Oakfield Wind Project // Oakfield, Maine
Evergreen Wind Power II, LLC, applicant
Site Location and NRPA

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Brian Raynes
51 Nelson Road
Oakfield Maine 04763
(207) 694-3234

Kristen Chamberlain
ME Dept. of Environmental Protection
17 State House Station
Augusta Maine 04333-0017

05/12/09

Subject: Oakfield Wind Project

Dear Ms. Chamberlain:

As a concerned resident of Oakfield, Maine, I am submitting the following letter regarding the proposed Oakfield Wind Project permit application recently filed by Evergreen Wind Power II, LLC (Evergreen II), a subsidiary of First Wind, with its principal offices at 85 Wells Avenue, Suite 305, Newton, MA 02459,(hereinafter First Wind). As a matter of reference to the impact this proposed project will have on me personally, my lot is designated as lot 36 on Oakfield tax map 4. Although I am to be greatly affected individually, my concerns are not limited to any one particular location within the proposal. Numerous other landowners and residents will be negatively impacted in a significant manner if this project is granted a permit as it is currently designed.

An informational meeting conducted by an entity other than First Wind or their representatives would serve to educate the general public in an unbiased manner. While First Wind did fulfill their requirements by holding "public forums" and informational meetings, these were generally very structured events designed more as public relations exercises than balanced presentations. The information provided was limited to industry sponsored data that cast a positive light on the proposed project. Open questioning by attendees was intentionally limited. Questioning that threatened the controlled direction of presented information was, on at least one occasion, answered inaccurately to the point of deception. An explanation for this particular response became evident upon examination of the State of Maine Department of Environmental Protection's Site Location of Development Rules.

Under the Department's rules, chapter 372, page 10, section 10, "Phased Development", a project

must include all phases of the proposed development at the time of application. First Wind has not met this requirement. The aforementioned company has applied for a permit detailing construction of a 34 turbine project with associated facilities. At a public forum in October 2008 a company representative was directly questioned by an audience member about the existence of a second phase of this proposed project. The representative stated that there were to be no additional phases, that it was "all one project". A second company representative explained to the questioner that he must have misunderstood what he had heard in a previous conversation. Questions were abruptly halted and the audience divided up and directed to a variety of trade show like booths. These responses were inaccurate. The questioner was a landowner who had previously been approached for "phase two" land control as had numerous others. Within two weeks following the October public forum, I was invited to a private meeting held at the above referenced questioner's camp. It was attended by approximately ten landowners and one of the two First Wind representatives who fielded the "phase two" questions. At this informal meeting the company representative stated to the individual who had questioned the "phase two" development plans that the company was not discussing that issue publicly yet and that he (the questioner) had caused a lot of trouble by bringing the issue up at the forum. The obvious reason being a second phase of the initial development proposal would place the applicant in direct violation of the aforementioned rule.

Phase two of the Oakfield Wind Project was and is very much in the development stage. Aggressive land acquisition attempts are currently under way and have been since the earliest work on the first phase of this proposal. Applying for a permit for one phase of a multi phased project creates a direct conflict with existing Site Location of Development rules. As stated in the referenced rule "A proper analysis of the potential primary, secondary and cumulative impacts of a proposed development can be made only when all phases of a proposed development are considered...". Sound modeling data cannot take the influence of additional turbines into account. Additional turbines within the greater project area will add 3dBa to the sound levels of the neighboring turbines in phase one; however, current turbines will not be required to be included in the phase two permit application due to the fact that they will be considered a pre-existing development. Only the sound modeling of the next turbine sites will be a requirement. Any new development on contiguous lands would push sound levels at the threshold of non-permissible limits even higher. In short, this project is not being developed in good faith or practice as very few people in the town of Oakfield appear to be aware of the existence of "phase two". As no provision is included for additional phases in the current permit application, it would appear the Department has no knowledge of the existing "phase two"section of this proposed development either, thus cannot account for the additional impacts in the analysis.

In phase one of this proposed project nine receptor sites are listed (Volume I, Section 5, Noise, R1-R9 as shown on pp. 6 and 10, Tables 1 and 3 of permit application submitted to MDEP) All are with-

in the likely margin of error under current sound modeling for permissible sound levels. (In the spirit of full disclosure I will volunteer that I am designated as "R4".) It is not appropriate to issue a permit for a project that has a substantial likelihood of violating the very rules under which it is permitted. If violations were to occur, what enforcement authority, if any, does the Department have? Would it be up to individual property owners to take legal action against the developer as is currently happening in Mars Hill as evidenced by at least one filing in Aroostook County Superior Court filed May 5, 2009? The nine receptor sites do not even include the ten sound/shadow flicker easements that the developer has obtained (Volume I, Section 5, Noise, D1-D10 as shown on pg. 10, Table 4 of permit application submitted to MDEP).These easements release the developer from the required sound limits. The overall number of residences in close proximity to the project's location cause a great deal of concern regarding the existing plan for the development of said project. The setbacks are inadequate to protect the long term health and well being of community members.

Currently, property owners are only being protected by the "A weighted" dB level measurements. Although the department only has guidelines to regulate dBa levels, the lower frequencies that are intentionally filtered out are of much greater concern. There has been enough public discussion of this issue to warrant further review of the regulations. Grid scale wind development is new enough to the state of Maine that the full extent of the impacts of low frequency sounds are likely to lag far behind the rapid pace of construction. This discrepancy only serves to highlight the need to hold this type of project to the highest standard allowable under site rules and not accept marginal development proposals. Sound levels and noise issues are the most common complaints experienced with grid scale wind development. The consistency and severity of the reported ailments associated with these complaints are such that they must be treated seriously. Clinical data takes longer to develop than the rate of industry expansion allows. The medical community is beginning to take notice. Annual international conferences are devoted to sound and noise issues. Instead of allowing sound related health concerns to be treated dismissively, as is currently the situation in the state of Maine, the Department has an obligation to study this issue independently and openly. Every wind power project developed near populated areas garners the same types of complaints. After enough time, this type of development will undoubtedly be regulated in a more effective manner. Until that occurs, the industry will continue to minimize these very legitimate concerns. It is presently up to the Department to handle this issue credibly. Given the number of pending and planned project proposals in the state at this time, these issues necessitate placement on the forefront of the regulatory process as the wind industry is certain to suffer a severe backlash of public opinion if projects continue to be sited too close to residential properties.

Another area of concern is to be found at the boundaries of the northern and southern turbine arrays. Three of the parcels subject to commercial sound easements (D3, D4, and D5) are located within a residential subdivision created in 1987/88 by the Patten Corporation Downeast. All parcels

of land within this subdivision are subject to deeded covenants that prohibit any commercial development. Easements granted to a commercial entity for ongoing and significant compensation could easily be considered commercial development. The permit application must include these easements as part of the project in order to have the sound/setback limits waived. These easements are perpetual and have the effect of imposing additional impacts on neighboring landowners subject to the same covenants by allowing the turbines and facilities to encroach upon them. The protective covenants are one reason landowners within this subdivision felt secure in the peace and solitude of their parcels. If permitted,this issue would have to be challenged by any impacted party via the court system. Protecting existing deed restrictions should not be the burden of private landowners. The Department has the authority to force modification or to reject the permit application outright before this violation is allowed to occur.

To summarize, I have outlined serious concerns relevant to the permitting process. I respectfully request the Department deny approval of the permit application presented for review by First Wind for the proposed Oakfield Wind Project. Several issues have been detailed which individually are significant enough to require further limitations or site restrictions. Together, these issues combine to demonstrate a project that may be well engineered but very poorly suited for this site layout and is in direct conflict with Department rules. The political popularity or perceived urgency of a particular type of development should have no bearing on the enforcement of the Department's site rules.

Names of the company representatives mentioned in my statements can be provided upon request. Further details as to landowners I referenced in this letter can be provided as well. All information cited regarding phase two of the project is verifiable. Copies of Patten Corporation deed restrictions can be forwarded if needed.

I look forward to your review of my concerns and would appreciate a reply regarding the Department's response to the aforementioned issues.

Sincerely,

Brian Raynes

Wind Turbine Neuro-Acoustical Issues

Dora Anne Mills, MD, MPH Maine CDC/DHHS

June, 2009

1. What protections are in Maine law regarding excessive noise and vibrations?
Maine DEP has rules that apply to all developments in unorganized areas of the state and in all municipalities without a more restrictive noise ordinance. The rules recognize in its text that excessive noise can degrade health and welfare of nearby neighbors, and they provide limits based on the type of development in the area surrounding the noise. For instance, they limit noise levels for routine operation of a proposed development: to 75 dBA at any time; to 60 dBA during the daytime and 50 dBA during the nighttime for non-commercial and non-industrial areas; and to 55 dBA daytime and 45 dBA nighttime for areas in which ambient sounds are 45 dBA or less daytime or 35 dBA or less nighttime.

Maine DEP also has retained the services of a noise expert to review noise study submissions as part of wind turbine applications and compliance evaluations.

DEP's ambient, post development monitoring at the Mars Hill wind farm shows dBA levels higher than 45, sometimes exceeding 60 when there are windy conditions both at ground level and at turbine height. This presents an example of how ambient noise from wind at these locations (which is why turbines are placed there) is in excess of the optimal nighttime 45 dBA. The DEP rules and compliance monitoring provide for distinguishing between the ambient contribution to noise and that from turbines at wind farms.

In summary: Maine law appears to essentially place a 45 dBA noise limit on most wind turbine projects in Maine. A 5 dBA variance to limits may be granted upon specific findings that concern pre-development existing ambient noises that are in excess of a particular standard. For compliance with the rule, noise levels are measured at the boundary of the property owned by the proposed developer.

Sources:

- Maine DEP rule-making authority on noise is in Title 38 Section 343
  Rules are in Chapter 375, Section 10:
  http://www.maine.gov/sos/cec/rules/06/096/096c375.doc
- Maine SPO Noise Technical Assistance Bulletin
  http://www.maine.gov/spo/landuse/docs/techassist/techassistbulletins/noisetabulletin.pdf

2. What do different noise levels compare to?
40 dBA is comparable to a quiet room. 55 dBA is comparable to a household room or office in which there is normal background vibration and sounds such as is commonly found from household appliances.

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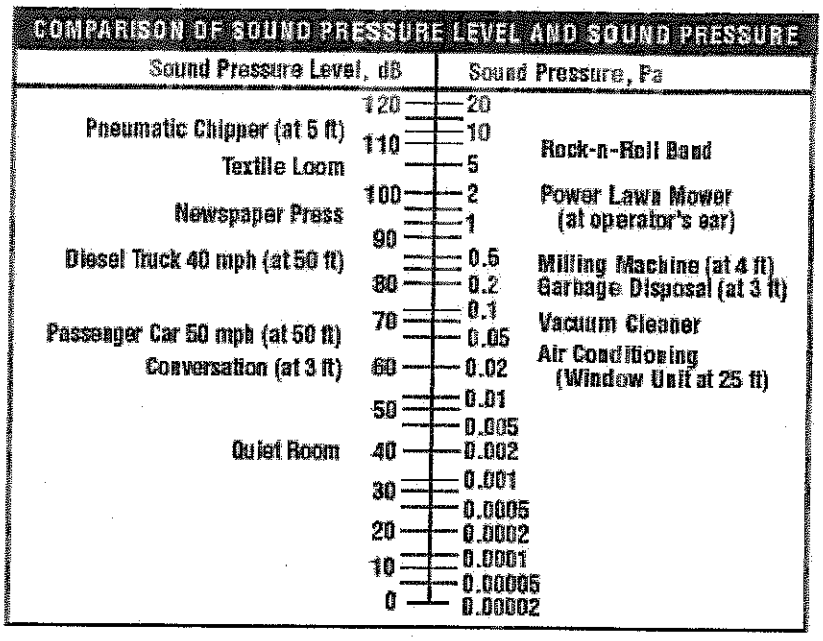

Canadian Centre for Occupational Health and Safety
(see www.ccohs.ca/oshanswers/phys_agents/noise_basic.html).

3. What kinds of noises are expected from wind turbines?
According to several resources, new wind turbines are relatively quiet, and meet federal and international standards and regulations for noise, including Maine's regulations. According to the US Department of Energy, a modern wind farm at a distance of 750 – 1,000' is no louder than a kitchen refrigerator or a moderately quiet room.

However, there are people who live about these distances from wind turbines who disagree with this federal agency statement. It appears from the research that distance from the wind turbine, height of the wind turbine relative to the surrounding topography, the quality of the sound (repetitive low frequency sound), wind conditions, and wind direction all affect how the wind turbine noise affects people. Research done on wind turbines, airport and other sources of noise indicates that annoyance levels are difficult to assess. However, taking in account the above factors as well as careful measurements need to be considered when siting wind turbines near residential properties.

Sources:

- US Dept of Energy's Wind Energy Guide for County Commissioners: http://www.nrel.gov/wind/pdfs/40403.pdf
  Page 6: An operating modern wind farm at a distance of 750'-1,000' is no louder than a kitchen refrigerator or moderately quiet room.
- University of Massachusetts Renewable Research Energy Laboratory: http://www.windpoweringamerica.gov/pdfs/workshops/mwwg_turbine_noise.pdf
  Contains a number of resources on sounds emitted from wind turbines
- Noise levels of small residential wind turbines:

Dept of Energy's Consumer Guide on Small Wind Turbines
http://apps1.eere.energy.gov/consumer/your_home/electricity/index.cfm/mytopic=10930
Comparable sounds to wind turbines

- Wind Turbine Noise Issues: A white paper prepared by Renewable Energy Research Laboratory, U of Massachusetts, 2004: http://www.town.manchester.vt.us/windforum/aesthetics/WindTurbineNoiseIssues.pdf

4. Are there health effects to the levels of sound heard by wind turbines?
According to a 2003 Swedish EPA review of noise and wind turbines:
"Interference with communication and noise-induced hearing loss is not an issue when studying effects of noise from wind turbines as the exposure levels are too low."

In my review I found no evidence in peer-reviewed medical and public health literature of adverse health effects from the kinds of noise and vibrations heard by wind turbines other than occasional reports of annoyances, and these are mitigated or disappear with proper placement of the turbines from nearby residences. Most studies showing some health effects of noise have been done using thresholds of 70 dBA or higher outdoors, much higher than what is seen in wind turbines.

Sleep disturbance is another commonly raised concern, and the WHO guidelines for community noise recommend that nighttime outdoor noise levels in residential areas not exceed 45 dBA, which is consistent with Maine law.

Sources:

- Noise Annoyance from Wind Turbines – A Review 2003 Sweden Environmental Protection Agency
  http://www.barrhill.org.uk/windfarm/noise/10%20pederson.pdf
  This study found no evidence of health problems, reviews the variety of noise regulation laws in place in Europe
- British Medical Journal 2007 Swedish Study (Eja Pedersen)
  http://oem.bmj.com/cgi/content/full/64/7/480?ijkey=b1a1ae4a98c9453315a90941395e0a05262aca53
  Survey in Sweden of residents near wind turbines found annoyance increased with increased sound pressure levels (SPLs), and increased annoyance was associated with lower sleep quality and negative emotions.
- Noise Pollution: Non-Auditory Effects on Health, 2003
  http://bmb.oxfordjournals.org/cgi/content/full/68/1/243
- World Health Organization Community and Occupational Noise
  http://www.who.int/mediacentre/factsheets/fs258/en/
- World Health Organization 2002 Technical Meeting on Relationship Between Noise and Health
  http://www.euro.who.int/document/NOH/exposerespnoise.pdf Page 52 says that WHO standard is for nighttime noise not to exceed 45 dB.

