due to reflection or attenuation due to screening.

If Hatch had included the three (3) dB tolerance for the ISO methodology, the results of the models for daytime and nighttime operating modes would have shown many of the homes proximate to the project being exposed to sound levels over 40 dBA. ISO 9613-2, Table 5, Section 9, "Accuracy and limits of the method" (Figure 1), shows the tolerance as plus/minus 3 dB for predictions. This applies when the noise source is at a height greater than 5m and less than 30 m above the receiver and the receiver is within 1000 m. of the noise source. Inspection of Table 5 shows that the ISO

[27] *Id.*, p. 12

standard is limited to receivers within 1000 m also limits it to situations where the noise source is no more than 30 m above the receiver.

It essential to include the three (3) dB tolerance in the predictions. Further, the predicted values should be viewed as estimates, not precise values.

Use of Sound Power Data Representing Sound Emissions in a Neutral Atmosphere

Sound power levels must represent the conditions that cause the intrusive blade swish that is commonly associated with nighttime sleep disturbance and complaints. The manufacturer's reported power levels represents a standardized value for 'typical' conditions of a neutral atmosphere with a moderate wind shear gradient. The Hatch report made no attempt to address this deficiency.

Evidence of wind farm noise exceeding certificate of approval levels

A spreadsheet model was developed for three of the properties near the wind project that applies the tolerances as they should be applied. Residences number 12, 61, and 249 were selected as representatives of other properties for comparison to the sound levels reported by Hatch. These models are attached as appendix materials for review.

Evidence of Kent Breeze Exceeding Certificate Approval Level of 40 dBA

Residence	Nearest turbine (m)	Hatch Study Reported dBA (w/o ISO tolerance)	E-CS Study dBA (w/ 3dB ISO tolerance)	Sound Level that reflects the 3 dB tolerance and 5 dBA increase in Turbine Sound Power Level for Night Blade Thump
012	580-M-5	39.1	41.6	46.6
061	1553 (K-1)	31.8	35.5	40.5
249	825 (K-1)	35.9	38.8	43.8
Number of receiving properties at 40 dBA or higher*	N/A	**1** (number 19)	**40** (including number 19)	**114** (including number 19)

* Determined by adding 3 and 8 dB to the sound levels reported in Table 6.1 of the Hatch report

It is worth noting that the Hatch report used the location of homes as the receiving locations instead of the property line at the point nearest to the turbine(s). If the property line had been selected as the receiving location it would increase the number of properties that would exceed the 40 dBA threshold. Use of property lines as the enforcement boundary is customary for noise pollution. It avoids granting a de facto noise easement to the noise emitter giving them the right to cause noise pollution on some or all of the receiving property.

Comments on the Ontario Chief Medical Officer of Health Report

The Health Report issued by the Ontario Chief Medical Officer does not represent a complete and unbiased review of information on how infra and low frequency sounds that are inaudible can affect the health of people exposed to the complex, modulated sounds emitted by wind turbines in the lowest frequency ranges. As discussed earlier in this review there have been other situations where inaudible levels of low frequency sound have caused adverse health effects. The most prominent case being that of office spaces for knowledge workers where inaudible modulated "rumble" created in the HVAC duct systems affected worker performance and health. In addition, the review did not include the findings of recent research of Dr. Salt.

The MOH document has been critically reviewed by members of the Society for Wind Vigilance. Its findings are incorporated into its document: "An Analysis of the Chief Medical Officer of Health (CMOH) of Ontario's "The Potential Health Impacts of Wind Turbines May 2010."" This document is attached.

Conclusion

It is the opinion of this reviewer, based on his personal experience and the review described in this document that a properly conducted study would identify many more homes in the vicinity of the wind turbines where the receiving properties will have sound levels that exceed 40 dBA. When adjusted for known tolerances of algorithms and measurements used to construct the model and the increased sound power emitted by wind turbines at night under conditions of high wind shear, a common situation during the warm season over 100 receiving properties will exceed the sound levels permitted by the MOE.

