Robert W. Rand, INCE
RAND ACOUSTICS
65 Mere Point Road
Brunswick, Maine 04011

rrand@randacoustics.com
207.632.1215
FAX 206.339.3441

May 16, 2011

Mary Reilly, Zoning and Building Director
Mason County Planning and Zoning
102 E. 5th St.
Scottville, MI 49454

Dear Ms. Reilly,

On request of Cary Shineldecker, a resident in Mason County, I am writing to provide on his family's behalf a short review of proposed changes requested by Tech Environmental for the document "DRAFT 12, Proposed language for Section 17.70 Amendment " (attached). I respectfully urge the Commissioners to proceed with caution and recommend that these proposed changes be set aside. I respectfully also make a suggestion regarding the use of the property lot line.

I am a Member of the Institute of Noise Control Engineering with over thirty years of experience in acoustics including many years working in industrial power generation noise control. I have conducted independent studies of wind turbine noise including field measurements of operating wind turbines where significant community reaction has occurred in quiet rural areas. As a Full Member of INCE, my guiding principle for environmental noise impacts is encoded in the INCE Canon of Ethics, which states, "*Hold paramount the safety, health and welfare of the public.*" I am required by INCE to call attention to actions which could adversely affect the safety, health, and welfare of people. I am troubled by the changes proposed by Mr. Peter Guldberg of Tech Environmental, an INCE Associate member. In my professional opinion, if adopted, Mr. Guldberg's proposed changes could weaken the ordinance and expose public welfare (well-being) to more adverse noise impacts from industrial wind turbine noise.

The following pages outline my concerns. I appreciate your consideration of this letter and believe you will find this information useful in your work to protect the safety, health and welfare of the residents and visitors of Mason County.

Please call me if you have any questions.

Respectfully submitted,

I have attached three documents:

- DRAFT 12, Proposed language for Section 17.70 Amendment,

- an email with comments by Dennis H Marvin, Communications Director, Consumers Energy, obtained by FOIA, and

- A copy of a transcript of testimony by Peter Guldberg in Vermont in 2006, where he argued eloquently about the importance of predicting and evaluating low frequency sound emissions from industrial wind turbines, including, the importance of predicting and evaluating one-third octave band sound levels. While perhaps it could be argued that Mr. Guldberg's testimony could be taken out of context, it is hard to see how that could occur in this process in Mason County, where general comments about the existence of low frequency wind turbine noise and its potential for community impact cannot be over-stated. I believe you will agree once you read Mr. Guldberg's testimony. It appears that Mr. Guldberg clearly understood in 2006 the importance of narrow-band and low-frequency analysis of sound emissions from wind turbines. Wind turbines still create significant low frequency noise. Wind turbines are getting bigger and bigger, with longer blades and more potential for low frequency noise generation. For this reviewer, Mr. Guldberg's 2006 testimony runs in unexplainable contrast to his proposed changes to the Mason County draft ordinance.

I address first the specific changes proposed by Peter Guldberg of Tech Environmental (TE) as shown in the attachment (DRAFT 12, Proposed language…) I show sections as notated and then my comments next to the specific changes proposed by Mr. Guldberg. (This letter's Section A.)

I make comment as to the assertions made by Mr. Dennis H Marvin, Communications Director, Consumers Energy. (This letter's Section B.)

I also make a suggestion to the Commission about the use of the property line as the point of compliance for noise limits. (This letter's Section C.)

I appreciate the Commission's consideration of these remarks.

SECTION A. Comments on proposed changes by Mr. Peter Guldberg.

17. Noise Levels [REVISED].

b. Studies Required.

1) Preconstruction Noise Background Survey [NEW].

The applicant shall provide a noise background study at the time of application which indicates $L_{eq}$, ~~$L_{10}$,~~ and $L_{90}$ ten-minute sound levels ~~using both A-weighting and C-weighting ($L_{10}$, $L_{90}$, $LA_{eq}$ and $LC_{eq}$ in dBA and dBC, respectively). The applicant shall submit proposed measurement locations to the Planning Commission in advance of the survey for review and approval.~~ Measurement procedures should generally follow the most recent versions of ANSI S12.18, and ANSI S12.9, ~~Part 2 and~~ Part 3 guidelines. The selected test locations shall be described with GPS coordinates or some other level of detail such that the location can be used by others to repeat or verify sound measurements. Measurements shall be taken using an ANSI or IEC Type 1 Precision Integrating Sound Level Meter. ~~In addition to measuring A-weighted sound levels, at least one monitoring location shall collect one-third octave band data down to 6.3 Hertz. The noise background study shall take into consideration topography, temperature, weather patterns, sources of ambient sound, and prevailing wind direction.~~ The study shall include a map showing proposed wind turbine locations, pooled and unpooled parcels, and all occupied buildings.

**The original wording was useful and should be retained.**

- The C-weighting is used to quantify pre-existing low frequency noise sources and should be retained for planning and permitting purposes.
- Equally to the L10 (dBA and dBC), which serve to identify the presence and extent of short term, intermittent noises, should be retained for information during planning and permitting.
- There is no logical reason to delete the requirement for coordinating noise measurement locations with the Planning Commission.
- One-third octave bands serve a vital task- to quantify the presence or absence of existing industrial tones and any unusual sounds that may not be present during portions of the year, such as crickets or frogs, which may raise the A-weighted level compared to other times of year. Removing the one-third octave band data and the other requirements would make it impossible to document or determine later what may have been contributing to the existing background sound levels and, in real measure render the sound study ineffective.

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using both A-weighting and C-weighting ($L_{10}$, $L_{90}$, $LA_{eq}$ and $LC_{eq}$

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and dBC, respectively). The applicant shall submit proposed measurement locations to the Planning Commission in advance of the survey for review and approval.

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In addition to measuring A-weighted sound levels, at least one monitoring location shall collect one-third octave band data down to 6.3 Hertz. The noise background study shall take into consideration topography, temperature, weather patterns, sources of ambient sound, and prevailing wind direction.

17. Noise Levels [REVISED].
    b. Studies Required.
        2) Sound Modeling Study [NEW].

A predictive sound study of turbine noise shall accompany an application for a wind energy system to verify that ordinance requirements can be met ~~and include both~~ for dBA sound limits. ~~and dBC measurements.~~ The sound modeling must follow the most recent version of International Standard, ISO 9613-2 "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation." The sound modeling study shall use wind turbine sound power levels determined according to the most recent version of IEC 61400 – Part 11. The sound study shall include a map with sound contour lines ~~for both~~ in dBA ~~and dBC sound emitted~~ from the proposed wind energy system. The study shall include a map showing sound contours at 5 dBA ~~and 5 dBC~~ intervals, proposed wind turbine locations, pooled and unpooled parcels, and all occupied buildings. The predicted values must include sound levels created by all proposed turbines from the applicant's project. The sound contour map shall extend out ~~study shall extend a minimum of 1 mile~~ beyond the boundary of the pooled parcels to the 35-dBA contour line.

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**The original wording was useful and should be retained.**

- The deletions in this section serve only to permit the developer to hide the magnitude of the wind turbine facility's low frequency emissions from the Planning Commission. Complaints can occur when the C-weighted sound level exceeds the A-weighted sound level by a significant margin. The World Health Organization has identified a 20 dB difference as indicative of a possible low frequency problem for residential areas. I assume for purposes of this review that the Commission wishes to permit facilities which do *not* generate widespread complaints. Therefore it appears vital that the Commission be empowered in the ordinance to require the C-weighted data be furnished during the permitting review process in order to be able to assess the potential for widespread complaints and set noise control conditions if needed.

- Mr. Guldberg proposed requiring contours to the 35 dBA contour line. I have no problem with this. Is he aware that this could go *beyond* the mile requirement he proposed deleting?

17. Noise Levels [REVISED].
    b. Studies Required.
        3) Post Construction Sound Survey [REVISED from previous "b" above].

Documentation of sound pressure level measurements shall be provided to the Zoning Administrator by a third-party qualified professional selected by the Planning Commission and at the expense of the wind energy system owner within 12 months of the commencement of the operation of the project. The post construction study shall be performed at the same locations as the pre-construction study unless additional locations are required by the Planning Commission. The study shall be completed using procedures in the most recent versions of ANSI S12.9, Part 2~~ ANSI S12.9 Part 3~~, and ANSI S12.18. All sound pressure levels shall be measured with instruments that meet ANSI or IEC Type 1 Precision integrating sound level meter performance specifications. ~~In addition to measuring A-weighted sound levels, at least one monitoring location shall collect one-third octave band data down to 6.3 Hertz.~~ The post construction test shall verify that equivalent $L_{eq}$ sound level limits in dBA ~~and dBC~~ are in compliance with the standards of this ordinance. The compliance test procedure will use an alternating series of turbine-on and turbine-off $L_{eq}$ measurements when wind speeds are fairly constant and measured levels (turbine-on and turbine-off) for similar hub-height wind speeds will then be compared. ~~The firm conducting the study shall collect $LA_{90}$ and $LA_{10}$ data.~~ The study shall address noise complaints on file with the County (as indicated in Section 17.70 (24)) and may require additional study locations as deemed necessary by the Planning Commission. The firm conducting the post-construction sound survey shall consult with the Planning Commission, or their representative, prior to conducting the study to agree on the compliance testing locations. The study shall delineate pooled and unpooled parcels as well as occupied buildings. Should the sound study indicate a non-compliant

**The original wording was useful and should be retained.**

- Peter Guldberg chooses in this section to reject ANSI standards (ANSI 12.9 Part 3) for community noise measurements. These should be retained so that the Commission and consultant retained to perform the study have a known standard for reference during short term testing.
- Peter Guldberg proposes to delete the one-third octave measurement requirement as in previous section. These should be retained. Previous comments apply.
- Peter Guldberg proposes on/off testing, which is reasonable. However, he does not specify under what atmospheric conditions to make the tests. As the Commission is now aware, under stable air conditions, and especially with low-

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In addition to measuring A-weighted sound levels, at least one monitoring location shall collect one-third octave band data down to 6.3 Hertz.

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The compliance test procedure will use an alternating series of turbine-on and turbine-off $L_{eq}$ measurements when wind speeds are fairly constant and measured levels (turbine-on and turbine-off) for similar hub-height wind speeds will then be compared.