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5. What about low frequency noises (LFN)?
Some have pointed to LFN emitted from wind turbines as a possible source of adverse health effects. The reasons LFN are focused on include: LFN encounter less absorption as they travel through air than higher frequency sound, so they persist for a longer distance; the amount of sound transmitted from the outside to the inside of a building is higher with LFN; and some models for assessing impact of noise do not adequately include LFN.

Low frequency and infrasound (lower than what is perceptible) vibrations are very common in our background, and known to be emitted from many household appliances and vehicles as well as in neighborhoods near airports and trains. Exposure to very intense LFN can be annoying and may adversely affect overall health, though these levels appear to be more intense than what is measured from modern wind turbines.

The DEP noise regulations are based on the "A" frequency range of noise, which measures the higher frequency end of the noise spectrum, and is denoted with the term dbA. Because the dbA measurement deemphasizes noises from the lower end of the frequency spectrum (or "C" weighted noise, dbC), Maine DEP has been evaluating noise models and predicted noise levels from proposed wind power facilities using a handicapping system that requires an applicant to prove that dbA noise levels will be at such a level at property boundaries that they are effectively controlling for low frequency noises in the dbC range. The Land Use Regulation Commission has required monitoring for dbC noise at one of its recently permitted wind turbine facilities in order to evaluate dbC noise levels at property boundaries.

One recent study commonly cited by proponents of the belief of the physiological impacts of LFN is: "Tuning and sensitivity of the human vestibular system to low-frequency vibration", Todd, et al. Neuroscience Letters, 2008, which can be found at: http://www.ncbi.nlm.nih.gov/pubmed/18706484. This study indicates that the human vestibular system is sensitive, which means it shows a physiological response, to low-frequency and infrasound vibrations of -70 dB, indicating that human seismic receptor sensitivity of the vestibular system may possibly be on par with the frog ear. However, sensitivity, i.e. showing a physiological response, does not mean there are adverse effects.

Summary:
Reviews found in peer reviewed journals of the possible health effects of low frequency noise have not found evidence of significant health effects (several references are listed below).

Sources:

- Infrasound from Wind Turbines: Fact, Fiction, or Deception? Journal of Canadian Acoustics, Volume 34, no 2, 2006. http://www.wind.appstate.edu/reports/06-06Leventhall-Infras-WT-CanAcoustics2.pdf

"Infrasound from wind turbines is below the audible threshold and of no consequence. Low frequency noise is normally not a problem, except under conditions of unusually turbulent in flow air. The problem noise from wind turbines is the fluctuating swish. This may be mistakenly referred to as infrasound by those with a limited knowledge of acoustics, but it is entirely in the normal audio range and is typically 500Hz to 1000Hz. It is difficult to have a useful discourse with objectors whilst they continue to use acoustical terms incorrectly. This is unfortunate, as there are wind turbine installations which may have noise problems. It is the swish noise on which attention should be focused, in order to reduce it and to obtain a proper estimate of its effects. It will then be the responsibility of legislators to fi x the criterion levels, However, although the needs of sensitive persons may influence decisions, limits are not normally set to satisfy the most sensitive."

- Sources and Effects of Low-Frequency Noise 1996
  http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=JASMAN000099000005002985000001&idtype=cvips&gifs=yes
  J. Acoust. Soc. Am. Volume 99, Issue 5, pp. 2985-3002 (May 1996)
- Characteristics of low frequency signals emitted from home electric appliances: http://sciencelinks.jp/j-east/article/200507/000020050705A0229983.php,
- Magnetic Emission Ranking of Electrical Appliances: http://rpd.oxfordjournals.org/cgi/content/abstract/ncm460v1)
- International Meeting on Low Frequency Noise and Vibration and Its Control, the Netherlands, 2004
  http://www.viewsofscotland.org/library/docs/LF_turbine_sound_Van_Den_Berg_Sep04.pdf

6. What are the health benefits to wind turbines?

- There are tremendous potential health benefits to wind turbines, including reductions in deaths, disability, and disease due to asthma, other lung diseases, heart disease, and cancer. Maine has among the highest rates in the country of asthma and cancer.
- Wind turbines mean less dependency on foreign oil and coal that contribute to global warming and pollution (coal produces carbon dioxide, acid rain, smog, particulate pollution, carbon monoxide, and mercury), which in turn contribute to the diseases above.
- According to the Maine DEP, if Maine generated 5% of its electricity from wind power, there would be significant pollution cuts:
  - 464,520 tons per year of CO2
  - 252 tons per year of SO2
  - 147 tons per year of NOx

7.What about a moratorium on wind turbine projects?

- I do not find evidence to support a moratorium on wind turbine projects at this time. The articles cited by those who are in favor of a moratorium are either from non-peer reviewed journals (though some are labeled as "peer reviewed") or are misinterpreted analyses from peer reviewed journals.

- If there is any evidence for a moratorium, it is most likely on further use of fossil fuels, given their known and common effects on the health of our population.

Basic Wind Turbine Noise-Related Resources:

- US Dept of Energy's New England Wind Power Website on Wind Turbine Sound – this has a good summary and links to references
  http://www.windpoweringamerica.gov/ne_issues_sound.asp
- Massachusetts DEP Regulations
  http://www.nonoise.org/lawlib/states/mass/mass.htm
  "A source of sound will be considered to be violating the Department's noise regulation (310 CMR 7.10) if the source: Increases the broadband sound level by more than 10 dB(A) above ambient, or Produces a "pure tone" condition - when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more. These criteria are measured both at the property line and at the nearest inhabited residence. Ambient is defined as the background A-weighted sound level that is exceeded 90% of the time measured during equipment operating hours. The ambient may also be established by other means with the consent of the Department."
- Ongoing Research is being done by the US Dept of Energy Wind Turbine Aeroacoustic Research:
  http://www1.eere.energy.gov/windandhydro/wind_research_enable.html#research
  "Turbine noise can be caused by rotor speed, blade shape, tower shadow, and other factors. The program is sponsoring both wind tunnel and field tests to develop a noise prediction code that turbine manufacturers can use to ensure that new rotor designs and full systems aren't too noisy. This is especially true for high-growth U.S. markets for small wind turbines that will demand quieter rotors, especially when turbines are sited in residential neighborhoods. Small turbines operate at high rotational speeds and tend to spin even if they are furled (pointed out of the wind).
- **Background Information on Noise:**
  http://www.osha.gov/dts/osta/otm/noise/health_effects/physics.html
  http://www.ccohs.ca/oshanswers/phys_agents/noise_basic.html
  http://www.phys.unsw.edu.au/jw/dB.html
  The decibel (**dB**) is used to measure the intensity of sound. It uses a logarithmic scale and describes a ratio where 0 is at the threshold of human hearing. When measuring sound, filters are usually used. The A scale filter results in sound level meters called dBA that are less sensitive to very high or very low frequencies. The C filter provides more of a measurement of low frequency noise.

Margerum, Mark T

From: Brian [braynes@fairpoint.net]
Sent: Sunday, July 19, 2009 1:08 PM
To: Margerum, Mark T
Subject: Oakfield Wind Project
Attachments: cover letter.pdf; Oakfield Wind Project Review.pdf

Dear Mr Margerum,

I have attached two files for your review. I prepared both of the enclosed documents before the meeting with your Department on Thursday, July 16, in Oakfield. I would like to offer additional comments and present questions not contained in the attached files.

In speaking with Mr. Cassida I was assured that written comments are granted the same weight as verbal questions. This is important as I did not feel comfortable with the process of speaking before the crowd. I have witnessed a great deal of contempt within some factions of the community towards those who seem to oppose this project in any manner.

I think that an important consideration when reviewing the comments offered is the relationship between the speaker and developer. In the case of both Mr. Gordon and Mrs. Gregor, the interests of both applicant and speaker are closely intertwined. The same is to be noted regarding Mr. Bartlett. A review of the application will confirm the financial gains that these speakers are protecting with their show of support. This is not to say that support does not exist for this project, only that these are not credible gauges of this support. There are also many in the community who do not support this project. I have found that these individuals, including myself, are much more reluctant to speak openly of our feelings and convictions. I can assure the Department that, although quiet, there is a great deal of opposition to this development proposal.

I also wish to point out, and hopefully demonstrate, that this is an educated, informed dissent. There are those of us in the region of Oakfield who have studied not only the issues surrounding industrial wind developments, but the Department's *Site Rules* and decision making process. That has caused some of us to question not only the project but the process as well.

The questions posed at the July 16 meeting by Timothy Cady were of particular interest. I referenced both of these issues in an earlier letter to the Department and included additional detail about phase two in the attached files. I feel that these particular issues are of great significance as to the appropriateness of the current application.

First, the covenants referenced by Mr. Cady apply to all of the lots within the Patten subdivision. All commercial and/or business activity is prohibited. In my earlier correspondence I detail the particular lots within this subdivision currently under commercial easements conveyed to Evergreen II, LLC. Copies of the deeds for these parcels are conspicuously absent from the application submitted to the Department. In addition to the easements, a met tower has been located within the subdivision for several years. This also constitutes commercial development. There is also language in these deeds prohibiting "temporary" structures. This tower would violate that covenant as well. The existence of the covenants would seem to prevent adequate demonstration of title, right, or interest on all parcels prohibited by deed from any commercial activity.

I would like to be informed as to the Department's intent to honor the deeded covenants prohibiting commercial activity on Patten subdivision parcels. If the Department chooses to allow the inclusion of these covenanted lots in the project permit, I would appreciate the opportunity to learn the reason why that is considered acceptable. I would ask to be informed of the Department's decision early enough in the process to either provide additional input on this subject or seek further opinion from legal counsel, should this prove necessary.

I have provided considerable input on the subject of the multiple phases of the Oakfield Wind project. At the risk of redundancy, it can not be overstressed that the addition of turbines to the arrays already contained in the

pending application will place an enormous added burden on the project locale. This would constitute a textbook example as to the importance of the phased development provision in the *Site Rules*. The work on phase two has been ongoing, alongside phase one. This is not a tentative project concept. It is pending and therefore should be subject to review along with phase one, even if the second phase is not ready for permitting.

I request to be notified as to the Department's decision about the phasing of the Oakfield Wind project. As with the above issue, please provide notice in a timely manner to allow for the full exercise of my options before permit issuance.

I would like to be informed as to the specifics detailing the Department's ability to compel mitigation of non-compliance issues, post construction. As detailed in my earlier correspondence and the attached review, compliance at certain receptor locations is most likely impossible. The sound modeling used to predict the impacts of the Oakfield Wind project has no record of accuracy at the distances required. The developer's analysis have provided nothing in their submissions indicating an understanding of the complexities of the particular terrain issues encountered in Oakfield. The modeling software chosen by the applicant's engineers is not capable of effectively predicting the influence of mountainous terrain and the associated meteorological conditions. The Department has extensive information regarding the type of impacts and complaints generated from other wind facilities. How has the permit analysis changed in the face of accumulating data?

The sound analysis provided by the applicant details the consideration of multiple wind turbines as point sources. There is an abundance of reviewed data detailing the inaccuracy of this model. Multiple turbines are more accurately represented as a line source. As the Department is undoubtedly aware, this renders the entire sound model inaccurate. Why is the Department not acknowledging this data? Please provide information as to the view of the Department's consultant, Warren Brown, regarding this discrepency.

I am requesting that pre-construction ambient sound data be **required** of the applicant. It has been noted that this is the only way to effectively judge the *true* impact of turbine noise. If the applicant does not wish to comply, I request that the Department consider it a necessary component of the permitting process and undertake it directly. If this testing is not completed, the applicant should be held to the standard of 40 dBA nighttime average as referenced in the *Site Rules*. The Department still has no acceptable data from quarterly testing at Mars Hill to refer to. This should demonstrate the need to assess the local ambient conditions **before** development proceeds.

To simplify:

1. Is the Department prepared to honor the deeded covenants restricting commercial activity when reviewing the inclusion of the three Patten subdivision lots in the development proposal? Perpetual commercial easements burdening these parcels with commercial impacts (non-compliant sound levels, release from setbacks), granted for ongoing compensation (income) are not reflective of the intent of the protections to be provided all subdivision owners by deeded covenant. There are additional commercial easements and leases granted to First Wind, not recorded in the Registry of Deeds or with the Department, within the Patten subdivision. Potential purchasers of those parcels would have little knowledge that they are not receiving the protections offered by the covenants. A title search would be of little help without recorded information. If the Department decides to allow the inclusion of the Patten subdivision parcels, please provide me with the basis for the reason(s) why.

2. Is the Department willing to consider the Oakfield project proposal a phased development? This acknowledgement would render the present application incomplete and unable to meet requirements for approval. If this is not deemed to be the situation, please provide me with the rationale for this decision. Please expedite your review of this information, as I am considering this, and the response to question 1., of the utmost importance as to the direction in which I am to proceed.

3. I request an action plan governing compliance enforcement post-construction. Please detail the legal authority available to the Department compelling action on the part of the developer. I would like allowances (tolerances) of noncompliance accepted by the Department before official action is to be implemented. Does the Department determine the mitigation measures necessary or is this deferred to the applicant?

4. Is the Department giving consideration to the uniquely mountainous nature of the town of Oakfield? The explanation of considerations of topography included in the RSE data provided within the application is not reflected in the sound model. There is an abundance of study given to this topic. The wind energy industry has

even noted the increased sound and noise burden imposed in mountainous regions when wind facilities are located within this type of terrain. It has been noted that amplification can occur when decay of sound is anticipated. I would appreciate insight as to the Department's viewpoint on this subject. Please provide comments from Warren Brown.

5. Evidence has shown multiple turbines to represent a line source sound emission, not multiple point sources, as indicated by RSE. Would the Department please provide input from Warren Brown on this issue? The modeling data is irreconcilably flawed without this inclusion. If the Department chooses to accept the data provided by RSE, please advise as to how this decision was arrived at. The included analysis for the Oakfield project allows for absolutely no margin of error. This is neither reasonable nor technically advisable.

6. Does the Department consider the lack of pre-construction ambient sound data significant? Will the Department either require this information be provided by the applicant or, preferably, a third party?

7. Has the Department ever received acceptable, accurate data concerning the impact of turbine sound and noise from Mars Hill? I have not been able to, in my review of the associated documents, ascertain if this has been determined. If the Department has possession of this data, please provide it. What I have concluded, is that the current standard does not provide enough clarity without substantial pre-construction data collection, throughout **all** seasons and conditions, to determine this impact with any certainty. There are many vague references to the masking effects of foliage and background noises, but through many hours of personal observation at various locations abutting the Mars Hill project, this is seldom, if ever, the situation. I have witnessed unbelievable and intolerable levels of noise, and more importantly, sound pressure at distances in excess of 3000 feet. Low frequencies will appear to be at permissible levels when artificially filtered with the A-weighted scale; however, the impacts are profound and severe.