End of Review

Richard R. James, INCE
For E-Coustic Solutions

Richard R. James

January 16, 2011

Appendix
Model Spreadsheets

	Predicted dBA, dBC, and dBZ Average (Leq) and Maximum (Lmax) Sound Pressure Levels (Residence #249)														
	Receiver Elevation to Tower Hub (m.)		83	1/1 Octave Band Center Frequency (Hz) with Un-weighted Sound Pressure Levels (dB(Z) L_{eq})								From 1/1 Octave Band SPL's			
	Octave Band Center Frequency (Hz)			63	125	250	500	1000	2000	4000	8000	dB(Z) Leq	dB(C) Leq	dB(A) Leq	
Sound Power (Lw)==>	GE 2.5 xl @ 8 m/s V10			112.0	108.5	107.2	102.4	102.5	93.0	85.4	71.1	115.0	114.6	105.9	
	ISO9613-2 Accuracy Tolerance (U.L.)			3	3	3	3	3	3	3	3	3	3	3	
	IEC 61400-11 Meas. Tolerance			0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
	Single Turbine Lw + Tolerances==>		GE 2.5 xl @ 8 m/s V10	115.9	112.4	111.1	106.3	106.4	96.9	89.3	75.0	118.9	118.5	109.8	
Lw	Turbines at specified distances from receiver		1	115.9	112.4	111.1	106.3	106.4	96.9	89.3	75.0	119	119	110	
				Air Absorption Coefficient (Alpha) db/m @ 10C 70%RH											
	MOE Absorption Coefficients			0.0001	0.0004	0.0010	0.0019	0.0037	0.0097	0.0328	0.1170	---	---	---	
Turbine No:	Distance to tower base (ft)	Distance to tower base (m)	Distance to hub (m)	63	125	250	500	1000	2000	4000	8000	dB(Z) L_{eq}	dB(C) L_{eq}	dB(A) Leq	Distance to tower hub (m.)
K-1	2706	825	829	46	43	41	35	34	19	-7	-91	49	49	38	829
K-3	9699	2956	2957	35	31	28	20	15	-12	-88	-351	37	37	23	2957
K-4	9473	2887	2889	35	31	28	21	15	-11	-86	-343	37	37	23	2889
K-5	7894	2406	2408	37	33	30	23	19	-5	-68	-285	39	39	26	2408
M-1	10376	3163	3164	35	30	27	19	14	-15	-95	-376	37	36	22	3164
M-3	14661	4469	4469	31	27	23	14	6	-30	-141	-532	33	33	17	4469
M-4	14210	4331	4332	32	27	23	14	7	-29	-137	-516	33	33	18	4332
M-5	15338	4675	4676	31	26	22	13	5	-33	-148	-556	33	32	17	4676
Cummulative Effect of Listed Turbines as Long Term Average L_{eq} SPL's												dB(Z) L_{eq}	dB(C) L_{eq}	dB(A) Leq	
Turbines Only (w/o AM or Turb.):				48	44	42	36	34	20	3	3	50	50	38.8	%HA
Turbines Plus Background (w/o AM or Turb.):				48	44	42	36	34	20	5	5	50	50	38.8	

Predicted dBA, dBC, and dBZ Average (Leq) and Maximum (Lmax) Sound Pressure Levels (Residence #61)