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The firm conducting the study shall collect $LA_{90}$ and $LA_{10}$ data.

level jet type air movement within the turbine blade heights, marked increases in wind turbine noise have been found (Van den Berg, 2006.) Mr. Guldberg does not specify a requirement to establish the wind shear index during the testing, nor does he require or specify a calibration method for the hub height wind anemometer (this is important because wind currents at the nacelle can affect the hub height anemometer accuracy).
- Mr. Guldberg wants no LA90 or LA10 data acquired during the testing, which could be important to quantify wind shear effects during testing.
**The original wording was useful and should be retained.**

17. Noise Levels [REVISED].

d. Low Frequency Sound and/or Vibration [NEW].

d. ~~**Low Frequency Sound and/or Vibration [NEW]**. The Planning Commission may require mitigation, operational changes, and/or further study if the operation of the wind energy system results in one-hour $LC_{eq}$ dBC exceeding the one-hour $LA_{eq}$ dBA by 20 dB or more and/or the operation of the wind energy system creates a persistent vibration within an occupied or non-occupied building, which is humanly perceptible and caused by low frequency sound emitted from a wind turbine generator. Interior sound levels less than the sound level limits of the most recent version of ANSI S12.2 for perceptible vibration will demonstrate acceptability of potential vibrations from low frequency wind turbine noise within buildings.~~

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**Low Frequency Sound and/or Vibration [NEW]**. The Planning Commission may require mitigation, operational changes, and/or further study if the operation of the wind energy system results in one-hour $LC_{eq}$ dBC exceeding the one-hour $LA_{eq}$ dBA by 20 dB or more and/or the operation of the wind energy system creates a persistent vibration within an occupied or non-occupied building, which is humanly perceptible and caused by low frequency sound emitted from a wind turbine generator. Interior sound levels less than the sound level limits of the most recent version of ANSI S12.2 for perceptible vibration will demonstrate acceptability of potential vibrations from low frequency wind turbine noise within buildings.

- Mr. Guldberg proposes to delete this section which provides the Commission a measure of response to complaints should they arise due to low frequency noise. The Commission and the residents of Mason County have every right to county control of excessive low frequency noise and vibration from industrial facilities. Mr. Guldberg may feel entitled to propose removing this section purely working on behalf of his client Consumer Energy, but not as an INCE member. As an INCE member I can find no possible justification for this proposed deletion.
**The section is useful and vital and should be retained.**

Section B. Comments on e-mail by Mr. Dennis H Marvin,
Communications Director, Consumers Energy.

I won't go too much into detail on this e-mail. The comments made by Mr. Marvin reveal quite a bit about the awareness of Consumers Energy as to the potential for excessive industrial wind turbine noise. As an INCE member, my impression is that Mr. Marvin's comments do not appear aligned with protecting the safety, health, and welfare of the residents and visitors of Mason County.

Some basic points for your consideration:
- The dBC does not "artificially inflate" anything. It is the dBA that hides the presence of low frequency energy. Small changes in low frequency energy create more apparent increase in loudness than small changes in high frequencies. The C-weighted sound level is more sensitive to sounds at low frequencies than the A-weighted sound level, and is sometimes used to assess the low-frequency content of complex sound environments.
- The dBC does not create "ficticious low-frequency sound results". The dBC weighting is flat through the bulk of the audible frequency span and rolls off low frequency energy below 100 Hertz (-3 dB at 31.5 Hertz). The dBA severely attenuates low frequency noise and is unable to quantify a low frequency condition. The low-frequency sound results from a dBC measurement are as accurate as the meter used to acquire them.
- Measuring dBC is not difficult with the proper equipment and measurements attended. Compliance with ANSI standards for limiting wind speeds at the microphone, combined with a good windscreen, attended measurements and listening to the signal recorded is usually sufficient to obtain a good reading free of wind noise.
- Mr. Marvin refers to the Section 17.d as a "project killer". Mr. Marvin states that the project could create excessive low frequency noise up to "a distance of 2 miles from the center of the project". By his term "project killer" Mr. Marvin clearly believes (and is telegraphing to the reader) that Consumers Energy may have no noise control options to eliminate the potential for excessive low frequency noise. In that case, ***it is doubly important for the Commission to***

***retain Section 17.d in the ordinance***, to insure that there are provisions for regulatory action if the project does in fact produce excessive low frequency noise conditions as Mr. Marvin forecasts.

- Mr. Marvin objects to the requirement in Section 17.d to meet ANSI 12.2 limits for perceptible vibration. On the contrary, one would hope that Consumers Energy would *wish to* design their wind turbine facility so that it does NOT produce perceptible vibration- *to be a good neighbor, and to avoid lawsuits*.
- Regarding Section 17.d, Mr. Marvin states that "this text introduces more uncertainty into the project and would make it difficult to design for compliance". Nothing could be further from the truth. The ANSI 12.2 standard quantifies the levels and thresholds to design for compliance. One would expect Consumers Energy to *welcome* the ANSI 12.2 standard. Rather than deleting Section 17.d, **the section is useful and should be retained.**

**In my professional opinion, the proposed changes submitted at this late date by Tech Environmental on behalf of Consumers Energy should be set aside.**

Section C. PROPERTY LINE NOISE LIMITS

17. Noise Levels [REVISED].

a. Sound Level Limits.

1) The A-weighted equivalent sound level ($LA_{eq}$) measured at the wall of an occupied building nearest to the wind turbine or turbines on ~~external property line of~~ an unpooled (single) parcel ~~on which the wind energy system has been installed or at the external property line of the pooled unit~~ (as defined in subsection 19 hereof) shall not exceed 45 dBA. If the ambient LAeq sound level exceeds 45 dBA, the standard shall be ambient $LA_{eq}$ in dBA plus 5 dBA. If a residence is built on an unpooled parcel after the special land use permit has been issued, the Owner of the wind energy system shall adhere with the parameter that prohibits sound levels over 45 dBA on that dwelling located on the unpooled parcel.

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If a residence is built on an unpooled parcel after the special land use permit has been issued, the Owner of the wind energy system shall adhere with the parameter that prohibits sound levels over 45 dBA on that dwelling located on the unpooled parcel.

In this section, I noticed that in the drafting process, the point of compliance for noise limits had been moved from the "external property line" to the "wall of and occupied building". As an INCE member I must take strong exception to this change, and urge the Commission to revert to the property line as the point of compliance. Here's a couple of examples that show why this is the best approach for the landowners in Mason County.

- Let's say a landowner has a large property with their house on one portion. A wind facility is built adjacent to their land. Then they sell or deed part of their property to their son or daughter. Their kids build a house to live in. So what happens if the ordinance limits are set at the property line? All possible residential uses of the property are protected equally. What happens if the ordinance limits are set at the original house? The kids are out of luck. The noise levels could be much higher, and could make it impossible to enjoy well-being or use the land for residential purpose.

Let's say the landowner has a lot near a wind facility that gets built. The

landowner has Boy Scout camps on his property. So what happens if the ordinance limits are set at the property line? The noise levels are controlled inside the landowner's property everywhere. What happens if the ordinance limits are set at the original house? The kids are out of luck. The noise levels could be much higher, and could make it impossible to enjoy the land for its intended purpose.
- Under standard zoning law, zoning restrictions and codes are tied to the property lot line. Why should wind turbine noise get an exception? The answer is that there is no justification to give wind turbine noise a special break compared to any other zoning restriction.
- If the house siding is used as the point of compliance, and the use of the rest of the land is destroyed by excessive noise levels, that constitutes a form of taking without compensation. Is there a property value guaranty (PVG) embedded in the wind turbine facility contract permitting? Who is held responsible if someone is unable to use their land as they wish, solely because they were unfortunate enough to live near a wind turbine facility that gets installed near them? Are the Commissioners prepared personally to weather the inevitable lawsuits against them that would emerge if the noise levels are excessive on neighbor properties?

The property line noise limit is found in virtually every state, county, and local land use and zoning ordinance.

I think you see the point here.
**The original wording was useful and should be retained.**

**Section 2.02 Definitions [new definitions added to existing section]**

Shadow Flicker: Alternating changes in light intensity caused by the movement of wind turbine generator blades casting shadows on the ground or a stationary object such as a window at a dwelling.

$LA_{90}$: The sound level in dBA exceeded 90 percent of the time during the measurement period. The $L_{90}$ is close to the lowest sound level observed. It is essentially the same as the residual sound level, which is the sound level observed when there are no obvious nearby intermittent noise sources.

$LA_{eq}$: The equivalent level, is the level of a hypothetical steady sound that would have the same energy (*i.e.,* the same time-averaged mean square sound pressure) as the actual fluctuating sound observed.

**Section 17.70 Utility Grid Wind Energy Systems**

1. All conversion systems shall be equipped with manual and automatic overspeed controls to limit rotation of blades to speed below the designed limits of the conversion system. The certified registered engineer and authorized factory representative shall certify that the rotor and overspeed control design and fabrication conform to good engineering practices. No changes or alterations from certified design shall be permitted unless accompanied by a certified registered engineer's and the authorized factory representative's statement of certification.

2. All electrical compartments, storage facilities, wire conduit and interconnections with utility companies will conform to national and local electrical codes.

3. A visible warning sign of "High Voltage" will be placed at the base of all conversion systems. The sign shall have at a minimum six (6) inch letters with 3/4-inch stroke. This sign shall include a 24 hour emergency phone number.

4. All towers or poles must be unclimbable by design or protected by anti-climbing devices such as:

    a. Fences with locking portals at least six (6) feet high;
    b. Anti-climbing devices twelve (12) feet from base of pole;

5. Tubular towers are required for wind turbine generators.

6. Engineering data concerning construction of the tower base must be submitted with an application and site plan. The base of the wind turbine must be constructed in such a manner that upon removal of said tower, the soil will be restored to its original condition to a depth of 4 feet.

7. “Up wind turbines” are required.

8. Constant velocity turbines are preferred. Variable speed turbines must submit additional data concerning noise when their revolutions per minute exceed 25 rpms.

9. Visual appearance and its impact on nearby dwellings will be limited by using muted colors, industry standard that minimizes visibility, and by using turbines that are consistent in their appearance.

10. No advertising of any kind shall be allowed on the wind turbine.

11. The electrical wires used to connect the turbine tower to its step-up transformer shall be installed at a depth of 48 inches or more below ground.