8. What is the Department's perspective concerning low frequency sounds emitted from industrial wind facilities? Is the Department aware of the lack of adequate attenuation of these frequencies of concern, even over great distances? Is the Department aware of the data demonstrating the inability of wood framed structures to attenuate these frequencies? Has the Department investigated the frequency resonance of residential structures in the vicinity of industrial wind facilities?

9. Does the Department have any familiarity with the condition known as *vibroacoustic disease*? Has the Department investigated ongoing research and preliminary conclusions linking vicinity based exposure to industrial wind facilities and vibroacoustic disease? If not, please investigate fully, and respond. If the Department is aware, please provide the reasoning for not including this data in the siting recommendations at the state level. This condition is not an annoyance, as all other health impacts suffered by proximity to industrial wind turbines have been coined, but a life shortening condition with debilitating effects on the victim, not to mention the imposition of enormous financial burden on the health care system.

I am certain that I have more unanswered questions for the Department. These are the most pressing concerns, at this time. Please acknowledge receipt of these documents and provide necessary responses in as timely a manner as possible. I understand the applicant's interest in proceeding as quickly as possible. I also wish to respond to this process in an efficient and effective manner. This requires the requested data as soon as you are able to compile the necessary information.

I feel that I should clarify that I am not attempting to exercise an agenda to needlessly derail a Development proposal. Through my own analysis, and comparisons with previous developments and Department decisions, I have concluded that this proposal is neither appropriate nor permissible under the *Site Rules.*

Thank you for your consideration of the matters presented.

Sincerely,

Brian Raynes

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Mark Margerum
ME Dept of Environmental Protection
17 State House Station
Augusta Maine 04333-0017
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07/16/09

Subject: Oakfield Wind Project

Dear Mr. Margerum,

I would like to thank you once again for returning my call the other afternoon at the end of your work day. It is most appreciated to have the opportunity to address issues of concern about this development directly. I am sorry that you will not be at the meeting in Oakfield this Thursday, but would like to ensure that you receive this input as soon as possible. I would be happy to mail you a paper copy in addition to this attachment if you prefer. Please let me know as soon as possible if that will be necessary.

Please find enclosed a document titled *Citizen Initiated Review of the Oakfield Wind Project Application.* It is my request that this document be entered as evidence in the review process of the application submitted by First Wind as Evergreen II, LLC of Newton, Massachusetts, for the Oakfield Wind Project proposal. In the enclosed review, conflicts and violations with the Department's own *Site Rules* are detailed. Shortcomings and errors in the technical information supplied by the applicant are included as well.

In the preparation of this review, I am in no way representing myself as a professional in any of the fields contained within. I do think that it is fair to say, however, that through the course of this project's development (since the autumn of 2007), I have chosen to acquire a "greater than average" working knowledge of the science of sound, sound propagation, and impacts imposed by industrial wind facilities. This has been achieved through hundreds of hours of study of the fundamentals of sound and noise, sound modeling studies of wind projects in particular, and both pre and post development reviews of facilities in the U.S. And abroad. It is through this research that I have come to strongly believe that the Oakfield Wind project, as it is currently proposed, is very poorly sited.

Being a layman, I have relied additionally on the research of credentialed experts in the represented

fields contained in my review. All information available reinforces my concerns about the inappropriateness of some of the the siting specifics chosen by the applicant. I am not advancing the argument that an industrial wind facility is not possible in the town of Oakfield, just that, as it currently stands, this proposal does not meet the necessary criteria for approval.

It is my sincere hope that the Department is willing to conduct a full, independent review of the applicant's proposal for the town of Oakfield. It has appeared, up until now, that the Department has been all too willing to accept the assurances of developers that impacts will be limited to acceptable levels. Cautions and recommendations by outside reviewers have seemingly gone unheeded.

This particular developer has a controversial development history. There are numerous instances where community impact has been deemed unacceptable. In the State of Maine, recently filed lawsuits remain unresolved. This would be the appropriate juncture to ensure a more deliberate approach to the permitting of this, and all industrial wind facility applications.

Thank you for your attention to this matter.

Sincerely,

Brian Raynes

Introduction

Wind energy has been identified as a valuable resource for the energy policy of the State of Maine as the challenges of global climate change and the need to reduce dependence upon unsustainable levels of fossil fuel consumption continue to be addressed. Specific targets have been set to achieve the goals of renewable energy production. The purpose of this review is not to engage in a discussion of the merits of the State policies in regards to alternative energy development but instead to demonstrate shortcomings in the current permitting process for wind power projects. In particular, this review seeks to focus on the permit application filed by Evergreen II, a subsidiary of First Wind, of Newton, Massachusetts, for wind power production facilities to be constructed in the town of Oakfield, Aroostook County, Maine, presently being processed by the Maine Department of Environmental Protection. The review of the above mentioned application is to be broken down as follows:

1. Siting and Sound. Limitations of the current MDEP guidelines for the regulation of sound in regard to wind turbines shall be detailed. Flaws in the propagation model used for the Oakfield Wind project shall be outlined.

2. Health and Safety. Regulators in the State of Maine refer to "safety setbacks" as an example of the concern shown towards nonparticipating abutters. These setbacks only relate to fall zones and therefore do not address real health impacts caused by sound levels from industrial wind turbines sited in proximity to residents.

3. Impacts on Wildlife. The studies performed as to the direct impact on bird and bat flight paths only detail part of the situation. The data collected is limited to migratory behavior of some species during *partial* migrating seasons. Additional concerns relate to habitat abandonment by many species, most significantly bald eagles. The study and risk of pulmonary barotrauma induced bat kills is not mentioned.

4. Phasing of development. The Department has guidelines prohibiting phased developments filing permit applications in piecemeal fashion for specific reasons stated clearly in the *Site Location of Development* rules. The developer, in this case, is planning a phased development but has used semantics to describe the second phase as a *separate* project. The current plan for the town of Oakfield is most definitely a phased development with no mention of additional impacts included in the pending application and therefore in violation of Department rules.

5. Financial Viability. Department rules state that a developer shall demonstrate the financial ability to construct a project, and in the case of wind project developers, the financial ability to decommission the proposed development once the project life has expired. The developer of the Oakfield Wind Project is unable to fulfill this requirement in a satisfactory manner. To the contrary, the company's own documentation creates serious doubts as to their long term fiscal solvency.

6. Local economic benefits. The applicant of the proposed Oakfield Wind Power Project states that 34 local landowners benefit as a direct result of this development proposal. While it must be acknowledged that there will be land owner benefit, the actual number of resident landowners is much lower. Tax benefits and job creation shall also be examined.

1.Siting and Sound

Wind turbine noise is the most common concern voiced by residents in close proximity to proposed industrial wind turbine facility developments. The actual operational noise and the associated impacts on health and quality of life are the most common complaints of nearby residents after construction. This, despite the assertions of developers and regulators alike that the noise regulations and siting controls are rigorous and adequate.

Assurances have been issued publicly, such as the following:

"I can say without any question the governor supports the development of appropriately sited wind farms. From the information we see, that has been happening and will continue to happen."[1]

This is not the case. Industrial wind projects are being sited solely for the convenience and profit structure of the developers and participating landowners. No regard is being shown for non-participating abutters, their concerns before construction, or their complaints about the impacts after development.

The industrial wind energy facility located in the town of Mars Hill was not *appropriately* sited. The Department issued a variance allowing a 5 dBA increase in sound levels over the standard for a "quiet area" in the rules. The decision to issue such a variance was not based upon any legitimate conditions as set forth in the Department's *Site Location of Development* rules.[2]

This decision has been publicly recognized as a mistake:

"We would not issue that variance again."[3]

The variance issued in the case of Mars Hill was only part of the problem. The *type* of sound emitted from industrial wind turbines is unique to this type of development:

"The use of sound levels to describe sounds or noises can be quite misleading and may lead to confusion. In fact, it can be shown that two sounds or noises of totally different spectra and hence different impacts can have the same value of sound level."[4]

Although the developers of such projects correctly claim that the sound from industrial wind turbines is generally broadband in nature, it is heavily weighted in very low frequencies, as noted by the Department's own consultant retained to study these development proposals:

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1 David Farmer, spokesman for Governor Baldacci, "An ill wind? Some say turbines cause sickness", *Bangor Daily News*, February 16, 2009

2 State of Maine Department of Environmental Protection, *Site Location of Development,* Rules, Chapter 375, Section 10, Subsection F, "Variance From Sound Level Limits"

3 James Cassida, licensing coordinator for the division of land resource regulation, MDEP, "An ill wind? Some say turbines cause sickness", *Bangor Daily News*, March 5, 2009

4 Chan Lok Shun Apple, PhD, Faculty of Science and Engineering, City University of Hong Kong, *Single Value Representation f Sound Spectrum,* Updated August, 2008

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"Increased low-frequency-content, sounds associated with windmill operation tend to propagate better and penetrate light weight building structures with much greater effectiveness than broadband sounds. In addition to wind mill low frequency sound emission, is the periodic swooshing or amplitude modulation produced as blades pass the support tower. These low-frequency modulations have been reported as penetrating and annoying."[5]

Even *The Governor's Task Force on Wind Power Development,* which offered strong endorsement of industrial wind facilities, recognized through their recommendations the significance of this topic:

"Noise generated from wind turbines does have attributes that warrant particular focus in the review of projects, including the low-frequency modulating noises generated as turbine blades pass by towers."[6]

Despite evidence and recommendations to the contrary, the Department has not changed its method of review in light of the singular characteristics of this particular type of development. Not only has the nature of sound emission been demonstrated to be unique, but also the very physical burden of the facilities is novel as well. The general pattern of industrial development sound emissions historically reviewed by the Department would be mainly comprised of single parcel facilities. In the case of industrial wind power projects, *miles* of land are directly impacted. The first phase of the project in Oakfield spans approximately five miles end to end. The background sound level of the entire community is going to be significantly altered.

The proposed Oakfield Wind project is not *appropriately* sited. There are inadequate setbacks to guarantee compliance with existing Department noise control guidelines. The application before the MDEP includes nine receptor sites that are presumed to be at or very near the allowable sound limit criteria set forth under the Department's *Site Location of Development* rules.[7] The stated sound levels anticipated at these sites rely on either total accuracy in the sound propagation models or the lack of enforcement by any regulatory agency, post construction, in the case of noncompliance. Given the shortcomings in the propagation model (to be discussed) and inherent variables of meteorological conditions in this region of complex and difficult topography, accuracy to the level required to comply with the regulations under this development scenario is improbable at best.

Sound level estimates have been included in the permit application currently before the Department. These estimates and the associated report were provided by Resource Systems Engineering (RSE). The report repeatedly emphasizes the *conservative* nature of the analysis and resulting estimates:

"The report conservatively estimates wind turbine sound levels and propagation by:

- utilizing conservative factors for ground attenuation by specifically mapping lakes and ponds as reflective surfaces and excluding potential sound attenuation due to foliage;
- adding 5 dBA to the manufacturer's wind turbine performance specification to account for uncertainty in measurements used to derive turbine sound output; and

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5 Warren L. Brown, *Mars Hill Windfarm Post Development Sound Level Study Peer Review,* Submitted to MDEP by EnRad Consulting, November 21, 2007

6 Report of the Governor's Task Force on Wind Power Development, *Finding Common Ground For a Common Purpose,* Final Report, "Conclusions and Recommendations", Page 66, February 14, 2008

7 Oakfield Wind Project Application, Volume 1, Section 5, *Noise,* Page 10, Table 3, *Estimated Sound Levels From Wind Turbine Operation*

- assuming that all turbines are operating simultaneously at continuous full sound output"[8]

Both the wording of the report and the public information provided locally have been presented in a manner designed to make the reader/listener believe that extraordinary measures have been taken to ensure compliance with required sound levels. This is clearly not the case:

- Excepting lakes and ponds, ground attenuation has been treated as a mix of hard and soft terrain. For a substantial portion of the year, and more importantly, the months with the greatest wind potential, the ground in the Oakfield hills is covered with snow. Typical snow conditions in this location consist of hard crusted top surfaces. A more accurate, and *conservative,* model would include a high percentage of reflectivity when calculating ground attenuation.

"A 2007 study in the UK, comparing modeled sound levels to measured sound levels, indicates that some models are more reliable predictors of sound transmission. Specifically, the researchers found that when they used a conservative (worst-case) factor for ground hardness (and thus sound transmission) the actual recorded sound was nearly always lower than predicted at close and mid range (100m-500m), with a bit more variation and scattered higher measured sound at longer range (750m). When using a "mixed cover" factor for ground cover, measured sound was more often louder than predicted, sometimes by as much as 5-7 dB (the mixed cover results were only reported at 750m)."[9]

This relates directly to concerns with the sound modeling for the proposed Oakfield project. Even with the more conservative sound model detailed above, actual recorded sound levels reflected modeling inaccuracies at greater distances. Using the less cautious approach to the model input data, as with the Oakfield project model, inaccuracies render the modeling totally ineffective at the relevant distances.

- It would be disingenuous to include foliage in the model. The project is located almost entirely on hardwood ridges. The season with the highest wind potential also has the least vegetative cover. It has been abundantly demonstrated that low frequencies, which are of particular concern when considering the impact from industrial wind facilities, are not subject to any significant foliage absorption.

- The statement concerning the addition of 5 dBA to the input data is not only included in the application but was emphatically discussed at public forums sponsored by the applicant to "educate" residents of Oakfield as to the impacts to be anticipated and the concern the developer has shown. To be correct, no dBAs have been *added* to the model input data. The manufacturer of the turbines specifies a "plus 2dBA uncertainty factor."[10] Furthermore, "The stated accuracy of sound level attenuation calculations per ISO 9613-2 is plus or minus 3 dBAs."[11] These adjustments to the calculations are consistent with only the stated margin of error of equipment and attenuation. No margin of error is included for the subjective nature of sound propagation model interpretation.

- Not only is it reasonable to assume that all turbines are operating simultaneously at full output, it is necessary. The turbines are likely to operate at full sound output often enough to require this measurement criteria.

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8 Oakfield Wind Project Application, Volume 1, Section 5, *Noise,* Page 5-1

9 Bullmore, Addock, Jiggins, Cand, *Wind Farm Noise Predictions: The Risks of Conservatism,* Second International Meeting on Wind Turbine Noise, Lyon, France, September 2007

10 Oakfield Wind Project Application, Volume 1, Section 5, *Noise,* Page 9

11 Oakfield Wind Project Application, Volume 1, Section 5, *Noise,* Page 9

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The section of the pending application for the proposed Oakfield Wind project concerning sound and noise , (Volume 1, Section 5), relies wholly on sound propagation models created by the engineering firm RSE. The propagation modeling is flawed for reasons as follow:

- The input data is limited and unreliable. The report bases turbine sound power levels on GE technical specifications. These measurements are based on new machines in laboratory conditions. The GE specifications do not state that the sound power tables are to be used as a basis for propagation models. To the contrary, the page includes the following:

"Note: these values are informative only."[12]

- It is well established that a substantial component of the sound power generated by industrial wind turbines is in the low frequency range. The above referenced technical document contains no information on sound power levels below 50 Hz. Manufacturers of utility-scale wind turbines are not required to test and document the very characteristics that cause the majority of siting complaints and related health and welfare concerns:

"Measurements of noise directivity, infrasound (< 20 Hz), low-frequency noise (20-100 Hz) and impulsivity (a measure of the magnitude of thumping sounds) are optional."[13]

Without this crucial input data, the entire model becomes inaccurate.