	Receiver Elevation to Tower Hub (m.)		83	1/1 Octave Band Center Frequency (Hz) with Un-weighted Sound Pressure Levels (dB(Z) L_{eq})											From 1/1 Octave Band SPL's			
	Octave Band Center Frequency (Hz)			8	16	32	63	125	250	500	1000	2000	4000	8000	dB(Z) Leq	dB(C) Leq	dB(A) Leq	
Sound Power (Lw)==>	GE 2.5 xl @ 8 m/s V10			125.0	125.0	125.0	112.0	108.5	107.2	102.4	102.5	93.0	85.4	71.1	129.9	123.8	105.9	
	ISO9613-2 Accuracy Tolerance (U.L.)			3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	IEC 61400-11 Meas. Tolerance			0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
	Single Turbine Lw + Tolerances==>		GE 2.5 xl @ 8 m/s V10	128.9	128.9	128.9	115.9	112.4	111.1	106.3	106.4	96.9	89.3	75.0	133.8	127.7	109.8	
Lw	Turbines at specified distances from receiver		1	128.9	128.9	128.9	115.9	112.4	111.1	106.3	106.4	96.9	89.3	75.0	134	128	110	
	Air Absorption Coefficient (Alpha) db/m @ 10C 70%RH																	
	MOE Absorption Coefficients						0.0001	0.0004	0.0010	0.0019	0.0037	0.0097	0.0328	0.1170	---	---	---	
Turbine No:	Distance to tower base (ft)	Distance to tower base (m)	Distance to hub (m)	8	16	32	63	125	250	500	1000	2000	4000	8000	dB(Z) L_{eq}	dB(C) L_{eq}	dB(A) Leq	Distance to tower hub (m.)
K-1	5088	1551	1553	54	54	54	41	37	35	29	26	7	-36	-182	59	53	31	1553
K-3	10948	3337	3338	47	47	47	34	30	26	18	13	-17	-102	-397	52	46	22	3338
K-4	9715	2961	2962	48	48	48	35	31	28	20	15	-12	-88	-352	53	47	23	2962
K-5	7709	2350	2351	50	50	50	37	33	30	23	19	-4	-66	-279	55	49	26	2351
M-1	6939	2115	2117	51	51	51	38	34	31	25	21	-1	-58	-250	56	50	27	2117
M-3	9868	3008	3009	48	48	48	35	31	28	20	15	-13	-90	-358	53	47	23	3009
M-4	8481	2585	2586	50	50	50	36	32	29	22	18	-7	-75	-307	55	48	25	2586
M-5	8018	2444	2445	50	50	50	37	33	30	23	19	-6	-70	-290	55	49	26	2445
Cummulative Effect of Listed Turbines as Long Term Average L_{eq} SPL's															dB(Z) L_{eq}	dB(C) L_{eq}	dB(A) Leq	
Turbines Only (w/o AM or Turb.):				60	60	60	46	42	39	33	29	9	3	3	64	58	35.5	%HA
Turbines Plus Background (w/o AM or Turb.):				60	60	60	46	42	39	33	29	10	5	5	64	58	35.5	

Predicted dBA, dBC, and dBZ Average (Leq) and Maximum (Lmax) Sound Pressure Levels (Residence #012)

	Receiver Elevation to Tower Hub (m.)		83	1/1 Octave Band Center Frequency (Hz) with Un-weighted Sound Pressure Levels (dB(Z) L_{eq})											From 1/1 Octave Band SPL's			
	Octave Band Center Frequency (Hz)			8	16	32	63	125	250	500	1000	2000	4000	8000	dB(Z) Leq	dB(C) Leq	dB(A) Leq	
Sound Power (Lw)==>	GE 2.5 xl @ 8 m/s V10			125.0	125.0	125.0	112.0	108.5	107.2	102.4	97.5	93.0	85.4	71.1	129.9	123.7	104.3	
	ISO9613-2 Accuracy Tolerance (U.L.)			3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	IEC 61400-11 Meas. Tolerance			0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
	Single Turbine Lw + Tolerances==>		GE 2.5 xl @ 8 m/s V10	128.9	128.9	128.9	115.9	112.4	111.1	106.3	101.4	96.9	89.3	75.0	133.8	127.6	108.2	
	Air Absorption Coefficient (Alpha) db/m @ 10C 70%RH																	
	MOE Absorption Coefficients						0.0001	0.0004	0.0010	0.0019	0.0037	0.0097	0.0328	0.1170	---	---	---	
Turbine No:	Distance to tower base (ft)	Distance to tower base (m)	Distance to hub (m)	8	16	32	63	125	250	500	1000	2000	4000	8000	dB(Z) L_{eq}	dB(C) L_{eq}	dB(A) Leq	Distance to tower hub (m.)
K-1	8562	2610	2611	50	50	50	36	32	29	22	12	-8	-76	-310	54	48	24	2611
K-3	13986	4263	4264	45	45	45	32	27	23	15	2	-28	-134	-507	50	44	18	4264
K-4	11132	3393	3394	47	47	47	34	29	26	18	7	-18	-104	-404	52	46	21	3394
K-5	8753	2668	2669	49	49	49	36	32	29	22	12	-9	-78	-317	54	48	24	2669
M-1	7136	2175	2177	51	51	51	38	34	31	24	16	-2	-60	-257	56	50	26	2177
M-3	6565	2001	2003	52	52	52	39	35	32	25	17	0	-53	-236	57	51	27	2003
M-4	4091	1247	1250	56	56	56	43	39	37	31	24	12	-25	-144	61	55	33	1250
M-5	1902	580	586	63	63	63	49	46	44	39	33	25	4	-60	67	61	40	586
Cummulative Effect of Listed Turbines as Long Term Average L_{eq} SPL's															dB(Z) L_{eq}	dB(C) L_{eq}	dB(A) Leq	
Turbines Only (w/o AM or Turb.):				64	64	64	51	47	46	40	34	25	6	3	69	63	41.6	%HA
Turbines Plus Background (w/o AM or Turb.):				64	64	64	51	47	46	40	34	25	7	5	69	63	41.6	