~~12. At the time of application, data from the Michigan DNR must be included that shows migratory routes, nesting sites and or feeding areas of protected avian species indigenous to Michigan and its neighboring states.~~

~~13.~~12.

**12. Avian Study Required [REVISED].**

a. At the time of application, the applicant shall submit a wildlife study, completed by a qualified professional, to assess the potential impacts of the proposed wind energy system upon bird and bat species. The wildlife study shall include the results of an environmental review request from the Michigan Department of Natural Resources, a literature review for threatened and endangered species and for birds and bats, the results of supplemental environmental surveys conducted by the applicant to provide information related to critical flyways, migratory routes, feeding areas, and/or nesting sites for protected species. It is the intent of this ordinance to reasonably consider and protect avian and bat species, not just those that are endangered or threatened. The applicant must identify any plans for post-construction monitoring and studies. The analysis shall also include an explanation of potential impacts and proposed mitigation plans, if necessary.

b. A qualified, third party review of the applicant's wildlife studies and/or environmental surveys may be required by the Planning Commission.

c. The Planning Commission may require a post-construction bird and bat mortality study completed by a third-party professional selected by the Planning Commission. The timing of such a study shall be specified as a condition of the special land use.

13. At the time of application, the compatibility of the tower structure with the rotors and other components of the conversion systems shall be certified by a certified, registered engineer and by the authorized factory representative. In addition, the lowest point of the blade shall be a minimum of thirty (30) feet above the ground.

14. **Height and Setback Requirements [NO CHANGE RECOMMENDED/no majority vote].**

a. Wind energy generators may exceed the height limitations of the zoning district in which they are located, subject to the limitations provided in this subsection 14.

b. In the case of a “pooling of parcels,” no wind turbine generator shall be located such that the distance between the center of the base of the tower and any outside boundary line of the area comprising the special land use in which the pooled parcels are located is less than two times the height of the wind turbine generator, as measured from the ground at the center of the base of the tower to the highest reach of the blade.

c. In the case of a single (unpooled) parcel, no wind turbine generator shall be located such that the distance between the center of the base of the tower and any property line is less than two times the height of the wind turbine generator, as measured from the ground at the center of the base of the tower to the highest reach of the blade.

d. No wind turbine generator shall be located such that the distance between the center of the base of the tower and the nearest point of any existing building designed or used for human occupancy or assembly (including but not limited to a dwelling, school, foster care facility, church and the like) is less than two times the height of the wind turbine as measured from the ground at the center of the base of the tower to the highest reach of the blade.

e. No wind turbine generator shall be located such that the distance between the center of the base of the tower to the nearest point of any existing building or structure that is not designed or used for human occupancy or assembly (including but not limited to a garage, other

accessory building, barn, storage building and the like) or road right-of-way is less than one and one half times the height of the wind turbine generator, as measured from the ground at the center of the base of the tower to the highest reach of the blade.

f. No wind turbine generator shall be located such that the distance between the nearest point of the blade (while in rotation) and the nearest boundary line of any individual land parcel comprising the pooled parcel is less than 50 feet; provided, however, that the Planning Commission may approve a lesser setback distance if written consents for such lesser distance are obtained from the owners of all lands located, in whole or in part, within one rotor-diameter of the wind turbine generator measured from the center of the base of the wind turbine generator. In determining whether such lesser setback may be approved, the Planning Commission shall consider the technical needs of the applicant, the feasibility of alternate locations, the nature and proximity of nearby buildings and structures, and the potential for adverse impacts that noise, shadow flicker, and other features may have on adjacent land uses.

g. All wind turbine generators shall fully comply with Article XV Airport Overlay District.

15. The certified registered engineer and authorized factory representative shall certify that the construction and installation of the conversion system meets or exceeds the manufacturer's construction and installation standards.

16. **Maintenance and Operation.**

a. A wind energy system must be maintained and kept in good working order or shall be removed by the owner of the wind energy system. Any wind energy system, or part of a wind energy system such as a wind turbine generator, that has not produced electrical energy for 12 consecutive months shall be deemed to be abandoned; provided, however, that the owner or operator of the wind turbine may apply to the Planning Commission, not less than three months prior to the expiration of said 12-month period, for one additional extension of up to twelve months upon establishing, to the satisfaction of the Planning Commission, that the lack of production was caused by reasons beyond the control of the owner or operator. In determining whether such abandonment has occurred, the Planning Commission or County Zoning Administrator may request, and the operator, system owner, or property owner shall provide written documentation accurately indicating the amount of electrical energy produced by the wind energy system during said 12-month period. It shall be the obligation of the wind energy system owner to remove the abandoned wind energy system.

1) To ensure that an abandoned wind energy system is removed, a performance bond or letter of credit, in an amount determined by the Planning Commission to be sufficient to cover the entire cost of removal, shall be submitted by the applicant prior to the issuance of the special land use. To assist the Planning Commission in determining the amount of the performance bond or letter of credit, the applicant may submit information regarding the estimated cost to remove a wind energy system.

2) The performance bond or letter of credit shall be conditioned upon the timely and faithful performance of the requirements of this ordinance and the special land use. The performance bond or letter of credit shall remain in effect for the duration of the special land use. The amount of the performance bond or letter of credit shall be adjusted at least every three years to reflect changes in the estimated cost of removal, based on the most recent inflation index for the cost of comparable services, as published by the U. S. Bureau of Labor Statistics, or other applicable federal agency or other commonly accepted index.

3) If the wind energy system owner fails to remove the wind energy system as required by this Section, then the County is entitled to use the proceeds from the performance

bond or letter of credit to have the wind energy system removed. Such removal by the County shall not relieve the owner of the wind energy system from its removal obligation.

b. A condition of the performance bond or letter of credit shall be written notification by the issuing company or institution to the County Zoning Administrator when the performance bond or letter of credit is about to expire or be terminated.

c. The wind energy system owner or operator shall provide the County Zoning Administrator with a copy of the yearly maintenance inspection.

d. Failure to keep the performance bond or letter of credit in effect while a wind energy system or weather testing tower is in place will be a violation of the special land use approval. If a lapse in the performance bond or letter of credit occurs, the County will use all available remedies including revocation of the special land use approval.

e. *[NEW- please note sentences moved within the existing paragraph from previous drafts due to suggested changes at 4-28-11 meeting]* If there is a mechanical failure resulting in an abnormal sound emission, release of a pollutant, or a public safety hazard, the Zoning Administrator shall be notified of the event the next day of business following the event. The applicant shall provide the County at the time of application with an operational procedure for this event, a mitigation strategy, and appropriate emergency contact information. A written report describing the failure and the owner's response to the failure shall be submitted to the Zoning Administrator within 10 business days of the event. Sound emitted from a wind turbine generator that is the result of a mechanical failure or lack of maintenance may not be subject to the complaint resolution procedure outlined in Section 17.70 (24). Emergency contact information and a turbine reference number shall be placed in an appropriate location near the site of the turbine, such as at the gate for the access road, so it can be viewed without trespassing on private property.

17. **Noise Levels [REVISED].**

**a. Sound Level Limits.**

~~a. The noise level measured at the external property line of an unpooled (single) parcel on which the wind energy system has been installed or at the external property line of the pooled unit (as defined in subsection 19 hereof) shall not exceed 55 decibels. If the ambient sound pressure level exceeds 55 decibels, the standard shall be ambient dB(A) plus 5 dB(A). After installation of the Utility Grid wind energy system, sound pressure level measurements shall be done by a third party, qualified professional according to the procedures in the most current version of ANSI S12.18. All sound pressure levels shall be measured with a sound meter that meets or exceeds the most current version of ANSI S1.4 specifications for a Type II sound meter.~~

1) The A-weighted equivalent sound level ($LA_{eq}$) measured at the wall of an occupied building nearest to the wind turbine or turbines on ~~external property line of~~ an unpooled (single) parcel ~~on which the wind energy system has been installed or at the external property line of the pooled unit~~ (as defined in subsection 19 hereof) shall not exceed 45 dBA. If the ambient LAeq sound level exceeds 45 dBA, the standard shall be ambient $LA_{eq}$ in dBA plus 5 dBA. If a residence is built on an unpooled parcel after the special land use permit has been issued, the Owner of the wind energy system shall adhere with the parameter that prohibits sound levels over 45 dBA on that dwelling located on the unpooled parcel.

2) On a pooled parcel, the ten-minute $LA_{eq}$ sound level measured at the wall of an occupied building nearest to the wind turbine or turbines shall not exceed 55 dBA. If the ten-

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minute $LA_{eq}$ ambient sound pressure level exceeds 55dBA the standard shall be ambient $LA_{eq}$ in dBA plus 5 dBA.

3) These sound level limits are to be evaluated using the A-weighted equivalent sound level ($LA_{eq}$) descriptor. The $LA_{eq}$ should be measured using a ten-minute time interval.

4) The sound level limits listed above apply to the contribution from the wind energy system only.