- The propagation model is based upon the assertion that multiple wind turbines comprise multiple point source emitters:

"For every doubling of distance from a stationary hemispherical point source, the sound level drops by 6 dB."[14]

This assumption allows for a generous rate of spherical attenuation, however, as stated by Paul Gipe, a longstanding proponent of wind energy, and internationally recognized authority on the subject of wind technology:

"Multiple turbines complicate matters further. From relatively long distances, an array of turbines appears as a point source, and doubling the number of turbines simply doubles the acoustic power increasing noise levels 3 dB. As you near the turbines, they begin to act as a line source. The decay rate for line sources is 3 dB per doubling of distance, and not 6dB for true spherical propagation."[15]

While at first glance the two clusters of turbine arrays proposed for the Oakfield Wind project appear disconnected on a map, there are several distinct line source formations. At the south end of the

12 GE Energy, *Technical Documentation Wind Turbine Generator System GE 1.5sl/sle 50 & 60 Hz, Noise Emission Characteristics,* 2005

13 Anthony L. Rogers. Ph.D., James F. Manwell, Ph.D., Sally Wright, M.S., PE, *Wind Turbine Acoustic Noise,* Amended January 2006,(Amherst, MA, University of Massachusetts at Amherst, Renewable Energy Research Laboratory)

14 Oakfield Wind Project Application, Volume 1, Section 5, *Noise,* Page 2

15 Paul Gipe, *Wind Power:Renewable Energy for Home, Farm, and Business,* edition 2, rev., (Chelsea Green Publishing, 2004)

project, turbines designated as S01-S05 represent a line source sound emission. The same is true for S06-S08. At the northern end of the project, turbines designated as N04-N08 are also in a line source emission formation. This also applies to N10-N13 and N15-N20. The placement of these turbines and the corresponding inaccuracies in attenuation levels are not being correctly reflected in the propagation models being used by RSE.

• Another complicating factor unique to the region of this particular development proposal is the repetitive mountain/valley topographical formation. Ridgelines dividing pronounced valleys give Oakfield its nickname of "The Switzerland of Aroostook". The town is the most mountainous community in Aroostook county. It has been noted by many sound engineers that a pronounced hill/valley configuration can not only complicate the predicted rate of attenuation but actually concentrate sound waves and *increase* the dB levels at distant receivers:

"Sloping landforms can create unusual sound propagation conditions, especially in consort with atmospheric fluctuations. ...because of the way the increasing ground angles caused sounds to combine, more than nullifying what, in a standard model, would be expected to be a 3 dB decrease over that distance,"[16]

This has not been accounted for in the current application before the Department. Without the inclusion of more sophisticated modeling parameters than are currently being utilized in the Oakfield Wind project proposal, the degree of accuracy is far from reliable and indeed the sound levels at receiver locations are likely to be much greater than anticipated by the developer's estimates.

Simply stated, the complexity of the sound propagation characteristics required to predict the anticipated outcome with any degree of accuracy is not being exhibited in the current application.

"First Wind's standards for its projects are also much more stringent than the DEP's."[17]

The above statement is incorrect. First Wind has adopted the practice of seeking sound easements from landowners in order to locate their facilities closer to residences and neighboring properties than otherwise allowed by MDEP sound regulations.[18] The sound easements are obtained from individuals largely unaware of the study of sound and its related effects. The methods used to obtain them would not meet the "best practices" standard of any other industry. The sound level of the proposed development, in the case of Oakfield, has been compared to "a refrigerator", "a dog's toenails on the floor", and in the words of First Wind's representative, Dave Fowler, "My voice is louder than 55 decibels". Although humorous at first, these statements convey either a total lack of comprehension as to the nature and study of sound or an intentional attempt to mislead the listener. The net result is that the property owner in the position of deciding whether to grant a perpetual easement releasing the developer from all obligation to meet state regulated sound levels has a false sense of what the actual burden on his/her property shall be. Once constructed, there is little recourse for the landowner who has granted such an easement since all rights to claim damages have been waived in the language contained in the easement.

16 Acoustic Ecology Institute, Special Report: *Wind Turbine Noise Impacts,* Predicted Noise is Unrealistically Optimized, Page 18, January 6, 2009

17 Matt Kearns, First Wind's vice president of development for New England, "LURC OKs Stetson II Wind Farm", *Bangor Daily News,* March 5, 2009

18 Oakfield Wind Project Application, Volume 1, Section 5, *Noise,* Page 10, Table 4, *Property Designations*

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First Wind sets its standards to the lowest level allowable under the *Site Location of Development* rules, yet does not even fully comply with them. As identified previously, there are nine receiver points located at the perimeter of the proposed project in Oakfield that have little or no likelihood of being in compliance with the MDEP standards. The applications are developed in a "one size fits all" fashion, with no demonstration of concern shown for repeated project design failures and community dissatisfaction. A review of applications and permits on file with the MDEP as well as project layout and development in other states clearly demonstrates this fact.

No pre-development ambient sound measurements have been recorded for the permit application currently before the Department.

"...(vi) Notwithstanding the above, the developer need not measure or estimate the pre-development ambient hourly sound levels at a protected location if he demonstrates, by estimate or example, that the hourly sound levels resulting from routine operation of the development will not exceed 50 dBA in the daytime or 40 dBA at night."[19]

The developer has included the *recommendation* of RSE that pre-development ambient sound levels be tested, however no action has as of yet been taken. The developer must include this information **before** the permitting process proceeds or demonstrate the ability to maintain a nighttime hourly sound level of no greater than 40 dBA, not 45 dBA as is the current project projection.

Residences in the vicinity of the proposed project area are on the extreme end of what one would term a quiet area. Nighttime ambient conditions of less than 20 dBA could be expected.("Sound levels for Common Environments: 20 dB Rural area at night.")[20] Not only will the noise from development, according to the permit application, cause the allowable nighttime sound levels to increase to a maximum allowable level of 45 dBA, this is the level to be anticipated for the listed receptors at the perimeter of the proposed project. These residences are in the most rural locations in the town of Oakfield. The allowable limit of 45 dBA can be reached at times when the cut-in wind speed is reached at or above the altitude of the turbine hub (262 or more feet above the ground on which the turbines are located). During many of these periods, there will be little or no ground level wind or associated noise. The net result is an anticipated increase of up to 25 dBA over existing background ambient conditions. This is perceived as an increase in the ambient noise level of greater than four times that of present. (" 20 dBA-4 times as loud change in perception")[21]

"The Board recognizes that the construction, operation and maintenance of developments may cause excessive noise that could degrade the health and welfare of nearby neighbors. It is the intent of the Board to require adequate provision for the control of excessive environmental noise from developments proposed after the effective date of this regulation."[22]

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19 State of Maine Department of Environmental Protection, *Site Location of Development,* Rules, Chapter 375, section 10, Subsection C (1 a, vi)

20 Ken Kaliski, P.E., INCE Bd. Cert., Resource Systems Group Inc., *Wind Turbine Noise Primer,* Presentation to the town of Oakfield, June 17, 2009

21 Ken Kaliski, P.E., INCE Bd. Cert., Resource Systems Group Inc., *Wind Turbine Noise Primer,* Presentation to the town of Oakfield, June 17, 2009

22 State of Maine Department of Environmental Protection, *Site Location of Development,* Rules, Chapter 375, section 10, Preamble

The stated intent of the Board is not being upheld in the permitting process of industrial wind energy developments in the State of Maine. The quality of noise analysis, in the case of Oakfield, has been treated simplistically with little or no chance of standing up to "real world" conditions. Once constructed, these facilities are an imposing feature of the landscape for years to come. Post construction mitigation plans do not alleviate the problems of poor siting requirements. Testing for compliance after commencement of operations is not adequate. Assuring compliance through proper site design before permitting is the only way to successfully develop projects of this scope.

2. Health and Safety

Admittedly, there is much crossover with the subject of sound when discussing health effects due to improper siting of industrial wind energy developments. However, the issue of non-participating residents being unfairly injured in any way warrants special consideration. The vast majority of serious complaints have been minimized by not only the developers of the offending projects but, in the case of the State of Maine, the head of the Maine Centers of Disease Control, Dr. Dora Ann Mills, as well.

"In my review I found no evidence in peer-reviewed medical and public health literature of adverse health effects from the kinds of noise and vibrations [from] wind turbines other than occasional reports of annoyances."[23]

To reduce the severity of reported symptoms to that of *annoyances* is staggering when coming from a person with a medical background. To further marginalize **consistent** reports of adverse impacts of the nature described as *occasional* demonstrates a bias not befitting a person in this position. While it may be accurate to note a lack of peer-reviewed data concerning health effects from industrial wind turbine facilities, the development of this type of project is relatively new. Studies have been conducted, with more underway. The evidence of severe impacts when wind turbines are improperly located is consistent and overwhelming.

Nina Pierpoint, MD (The Johns Hopkins University School of Medicine, 1991), PhD (Population Biology, Princeton University, 1985), BA (Biology, Yale University, 1977), resides in New York State, and has been studying the impacts of improperly sited industrial wind facilities for several years:

"Three doctors that I know of are studying the Wind Turbine Syndrome: myself, one in England, and one in Australia. We note the same sets of symptoms. The symptoms start when local turbines go into operation and resolve when the turbines are off or when the person is out of the area. The symptoms include:

1) Sleep problems: noise or physical sensations of pulsation or pressure make it hard to go to sleep and cause frequent awakening.
2) Headaches which are increased in frequency or severity.
3) Dizziness, unsteadiness, and nausea.
4) Exhaustion, anxiety, anger, irritability, and depression.
5) Problems with concentration and learning.

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23 Dr. Dora Ann Mills, State of Maine's Chief Medical Officer, "An ill wind? Some say turbines cause sickness", *Bangor Daily News,* February 16, 2009

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6) Tinnitus (ringing in the ears)."[24]

While Dr. Pierpoint's research has been severely criticized by the wind industry, she has gained credibility with medical professionals around the world who have confronted this issue through patient exposure to industrial wind facilities.

Separate from the study of effects of wind turbines, research into *Vibroacoustic Disease,* or VAD has been ongoing since 1980.

"Vibroacoustic disease (VAD) is a whole-body, systemic pathology, characterized by the abnormal proliferation of extra-cellular matrices, and caused by excessive exposure to low frequency noise (LFN)...In both human and animal models, LFN exposure causes thickening of cardiovascular structures. Indeed, pericardial thickening with no inflammatory process, and the absence of diastolic dysfunction, is the hallmark of VAD. Depressions, increased irritability and aggressiveness, a tendency for isolation, and decreased cognitive skills are all part of the clinical picture of VAD."[25]

Since 2004, the study of VAD has included residents in proximity to industrial wind facilities. The levels of low frequency noise (LFN) in the homes near these facilities was *higher* than in proximity to other studied industrial developments linked to cases of VAD in non-occupational subject exposure (in the case of this study, a port grain terminal causing LFN contamination of nearby homes).

"These results irrefutably demonstrate that wind turbines in the proximity of residential areas produce acoustical environments that can lead to the development of VAD in nearby home-dwellers."[26]

To adequately protect the public, regulators have the obligation to study the low frequency sounds produced by industrial wind facilities. This can not happen until the acknowledgement of the inability to perform these studies relying solely on the A-weighted decibel measurements currently employed.

"Four weighting scales: A, B, C and D were introduced. These weighting curves are in fact the inverse of equal loudness curves and taking the fact that the equal loudness curves get flatter as sound pressure level increase. The A-weighting was for sound pressure levels below 55 dB; B-weighting for levels between 55 and 85 dB; C-weighting for levels above 85 dB; and the D-weighting for even higher levels."[27]

The source of sound emissions, in the case of the Oakfield Wind project, are 34 GE 1.5 MW SLE turbines with an *estimated* output well in excess of 100 dB each. The A-weighted scale is not designed to accurately reflect the impact of an emission source of this sound power level. This inaccuracy becomes magnified by the fact that A-weighted measurements also become increasingly ineffective in measuring frequencies below 500Hz. The frequencies with the greatest consequence to long distance

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24 Nina Pierpoint, MD, PhD, Testimony before the New York State Legislature Energy Committee, March 7, 2006

25 Nuno Castelo Branco, MD, President, Scientific Board, Center for Human Performance, Alverca, Portugal, Professor Mariana Alves-Pereira, Department of Environmental Sciences and Engineering, New University of Lisbon, Caparica, Portugal, "Vibroacoustic Disease", *Noise and Health,* 2004, 6(23): 3-20

26 Mariana Alves-Pereira, Nuno Castelo Branco, MD, "Industrial Wind Turbines, Infrasound and Vibro-Acoustic Disease (VAD), excerpted from press release, May 31, 2007

27 Chan Lok Shun Apple, PhD, Faculty of Science and Engineering, City University of Hong Kong, *Single Value Representation of Sound Spectrum*, Updated August, 2008

receptors are those of less than 200 Hz. Of still more concern are the frequencies below 100 Hz. These propagate farther with little attenuation. If metered in only the A-weighted scale, the decibel level of these and lower frequencies appear quite low at the distance of the receptors. The **true** sound power level, however, is still significant enough to cause very real harm to sensitive receptors.

The wind energy industry is in denial over the consideration of health impacts by industrial wind facilities. This behavior is an economically motivated reaction. If the true impact of this type of development is addressed, siting must be given a level of scrutiny that is not being experienced today.

The complaints, grouped together by the title *Wind Turbine Syndrome,* as described by Charles Wallace, sound consultant contracted by First Wind, ... "a term coined by somebody to make a point".[28]

The above statement, and others offered at public forums in Oakfield, put forth by the individual responsible for very flawed sound modeling performed on several First Wind projects in the State of Maine, is a reactionary response to the suggestion that the pattern of inadequate siting reviews must be changed in the light of repeated complaints and erroneous predictions. It represents, more importantly, the all too frequent example of industry representatives overstepping their disciplines to act as medical authorities. It has become commonplace for the industrial wind energy industry and affiliated sound engineers to be the source of information cited by public officials as "evidence" of the lack of deleterious health effects.

The attitude of developers is aggravated by the unwillingness of regulators to aggressively protect the welfare of residents living in proximity to these development proposals. Industrial wind facilities are being repeatedly constructed in locations that are demonstrated **before** permit issuance to lack the necessary compliance ability once operational. The current approach, in the State of Maine, is to require *post-construction* monitoring. This offers little reassurance to impacted residents as it is impossible to remedy inappropriate siting once turbines are placed.

3. Impacts on Wildlife

Although specific cataloging of species and a very limited review of impacts on wildlife in the immediate project area have been included, as required by the Department, this in no way constitutes a comprehensive understanding of the direct and peripheral impacts on the wildlife and greater ecosystems of the Oakfield hills.

Of particular concern when discussing the development of industrial wind turbine facilities is the impact on bird and bat species. It is incorrect to group these two distinct populations together. Differences in the behavior and physiological structure of these two species warrants separate examination.

The direct impact on birds is primarily perceived as impacts or strikes with turbines. There is the impact of loss of habitat due to the clearcutting practices associated with turbine placement as well.