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE	BIRTHDATE
Richard R. James	Principal Consultant, E-Coustic Solutions	3/3/48
	Adjunct Instructor, Michigan State University Adjunct Professor, Central Michigan University	

EDUCATION

INSTITUTION	DEGREE	YEAR	FIELD OF STUDY
General Motors Institute, Flint, MI	B. Mech. Eng.	1971	Noise Control Engineering

RESEARCH AND PROFESSIONAL EXPERIENCE:
Richard R. James has been actively involved in the field of noise control since 1969, participating in and supervising research and engineering projects related to control of occupational and community noise in industry. In addition to his technical responsibilities as principal consultant, he has developed noise control engineering and management programs for the automotive, tire manufacturing, and appliance industries. Has performed extensive acoustical testing and development work in a variety of complex environmental noise problems utilizing both classical and computer simulation techniques. In 1975 he co-directed (with Robert R. Anderson) the development of SOUND™, an interactive acoustical modeling computer software package based on the methods that would be later codified in ISO 9613-2 for pre and post-build noise control design and engineering studies of in-plant and community noise. The software was used on projects with General Motors, Ford Motor Company, The Goodyear Tire & Rubber Co., and a number of other companies for noise control engineering decision making during pre-build design of new facilities and complaint resolution at existing facilities. The SOUND™ computer model was used by Mr. James in numerous community noise projects involving new and existing manufacturing facilities to address questions of land-use compatibility and the effect of noise controls on industrial facility noise emissions. He is also the developer of ONE*dB(tm) software. He was also a co-developer (along with James H. Pyne, Staff Engineer GM AES) of the Organization Structured Sampling method and the Job Function Sound Exposure Profiling Procedure which in combination form the basis for a comprehensive employee risk assessment and sound exposure monitoring process suitable for use by employers affected by OSHA and other governmental standards for occupational sound exposure. Principal in charge of JAA's partnership with UAW, NIOSH, Ford, and Hawkwa on the HearSaf 2000tm software development CRADA partnership for world-class hearing loss prevention tools.