~~b. Documentation of sound pressure level measurements shall be provided, at the expense of the applicant, to the local government within 90 days of the commencement of the commercial operation of the project.~~

c. ~~The applicant shall submit all of the following data at the time of the application that clearly demonstrates that the placement and design of the wind turbine(s) can meet or not exceed the prescribed noise levels.~~

~~**Wind Rose Chart.** This is a chart or graph that describes 12 months of wind data collected from the proposed parcel. This graph or chart will demonstrate direction, duration, and intensity of the wind for the entire parcel (pooled or not).~~

~~**Site Plan.** Site plan to scale that shows the relationship of all dwellings at the external property lines of the proposed wind turbine(s) parcel.~~

~~**Sound chart or sound data**. Sound chart or sound data that shows the sound level in decibels at the base of the turbine tower and at the nacelle. In addition, the reduction of noise of the specific wind turbine, up to and including, 7 rotor diameters away from the base of the wind turbine shall be included. Modeling and analysis shall conform to the IEC 61400 and ISO 9613.~~

~~d. **Sound Pressure Mediation.** Should an aggrieved property owner call into question the sound pressure level of a wind tower, the aggrieved property owner shall follow the following procedure:~~

~~i. Notify the County in writing regarding concerns about sound pressure and ask the County to perform a sound pressure test at the aggrieved owner's property line.~~

~~ii. The County will request the aggrieved property owner deposit funds in an amount sufficient to pay for a sound measurement test according to the specifications of 17.48 17.a.~~

~~iii. If the sound test indicates that the sound pressure level is within ordinance guidelines, the County will use the deposit to pay for the sound pressure test.~~

~~iv. If the wind tower owner is in violation of the ordinance sound standards, the tower owner shall reimburse the County for the sound pressure test and take immediate action to bring the wind tower into greater compliance which may include ceasing operation of the wind turbine until ordinance violations are corrected. The County will refund the deposit to the aggrieved property owner.~~

**b. Studies Required.**

**1) Preconstruction Noise Background Survey [NEW].**

The applicant shall provide a noise background study at the time of application which indicates $L_{eq}$, ~~$L_{10}$,~~ and $L_{90}$ ten-minute sound levels ~~using both A-weighting and C-weighting ($L_{10}$, $L_{90}$, $LA_{eq}$ and $LC_{eq}$~~ in dBA ~~and dBC, respectively). The applicant shall submit proposed measurement locations to the Planning Commission in advance of the survey for review and approval.~~ Measurement procedures should generally follow the most recent versions of ANSI S12.18, and ANSI S12.9, ~~Part 2 and~~ Part 3 guidelines. The selected test locations shall be described with GPS coordinates or some other level of detail such that the location can be used by others to repeat or verify sound measurements. Measurements shall be taken using an ANSI or IEC Type 1 Precision Integrating Sound Level Meter. ~~In addition to measuring A-weighted sound levels, at least one monitoring location shall collect one-third octave band data down to 6.3 Hertz. The noise background study shall take into consideration topography, temperature, weather patterns, sources of ambient sound, and prevailing wind direction.~~ The study shall include a map showing proposed wind turbine locations, pooled and unpooled parcels, and all occupied buildings.

**2) Sound Modeling Study [NEW].**

A predictive sound study of turbine noise shall accompany an application for a wind energy system to verify that ordinance requirements can be met ~~and include both~~ for dBA sound limits. ~~and dBC measurements.~~ The sound modeling must follow the most recent version of International Standard, ISO 9613-2 "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation." The sound modeling study shall use wind turbine sound power levels determined according to the most recent version of IEC 61400 – Part 11. The sound study shall include a map with sound contour lines ~~for both~~ in dBA ~~and dBC sound emitted~~ from the proposed wind energy system. The study shall include a map showing sound contours at 5 dBA ~~and 5 dBC~~ intervals, proposed wind turbine locations, pooled and unpooled parcels, and all occupied buildings. The predicted values must include sound levels created by all proposed turbines from the applicant's project. The sound contour map shall extend out ~~study shall extend a minimum of 1 mile~~ beyond the boundary of the pooled parcels to the 35-dBA contour line.

**3) Post Construction Sound Survey [REVISED from previous "b" above].**

Documentation of sound pressure level measurements shall be provided to the Zoning Administrator by a third-party qualified professional selected by the Planning Commission and at the expense of the wind energy system owner within 12 months of the commencement of the operation of the project. The post construction study shall be performed at the same locations as the pre-construction study unless additional locations are required by the Planning Commission. The study shall be completed using procedures in the most recent versions of ANSI S12.9, Part 2 ~~ANSI S12.9 Part 3~~, and ANSI S12.18. All sound pressure levels shall be measured with instruments that meet ANSI or IEC Type 1 Precision integrating sound level meter performance specifications. ~~In addition to measuring A-weighted sound levels, at least one monitoring location shall collect one-third octave band data down to 6.3 Hertz.~~ The post construction test shall verify that equivalent $L_{eq}$ sound level limits in dBA ~~and dBC~~ are in compliance with the standards of this ordinance. The compliance test procedure will use an alternating series of turbine-on and turbine-off $L_{eq}$ measurements when wind speeds are fairly constant and measured levels (turbine-on and turbine-off) for similar hub-height wind speeds will then be compared. ~~The firm conducting the study shall collect $LA_{90}$ and $LA_{10}$ data.~~ The study shall address noise complaints on file with the County (as indicated in Section 17.70 (24)) and may require additional study locations as deemed necessary by the Planning Commission. The firm conducting the post-construction sound survey shall consult with the Planning Commission, or their representative, prior to conducting the study to agree on the compliance testing locations. The study shall delineate pooled and unpooled parcels as well as occupied buildings. Should the sound study indicate a non-compliant

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measurement, the owner of the wind energy system will be required to obtain compliance through mitigation or other measures.

c. **Wind Rose Chart [REVISED].** The applicant shall submit a Wind Rose Chart at the time of the application. This is a chart or graph that describes 12 months (or more) of wind data collected from the proposed project area. This graph or chart will demonstrate direction, duration, and intensity of the wind (pooled or not). These data will be for each height of wind sensor mounted on the meteorological tower.

d. ~~**Low Frequency Sound and/or Vibration [NEW].** The Planning Commission may require mitigation, operational changes, and/or further study if the operation of the wind energy system results in one-hour $LC_{eq}$ dBC exceeding the one-hour $LA_{eq}$ dBA by 20 dB or more and/or the operation of the wind energy system creates a persistent vibration within an occupied or non-occupied building, which is humanly perceptible and caused by low frequency sound emitted from a wind turbine generator. Interior sound levels less than the sound level limits of the most recent version of ANSI S12.2 for perceptible vibration will demonstrate acceptability of potential vibrations from low frequency wind turbine noise within buildings.~~

18. Any lighting required by the FAA shall be of the lowest intensity and of the slowest pulse allowed.

**19. Pooling of Parcels [NO CHANGES TO ENTIRE SECTION]**

a. If two or more parcels of land are included in the special land use, they shall be pooled into a single unit (the "pooled unit") for purposes of the special land use, in accordance with this paragraph 19.

b. The applicant shall attach to its application the pooling instrument and copies of all leases, easements or other instruments which constitute the applicant's land use rights for all parcels comprising the pooled unit, and which together with the pertinent facts in the application and site plan establish that the applicant will not be required to release or terminate its lease, easement, or other land use rights with respect to any parcel being pooled for the purpose of obtaining a single special use permit for the duration of the special land use if and to the extent that such a release or termination would result in a conflict with or a violation of the special land use permit or any other provisions of this zoning ordinance. The pooling instrument shall be executed and recorded by the applicant with the County Register of Deeds prior to the issuance of the special land use.

c. The pooling instrument shall be the form of a declaration of pooling, and shall contain the content thereof, as prepared and furnished by the County for use by all applicants requesting a special land use, with the appropriate land descriptions provided by the applicant and other specific references applicable to the lands involved. The form of declaration of pooling furnished by the County shall include a statement that the lands are being pooled for the purpose of operations under the approved special land use and shall have the legal effect of imposing the terms of the special land use upon each parcel of land comprising the pooled unit.

d. The form of declaration of pooling furnished by the County, as completed by the applicant with the relevant legal descriptions and other matters specific to the lands involved, shall be subject to final approval by the Planning Commission prior to the instrument being recorded with the Register of Deeds,

e. The form of declaration of pooling furnished by the County shall by its terms run with the land so as to be binding upon and inure to the benefit of all successors and assigns of the applicant and the owners of the parcels comprising the pooled unit. It shall be enforceable by the County, the applicant, and the owners of the parcels comprising the pooled unit.

f. As a condition of the special land use, the Planning Commission may require the applicant to submit a last owner of record search, at the applicant's expense, certified to the date of the special land use application or, as determined by the Planning Commission, to the date of recording of the applicable pooling instrument, lease, easement or other recorded instrument, by an approved title examiner or title insurance company, covering the proposed pooled unit, and disclosing the then owners of the lands comprising the pooled unit.

g. Neither the applicant nor the property owner, may release or terminate the declaration of pooling, or other pooling instrument, or any lease, easement or other instrument executed in compliance with the special land use, as to the entire pooled unit or any part thereof, for the duration of the special land use, in whole or in part, if and to the extent that such a release or termination would result in a conflict with or a violation of the special land use or other applicable provision of this zoning ordinance.

h. The applicant shall record with the Register of Deeds a memorandum of the special land use permit issued with respect to all parcels pooled as part of the special land use obtained hereunder. The memorandum shall consist of the form of memorandum prepared and furnished by the County for use by applicants for the special land use, and shall contain the content thereof as prepared by the County, except for legal descriptions and other references specific to the lands involved, which shall be included by the applicant. Prior to the memorandum being recorded with the Register of Deeds, the applicant shall submit to the Planning Commission for approval, consistent with the provisions of this Section, the proposed memorandum as completed by the applicant with the land descriptions and other references specific to the land involved.

**20. Signal Interference [NEW].**

No wind energy system shall be installed in any location where its proximity with existing fixed broadcast transmission, or reception antennas for AM or FM radio, 911, emergency systems, internet broadband, satellite reception, off-air television, or wireless phone or other personal communication systems would produce electromagnetic interference with signal transmission or reception.

a. An application shall include a Licensed Microwave Search and Worst Case Fresnel Zone (WCFZ) analysis. The application shall include an electromagnetic interference mitigation plan. All wind turbine generators shall be sited in accordance with the findings of electromagnetic interference mitigation plan and approved by the Planning Commission. The applicant shall eliminate any electromagnetic interference and line of sight interference such as, but not limited to, internet, radio, emergency services/radio, and television.

**21. Shadow Flicker [NEW].**

a. **Flicker Study.** A shadow flicker study shall be required, and shall be submitted by the applicant with the application. The purpose of the shadow flicker study is to examine the duration and location of shadow flicker on unpooled parcels. The model study area shall include all land extending a minimum of 10 rotor diameters in all directions beyond the exterior boundaries of the pooled parcels. The model shall be calculated using the following minimum inputs: turbine locations, shadow flicker receptor locations, existing topography, rotor diameter and hub height, joint wind speed and direction distribution (wind rose table, and hours of sunshine (long term monthly references). The model shall calculate the locations and durations of shadow flicker caused by the proposed wind energy system within the study area, and the total number of hours anticipated per year of shadow flicker. Assumptions regarding the percentage of time that shadow flicker is likely to occur shall be clearly explained and subject to approval of the Planning Commission. The shadow flicker study shall include a map that indicates pooled and unpooled parcels, all dwellings, and the exterior boundary of the pool. Estimates for shadow flicker shall be to the nearest tenth of an hour.