Bird strikes are an unavoidable consequence of building in the vicinity of prime avian habitat. The

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28 Charles Wallace, Research Systems Engineering, "LURC OKs Stetson II Wind Farm", *Bangor Daily News,* March 5, 2009

analysis must then focus on vulnerable species. Of the many species that may suffer undue impact in the siting of the proposed Oakfield Wind project, raptor species are of particular concern. This is both because of behavioral patterns as well as specific vulnerability. When identifying locally encountered raptor species likely impacted by the proposed project, eagles are of the greatest regulatory significance.

According to data from the U.S. Fish and Wildlife Service the closest known eagle nesting sites to the Oakfield Wind project are located on the Meduxnekeag Lake. One nest is 2.8 miles and another is 4.8 miles from the proposed turbine locations. There is also a known eagle nesting site on the Mattawamkeag Lake. This site is about 5.8 miles from proposed turbine locations. There could be additional nesting sites on either of these two lakes as well as Pleasant, Skitacook, Mud, and Spaulding Lakes as there has not been a survey for eagle nests for many years. As stated by Mark McCollough, Endangered Species Specialist, U.S. Fish and Wildlife Service:

"In general, Maine bald eagles travel up to 4 miles distant from nests, but it could be farther in northern Maine where food resources are not as concentrated. ... Eagles regularly use nearby topography to seek thermal advantage."[29]

Local residents have reported regular sitings of bald eagles at the Mattawamkeag River, Spaulding Lake, Skitacook Lake, and possibly other locations. The ridges of the Oakfield hills on which the proposed development is to occur are also noted as the regular flight path of the bald eagle population observed locally. A development of 34 (or more) industrial wind turbines would directly interfere with the well being of the local population of bald eagles. The U.S. Fish and Wildlife Service must be consulted by the developer or regulator to update nesting location information and identify current critical habitat boundaries. To date, this has not occurred.

Bat species are also directly impacted by the development of industrial wind turbine facilities. Migratory bat data was collected for the project proposed for Oakfield but that analysis is but a small fraction of the actual impact. Bat species are affected in a very different manner than the impact on birds. There is a growing body of evidence that indicates direct strikes with turbines has not been the primary risk associated with bat deaths linked to industrial wind turbine developments. It is becoming increasingly clear that pulmonary barotrauma, an internal hemorrhaging of the tissues of the lungs caused by rapid air pressure reduction, is of much greater concern to the preservation of bat species in and around industrial wind turbine installations.

"As with any airfoil, moving wind-turbine blades create zones of low pressure as the air flows over them. Animals entering these low pressure areas may suffer barotrauma. To test the decompression hypothesis, we collected hoary (Lasiurus cinereus) and silver-haired bats (Lasionycteris noctivagans) killed at a wind energy facility in south-western Alberta, Canada, and examined them for external and internal injuries."[30]

The above referenced study involved the collection of 188 bats killed at turbines. Of the bats

29 Mark McCollough, Endangered Species Specialist, U.S. Fish and Wildlife Service, excerpted from correspondence from Mr. McCollough to Mark Small, resident of the town of Oakfield, dated 06/09/2009

30 Erin F. Baerwald, Genevieve H. D'Amours, Brandon J. Klug and Robert M.R. Barclay, Department of Biological Sciences, University of Calgary, Calgary, AB Canada, *Barotrauma is a Significant Cause of Bat Fatalities at Wind Turbines,* as published in "Current Biology", Vol. 18, No. 16, August 26, 2008

examined, 87 had no serious external injuries. Of 75 necropsies performed, 32 specimens had external injuries, 69 had internal hemorrhaging. Fifty seven percent of the bats studied had internal hemorrhaging but no external injuries. Only 6 bats were found to have external injuries with no internal hemorrhaging consistent with a rapid drop in air pressure.

The study also found that the majority of bats killed by industrial wind energy facilities are migratory tree roosting bats, consistent with known species in the Oakfield hills. This can have a significant long term impact as bats typically live for several decades and rear just one or two pups at a time, not necessarily every season.

This risk to bat species is not limited to the spring and fall migration seasons. Not only do the Oakfield hills create season long habitat for tree roosting bat populations, if constructed, the operating wind turbines create an "attractive nuisance" to the bats. For reasons still being researched, bats seem to interact with turbine blades instead of practicing avoidance. This factor allows for continued exposure to the documented low pressure fields created by the turbines throughout the entire season.

The application before the Department for review lists eight species of bats believed to populate the Oakfield region. Of these, four are species of Special Concern. One is believed rare. Overall, little is known about precise population health. Without this knowledge it is impossible to gauge the impact on such a fragile and poorly understood wildlife community. There must be further review and mitigation plans developed **before** the issuance of a permit.

4. Phasing of Development

Chapter 372 of the *Site Location of Development* rules clearly states:

"The Board requires that an application for approval include present plans for all phases of a development to be undertaken on a parcel. In the absence of evidence sufficient to approve all phases of the proposed development, the Board may approve one or more phases of the development based on the evidence then available. Approval of phases, however, shall be based on compliance of the entire proposed development with the standards of the Site Location Law.

NOTE: A proper analysis of the potential primary, secondary and cumulative impacts of a proposed development can be made only when all phases of a proposed development are considered. Also, the plans for site modification and pollution mitigation need to be based on the entire extent of a proposed development in order to insure their effectiveness in accomplishing the desired objectives." [31]

The application for the Oakfield Wind project currently under review by the Department contains no provisions for a phased approach to development. Most residents of the town of Oakfield have no knowledge of further phases being developed. The developer, First Wind, does have additional phases planned and in the development stages. This constitutes a clear violation of the rules of the *Site Location* law.

31 State of Maine Department of Environmental Protection, *Site Location of Development,* Rules, Chapter 372, Section 10

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The developer publicly denied the existence of additional development plans when questioned at a public forum in October 2008. At this forum, Alex Hutchinson, of Hodgdon, Maine questioned the extent of the "phase two" portion of the project. Matt Kearns, First Wind's vice president of development for New England, responded that he had "no idea" what Mr. Hutchinson was referring to. Mr. Kearns went on to state that there was no phase two, that his company only had plans for one project in Oakfield.

Mr. Hutchinson is a camp owner in the Patten Corporation subdivision located in the Oakfield hills. He had previously been approached, along with other Patten Corporation lot owners, for the purpose of land control for the second phase of the Oakfield Wind project.

Within two weeks following the October 2008 public forum a meeting was held at Mr. Hutchinson's camp. This meeting was on a Saturday morning, largely outside of public scrutiny. At this meeting, Dave Fowler, of First Wind, spoke to a group, primarily made up of Patten Corporation lot owners. There were approximately twelve individuals in attendance. Mr. Fowler first expressed his displeasure with Mr. Hutchinson for voicing information about phase two of the project publicly. Mr. Fowler stated that this had caused "a lot of trouble". He stated further that his boss, Mr. Kearns, was "really put on the spot" by this questioning as they didn't want "to talk about this issue publicly". Discussions about phase two were quite open in the context of this semi-private meeting however, as the overall purpose was to gain additional land control for the second phase of the Oakfield Wind project.

Efforts to obtain leases and easements for the phase two portion of the proposed project in Oakfield have continued uninterrupted. Leases have been obtained. Sound easements have been acquired. The project is being enlarged before the initial permit has been issued.

Recently, the developer has acknowledged the existence of phase two at a public meeting. This was handled in a reluctant manner and only when directly approached by a town official. The second phase has been mis-characterized as having been only just initiated, and as a separate project.

The additional land control has been explained as having no impact on the Oakfield project's phase one portion. From the standpoint of sound, this is not the case. At least some of the parcels leased for phase two are contiguous to the parcels listed in the first phase of the Oakfield project. The burden on wildlife, environment, and non-participating abutters will increase as a result of further industrial use of the project area.

This phased addition of turbines in Oakfield can not be considered a separate project. The viability and very existence of phase two relies on the approval and construction of phase one. It is safe to assume that certain infrastructure of the first phase will be utilized. Phase two is not being engineered to stand alone.

The second phase of the planned development can not be considered an expansion. A project would need to be permitted and constructed in order to undergo expansions. The simultaneously planned phases represent an intentional means to simplify permitting. It should be noted that smaller projects are generally more acceptable to the general public; therefore, public dissatisfaction is lessened by phasing the overall proposal.

In examining the phased approach to the Oakfield Wind project it is clear that a common scheme of development exists:

"Common Scheme of Development. "Common scheme of development" means a plan or process of development which:

(1) Takes place on contiguous or non-contiguous parcels or lots in the same immediate vicinity; and

(2) Exhibits characteristics of a unified approach, method, or effect such as:

(a) unified ownership, management, or supervision;

(b) sharing of common equipment or labor; or

(c) common financing"[32]

The industrial wind energy facility planned for the town of Oakfield is a multi phased development proposal applying for the required permits in separate stages. This does not allow for necessary consideration of the *total* impact of the final development nor does it allow for true public response to the development proposal.

It is very disconcerting to witness such a flagrant violation of the Department's rules. The application currently under review by the Department is in no way complete without the inclusion of *all* phases of development. The enforcement of this rule is more important in this particular type of project than many previously reviewed by the Department. Industrial wind facilities are unique in both their ability to be constructed in phases relatively easily, as well as the impact imposed upon communities if allowed to avoid the regulatory hurdles created by the inclusion of all phases in the initial permit application.

- Industrial wind facilities are modular in nature. Turbines can be added and powered to existing infrastructure at a later date.

- Industrial wind facilities are controversial. The more turbines proposed for a development, the more opposition can be expected. Phasing limits the local populace from knowing the true extent of development in order to make informed decisions.

- Industrial wind facilities significantly alter the background noise levels of rural communities. If a project is allowed to apply for permits in a phased manner the initial sound level calculations are meaningless. Additional turbines add to the overall sound levels of the project. In addition, if a project is permitted as an expansion or "new" development the sound levels can increase over what the local population has been told to expect as the impact on the community:

"...(c) For any protected location near an existing development, the hourly sound level limit for routine operation of the existing development and all future expansions of that development shall be the

32 State of Maine Department of Environmental Protection, *Site Location of Development,* Rules, Chapter 371, Section 1 (c)

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applicable hourly sound level limit of 1(a) or 1(b) above, or, at the developer's election, the existing hourly sound level from routine operation of the existing development plus 3 dBA."[33]

This alone demonstrates additional impact and burden placed on residents in proximity to the development if allowed to avoid the current regulations regarding the phasing of development. The outcome, depending on the intent of the developer, could be even more dramatic:

"...(ii) At any protected location in an area for which zoning, or, if unzoned, the existing use is not predominantly commercial, transportation, or industrial;

> 60 dBA between 7:00 a.m. and 7:00 p.m.
> (the "daytime hourly limit"), and
> 50 dBA between 7:00 p.m. and 7:00 a.m.
> (the 'nighttime hourly limit')."[34]

The developer could choose to argue that the next phase of the Oakfield Wind project be subject to pre-development ambient sound measurements taken after the construction of the first phase. This would include the noise from phase one as "pre- development"; therefore, sound levels for the area to be developed further would no longer qualify as a "quiet area" with a nighttime ambient average below 35 dBA. This would allow for the increase of 5 dBA over the current permit application limit for phase one.

In considering nothing other than sound and noise generated by the proposed project it becomes clear as to the necessity of *all* phases being publicly disclosed and *all* phases undergoing the application process at the same time as **required** under the Department's rules.

5. Financial Viability

In order for an application for an industrial wind power facility to be considered by the Department, the financial ability to construct, operate, and (as importantly) decommission must be demonstrated by the applicant. In the case of the proposed Oakfield Wind project serious doubts remain.

The primary evidence provided by the developer in the application for permitting by the Department as to the financial ability to construct the project as proposed was a letter from the company CFO, Michael Metzner, stating as much. In addition, a letter of support from David Watson, Vice President-Energy Finance, HSH Nordbank was provided. This letter does not constitute a contractual obligation or commitment, as was clearly stated in the correspondence. More relevant to the project currently undergoing review is the following, provided by the developer to the SEC in July of 2008:

"...These risks include, but are not limited to the following:

- The growth of our business depends upon our ability to convert our pipeline of projects under development into operating projects.

33 State of Maine Department of Environmental Protection, *Site Location of Development,* Rules, Chapter 375, Section 10, Subsection 1 (c)

34 State of Maine Department of Environmental Protection, *Site Location of Development,* Rules, Chapter 372, Section 10, Subsection C (1 ii)

- We have generated substantial net losses and negative cash flow from operating activities since our inception and expect to incur substantial losses in the future as we develop and construct new wind energy projects.

- Our recurring losses from operations, negative operating cash flows, accumulated deficit and need to obtain adequate funding to procure wind turbines and fund capital expenditures raise substantial doubt as to our ability to continue as a going concern.

- We may not be able to finance the development of our business or the construction costs of building wind energy projects, without which we may never achieve profitability.

- A sustained decline in market prices for electricity or RECs may materially adversely affect our revenues and the growth of our business.

- The growth of our business depends upon the extension of the expiration date of the PTC, which currently expires on December 31, 2008, and other federal and state governmental policies and standards that support renewable energy development.

- One of our key turbine suppliers, Clipper Windpower, has a limited operating history, has experienced certain technical difficulties with its wind turbine technology and may continue to experience similar issues."[35]

The above detailed risks cast serious doubts as to the ability of the developer to commit the necessary long term financial resources to the construction,operation and maintenance, and, ultimately, decommissioning of a project such as is proposed for Oakfield. Proof of financial ability is a **requirement** under the *Site Location of Development* rules. This must be provided **before** the issuance of a permit, not as an afterthought, as was the condition set in the permit issued for the Rollins Ridge project to be constructed in Lincoln and surrounding communities.

It was reported in February 2009 that First Wind had placed their industrial wind facility at Stetson Ridge up for sale:

"Newton, Mass.-based First Wind has put its 57 MW Stetson wind project in Danforth, Maine up for sale. Credit Suisse is running the deal.
The reason for the sale could not be learned, though industry executives note a smaller player like First Wind might simply need capital."[36]

Another noteworthy development within First Wind:

"Tim Rosenzweig, senior v. p. of finance at First Wind, has left the developer. 'He was the one that used to push us. He was very professional and very aggressive,' says a banker in New York. Rosenzweig left two weeks ago. The reasons behind his departure and his plans for employment could not be learned."[37]

35 First Wind Holdings Inc., *Risk Factors,* As filed with the Securities and Exchange Commission, July 31, 2008
36 Power Finance and Risk, *First Wind Shops Maine Farm,* February 27, 2009
37 Power Finance and Risk, *First Wind Financier Exits,* June 19, 2009

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Given the stated uncertainties of the developer, the global economic climate, and direct indications within the applicant's corporation itself, this does not appear to be a developer meeting the substantive burden of proof required for the issuance of a permit for a project proposal of this size.

The application did not contain the necessary information required to complete processing. Volume II, Section 29, *Decommissioning Plan,* is missing entirely. The plan for the financing of the eventual decommissioning of the turbines, provided at a recent public forum held in Oakfield, is limited at best, but without the written outline the application should never have been accepted as complete for review.

The developer's (verbally) stated decommissioning plan provides a mechanism, with no demonstrated contractual requirements ensuring compliance, of saving a portion of the decommissioning costs yearly, for a period of seven years, then providing the balance at year fifteen. If the need to decommission arises before that timeframe, there will be a serious financial shortcoming. The developer also relies on generous estimates as to the worth of turbine components as scrap. This can not be relied upon. The world market for any type of scrap or salvaged materials is an ever fluctuating and fickle market.