1966-1970	Co-operative student: General Motors Institute and Chevrolet Flint Metal Fabricating Plant.
1970-1971	GMI thesis titled: "Sound Power Level Analysis, Procedure and Applications". This thesis presented a method for modeling the effects of noise controls in a stamping plant. This method was the basis for SOUND™.
1970-1972	Noise Control Engineer-Chevrolet Flint Metal Fabricating Plant. Responsible for developing and implementing a Noise Control and Hearing Conservation Program for the Flint Metal Fabricating Plant. Member of the GM Flint Noise Control Committee which drafted the first standards for community noise, GM's Uniform Sound Survey Procedure, "Buy Quiet" purchasing specification, and guidelines for implement-ing a Hearing Conservation Program.
1972-1983	Principal Consultant, Total Environmental Systems, Inc.; Lansing, MI. Together with Robert R. Anderson formed a consulting firm specializing in community and industrial noise control.
1973-1974	Consultant to the American Metal Stamping Association and member firms for in-plant and community noise.
1973	Published: "Computer Analysis and Graphic Display of Sound Pressure Level Data For Large Scale Industrial Noise Studies", Proceedings of Noise-Con '73, Washington D.C.. This was the first paper on use of sound level contour 'maps' to represent sound levels from computer predictions and noise studies.
Nov. 1973	Published: "Isograms Show Sound Level Distribution In Industrial Noise Studies", Sound&Vibration Magazine
1975	Published: "Computer Assisted Acoustical Engineering Techniques", Noise-Expo 1975, Atlanta, GA which advanced the use of computer models and other computer-based tools for acoustical engineers.
1976	Expert Witness for GMC at OSHA Hearings in Washington D.C. regarding changes to the "feasible control" and cost-benefit elements of the OSHA Noise Standard. Feasibility of controls and cost-benefit were studied for the GMC, Fisher Body Stamping Plant, Kalamazoo MI.
1977-1980	Principal Consultant to GMC for the use of SOUND(tm) computer simulation techniques for analysis of design, layout, and acoustical treatment options for interior and exterior noise from a new generation of assembly plants. This study started with the GMAD Oklahoma City Assembly Plant. Results of the study were used to refine noise control design options for the Shreveport, Lake Orion, Bowling Green plants and many others.

1979-1983	Conducted an audit and follow-up for all Goodyear Tire & Rubber Company's European and U.K. facilities for community and in-plant noise.
1981-1985	Section Coordinator/Speaker, Michigan Department Of Public Health, "Health in the WorkPlace" Conference.
1981	Published: "A Practical Method For Cost-Benefit Analysis of Power Press Noise Control Options", Noise-Expo 1981, Chicago, Illinois
1981	Principal Investigator: Phase III of Organization Resources Counselors (ORC), Washington D.C., Power Press Task Force Study of Mechanical Press Working Operations. Resulted in publishing: "User's Guide for Noise Emission Event Analysis and Control", August 1981
1981-1991	Consultant to General Motors Corporation and Central Foundry Division, Danville Illinois in community noise citation initiated by Illinois EPA for cupola noise emissions. Resulted in a petition to the IEPA to change state-wide community noise standards to account for community response to noise by determining compliance using a one hour L_{eq} instead of a single not-to-exceed limit.
1983	Published: "Noise Emission Event Analysis-An Overview", Noise-Con 1983, Cambridge, MA
1983-2006	Principal Consultant, James, Anderson & Associates, Inc.; Lansing, MI. (JAA), Together with Robert R. Anderson formed a consulting firm specializing in Hearing Conservation, Noise Control Engineering, and Program Management.
1983-2006	Retained by GM Advanced Engineering Staff to assist in the design and management of GM's on-going community noise and in-plant noise programs.
1984-1985	Co-developed the 1985 GM Uniform Plant Sound Survey Procedure and Guidelines with James H. Pyne, Staff Engineer, GM AES.
1985-Present	**Adjunct Instructor, Michigan State University, Department of Communicative Sciences and Disorders**
1986-1987	Principal Consultant to Chrysler Motors Corporation, Plant Engineering and Environmental Planning Staff. Conducted Noise Control Engineering Audits of all manufacturing and research facilities to identify feasible engineering controls and development of a formal Noise Control Program.
1988-2006	Co-Instructor, General Motors Corporation Sound Survey Procedure (Course 0369)
1990	Developed One*dB(tm), JAA's Occupational Noise Exposure Database manager to support Organizational structured sampling strategy and Job Function Profile (work-task) approach for sound exposure assessment.
1990-1991	Co-developed the 1991 GM Uniform Plant Sound Survey Procedure and Guidelines with James H. Pyne, Staff Engineer, GM AES. Customized One*dB(tm) software to support GM's program.
1990-2006	Principal Consultant to Ford Motor Company to investigate and design documentation and computer data management systems for Hearing Conservation and Noise Control Engineering Programs. This included bi-annual audits of all facilities.
1993-2006	GM and Ford retain James and JAA as First-Tier Partners for all non-product related noise control services.
1993	Invited paper: "An Organization Structured Sound Exposure Risk Assessment Sampling Strategy" at the 1993 AIHCE
1993	Invited paper: "An Organization Structured Sound Exposure Risk Assessment Database" at the Conference on Occupational Exposure Databases, McLean, VA sponsored by ACGIH
1994-2001	Instructor for AIHA Professional Development Course, "Occupational Noise Exposure Assessment"
1996	Task Based Survey Procedure (used in One*dB(tm)) codified as part of ANSI S12.19 Occ. Noise Measurement
1995-2001	Coordinate JAA's role in HearSaf 2000tm CRADA with NIOSH, UAW,Ford, and HAWKWA
1997-Present	Board Member, Applied Physics Advisory Board, Kettering Institute, Flint Michigan
2002-2006	Member American National Standards Accredited Standards (ANSI) Committee S12, Noise
2005-Present	Consultant to local communities and citizens groups on proper siting of Industrial Wind Turbines. This includes presentations to local governmental bodies, assistance in writing noise standards, and formal testimony at zoning board hearings and litigation.
2006	Founded E-Coustic Solutions
2008	Paper on "Simple guidelines for siting wind turbines to prevent health risks" for INCE Noise-Con 2008, co-authored with George Kamperman, Kamperman Associates.
2008	Expanded manuscript supporting Noise-Con 2008 paper titled: "The "How To" Guide To Siting Wind Turbines To Prevent Health Risks From Sound"