**b. Shadow Flicker Limits.** Shadow flicker shall not exceed 20 hours per year at the wall of an occupied building on an unpooled parcel. Any shadow flicker over 10 hours per year on a dwelling located on an unpooled parcel shall require mitigation provided by the wind energy system owner and subject to Planning Commission approval. If a residence is built on an unpooled parcel after the special land use permit has been issued, the Owner of the wind energy system shall adhere with the parameter that any shadow flicker over 10 hours per year on that dwelling located on the unpooled parcel shall require mitigation.

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**c. Mitigation.** Mitigation measures for each receptor site shall be described, including but not limited to, siting changes, operational procedures, grading, modifications to a dwelling, and/or landscaping. If landscaping is used as a mitigation procedure, the planting of mature trees shall be required. The Planning Commission may require a performance guarantee, in the case of landscaping and/or other mitigation measures, to assure the long term viability and effectiveness of the mitigation.

**22. Roads [NEW].**

The utilization of roads and the road right of way for the construction of a wind energy system must meet the requirements set forth by the Mason County Road Commission.

**23. Performance Review [NEW]**.

The Planning Commission shall require a performance review of the special land use on a three-year basis or as it may be required. The three-year time period commences after the first turbine of the wind energy system becomes operational. The Planning Commission shall provide the performance review and the County shall perform, where reasonably practicable, investigation regarding a complaint or other matter requiring a performance review. In its sole discretion, the County may require the assistance of an independent third party due to the specialized nature of the complaint, conflicting evidence, or other condition. The reasonable cost of an independent third-party consultant shall be at the expense of the wind energy system owner. Failure to maintain compliance with Section 17.70 of this ordinance shall result in enforcement action which may include the termination of the special land use, or portions of the special land use. The purpose of the performance review is to evaluate the status of:

a. **Compliance with Special Land Use.** Compliance with the conditions set forth by the special land use, such as specific mitigation measures or operation procedures.

b. **Ownership Change.** Changes in ownership or operation of the wind energy system.

c. **Avian or Bat Mortality.** A significant avian or bat mortality event that exceeds projected impacts described in the Wildlife Study as required in Section 17.70 (12) of this ordinance.

d. **Other.** Other matters as determined by the Planning Commission.

e. **Unresolved and/ or repeated complaints.** A complaint taking longer than thirty (30) days to resolve may require a performance review unless otherwise specified in the ordinance. If after the performance review and further investigation, the Planning Commission verifies that alleged ordinance violations are the result of the operation or condition of the wind energy system, the owner/operator shall eliminate the non-compliance by mitigation or other measures which may include temporary operational changes. The Planning Commission shall establish the effective date of the mitigation measure based on the nature of the mitigation.

f. As a condition of the Planning Commission conducting a performance review, the complainant shall be required to allow County staff, the wind energy system owner or designated staff, or

other authorized personnel such as an engineer or acoustic professional, on the property of the complainant for further investigation and testing.

g. Actions taken by the Planning Commission to terminate or modify the Special Land Use, portions of the Special Land Use, or the conditions of the Special Land Use shall require a public hearing and notification to the wind energy system owner pursuant to the conditions of the original permit and in accordance with Section 25.05 of this ordinance.

**24. Complaint Resolution [NEW/REVISED in lieu of 17 d. Sound Pressure Mediation].**

The purpose of this section is to provide the public with a mechanism to file a complaint with the wind energy system owner and the Zoning Administrator and receive a timely response from the wind energy system owner regarding alleged wind energy system ordinance violations. The applicant shall submit procedures which it intends to implement for receiving, acting upon, and resolving complaints or allegations that the wind energy system is not in compliance with this ordinance.

a. Complaint resolution procedures must be presented at the time of application and must meet the approval of the Planning Commission prior to approval of a special land use. Those procedures, at a minimum, shall:

1) Require the system owner to accept complaints regarding non-compliance with the ordinance from all property owners within the project boundary and up to one mile radius of a wind turbine generator.

2) Provide a telephone number and mailing address at which the operator can be contacted for purposes of submitting complaints or allegations of non-compliance.

3) Require that all such complaints or allegations be submitted in writing.

4) As a condition of the system owner acting on the complaint, require that a complainant allow the wind energy system owner or designated staff, or other authorized personnel such as an engineer or acoustic professional, on the property of the complainant for further investigation and testing.

5) Set forth information that must be included in the complaint or allegation.

6) Require that a complaint is acknowledged in writing by the wind turbine owner to both the complainant and the Zoning Administrator within five (5) business days of receipt of said complaint.

7) Set forth the number of days, not to exceed thirty (30), in which the operator shall investigate and resolve any and all complaints or allegations, either by way of correction or formal denial of non-compliance.

8) Require the operator to advise the Zoning Administrator in writing of the resolution of any complaint or allegation of non-compliance within thirty (30) days of its receipt of the same.

b. Any complaint not resolved within thirty (30) days shall result in a performance review by the Planning Commission as described in Section 17.70 (23). Resolution or mitigation of a complaint that involves construction, landscaping, or other significant alteration that is dependent on seasonal conditions, may exceed thirty (30) days if approved by the Planning Commission.

c. It shall be a violation of this ordinance to modify the approved complaint resolution procedures without the prior approval of the Planning Commission.

**Subject:** FW: FW: Draft 12 Comments and Follow Up
**From:** <Cary_Shineldecker@oxy.com>
**Date:** Thu, 12 May 2011 10:37:04 -0500
**To:** <robertwrand@gmail.com>

guldberg's comments to mason county draft.

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**From:** Knizacky, Fabian [mailto:fknizacky@masoncounty.net]
**Sent:** Wednesday, May 11, 2011 5:50 PM
**To:** Shineldecker, Cary L (Precision Design Inc )
**Subject:** FW: FW: Draft 12 Comments and Follow Up

Pursuant to your Freedom of Information Act request, I am forwarding a copy of the Consumers Energy's recent ordinance comments in a version that incorporates the sound consultants comments into the document. There is no charge for this information.

Fabian L. Knizacky
Mason County Administrator
304 E. Ludington Avenue
Ludington, MI 49431
(P) 231-843-7999
(F) 231-843-1972


**From:** Steven A Schneider [mailto:saschneider@cmsenergy.com]
**Sent:** Wednesday, May 11, 2011 4:47 PM
**To:** Knizacky, Fabian
**Cc:** Dennis H Marvin; Vincent P Provenzano
**Subject:** Re: FW: Draft 12 Comments and Follow Up

Fabian,

Pursuant to the feedback Dennis Marvin received from you yesterday, for ease of use by the County Commissioners we incorporated our sound consultants (Peter Guldberg's, Tech Environmental) comments into Draft 12 of the proposed Text Amendment. Attached below is this latest redline version for your use as well as to re-issue to the County Commissioners. Sorry for the delay.

Finally, we want to ensure you that we are working very diligently in developing Good Neighbor Policy plan which we anticipate sharing with you in the near future. More to follow....

In the meantime, please do not hesitate to contact Dennis or me should you have any questions.

Regards,
Steve

_____
Steven A. Schneider
Consumers Energy Company (P26-405)

1945 West Parnall Road
Jackson, MI 49201
Direct: 517-788-0064
Cell: 517-917-6462

From: "Knizacky, Fabian" <fknizacky@masoncounty.net>
To: "Chuck Lange (chucklange@hotmail.com)" <chucklange@hotmail.com>, "Curt VanderWall (cdvwall@charter.net)" <cdvwall@charter.net>, "Jeffrey S. Barnett (KelderLLC@Live.com)" <KelderLLC@Live.com>, "Joe Lenius (naders@nadersmotel.com)" <naders@nadersmotel.com>, "Lewis Squires (drsquires@sbcglobal.net)" <drsquires@sbcglobal.net>, "Mary Nichols (mary_mo@hotmail.com)" <mary_mo@hotmail.com>, "Rich Morong (GreatLakesholders@att.net)" <GreatLakesholders@att.net>, robert erickson <perch7@frontier.com>, susan boes <susan.boes67@gmail.com>, "Thomas M Posma (clipper@t-one.net)" <clipper@t-one.net>
Cc: Steven A Schneider <saschneider@cmsenergy.com>, Vincent P Provenzano <vpprovenzano@cmsenergy.com>, "Reilly, Mary" <mreilly@masoncounty.net>, 'Dennis H Marvin' <dhmarvin@cmsenergy.com>
Date: 05/11/2011 03:49 PM
Subject: FW: Draft 12 Comments and Follow Up

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I am forwarding an e-mail that I received from Consumers Energy concerning their comments about the proposed amendments to the zoning ordinance. Please feel free to contact me with any questions

Fabian L. Knizacky
Mason County Administrator
304 E. Ludington Avenue
Ludington, MI 49431
(P) 231-843-7999
(F) 231-843-1972

**From:** Dennis H Marvin [mailto:dhmarvin@cmsenergy.com]
**Sent:** Tuesday, May 10, 2011 2:46 PM
**To:** Knizacky, Fabian
**Cc:** Steven A Schneider; Vincent P Provenzano; Reilly, Mary
**Subject:** Draft 12 Comments and Follow Up
**Importance:** High

Good afternoon Fabian:

As a follow up to our discussion last Friday, I am providing you with two sets of comments to Draft 12 of the proposed Mason County Wind Ordinance text amendments. The attached document is our comments with respect to Draft 12 language showing proposed deletions and insertion of new language (highlighted and underlined). In addition, below sets out additional comments from Mr Peter Guldberg of Tech Environmental concerning other portions of the proposed amendment language with respect to sound. This evening Steve Schneider and I will speak during the portion of the agenda we have been allotted time. I will cover some general comments and Steve will offer some insights of our views of Draft 12.

I am in Ludington now so feel free to contact me if you have any questions. Thank you very much.

April 22, 2011

**Section 17.b.1**

This section still includes requirements for C-weighted decibels (dBC), which are scientifically invalid for the low sound levels (25-45 dBA) experienced from a wind farm; C-weighted sound levels are designed to mimic human hearing for very loud sounds above 85 decibels (Bolt, Beranek & Newman, Handbook of Noise Ratings). There are several problems with this requirement: 1) Since there are no dBC sound limits for the turbines (section 17.a.1), the data are unnecessary; 2) dBC sound levels are scientifically invalid to represent low level baseline and turbine sound levels; 3) dBC levels artificially inflate low-frequency sounds by 38 to 46 decibels, creating fictitious low-frequency sound results; 4) measuring dBC levels is difficult because of wind noise across the microphone, even with the best and most expensive wind screens, and often false signals are created; 5) since we did not measure dBC levels in the baseline sound monitoring last year, the entire program will need to be redone with double the instrumentation (separate co-located meters will be needed at each site for dBA and dBC measurements). What is the County going to do with this information since it has no connection to the sound limits? All references to dBC should be deleted.