If the developer's proposal is allowed to proceed as currently designed, a substantial risk exists that the financial needs for decommissioning will not be adequately provided. This situation will be complicated further if the project is sold in the future, as is the likely outcome for this developer's most recent project in the State of Maine at Stetson Ridge. The Maine Department of Environmental Protection has first hand experience with the difficulties associated with enforcing compliance with regulation of development after changes in project ownership. When conflicts arise, the ultimate victims are the resident's of the community in which the development is located.

6. Local Economic Benefits

The primary direct economic benefits listed in the application for the proposed Oakfield Wind project include the lease payments to "34 local landowners".[38] While the stated number of total landowners to benefit through direct lease payments appears accurate, the actual number who reside in Oakfield reduces the "local benefit" number to a total of six households. The remainder of landowners live throughout the state and beyond, simply utilizing this development as an investment opportunity with no positive impact on the local economy.

It is important to note that only two of the local households actually reside in close proximity to the parcels under their ownership being leased to First Wind. The negative impacts of this development are not to affect them, although these leases allow turbine placement as close as 1850 feet from non-participating residents. This fact may not relate directly to the permitting process but must be noted.

Increased employment due to short term construction activity is an obvious result of the construction of any new development. The application grossly overstates the local significance of this effect. It can be expected that development activity would lead to a temporary increase in traffic for certain local businesses, however, this impact is fleeting in nature and unpredictable. The construction jobs are highly specialized and largely consist of the same group of contractors one project after another. It is misleading to promote to either the local populace or regulators the expectations of any long term

38 Oakfield Wind Project Application, Volume II, Section 28, Page 28-1, 1.1.1. *Local Landowner Benefits*

increase in employment due to the construction and operation of an industrial wind facility. One of the attractive qualities to investors in this type of project is the limited maintenance and operations staff required.

Another misconception perpetuated by the developer about the Oakfield Wind project is the created expectation that a reduction in local property taxes will occur. First Wind has perpetuated this misconception in written material distributed to residents and in the application before the Department as well. The town officials have tried repeatedly to clarify this issue, stating that no reduction in property taxes is to be expected. The developer continues to state otherwise.

Tax Increment Financing (TIF) agreements, such as the example before the town of Oakfield, are certainly useful economic tools in communities with larger commercial or industrial economic sectors. In a rural community with an approximate population of 725 residents the constraints of this type of agreement prohibit the money captured from such agreements from being utilized in the best manner suitable for the overall benefit of the community. The revenue generated must be used for purposes approved by the State of Maine Department of Economic and Community Development. Through creative accounting and semantics, monies are being allocated for uses not directly associated with community development but in a manner more palatable to average community members. The examples cited in the proposed framework appear attractive to many residents at first glance:

- $2 million for a new public safety building
- $500,000 for fire station equipment
- $7,500,000 for local road construction
- $265,000 for public works equipment
- $500,000 for skills development, training, and college scholarships for Oakfield residents who attend in-state institutions
- $750,000 for capital improvements to public infrastructure and investment in a business assistance program, pending successful completion of a village plan

The way in which the developer has chosen to present the "economic benefits" to the residents of Oakfield has been disingenuous. The above referenced list of community benefits to be obtained is the cumulative total for twenty years. Community members see the total figures first and immediately envision the amount of improvement that can be achieved with those figures at the municipality's disposal. The reality is that if these figures are simply broken down as to the **yearly** amount of revenue generated by this proposed project, then the positive impacts of the proposal become much more diffuse.

Another issue not being discussed at length is the benefit the developer receives under a TIF agreement. For every dollar assessed in property taxes, the developer shall receive approximately sixty three cents back. In figures more relevant to development of this scale, For every $1,000,000 in property taxes collected on the project the town returns $630,000 immediately to the developer. This only allows for the remaining $370,000 to be utilized by the community. TIF agreements typically involve business ventures expected to significantly increase the employment base of host communities. This is not the case with industrial wind facilities. The employment, as previously referenced, is of short duration and largely consists of contract employees based in other areas. Little **new** employment is to be anticipated. As a "reward" for investment leading to greater employment in the community, TIF

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agreements seem a reasonable compromise between fair taxation and community benefit. In the case of industrial wind facilities, TIF agreements serve as the most generous form of investment vehicle available to a select minority at the expense of existing taxpayers.

The addition of a so called *Community Benefit Package* has been identified as a "benefit the residents can **feel**". This, in the case of Oakfield, is to consist of approximately $250,000 per year, paid directly to the town, free of restrictions. The stated intention at the town level is to distribute those monies directly to the taxpayers. This type of "benefit" largely serves the necessary purpose of accumulating support at the expense of reasoned discussion as to the impacts of a development, to a great extent, poorly understood by the populace.

The aspect of this section of "benefit" that is misunderstood, from a legal perspective, is the fragility of the payment. It is to be considered a "voluntary contribution". There is very little legal recourse if the developer stops *volunteering* this payment at some point in the future. The potential for a future sale of developer assets, or even bankruptcy, adds greater uncertainty. A bankruptcy judge would most likely provide a so called "wild card" to this, and potentially other benefits to be received at the community level. The permitting process may not be able to regulate this in a binding fashion with any certainty. I have seen nothing in the existing *Site Rules* regarding this matter.

The other concern with the *Community Benefit Package* is the developer's insistence that it be tied to the *commercial* sale of electricity. Wind power developers at facilities in other states have been accused of using spot market contracting as a means of avoiding payments linked to annual production of *commercial* electricity. In other instances, subsidiaries have been formed to purchase electricity at lower prices to reduce *commercial* production linked payments. (To my knowledge, First Wind has not been documented in this fashion; however, a complete search of the corporate ownership of referenced practices has not been undertaken.)

The inclusion of such a poorly understood and minimally protected form of payment as a sign of tangible benefit is very risky, from a legal perspective.

Conclusion and Recommendations

Despite the expertise and financial resources involved in the preparation of the design of the proposed Oakfield Wind project, the pending permit application is inadequate. Serious problems exist in all sections covered in this review. Sections 1 and 4 constitute direct violations of the Department's own rules. Sections 2 and 3 reflect areas of permitting deficiency resulting in unacceptable impacts and resident concerns remaining unanswered. Section 5 has been inadequately demonstrated in a manner sufficient to fully satisfy Department requirements. Section 6 contains claims of benefit that have been grossly overstated by the wind development industry repeatedly, including the Oakfield application.

The State of Maine, and more specifically, the Department of Environmental Protection has not required accuracy or accountability in the permitting process of industrial wind energy facilities to date. This has created a climate of impunity among project developers at the expense of the health, well being, and general quality of life of non-participating neighboring residents. Unless the manner in which this type of project gains regulatory approval changes, the further development of the State's

wind resources will become ever more divisive.

To be further noted, the majority of wind resource exploration and pending development is occurring in the more rural, isolated areas of the State of Maine. These regions are typically politically underrepresented and economically depressed. Towns are comprised of low population density and little or no zoning protection to regulate large scale development. The result, as has been the situation in Oakfield, is a development proposal imposed on a community by the developer and determined by State regulators with little to no substantive involvement by the very community to be impacted.

The interests of The Oakfield Wind Project's developer and impacted community members need not be seen as mutually exclusive. The development of a **responsibly** sited project could be an asset for the community as a whole. As the proposal currently exists, the probability of long term operation without significant adverse impact imposed on those in proximity to the wind facility is statistically impossible. Alterations to the project proposal must be required **before** the permit is issued. The current practice of monitoring compliance post-construction is not realistic. Changes to the project's design are not feasible at that stage of development and operation. Only if compliance is required before the issuance of the necessary permit can the protection of the residents be balanced with the economic concerns of the developer.

Correction of a deficient project proposal, such as the Oakfield Wind project, is simplified by the modular nature of this type of development. Necessary project modifications can be required during the permitting process while allowing the overall project to proceed. If implemented correctly, the development proposed for Oakfield could be viewed as a model for developer, regulator, and impacted residents to collectively achieve an outcome not usually associated with industrial wind facilities. In order to achieve a positive resolution, the following must be recognized and corrected:

- The developer has used flawed sound propagation modeling. The predictive model uses incomplete input data and fails to address software limitations concerning complex meteorological interactions with mountainous topography. Spherical sound propagation has been assumed even in areas of turbine configuration conducive to the diminished attenuation characteristics of cylindrical propagation models. Ambient sound levels have never been recorded in proximity to the proposed project location.

The nine receiver locations noted in the project application are highly unlikely to meet regulated sound level limitations. The predictive modeling must be restricted to a margin of error of zero to achieve this outcome. This level of accuracy has never been demonstrated over long distances in predictive modeling using the methodology employed in the preparation of this project application. Without corrections to the turbine placement these, and other locations, will suffer substantial adverse impacts outside of permissible limits under Department rules.

In order to protect "the health and welfare" of the residents at these designated locations, as is the stated intent of the Board, alterations must be made to the turbine arrays. This can only be accomplished at this time, before project approval and construction. In the southern array, turbines designated as S01, S05, S07, and S12 all contribute directly to what will most certainly be levels of noise above the levels allowable under MDEP *Site Rules* at the corresponding locations designated as R8, R9, R6, and R7. In the northern array, N04, N17, N18, and N20 impact receptor locations R4, R5, R1, R2, and R3 in the same inappropriate fashion. Of special significance are turbines N04 and N20.

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In the case of these two turbines, placement is too close to multiple receptors (N04 impacts R4 and R5, N20 impacts R2 and R3). The designation of specific turbines, referenced above, is in no way to represent the perspective that these turbines are the only project components creating an unacceptable burden on non-participating residents. These referenced turbines are simply demonstrated to cause noncompliance with Department *Site Rules*. Relocation and/or removal is the only way to accomplish an effective balance between the developer's priorities and the rights of the non-participating neighboring residents. The applicant could, at their discretion, choose to seek additional sound and setback easements in order to minimize array adjustments.

Although this seems a dramatic reduction in array size, it is to be noted that if the entire phased project is permitted as one proposal, as is **required** under the Department's *Site Rules*, these turbines would be inconsequential in comparison to the size of the entire project. Land control for additional phasing dwarfs this phase of the project. The developer has the *ability* to easily mitigate all siting concerns, simply not the *desire*. Without Department enforcement, this development will continue to impose unacceptable impacts on surrounding residents.

• Legitimate health and safety concerns become statistically nonexistent with the appropriate relocation or removal of turbines in proximity to affected residents. The Department should insure that health concerns and impacts are considered fully when permitting projects. The current dismissive attitudes must be corrected in order to continue towards the goal of increased wind energy utilization in the State of Maine without alienating an increasing number of residents.

• Impacts on wildlife must receive a more comprehensive review. Although the Department may deem the necessary criteria are met when reviewing the application, there was relatively little "on the ground" study. The U. S. Fish and Wildlife Service has expressed numerous concerns with this new type of development and associated studies. Maine is the first state to develop or propose industrial wind energy development in areas of close proximity to bald eagle habitat. This issue must be addressed in a cautious and deliberate manner to avoid irreconcilable harm. Potential bat mortality must be recognized as a phenomenon not limited to direct turbine strikes. The risk is from *proximity* to turbines, not impact. This is a season long occurrence in some habitats, primarily wooded ridges on the east coast. Particular focus should occur during breeding and pup rearing stages as this corresponds with increases in mortality. Habitat fragmentation should be addressed as a significant impact to various species. Many indigenous forms of wildlife will simply relocate due to the disturbance of existing habitat. Elusive species, such as the Canada Lynx, are of special concern.

• The phased nature of the proposed Oakfield wind facility must be addressed and **permitted as one project** as is **required** under Maine Department of Environmental Protection *Site Location of Development* rules. As previously outlined, allowing the developer to intentionally segregate this project into separately permitted phases will substantially increase the tangible negative impacts on residents, most notably, sound and noise. Wildlife studies are only valid when considering the entire habitat at one time. The reasons for permitting the entirety are obvious. As stated in the Department's rules, the project phases need not be ready for approval at one time. Permitting, however, must include the entire project in order to maintain the credibility of the *Site Law.*

• Further demonstration of the financial viability of the developer of the proposed Oakfield wind project must occur before permitting. There are numerous indications of financial instability within the

company that must be investigated before the issuance of a permit. A permit for a project of this magnitude, with the associated financial benefits from completion, including tax funded incentives and Department of Energy grants, is a substantial asset in and of itself. A developer lacking the resources to construct the project should not be allowed to obtain the permit only to sell the now permitted project proposal to another entity. This situation creates uncertainty in the host community as to the solidity of negotiated agreements. (This scenario is not implied to be the business plan of the current developer, only to demonstrate the need for full verification of financial viability.)

• Local economic benefits are very difficult to accurately assess before the proposed project is operational for a period of time. With a Tax Increment Financing agreement, the only long term guaranteed benefit is to the developer through return of property taxes paid. The community benefit is dependent upon long term fiscal policy. In small, rural communities , such as Oakfield, TIF agreements are challenging to implement. This type of focused tax revenue designation is much more suited to communities with a larger commercial and/or industrial sector. The attempted implementation of programs of this type in towns the size of Oakfield has the potential to artificially increase infrastructure expenditures for the period of the agreement, leaving the community with the necessary maintenance costs after the project has been substantially depreciated or decommissioned entirely. Projects relying on the annual funding through tax revenue from this project could be jeopardized if early decommissioning were to occur.

The success of a project subject to State regulation can not be determined solely by the completion or profitability of said project. The well-being and feeling of representation of non-participating neighboring residents is of equal importance. This has been entirely neglected in the area of industrial wind facility development in the State of Maine. This type of project is vast when compared to traditional developments. The impacts are felt far beyond the project's boundaries.

Success is never achieved if projects are simply massaged through the regulatory process. Although, in the opinion of many, the MDEP regulations are lacking in the ability to adequately regulate industrial wind energy facilities, it is recognized that change will not happen in the immediacy. Therefore, the *Site Rules*, as they exist today, must be enforced to the fullest extent possible and not allowed to be expertly circumnavigated - as is happening in the case of the project application for the Oakfield Wind project.

"The strength of the Site Law is that it provides an agency with authority and flexibility to address the range of potential site-specific impacts from significant developments. Such impacts typically vary from one development to another, and from one site to another, even for the same type of development. This holistic approach has held up well for over 35 years."[39]

Commissioner Littell stated the above correctly. The Department has the *flexibility* to regulate this, and many, types of developments to mitigate adverse impacts. The *strength* is demonstrated when this flexibility is used to protect the vulnerable from inappropriate encroachment and to uphold the Site Rules to the highest extent allowable in the face of pressure by overzealous politicization of otherwise beneficial technologies.

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39 David Littell, Commissioner of The Maine Department of Environmental Protection, "Regulatory Framework for Organized Areas", Presentation to *The Governor's Task Force on Wind Power*, September 26, 2007

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September 15, 2009

By E-mail
Mr. Mark Margerum
Bureau of Land and Water Quality
Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333

Re: Oakfield Wind Project, Aroostook County, Maine
DEP # L-24572-24-AN; IL-24572-TF-B-N

Dear Mark:

The Town of Oakfield (the "Town") established a Wind Energy Review Committee (the "Committee") to discuss siting and environmental issues associated with the above-referenced application for the Oakfield Wind Project. Over the course of the last several months, the applicant, Evergreen Wind Power II, LLC ("Evergreen"), has worked with the Committee and the Committee's experts to provide information through a series of public workshops, as well as meetings with the Committee and meetings and discussions with the experts retained by the Committee. The Committee's Final Report, dated September 4, 2009, includes a summary of the key issues evaluated throughout the process, and a number of recommendations. I understand that a copy of the report has already been provided to the Department.