2009 "Guidelines for Selecting Wind Turbine Sites," Kamperman and James, Published in the September 2009 issue of Sound and Vibration.

2010 Punch, J., James, R., Pabst, D., "Wind Turbine Noise, What Audiologists should know," Audiology Today, July-August 2010

2011 Jerry L. Punch, Jill L. Elfenbein, and Richard R. James , "Targeting Hearing Health Messages for Users of Personal Listening Devices," Am J Audiol 0: 1059-0889_2011_10-0039v1

2011 Bray, W., HEAD Acoustics, James, R., "Dynamic measurements of wind turbine acoustic signals, employing sound quality engineering methods considering the time and frequency sensitivities of human perception," invited paper for Noise-Con 2011, Portland OR

2012 James, R., "Wind Turbine Infra and Low Frequency Sound: Warning Signs that were not Heard," Pending publication 2012 by the Bulletin of Science, Technology and Society a publication of Sage Publications.

2012 Appointed to a three year position as Adjunct Professor in the Department of Communication Disorders at Central Michigan University.

Professional Affiliations/Memberships/Appointments

Research Fellow - Metrosonics, Inc.		American Industrial Hygiene Association (through 2006)
National Hearing Conservation Association (through 2006)		Institute of Noise Control Engineers (Full Member)
American National Standards Insititute (ANSI) S12 Working Group (through 2006)		Founder and Board Member of the Society for Wind Vigilance, Inc.
Adjunct Professor, CMU 2012-2015		Adjunct Instructor, MSU 2011-2014 (since 1985)

E-Coustic Solutions
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Richard R. James
Principal
Tel: 517-507-5067

List of Recent Publications

Dec. 28, 2011

2008 Paper on "Simple guidelines for siting wind turbines to prevent health risks" for INCE Noise-Con 2008, co-authored with George Kamperman, Kamperman Associates.

2008 Expanded manuscript supporting Noise-Con 2008 paper titled: "The "How To" Guide To Siting Wind Turbines To Prevent Health Risks From Sound"

2009 "Guidelines for Selecting Wind Turbine Sites," Kamperman and James, Published in the September 2009 issue of Sound and Vibration.

2010 Punch, J., James, R., Pabst, D., "Wind Turbine Noise, What Audiologists should know," Audiology Today, July-August 2010

2011 Jerry L. Punch, Jill L. Elfenbein, and Richard R. James , "Targeting Hearing Health Messages for Users of Personal Listening Devices," Am J Audiol 0: 1059-0889_2011_10-0039v1

2011 Bray, W., HEAD Acoustics, James, R., "Dynamic measurements of wind turbine acoustic signals, employing sound quality engineering methods considering the time and frequency sensitivities of human perception," invited paper for Noise-Con 2011, Portland OR

2012 James, R., "Wind Turbine Infra and Low Frequency Sound: Warning Signs that were not Heard," Pending publication 2012 by the Bulletin of Science, Technology and Society a publication of Sage Publications.