A new requirement has been added that measurements follow ANSI S12.9 Part 2 guidelines. (Part 3 was in the text before and is still there. Part 3 guidelines impose the requirement for the 7.5 m setback from reflecting surfaces, which we followed). The new Part 2 guidelines could require a very large and costly baseline sound survey. First, they require that measurements be done 15 m (50 feet) from the nearest traffic lane of a roadway, which is different than the setback distances used in the baseline survey done last year, which were selected to mimic the actual setback of houses from the rural roads. Second, Part 2 requires that long-term monitoring locations in a project area be randomly selected on a grid, and depending on whether a Class A, B or C survey is being done, a minimum of 30 monitoring stations may be required. A Class A survey is one to achieve a +/- 3 dB spatial accuracy and requires a minimum 30 stations. A Class B survey is one to achieve a +/- 5 dB spatial accuracy and requires a minimum 8 long-term stations. A Class C survey has no minimum number of stations. The baseline survey done last year in Mason County used two long-term stations in the baseline monitoring supplemented by many short-term locations. ANSI S12.9 Part 2 is designed to guide a survey where the goal is to provide a complete spatial mapping of existing sound levels in an area. That level of detail is not needed to provide general information to the County on existing sound levels. By referencing Part 2 but not specifying which Class of survey is to be done, uncertainty is added. Part 2 guidelines also state that monitoring should be done "long enough to achieve the desired accuracy and confidence interval" whatever that may mean in a particular instance. The reference to Part 2 guidelines should be deleted.

**Section 17.b.2**

The sound modeling section still has references to dBC sound levels – a MAJOR problem. The first sentence refers to showing that ordinance limits for dBC be met, yet there are no such limits. The second sentence requires use of the ISO 9613-2 method (which is OK), and it should be noted that ISO method requires the prediction of dBA sound levels, not dBC – another contradiction. The third sentence requires contour lines for dBC sound levels, which is a big problem since none of the existing acoustic models (CadnaA, SoundPlan, Wind-Pro) can produce that information; custom software would have to be developed. All references to dBC should be deleted. There are no dBC sound limits and dBC levels are scientifically invalid for wind turbine studies (see 5-point list above).

**Section 17.d**

The low-frequency and vibration section is worse than in Draft 8 and now includes a project-killer. In the

LakeWinds acoustic modeling report, it states that the difference between the V100 turbine's sound power levels as measured on a dBA and dBC scale is 15.4 dB and below the IEC 61400-11 threshold for possible low frequency sound annoyance. The Planning Commission has taken that rule of thumb and applied it to sound pressure levels anywhere in the project area, AND rather than having the threshold trigger a further examination of the issue (what IEC recommends) it now would require "mitigation, operational changes". That is, the text now sets this as a limit for the project and if not met the turbines would likely be shutdown. Here is the problem. As sound propagates away from a wind turbine, air absorption attenuates the high frequency sounds quickly and then at greater distances swallows up the mid frequency sounds. At a far distance, the frequency spectrum of a wind turbine is truncated so only the lower frequency sound remains. Since wave spreading occurs with distance, the absolute level of audible sound in dBA drops to a point that it is inaudible when there are only low-frequency components left. Acoustic modeling however will reveal the difference between dBC and dBA growing as distance from a turbine increases, even if the absolute numbers are very low. The reason is as follows. The A-weighted decibel scale discounts low frequencies by 30 to 40 dB since our ears do not hear those low tones very well compared to mid-frequency sounds. The C-scale however does no discounting. Thus, at a distance of 2 miles from the center of the project, you could end up with predicted levels of 25 dBA and 50 dBC, and a difference > 20 dB. Whether this occurs or not depends on the layout, the extent of the modeling domain, the methodology for predicting dBC (remember, ISO 89613-2 is a method only for dBA), and other factors. This text, which would require acoustic modeling of dBC sound levels, suffers from all the problems listed above for Section 17.b.2. Section 17.d should be deleted in its entirety.

A new requirement has been added to Section 17.d that the project meet ANSI 12.2 standards for perceptible vibration. These standards are keeping octave band sound pressure levels in the 16 Hz and 31.5 Hz bands below 65 dB and in the 63 Hz band below 70 dB. These are *interior* sound standards and proving compliance with them will require going into people's homes (many of them opponents) and taking measurements. Since the project cannot count on the attenuating abilities of any structure, this text introduces more uncertainty into the project and would make it difficult to design for compliance. Section 17.d should be deleted in its entirety.

Consumers Energy

**Dennis H Marvin** |*Communications Director*|*New Generation*

*One Energy Plaza, EP8-278*|*Jackson, MI 49201* | T: 517.788.0318 | M: 517.740.0209

www.ConsumersEnergy.com/newgeneration

[attachment "DRAFT 12 FINAL-redline.docx" deleted by Steven A Schneider/Pr/Consumers/CMS]

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| **DRAFT 12 FINAL-redline with Guldberg edits.docx** | **Content-Description:** | DRAFT 12 FINAL-redline wit edits.docx |
| | **Content-Type:** | application/vnd.openxmlfo officedocument.wordproce |

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|---|---|
| | **Content-Encoding:** base64 |

STATE OF VERMONT
PUBLIC SERVICE BOARD

Docket No. 7156

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| Petition of UPC Vermont Wind, LLC for a Certificate of Public Good pursuant to 30 V.S.A. § 248, authorizing it to construct a 52 MW wind electric generation facility, and associated transmission and interconnection facilities, in Sheffield and Sutton, Vermont, and operate the same | ) | Docket No. 7156 |

PREFILED TESTIMONY OF
PETER H. GULDBERG

ON BEHALF OF

UNIVERSAL HEALTH SERVICE, INC., UHS OF SUTTON, INC., AND
RIDGE PROTECTORS, INC.

Mr. Guldberg provides testimony on the noise-related effects of the project on aesthetics, air and water purity, and public health and safety pursuant to section 248(b)(5). Mr. Guldberg's testimony also considers the testimony provided by the Petitioner's witness, Mr. Christopher J. Bajdek.

STATE OF VERMONT
PUBLIC SERVICE BOARD

Docket No. 7156

| | | |
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| Petition of UPC Vermont Wind, LLC for a Certificate of Public Good pursuant to 30 V.S.A. & 248, authorizing it to construct a 52 MW wind electric generation facility, and associated transmission and interconnection facilities, in Sheffield and Sutton, Vermont, and operate the same | ) | Docket No. 7156 |

**PREFILED TESTIMONY OF**
**PETER H. GULDBERG**

**ON BEHALF OF**

**UNIVERSAL HEALTH SERVICE, INC., UHS OF SUTTON, INC., AND RIDGE PROTECTORS, INC.**

Q1. Please state your name and occupation.

A1. My name is Peter H. Guldberg. I am President of Tech Environmental, Inc. ("TEI"), which is an environmental consulting firm based in Waltham, Massachusetts. TEI specializes in, among other things, noise studies, sound level measurements and acoustic modeling.

Q2. Have you previously filed testimony in this proceeding?

A2. No.

Q3. What is the purpose of your prefiled testimony?

A3. I will provide testimony on those section 248 criteria that relate to aesthetics, air and water purity, and public health and safety (section 248(b)(5)). I have reviewed the

testimony of Mr. Christopher J. Bajdek on behalf of UPC Vermont Wind, LLC. In my review, I noted many statements by Mr. Bajdek that are incorrect and unsubstantiated by fact. My testimony will rebut his claims and identify likely noise impacts that Mr. Bajdek has ignored, which will adversely affect aesthetics of the acoustic environment.

Q4. Please describe your professional background.

A4. I am an acoustic scientist with over 30 years of experience in the field. As President of Tech Environmental, I have conducted sound monitoring and acoustic modeling studies for a wide variety of sources including power plants, industrial facilities, and wind turbines. I have degrees in Mathematics and Atmospheric Science from the Massachusetts Institute of Technology and the University of Michigan, respectively. I am an Associate Member of the Institute of Noise Control Engineering, a member of the Acoustic Society of America, and a Certified Consulting Meteorologist. I have served as an expert witness on noise impacts before State and local regulatory boards. For example, I have testified before the Massachusetts Energy Facilities Siting Board for the Cape Wind Project (EFSB 02-2/DTE 02-53), before the Vermont Environmental Court for a Verizon telecommunications facility in Newport (VEC 203-11-03), and before the New York Department of Public Service for the repowering of the Astoria Generating Station (Case No. 00-F-1522). A copy of my CV is attached.

Q5. What are the principal deficiencies of the Mr. Bajdek's analysis?

A5. There are five major deficiencies in the noise analysis of the UPC Vermont Wind project:

1) The sound power data are incomplete, especially for low frequency sounds, and do not conform to International Standard IEC 61400-11 for wind turbine generator systems.

2) No impulsivity analysis was performed. Recent research reveals that low frequency modulated sound from wind farms at night are the most annoying audible sounds these installations produce. Mr. Bajdek failed to consider these impacts.

3) The noise criterion selected by Mr. Bajdek, a 24-hour averaged broad-band measure, does not address the types of audible noise from wind farms that people find most objectionable: audible tones and a rhythmic "beating" character of noise that often occurs in the evening.

4) The acoustic modeling of the project underestimates maximum sound levels.

5) The baseline sound level monitoring done for the project is inadequate and fails to reveal how low ambient sound levels are in inhabited areas near the project site during time periods when the wind farm would operate.

Q6: Are the sound power data presented in Mr. Bajdek's report complete?

A6: No, they are inadequate, and they do not conform to International Standard IEC 61400-11 for wind turbine generator systems. All major WTG manufacturers publish sound power test data in conformance with IEC 61400-11. In response to discovery request UHS/RPI:UPC1-21 and UHS/RPI:UPC2-27, Mr. Bajdek has failed to provide such fundamental test data for either the Gamesa G87 WTG or the comparable GE WTG that UPC has said they will use on this project.