At its September 4, 2009 meeting, the Committee adopted a number of resolutions, including a request that the Board of Selectmen adopt a resolution seeking adoption of the Final Report in lieu of a moratorium or any opposing motion made at the Town Meeting currently scheduled for September 28, 2009. There are a number of articles related to the project proposed for the warrant for the September 28, 2009 Town Meeting, and the Selectmen are scheduled to adopt the Committee's Final Report and finalize the warrant for the Town Meeting at their meeting on September 16, 2009.

Evergreen has committed to working with the Town to implement the recommendations set forth in the report and, to that end, I am writing to inform the Department that Evergreen hereby amends its application as follows:

First, Evergreen has developed a Sound Complaint Response and Resolution Protocol to provide a transparent process for identifying and responding to potential sound complaints. It includes measures to ensure a consistent approach to documenting complaints, a process for communicating with the Town and DEP regarding potential complaints, and flexibility for ensuring appropriate actions are taken in response to potential complaints. A copy of the Sound Complaint Response and Resolution Protocol is attached as Exhibit A and is hereby incorporated into Section 5 of Evergreen's application.

Second, there are a number of recommendations in the report that Evergreen intends to implement by amending its application as follows:

- Section 20 of the application is amended to specify that pre-blast surveys will include bedrock wells and Evergreen (or its contractor) will provide written notice to the Town and all landowners with structures located within 2,000 feet of any blasting area at least three (3) days prior to commencing any blasting operations.
- Section 5 of the application is amended to specify that Evergreen will implement a post-construction monitoring protocol consistent with the following:
    - Within 12 months from when the project becomes operational, Evergreen shall conduct sound monitoring at two or more representative locations around the project. These locations shall be chosen in consultation with the DEP and the Town based on how well they represent local meteorology and their relative noise impact from the wind turbines (highest potential to exceed the applicable noise standards). In addition, special consideration shall be given to landowners that have registered sound complaints. The April 6, 2009 Rollins protocol shall be followed except that the weather conditions in Section b of the protocol will be relaxed if either A or B are met:
        - A is met if (i), (ii) and (iii) are satisfied:
        - (i) the difference between the LA90 and LA10 during any 10-minute period is less than 5 dBA, and
        - (ii) the surface wind speed (10 meter height) is 6 mph or less for 80% of the measurement period and did not exceed 10 mph at any time *or* the turbines are shut down during the monitoring period and the difference in the observed LA50 after the shut down is equal to or greater than 6 dB, and
        - (iii) observer logs or recorded sound files clearly indicate the dominance of turbines sounds.
        - B is met if (iv) is satisfied:
        - (iv) the overall 10 minute LAeq is 40 dBA or less.
- Section 5 of the application is amended to specify that if tonal sounds cause an exceedance of Chapter 375.10 sound limits, Evergreen will promptly notify the DEP and the Town. Evergreen will then expedite an investigation of the sound level exceedance and the associated tonal sound and develop a mitigation plan and schedule to achieve compliance with the applicable sound level limits. Evergreen will provide copies of the mitigation plan to the DEP and the Town,

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implement the mitigation plan, and provide a written report describing the actions taken and new measurement results that demonstrate compliance. Mitigation options could include reduction of the overall sound level and/or the tonal sound component.

- Section 5 of the application is clarified to state that the project will comply with the 45 dBA quiet nighttime limit during nighttime hours at applicable regulatory locations even if the pre-development ambient sound level is more than 35 dBA. Similarly, the project will comply with the 55 dBA quiet daytime limit during daytime hours at applicable regulatory locations even if the pre-development ambient sound is greater than 45 dBA.
- Section 5 of the application is supplemented to state that any future First Wind wind power project sited proximate to the project that is the subject of the application will be sited and operated in a manner to ensure that the *combined* sound, i.e., the sound associated with the existing project and potential future project, comply with the quiet noise limits at applicable regulatory locations.
- Section 29 of the application is amended to provide that on or prior to the end of calendar year 15 of the project's operation, Evergreen will simultaneously submit to the Town and the DEP the reassessed estimated cost of decommissioning (minus salvage value).

Finally, there are a number of other recommendations in the report that Evergreen is committed to working with the Town to implement, but which we do not believe require an amendment to the application. These recommendations are summarized in my e-mail of September 4, 2009 to counsel for the Town, which was provided to you previously.

We appreciate the hard work undertaken by the Committee and look forward to working with the DEP and the Town to implement these recommendations. If you have any questions, please do not hesitate to contact me.

Sincerely,

Juliet T. Browne

JTB/prf
cc: Alec Jarvis
Brooke Barnes
Jim Sholler
Dale Morris
Andy Hamilton

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EXHIBIT A

Oakfield Wind Project Sound Complaint Response and Resolution Protocol

firstwind SM
OAKFIELD

Evergreen Wind Power II, LLC (herein referred to as Evergreen) submitted a sound level study completed by RSE. The sound level study was conducted to model expected sound levels from the proposed Oakfield Wind Project (the "Project") and to compare model results to operation standards pursuant to the Site Location of Development Rules, Chapter 375 §10.

In recognition of the rural nature of the site, the applicant elected to apply quiet limits of the 55 dBA during daytime and 45 dBA at night at all nearby protected locations in accordance with Chapter 375 §10 (H) (3) (1). This is a conservative approach, because ambient sound levels under weather conditions suitable for wind turbine operation can exceed thresholds of 45 dBA daytime and 35 dBA nighttime. Conservative assumptions were also incorporated into the modeling of predicted sound levels from the project. Thus it is expected that sound levels from the operating Project will remain within predicted levels.

As an added measure, Evergreen will implement the following procedure for receiving input and responding to the public, in the event there are concerns regarding compliance with applicable sound level standards during operation of the Project. This procedure is in addition to the compliance testing protocol that will be implemented as part of the DEP Site Location Permit.

The intent of the sound complaint resolution protocol is to:

1. **provide a transparent process for reporting sound complaints to Evergreen;**
2. **provide a consistent approach to documenting complaints and to inform subsequent monitoring efforts; and**
3. **provide a process for informing the Town and DEP of sound complaints.**

Evergreen will provide a contact person and 24 hour "hotline" telephone number for complaints regarding sound from the Project. Contact information along with a copy of this protocol and a "Sound Complaint Record Form" will be mailed to all abutters, consistent with the definition of abutters set forth in Chapter 2 of the Maine DEP regulations, and provided to the Town and DEP.

Residents of Oakfield are encouraged to fill out the Sound Complaint Record Form but they are not required to do so in order to make a complaint on the hotline. The purpose of the form is to ensure that a standardized set of basic information is collected for each complaint in order to facilitate analysis. The following information will be required from the complainant in order to process the form:

- Name and address of complainant
- Date, time and duration or periods of sound event
- Description of sound event—relative amplitude, source of annoyance, steady or fluctuating, low/mid/high or mix of frequencies/pitch, noticeable vibration, indoor or outdoor and specific location
- Description of other audible sounds from sources outside and inside the dwelling of the complainant.

Evergreen will complete the Sound Complaint Record Form by providing the following:

- Nearest turbine to complaint location
- Date and time call or form processed
- Power output (kW), wind speed and direction of closest turbines during sound event
- Local/surface weather conditions—cloud cover, precipitation, relative wind speed and direction, temperature, and relative humidity
- Ground conditions – field, wooded, snow, foliage, frozen/icing

A log of complaints will be kept and managed by the operational staff at the Project site. Evergreen will provide a copy of the complaint log to the Town and DEP on a quarterly basis or more frequently upon request by the Town or DEP.

The response to each complaint will depend on each situation, but may include, without limitation, a visit to the location of the complaint; inspection of the operating condition of the turbines closest to the complaint location to evaluate potential upset conditions that might increase sound levels; informal sound monitoring by Evergreen; an informal evaluation of the complaint by Evergreen's sound consultant; or formal sound monitoring. In the event that Evergreen conducts formal sound monitoring at a complaint location, it will notify the Town ahead of time, allow the Town Manager the opportunity to observe, and will provide the results to the Town. In addition, if Evergreen conducts a visit to a complainant or conducts informal sound monitoring at a complaint location, it will undertake best efforts to notify the Town Manager and allow him or her the opportunity to observe. In any event, a Sound Complaint Response Form and Follow-up Record will be completed by Evergreen staff.

Evergreen will use the information collected during the first three months of operation to assist in selecting compliance monitoring locations for testing in accordance with the DEP post-construction sound level compliance assessment plan, as well as timing to ensure monitoring is conducted under weather and operating conditions when sound from the project is most noticeable.

If Evergreen or the DEP determines that there is a consistent pattern of complaints that suggest sound levels from the Project may exceed applicable DEP sound level limits, Evergreen will develop and implement an appropriate protocol for ensuring that the Project continues to meet applicable sound level limits. Evergreen shall take reasonable steps to provide a copy of the protocol to the Town and DEP prior to its implementation, and will provide the results of testing undertaken as part of the protocol to the DEP and the Town. If the Project is not in compliance with the DEP standards, and as set forth in the DEP Site Law permit, Evergreen will submit a revised operation protocol to the DEP and provide a copy to the Town that demonstrates the Project will be in compliance at all the protected locations surrounding the Project.

Protocol Implementation:

Evergreen Wind will hold an initial public information meeting in conjunction with the Town to explain the complaint response and resolution process, including how to properly file complaints and complete the form(s).

Forms will be mailed to project abutters and will be available at the Town Office and the DEP.

The 24/7 hotline number will be mailed to abutters and posted at the Town Office.

For the first year of operations, Evergreen will hold quarterly meetings in conjunction with the Town to discuss complaints and their resolution. This process can also be used to report the results of compliance testing per the DEP protocol.

Evergreen Wind will develop and schedule in consultation with the DEP compliance testing to occur sometime after commercial operations but during the first year of routine operations so that complainant locations can be incorporated as appropriate.

The proactive and innovative measures identified in this sound complaint response and resolution protocol will facilitate a more complete understanding and evaluation of potential sound complaints and will ensure that those complaints are appropriately addressed. Evergreen invites the public to participate in this process to ensure that the Oakfield Wind Project remains a positive contributor to the community.

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RUFUS E. BROWN
M. THOMASINE BURKE

October 16, 2009

VIA E-mail (Mark.T.Margerum@Maine.gov)
And U.S. Mail

Mark Margerum
Project Manager, Oakfield Wind Project
Department of Environmental Protection
17 State House Station
Augusta, ME 04333-0017

Re: Objections of the Trustees of Martha A. Powers Trust to Oakfield Wind Project

Dear Mark:

As promised, please find attached the Report of Rick James on the *Noise Assessment* prepared by Resource Systems Engineering and submitted by the Applicant, Evergreen Wind Power II, LLC, in support of the Oakfield Wind Project.

Thank you for your patience.

Sincerely yours,

Rufus E. Brown

REB/

cc. Philip Powers
Rick James

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Comments on Oakfield Wind Project, Evergreen Wind Power II, LLC Regarding Wind Turbine Noise and Its Impact on the Community

Oct. 15, 2009

Please accept the following report on behalf of the Martha A. Powers Trust in support of the following assertions on the noise assessment submitted by Evergreen Wind Power II, LLC in support of the Oakfield Wind Project. The following is a summary of the findings of this report:

1) The documents submitted to the Maine Department of Environmental Protection (MDEP) by Evergreen Wind Power II, LLC. do not correctly or adequately describe the potential health effects of the proposed project on the host community and the residents whose homes and properties are close to or within the footprint of the project.
2) Background sound levels submitted on behalf of Evergreen Wind Power II, LLC. do not adequately define the background sound levels and of the existing community or the unique characteristics of wind turbine noise for the purpose of making decisions about locating large industrial scale wind turbines near homes and properties in a quiet rural community. If the quiet background sounds of a rural community were properly taken into account it would be clear that the sounds emitted from the Oakfield Wind Project will have a greater negative health impact on the host community and its residents than on other noisier communities in suburban and urban areas. One reason why Evergreen may not have adequately taken into account the negative health impacts on the host community is that it did not include this type of study.
3) Computer model estimates of operational sound levels from the proposed projects understate the impact of the turbines on the community. If the modeling were corrected as described below limitation in the MDEP regulations would be violated.
4) That information in the Town of Oakfield Wind Energy Review Committee's Wind energy Workshop Session: Final Report, presumably approved by RSG, that long term exposure to sound immissions from wind turbines do not pose any health risks to the exposed members of the community and that there is no research supporting a causal link between wind turbine sound immissions at receiving properties and homes and health effects does not reflect current understanding of thresholds of perception and mechanisms whereby such perception can occur.
5) The firm conducting the noise study for the Oakfield Wind Project, Resource Systems Engineering (RSE) and the firm hired by the Wind Energy Review Committee to advise on noise related issues, Resource Systems Group (RSG), have both been involved with wind developments where initial reports indicated the projects would be compatible with the adjacent residential properties and where subsequent to construction and operation complaints about noise were made. Therefore the MDEP needs to view their work with skepticism and to consider the need for more conservative siting requirements than recommended by RSE and RSG.
6) The combination of the above negative factors related to wind turbine noise emissions will result in sleep disturbance and other adverse health effects for a susceptible fraction of those who live within a mile. People in homes located at distances of up to 2600 feet

have the greatest potential for chronic sleep disturbance or other adverse health effects from wind turbine sound immissions. The noise assessment submitted by RSE identifies 19 homes within 2600 feet, 10 of which are purported exempted from the MDEP rules because of the easements obtained. (See page 10 of the RSE Noise Assessment.) The combination of the factors above means that of the 19 homes exposed to sound levels of 40 dBA or higher all will be subject to adverse health effects. Because of the problems of reliability and the failure to properly model the wind project all of these cases the MDEP rules would be violated. For the ten (10) of these properties that signed easements the MDEP should make an independent determination of whether adequate disclosures of annoyance and health risks were made.

The basis for these assertions is from a review of:

A. **Sound Level Assessment**, April 2, 2009, prepared by Resource Systems Engineering (RSE), on behalf of Evergreen Wind Power II, LLC. Section 5: MDEP NRPA/Site Location of Development Combined Application, Oakfield Wind Project, Maine
B. **Wind Energy Workshop Session: Final Report**, September 4, 2009, Town of Oakfield Wind Energy Review Committee
C. Letter from RSG to RSE, Subject: **Response to Information Request No. 1 – Item 2 (low frequency sound analysis)**, Dated July 22, 2009
D. The papers and research presentations referenced in the above documents.

This review was conducted after the September 28, 2009 letter from Mr. Rufus Brown, Brown and Burke, representing the Martha A. Powers Trust to Mr. Mark Margerum, Project Manager, Oakfield Wind Project, MDEP, regarding objections of the Trust to the Oakfield Wind Project September 28, 2009. The review that follows is intended to support and expand upon the statements made by Mr. Brown in the letter's "Section B. Objections as to Noise." This section addresses issues related to the Oakfield project that have also been raised in other wind turbine projects in Maine. It fairly and accurately covers many of this reviewer's opinions, observations, and conclusions regarding topics 1-6 above. To avoid duplication of reference documents it is requested that the references provided with Mr. Brown's letter also be considered part of this review.