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Feb. 28, 2012

Summary of Court and Administrative Agency Cases for Richard R. James

Jurisdiction	Date	Case No.	Topic
Huron County, MI Zoning Board	04-04-2007	N/A	Oral testimony at Hearing on Permit Application before ZB by Noble Env. for Michigan Wind I on why 50 dBA criteria will result in complaints and litigation
Calumet County Board of Supervisors, WI	10-30-2007	N/A	Oral Testimony to County Board of Commissioners on requirements for sound criteria in a License and its Appendices related to Wind Energy Systems.
Logan County, IL, ZB/PC	05-01-2008	N/A	Oral Testimony on Wind Turbine Siting, Illinois Noise Regulations, and rebuttal of reports prepared on behalf of the Rail Splitter Wind LLC
Tazewell County, IL, ZB/PC	05-14-2008	N/A	Oral Testimony on Wind Turbine Siting, Illinois Noise Regulations, and rebuttal of reports prepared on behalf of the Rail Splitter Wind LLC
Laurel Mtn, WV (PSC)	08-05-2008	08-0109-E-CSCN	Oral Testimony on Wind Turbine Siting, background sound levels, and rebuttal of reports prepared on behalf of AES Laurel Mountain, LLC
Wellington, NZ (Hearing)	09-05-2008	N/A	Provide written and oral testimony at hearing to rebut reports prepared on behalf of Meridian Energy Ltd for Mill Creek Wind Utility
Beech Ridge, WV (PSC)	10-16-2008	05-1590-E-CS	Oral Testimony on Wind Turbine Siting, background sound levels, and rebuttal of reports prepared on behalf of Beech Ridge Energy, LLC
Record Hill Wind, ME (DEP)	02-18-2009 08-17-2009	#L-24441-24-A-N/L-24441-TF-B-N	Written Testimony on Wind Turbine siting and rebuttal of reports prepared on behalf of Record Hill wind, LLC
DeKalb County, IL	05-11-2009	Public Hearing	Oral Testimony on Wind Turbine Siting, background sound levels, and rebuttal of reports prepared on behalf of Florida Power and Light
Ontario, CA	07-24-2009	MOE EBR – 010 – 6708 and EBR-10-6516	Comments on behalf of APPEC (Association to Protect Prince Edward County), Proposed Ministry of the Environment Regulations to Implement the Green Energy and Green Economy Act, 2009
Buckeye Wind, Champaign-Urbana, Ohio	Oct.-Dec. 2009	OPSB Case No: 08-666-EL-BGN	Hearing on Application for Permit by Buckeye Wind before OPSB.
Glacier Hills, WI.	Sept.-Nov. 2009	WPSC Case 6630-CE-302	Hearing on Application for Permit by WEPCO for Glacier Hills project before Wisconsin PSC.
Record Hill Wind, Roxbury Pond, Me	March 2010	L-24441-24-A-Z L-24441-TF-B-Z	Hearing on Appeal before Maine DEP Board
Georgia Mountain Wind, VT	March 2010	PSB Docket No. 7508	Hearing before Public Services Commission
Goodhue, MN	July 21, 22, 2010	MPUC Docket No. IP/6701/CN-09-1186 and IP-6701/WS-08-1233	Hearing before PUC ALJ on application for Certificate of Need and Large Wind Energy System Site Permit for 78 MW Goodhue Wind Project
Madison, WI for CWESt	October 10, 2010	Clearinghouse Rule 10-057,	Senate Committee on Commerce, Utilities, Energy, and Rail Public Hearing onp Siting Wind Energy Systems
Georgia and Milton, VT	Nov. 2010	Hearing before Public Services Commission, Docket No. 7508	Hearing before PUC on application for permit to build wind turbine utility on Georgia Mountain
Saddleback Ridge Wind, Carthage, ME for Friends of Maine's Mountains	Nov. 2010	Hearing on Application	Application approval process before Maine's Dept. of Env. Prot. for ridge mounted turbines.