Q7: Could you provide an example of fundamental test data that are missing?

A7: Yes. Discovery request UHS/RPI:UPC1-21 asked for "all acoustic emission test reports on the Gamesa G87 wind turbine generator, including 1/3-octave band sound power levels from 16 Hz to 16 kHz..." In response, Mr. Bajdek only provides a short document

from Gamesa Eolica (CB-1) that contained no 1/3-octave band sound power information. In his report dated February 14, 2006 (UPC-CB-2, pages 35 and 36), Mr. Bajdek makes express reference to such data and indicates that he performed "a comparison of projected wind farm noise levels in 1/3-octave bands" to vibration criteria. However, from the modeling results (CB-10) it is apparent that Mr. Bajdek did not use actual test data but instead created 1/3-octave band data by merely dividing the sound energy for each whole octave band into three equal parts. As explained below, this is inappropriate because in these circumstances the relevant international standards require, among other things, that an actual examination of 1/3 or whole octave bands down to 20Hz be performed.

Q8: Please summarize the sound power information that is missing from the UPC noise report?

A8: The following three items are missing:

1) No narrow-band frequency analysis of the WTG was done, and no tonality analysis was performed, as required by International Standard IEC 61400-11. Those data are important as they identify the frequency and sound power of pure tones generated by the WTG, information that is essential to any tone audibility impact analysis.

2) Low frequency sound power data are completely missing from the report and analysis. The very limited sound power data shown in Figure 7 (page 21) of the report (UPC-CB-2) are only for whole octave bands and thus obscure the fine detail of tonal peaks in the spectrum of the WTG. Every WTG has tonal peaks. The limited data used by Mr. Bajdek exclude the most important part of the spectrum, namely frequencies below 31.5 Hz, where the bulk of the WTG sound energy is produced and where the greatest noise impacts may occur. Table 3 and Figure 7 in the report show that sound power (Lw) in dB (unweighted) increases steadily up to 119 dB (re 1 pW) at the 31.5 Hz band and reveal that

most of the sound energy is below the point where the data cut off. In short, the greatest potential for aesthetically unpleasant noise exists at low frequencies below the point where Mr. Bajdek stopped his analysis. A proper low-frequency analysis would present 1/3-octave band sound power data down to 12.5 Hz to include some portion of the infrasound spectrum (frequencies below 20 Hz) where sound is not directly heard but often sensed by people as a rhythmic pressure oscillation. As discussed above, Mr. Bajdek did not work with actual 1/3-octave band sound power data.

3) Sound power data are only shown for a wind speed (at hub height) of 10 m/s. A proper assessment of impacts requires modeling the full range of WTG operation from the cut-in wind speed (3 m/s) to the cut-out wind speed (25 m/s). At the cut-in wind speed, ambient sound levels are low and WTG operation may have its greatest impact because sound masking is minimal. At the cut-out wind speed, high winds and a steep vertical wind profile enhance sound propagation through refraction in the atmosphere, causing WTG noise to travel further.

Q9: What is the effect of these missing data on the project's noise analysis?

A9: It means the project's noise analysis did not properly study the adverse impact of audible tones and low frequency noise on nearby residents, and did not model the worst-case operational conditions.

Q10: What types of noise are produced by a large WTG?

A10: There are three components to WTG noise: (1) Broadband aerodynamic sound caused by air flow around the blades; (2) Mechanical noise from the gearbox and generator that may contain discrete pure tones; and (3) Beating noise that is amplitude modulated, i.e., the sound pressure rises and falls with time at a rate that matches the blade passage frequency.

Q11: Which of these are addressed by the project's noise report?

A11: Only the first, broadband aerodynamic sound, which is the type of noise least likely to annoy people. The second and third kinds of noise, audible tones and impulse noise, were not analyzed. These two types of noise are also the impacts most likely to adversely effect public health and aesthetics.

Q12: Please describe the character of beating or impulse noise produced by a wind farm, noise that UPC did not study.

A12: For a single WTG, the impulse noise has a "swishing" sound with an oscillatory beat equal to the blade passage frequency (1 to 2 times per second). The amplitude modulation is most apparent in the well-audible range of sounds of 1,000-2,000 Hz where human hearing is most sensitive, and the cause is thought to be due to blade interaction with air turbulence around the tower or the variation in wind speed in the vertical space transversed by the blade.[1] When many WTGs are operated together in a wind farm, two or more of the individual turbines will, by chance, operate nearly synchronously for periods of time and the blade passage pulses accumulate into an audible beat. For example, Rhede Wind Park in Germany, which began operation in 2001, contains seventeen 1.8 MW turbines and is comparable in size to the proposed UPC project, which has twenty-six 2 MW turbines. Since the start of operation, residents living up to 2 km from the Rhede Wind Park have made complaints about the noise and have sued the operator in court. A research study done by the University of Groningen (Netherlands)[2] included detailed measurements in nearby residential areas and reached the following conclusions:

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[1] Eja Pedersen, "Noise annoyance from wind turbines – a review," Swedish Environmental Protection Agency Report 5308, August 2003, p. 9.

[2] G.P. van den Berg, "Effects of the wind profile at night on wind turbine noise," Journal of Sound and Vibration, 2004, pp. 955-970.

> On quiet nights the wind park can be heard at distances of up to several kilometers when the turbines rotate at high speed. On these nights, certainly at distances between 500 and 1,000 meters from the wind park, one can hear a low pitched thumping sound with a repetition rate of about once a second (coinciding with the frequency of blades passing a turbine mast), not unlike distant pile driving, superimposed on a constant broadband 'noisy' sound. A resident living at 1.5 km from the wind park describes the sound as 'an endless train.'[3]
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> At night the turbines cause a low pitched thumping sound superimposed on a broadband 'noisy' sound, the 'thumps' occurring at the rate at which blades pass a turbine tower. It appears that the characteristic, but usually small 'swishing' pulses . . . coincide because turbines operate nearly synchronously. Two coinciding pulse trains thus give a 3 dB higher pulse level, three a 5 dB pulse level. The measured pulse levels and frequencies agree with values expected from nearly synchronous pulse trains generated by a small number of wind turbines.[4]

Van den Berg[5] has demonstrated that the pulsing noise generated by a modern WTG increases by several decibels at night when the atmosphere is stable because of a greater difference in wind speed experienced at the top and bottom of the turbine blade's rotational cycle (a steeper wind speed gradient) and because of reduced air turbulence allowing nearby WTGs to spin at identical rotational speeds and synchronize. The noise is also more audible at night because of the lower background sound levels.

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[3] Ibid, p. 957.

[4] Ibid, p. 969.

[5] G.P. van den Berg, "The Beat is Getting Stronger: The Effect of Atmospheric Stability on Low Frequency Modulated Sound of Wind Turbines," Journal of Low Frequency Noise, Vibration and Active Control, 2005, pp. 4-6.

Detailed sound pressure level measurements at a residence 1 km from the WTGs shows broadband sound variations were substantial, 4 to 6 dB, with pulses matching the blade passage frequency.[6]

Given the similarities between the Rhede Wind Park and the UPC wind project, both in terms of WTG size and numbers of turbines, it is likely that highly-annoying impulse noise (described as a rhythmic thump described as distant pile driving) will be audible in the evening at the sensitive receptors within 2 km of the turbines, which include the King George School and many residences. This impulse noise would substantially impact public health and aesthetics in the very quiet rural area where the UPC wind park is proposed.

Q13: Does Mr. Bajdek's work take into account the work of G.P. van den Berg?

A13: No. In his response to Q.UHS/RPI:UPC2-19, Mr. Bajdek stated that the HMMH study "did not take into account the work of G.P. van den Berg" and indicated that he was unaware of the work at the time he performed his work for UPC.

Q14: Are there other aspects of Mr. Bajdek's analysis that are flawed?

A14: Yes. International standard IEC 61400-11 states that received sound levels have a low frequency component when the difference in dBC (used to measure sound sources with a dominant low frequency spectrum) and dBA (which roughly duplicates the hearing response of the human ear) exceeds 20 dB. The data produced by Mr. Bajdek clearly shows, see CB-10 ( Excel document "Results_122005"), that for nearly all the sites measured, the difference between dBC and dBA exceeded 20dB.

[6] G.P. van den Berg, "The Beat is Getting Stronger: The Effect of Atmospheric Stability on Low Frequency Modulated Sound of Wind Turbines," Journal of Low Frequency Noise, Vibration and Active Control, 2005, p. 12.

Q15: What does IEC 61400 require if the difference exceeds 20 dB?

A15: If the difference exceeds 20dB, the international standard calls for an examination of 1/3 or whole octave bands down to 20Hz and it also requires the analysis of narrow band spectra for frequencies below 100Hz down to 20 Hz to determine the low-frequency noise produced by the wind turbine .

Q16: Did Mr. Bajdek perform that low frequency analysis correctly?

A16: No. Mr. Badjek failed to analyze any narrow-band spectra for audible low frequency tones, and the analysis he presents in his report using 1/3-octave band levels does not extend down to 20 Hz and most importantly it utilized fictitious sound power data that are incapable of revealing whether the proposed wind turbine would create a low frequency noise problem. Mr. Bajdek did not use actual 1/3-octave band data, but instead created 1/3-octave bands by merely dividing the sound energy for each whole octave band into three equal parts.

Q17: Is this an accepted practice?

A17: No. It is not recommended in IEC 61400-11 or any standard guidance document in the acoustic consulting profession. By creating fictitious 1/3-octave bands that are flat across three bands and which do not represent the true tonal peaks of the wind turbine, Mr. Badjek has hidden the true low-frequency noise impacts of the project.

Q18: What should have been done to comply with IEC 61400-11?

A18: Actual 1/3-octave band sound power data for the Gamesa G87-2MW turbine covering the 20, 25, 31, 40, 50 and 63 bands should have been input to the acoustic model to predict the true 1/3-octave band sound level spectrum at each sensitive receptor. In addition, the narrow band spectra for frequencies from 20 Hz to 100 Hz with a bandwidth not exceeding 0.5 Hz should have been analyzed. These requirements are clearly stated in Sections 4.2.2.3 and A.3 of IEC 61400-11

Q19: You cite as the third major deficiency in the UPC noise analysis that the noise criterion selected by Mr. Bajdek does not address the types of noise from wind farms that people find most objectionable: audible tones and the rhythmic impulse noise or "beating" that can be heard in the evening hours. Please explain what Mr. Bajdek should have done in each instance.