Chatham Ontario, Kent Breeze Wind	February 2011	Hearing before Ontario Environmental Board of Review	Hearing on whether project complies with Ontario regulations to protect health under the Green Energy Act.
Town of Albany, VT	February 2011	Hearing before Public Services Commission, Docket No. 7628	Hearing before PUC on application for permit by Green Mountain Power Corp. for Kingdom Mountain Wind, LLC.
State of Maine	July 7, 2011	Hearing before the Maine Board of Environmental Protection	Hearing before the BEP on a Petition for Rule Change for Maine's Chapter 375 Noise Regulations to add specific Rules for wind turbine noise.
State of Michigan Circuit Court of Leelanau county	Nov. 8-10, 2011	Case No: 11-8456	Complaint of Nuisance Noise and other effects of a 10KW Residential class wind turbine
Illinois, Bureau County, Federal: Friesland Farms, LLC, Pierson, Plaintiff, v. Big Sky Wind, LLC)	Dec. 30, 2011 (filed testimony) Feb. 1, 2012 Deposed	Case No. 10-01232	Complaint of noise annoyance and adverse health effects

List of Communities Where Other Services Were Performed

Wisconsin

1. Calumet County Board of Supervisors
2. Town of Calumet Supervisors
3. Town of Union, Wind Committee
4. Trempealeau County Wind Committee
5. Coalition for Wisconsin Environmental Stewardship (CWESt)

Illinois

6. Tazewell, County Zoning Board (Railsplitter)
7. Logan County Zoning Board (Railsplitter)
8. McLean County (White Oaks)
9. DeKalb County (Next Era)
10. Libertyville (Community Wind)

Iowa

11. Harris (Endeavor Wind)

California

12. East County (Tule Wind) (Citizens)

Minnesota

13. Goodhue County (Goodhue Wind)

Michigan

14. Bingham Twp., Ubly (Michigan Wind I)
15. Lake Township (Planning Commission)
16. Allegan County (citizens)
17. Clinton County (citizens)
18. Emmet County (Board and Planning Committee)
19. Sherman Twp, (Citizens)
20. Benzie County (Citizens)
21. Mason County (Citizens)
22. Reading Township (Planning Committee)
23. Riga Township (Citizens)
24. Michigan Public Service Commission (Public Hearing)
25. Merritt Township (Public Hearing before PC on FPL application)

Ohio

26. Champaign-Urbana (Citizens and Wind Committee)
27. Logan County (Citizens)

Washington

28. Skamania County (Public Hearing)

West Virginia

29. Laurel Mountain (Citizens)
30. Beech Ridge (Citizens)

Pennsylvania

31. Fayette County, (Citizens-South Chestnut Wind)

32. Schuylkill County (Citizens- Butler Wind Farm)
33. Juniata (Attorney for Citizens)
34. Folmont, (Citizens (SOAR))
35. Dunning, (Citizens (SOAR))

Vermont,

36. Georgia Mountain (Citizens)
37. Albany (Town of Albany)
38. Rutland (Public Presentation for Vermonters for Clean Environment)

New Zealand

39. Mill Creek (Ohariu Preservation Society)

New York

40. Cohocton (Citizens)
41. Prattsburg (Citizens and Attorney)
42. Bliss, (Citizens)
43. Town of Italy (Citizens and Attorney)
44. Machias, Yorkshire, Ashford (Cattaraugus County Citizens and Attorney)
45. Town of Allegany, Olean (Attorney)
46. Jordanville, (Otsego 2K)
47. Varysburg, (Citizens)
48. Orangeville, (Attorney)

Maine

49. Roxbury Pond (Attorney and Citizens)
50. Mars Hill (Citizens)
51. Oakfield (Attorney)
52. Vinalhaven (Attorney)
53. Spruce Mountain (Attorney)
54. Saddleback Ridge (Attorney)

Ontario

55. Prince Edward County (Citizen and Attorney)
56. Amaranth-Shelburne (APPEC and Attorney)
57. Port Burwell and Clear Creek (APPEC and Attorney)
58. Ripley, (APPEC and Attorney)
59. Kent Breeze (Attorney)