A19: A proper analysis of audible tones would start with the narrow-band sound power spectrum and an identification of pure tones from the WTG that could be audible when ambient sound levels are low. The lowest measured ambient sound levels in each 1/3-octave band, from a long-term monitoring study, would then be added to the wind farm noise in each 1/3-octave band and compared to the ambient level in each band to determine whether the wind farm would create an audible tone. The audibility analysis presented in the noise report (UPC-CB-2, pp 34-35) did not follow this approach and reaches conclusions unsupported by facts. First, as discussed earlier, narrow-band sound power data were not obtained for the proposed 2 MW turbine and tonality in the frequency spectrum was not analyzed. In Figure 10 of the noise report, Mr. Bajdek presents wind farm sound level predictions alongside background noise levels measured at three sites. The comparison is deceptive for three reasons:

1) Mr. Bajdek did not add the wind farm noise to the background levels and compare the total future sound levels to existing backgrounds levels. By failing to properly calculate future sound levels, project impacts are underestimated.

2) The background sound data include measurements from the high-noise station M4 and thus do not represent the very low ambient sound levels at most of the sensitive receptors. As a result, project impacts are underestimated.

3) No low-frequency impacts for the project (sound below 31.5 Hz) are presented.

Q20: Are there other conclusions in this section that are incorrect and/or unsubstantiated?

A20: Yes. Three conclusions in this section of the noise report are incorrect and unsubstantiated by fact:

The conclusion (1st paragraph of page 34): "ambient wind noise will also mask the wind farm under certain conditions, such as during periods of high wind speeds" has no foundation. The authors did not perform acoustic modeling for a high wind speed condition. In fact, on page 30, they admit no attempt was made to quantify masking in their study.

The conclusion (3rd paragraph of page 34): "The graph of Figure 10 also illustrates that wind farm noise is 'broadband' in nature, that is, there are no peaks in the spectra, illustrating that the wind turbines would not produce audible tones" is completely unsubstantiated. First, Figure 10 does not present frequency spectrum results at a level of detail (1/3-octave band) that could even detect a "peak in the spectra," nor does it cover the important low-frequency range. Second, any claim of inaudibility must rest on masking by ambient noise, and the authors readily admit no such analysis was done.

The conclusion (top of page 35): "the wind farm . . . sound characteristics are similar to that of the background and are expected to blend well in the existing acoustic environment" has no factual foundation. To "blend well into the existing acoustic environment," a wind farm would need to have a frequency spectrum similar to that of the existing rural environment. Figure 10 in the noise report reveals that it does not; the wind turbine noise has a strong low-frequency component and as previously discussed the wind farm would likely produce annoying impulse noise out of character with the existing quiet rural environment.

Q21: What would a proper study of impulsive noise entail?

A21: A proper analysis of impulse noise would start with measurements of the time varying characteristics of audible noise from the proposed WTG, e.g., tests at an existing wind farm that utilizes the Gamesa G87 WTG or the equivalent GE model during nighttime temperature inversion conditions; or estimates using the measurement data from the Rhede Wind Park. The impulse noise from the wind park would then be compared to the lowest ambient sound level at sensitive receptors during nighttime conditions when the WTGs would operate to determine if impulse noise would be audible. No such analysis was done for the UPC project.

Q22: Does the acoustic modeling of the project provide accurate estimates of the maximum noise impacts?

A22: No, the acoustic modeling underestimates maximum sound levels for three reasons. First, Mr. Bajdek's use of the "moderate downwind" condition in the ISO 9613-2 standard does not produce maximum sound levels from a wind farm and does not represent "worst case conditions" as Mr. Bajdek has testified (Bajdek Direct, page 3, line 20). What the ISO standard calls "moderate" winds are winds of 1 to 5 m/s (2 to 10

mph), more accurately termed light winds. The use of actual hub height wind speeds in the 10 to 25 m/s range in the acoustic model would result in higher predicted noise impacts. The existence of a vertical wind profile in the atmosphere (higher winds at the turbine blade height and low winds at ground level) causes sound waves to bend downward, an effect called refraction, in the downwind direction. Higher wind speeds produce a steeper vertical wind profile and greater refraction. The refraction effect in high winds increases the sound levels downwind of a wind farm over what would exist under lighter wind conditions. Acoustic modeling that our firm has done on another wind power project reveals that decibel contours stretch out toward downwind receptors as wind speed increases, if the model is told to use actual wind speed. In my opinion, using the ISO "moderate" wind assumption underestimates noise impacts by 2 to 3 dBA.

The second error in the UPC noise modeling was to assume sound attenuation by foliage (deciduous trees) when in fact there are no leaves on the trees six months of the year and sensitive receptors (including the residential buildings and open recreational areas at King George School) have a clear line of sight to where the WTGs would stand on the mountain ridges. In my opinion, this error underestimated noise impacts by 1 to 2 decibels.

The third modeling error by Mr. Bajdek was to assume special sound attenuation for ground absorption (UPC Response to Town of Sutton's First Set of Discovery Request, #61, page 29), which is inappropriate in uneven terrain and should not be used. The modeling methodology in ISO Standard 9613-2 used by Mr. Bajdek states in Section 7.3.1 that:

"This method of calculating the ground effect is applicable only to ground

which is approximately flat, either horizontally or with a constant slope"[7]

The mountainous terrain around the UPC site does not satisfy these conditions and Mr. Bajdek's assumption of sound absorption by the ground per the ISO method underpredicted nose impacts by 2 to 3 dBA, in my opinion.

In sum, these three errors likely underestimate the sound level by 5 to 8 decibels, collectively.

Q23: Chapter 4 of the noise report states noise measurements were made at four locations to "characterize the existing noise environment in the vicinity of the wind farm." (CB-82, page 25). Are those data accurate and do they accomplish the stated goal?

A23: No. The baseline sound level monitoring done for the project is both inadequate and violates guidelines used by acoustic consultants. To illustrate this point, consider monitoring site M1 on Hardscrabble Road, southwest of King George School. Mr. Bajdek's company HMMH measured sound levels for less than two days, from 1:40 p.m. October 26, 2005 to 8:45 a.m. October 28 (CB-82, page 25). This short period of time is inadequate. In my experience, baseline sound level monitoring for a wind farm project is done for 1 to 2 weeks to ensure a broad range of meteorological conditions are covered.

According to National Weather Service (NWS) records from the Burlington Airport (at a lower elevation and 55 miles to the west), there was a storm on October 26 with wind gusts over 30 mph and rain until 2 a.m. the following day. Up in the mountains of Caledonia County there was rain and snow, as evidenced by Figure 13 in the noise report.

[7] International Organization for Standardization, Standard ISO 9613-2, "Acoustics – Attenuation of Sound During Propagation Outdoors—Part 2: General Method of Calculation," 1996, page 5.

Not surprisingly, baseline sound levels at Station M1 during the first 24 hours of measurements were high due to the winds of the storm. NWS records show that while there was no precipitation after dawn on October 27 through to 8 a.m. on October 28, there were moderate winds of 6 to 15 mph during the day, which would elevate baseline sound levels. (Winds on the ridgelines where the WTGs would operate were presumably much higher than those measured at Burlington Airport). Only after 8 p.m. on October 27 do the winds subside.

The Acoustical Society of America has published an ANSI Standard for outdoor sound level measurements[8] that recommends no sound level measurements be made when the average wind velocity exceeds 5 m/s (11 mph) or during measurable precipitation. The reason for these restrictions is obvious: wind and precipitation impact a microphone creating noise. Using the best available hourly weather data from the nearest NWS station (Burlington), it can be concluded that about half of the baseline sound measurements are invalid because they fail to meet ANSI criteria. In addition, Figures 13 and 15 in the noise report clearly show snow accumulated on top of the microphone windscreen at Stations M1 and M2, which calls into the question the validity of all the measurements.

Q24: Did the measurements conducted by HMMH fail to capture other possible effects?

A24: Sound power data for the proposed Gamesa G87 WTG (CB-1, page 3) show the turbine operates in ridge-top winds (at 10 m) as light as 3 m/s. In mountainous terrain, temperature inversions often form at night in which cool, stable air pools at lower elevations (e.g., in and around the sensitive receptors for this project) and winds go calm.

[8] Acoustical Society of America, "American National Standard S12.18-1994, Procedures for Outdoor Measurement of Sound Pressure Level," Section 4.4.1.

Existing sound levels are extremely low during these nighttime inversion conditions. At the same time, substantial winds may blow across the ridge tops at higher elevations above the inversion layer. Thus, the UPC wind project would operate under these nighttime inversion conditions producing noise impacts when ambient sound levels are very low. With the existence of such a temperature inversion, noise from the ridgeline would tend to be more audible because of the still air in the inversion layer at the sensitive receptors and because the stable atmosphere will refract sound waves downward toward the sensitive receptors. It is important, therefore, that baseline sound monitoring at locations such as monitoring station M1 be done for a sufficient length of time to capture several nights with temperature inversion conditions. HMMH has failed to do this and has failed to properly characterize the existing noise environment.

Q25: Mr. Bajdek has testified that the Project "will not have an undue adverse effect on public health or on aesthetics" (Bajdek Direct, page 2 line 18). Does the factual evidence he presents support that claim?

A25: No. The five major deficiencies discussed in detail above reveal that Mr. Bajdek has ignored the noise impacts of the Project that would be most damaging (pure tones, impulsive noise), has failed to provide complete sound power data for the project, has not modeled the worst-case condition, and has not documented the very low nighttime ambient sound levels in sensitive areas. In short, Mr. Bajdek has failed to demonstrate that the project will not have an undue adverse impact on public health or aesthetics.

Q26: Mr. Bajdek admits that the Project will be audible during nighttime periods with temperature inversions (UPC-CB-2, page 34). You have previously testified that a wind farm in Germany similar in size to the Project produces highly annoying impulse noise

under these nighttime conditions at distances coincident with the location of many sensitive receptors near this Project. What conclusion do you draw?

A26: The UPC Project will likely create impulse noise at night that would adversely impact aesthetics in the very quiet rural area where there are homes and a boarding school for special-needs children (King George School).

Q27: Does this conclude your testimony?

A27: Yes.