The result of the technical flaws along with an outdated understanding of how the human body responds to acoustical and other forms of mechanical energy previously considered to be below the threshold of perception leads to a conclusion that if the Evergreen Wind Power II, LLC project, as proposed, is approved, it will, with a high degree of certainty, have negative noise impacts that are "significant" even if the project complies with the MDEP criteria. The MDEP criteria are not appropriate for determining land-use compatibility between wind turbine projects in rural and wilderness areas and the host community. They were not developed to address the location of industrial equipment in quiet rural or wilderness areas. Its inability to prevent complaints on previous wind utility projects where it was applied is offered to support this position.

1) General Comments

There is considerable similarity between Evergreen Wind Power II, LLC's documents, and similar documents filed in Maine and other states on behalf of wind utility developers

requesting permits for their projects. The arguments presented in these documents appear on the surface to be well-crafted technical statements regarding wind turbine noise, community and land-use compatibility, and public health risks. Despite the similarities in presentation, methodologies, and conclusions between the various authors of these documents there are serious flaws in the arguments and information used to support those conclusions. These studies present one-sided information to support the development of wind utilities in locations where people will be expected to live within 1000 to 3000 feet of industrial scale wind turbines.

For wind turbine siting projects in Maine, RSE has been the firm used for many of the first projects. This experience means they should be intimately familiar with the problems at Mars Hill, Maine, where residents located at distances of 2000 to 3000 feet from ridge mounted GE 1.5MW turbines are reporting extremely high noise levels (over 50 dBA) in excess of predicted values and adverse health effects. The higher sound levels were present in RSE's own studies of Mars Hill for the MDEP. They have also been reviewed and accepted by Warren Brown, the peer reviewer, for the MDEP. The adverse health effects have been studied and reported by Dr. Michael Nissenbaum of the Northern Maine Medical Center. RSE should be concerned that the projects they have worked on are also the current focus of the debate about noise and health. Even if RSE disagrees with the complainants, they should have acknowledged these facts in the Oakfield report. Given the numerous complaints from people living adjacent to or within the footprint of wind utilities; and the many reports that have been commissioned and written by acoustical consultants on behalf of the utility operator to address these complaints it should be common knowledge among all who work for wind developers that turbines located within 2500 to 3000 feet of people's homes is at least controversial enough to warrant disclosure on other similar new projects.

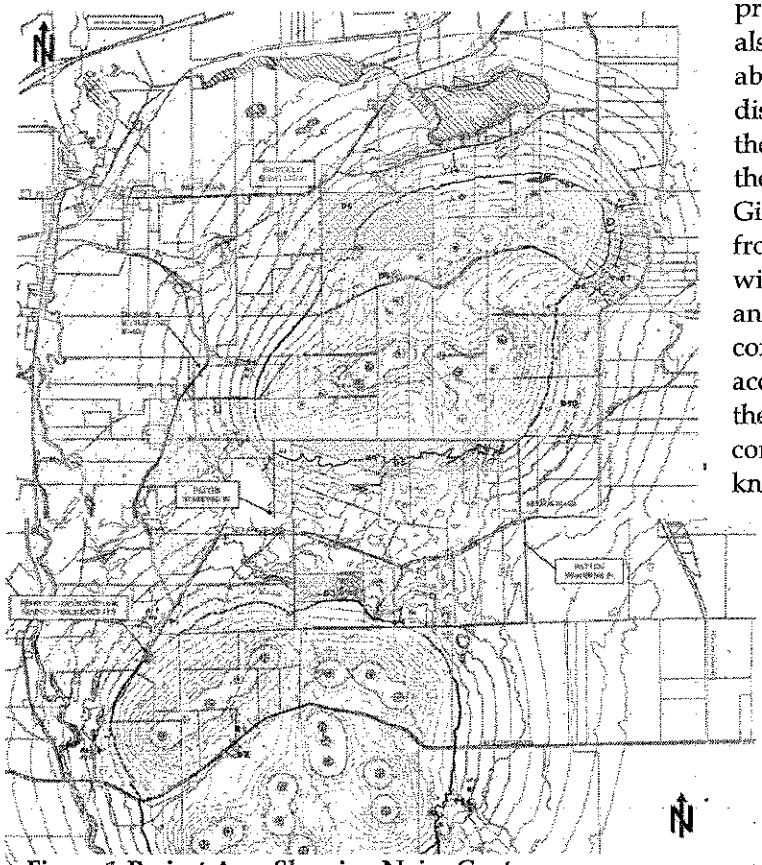

Figure 1-Project Area Showing Noise Contours

In this reviewer's opinion the size and type of wind turbines and the ridge-mounted linear arrangement at both Oakfield Wind and Mars Hill are similar enough to have warranted the disclosure and acknowledgment of these well documented problems at Mars Hill by RSE in its report. It is this reviewer's opinion that it would have been appropriate for RSE to have

incorporated the lessons learned at Mars Hill, Record Hill regarding failures of RSE's procedures in its noise studies and modeling. Both are projects to which this reviewer and other independent acoustical consultants have raised objections in written testimony which is available for review. The absence of any indication that RSE accepted these past critiques[1] and incorporated them into its current work and recommendations for Oakfield, must be considered in the weight that is placed on their opinions and conclusions for the Oakfield Wind project.

It is the goal and focus of this report to present the other side of this argument, and to provide the foundation research, papers, and presentations needed to understand that what is not disclosed in the wind utility application reports and supporting documents is critical. Given the opportunity for the agency(ies) responsible for protecting the public from known risks to review the information provided in this report and its attached references, it is hoped that they will understand why wind utility projects from Iowa to Maine, Ontario to West Virginia are now the locus of numerous complaints and lawsuits. These detail the complainant's problems with wind turbines causing sleep disturbance, adverse health effects, and other related problems. Yet, it must be remembered that at the time of the permit application, the developer for each of these projects assured the permitting agency that none of these problems would occur. This report is intended to provide information such that the MDEP will not permit similar situations to occur as a result of the Oakfield Wind Project.

The Oakfield Wind project will result in nine (9) of residences (Sites R1 to R9 in Figure 1) that have not signed easements (ten (10)) being within 1860 and 2690 feet of one of more wind turbines. Figure 1 illustrates the extent to which the proposed footprint of the wind utility will encroach on residential homes. According to Table 3 of the RSE Noise Study people in these homes will be exposed to sound levels of 42 to 45 dBA on a regular basis day and night. In the Sound and Noise section of the Wind Energy Committee report (page 13, section II.A.1) it is noted that for research relating wind turbine sounds in dBA and annoyance (WindFarm-Perception Study) finds that at or over 45 dBA 28% or 1 out of every 3 to 4 people will be "very annoyed." This is a best case estimate of annoyance since it is based on the RSE model's predictions which this reviewer believes are flawed and understate the sound levels that will be frequently present at those homes.

2) Wind Turbine Sounds

It is common for people to look at wind turbines as a new type of noise source. However, some of the problems associated with them are easier to understand if we view wind turbines as a special case of very large exposed-blade industrial fans. For example, if we take a look at the spectrum from a fan, as shown in Figure 2, there are certain characteristics that all fans have in common. There is maximum energy at the blade passage frequency, tones above the blade passage frequency, and broadband noise. The harmonics of that tone have somewhat lower

[1] The reviewer does acknowledge that RSE has accepted that known tolerances must be accounted for in their models. The Oakfield model was developed using sound power level data offset by two known tolerances (ISO 1962-2 (3 dB) and IEC 61400-11 measurement error (2 dB). However, RSE is still modeling rows of turbines as point-sources and not as line-sources as would be appropriate based on the work of Hubbard and Shepherd in the 1990 NASA Wind Turbine Study. By not using a line-source model the predicted sound levels at the nearest homes were likely underestimated by at least 5 dB, putting the sounds at the nearest homes at 50 dBA or higher.

energy content. The broadband spectrum starts above the range where the tones longer dominate. The energy is highest at the blade passage frequency and drops off as frequency increases.

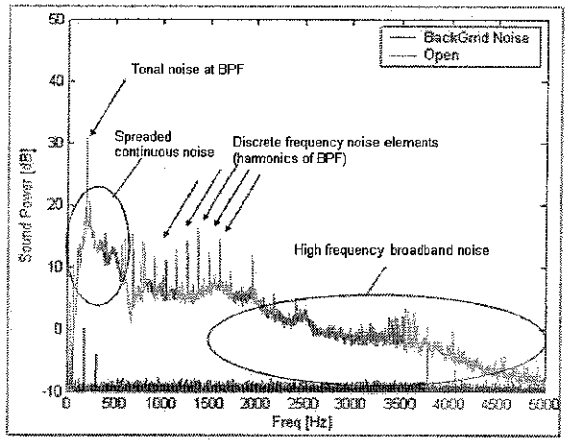

Figure 2-Typical Fan Noise Spectrum

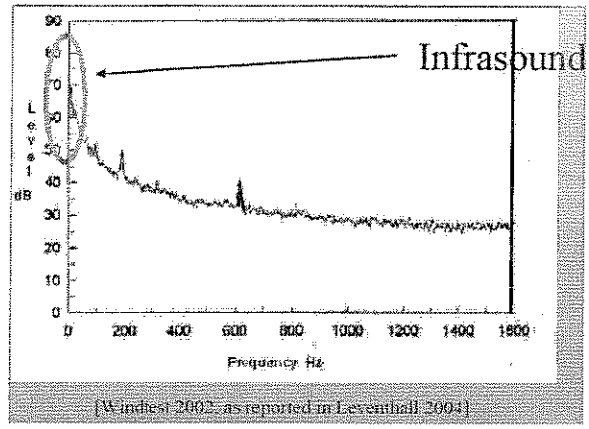

Figure 3-Vestas V-52 Spectrum (From NREL)

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

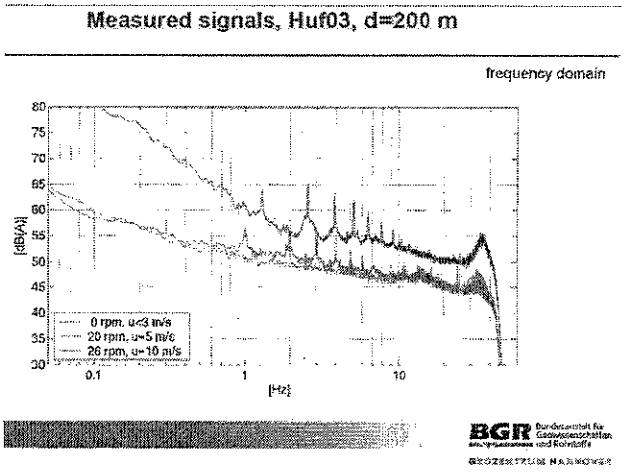

Figure 4-Wind Turbine Infrasound

The graphic to the left (Figure 4) is expanded in the lower frequency range to show a wind turbine's spectrum for the frequency range of 0-10 Hz. Now the tones and harmonics are clearer. Also note the correlation of the frequency of the tones to rotational speed. This graph is from a study conducted by the Federal Institute for Geosciences and Natural Resources, Hannover, Germany, titled: "The Inaudible Noise of Wind Turbines" presented at the

Infrasound work shop in 2005 (Tahiti). All modern upwind industrial scale wind turbines have similar tones in these lowest frequencies.

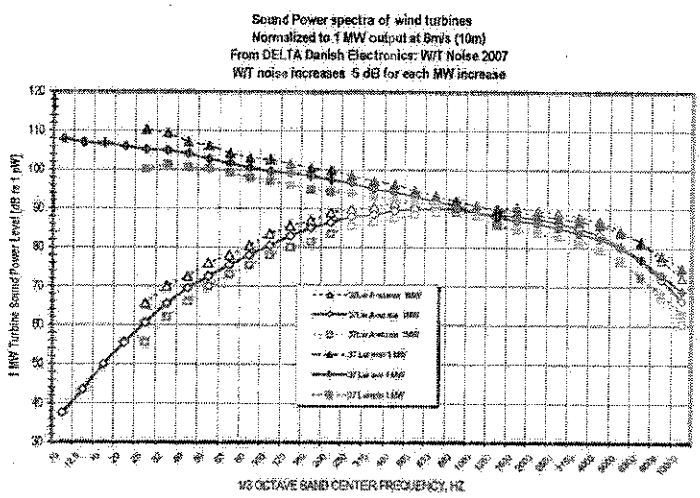

Figure 5-Sound Power Level of 37 Turbines Normalized to 1MW

Are the sound emission characteristics similar or different for different models and makes of wind turbines? Figure 5 shows the general spectrum shape of 37 modern upwind turbines of the type and sizes being located in the Oakfield. This graph shows the sound power data after normalizing the data for each turbine to 1 MW of power output.[2] It is clear that there is little deviation in spectral shape between any of the various models that is not related to power produced. However, as seen in the A-weighted curves of the same data, the use of A-weighting masks the low frequency energy content. In fact, the DELTA study concluded that for each increase of 1 MW in power output the graph would shift upward by approximately 5 dB. Given that power to sound level relationship and the constant increase in the power rating of turbines being installed we could see the wind turbine sound levels increase another 25 dB by the time 5 MW turbines are commercially available.

3) Wind turbine noise is distinctively annoying

There have been several studies, primarily conducted in European countries with a long history of wind turbines, showing that at the same sound pressure (decibel) level or less, wind turbine noise is experienced as more annoying than airport, truck traffic or railroad noise[3][4][5]. There are

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

3 Pedersen, E., Waye, K. P., "Human response to wind turbine noise – annoyance and moderating factors", Proceedings of the First international Meeting on Wind Turbine Noise: Perspectives for Control, Berlin, October 17-18, 2005.

4 E. Pedersen and K. Persson Waye, "Perception and annoyance due to wind turbine noise: a dose–response relationship," J. Acoust. Soc. Am. 116, 3460–3470 (2004).
K. Persson Waye and E. Ohrstrom, "Psycho-acoustic characters of relevance for annoyance of wind turbine noise," Journal of Sound and Vibration 250(1), 65-73 (2002).
K. Persson Waye, E. Ohrstrom and M. Bjorkman, "Sounds from wind turbines – can they be made more pleasant?" In: N. Carter and R. F. S. Job (eds), 7th International congress on noise as a public health problem, pp 531-534 (22-26 Nov, Sydney, Australia 1998).
K. Persson Waye, A. Agge and M. Bjorkman, "Pleasant and unpleasant characteristics in wind turbine sounds," In: D. Cassereau (eds), Inter-Noise 2000, (August 27-30, Nice, France 2000).
K. Persson Waye and A. Agge, "Experimental quantification of annoyance unpleasant and pleasant wind turbine sounds," In: D. Cassereau (eds), Inter-Noise 2000, (August 27-30, Nice, France 2000).

several reasons why people respond more negatively to wind turbine noise that are directly a result of the character of the noise more than the absolute level of the sounds received.

Amplitude Modulation (Audible Blade Swish)

It is not clear whether the distinctive **rhythmic, impulsive or modulating character of wind turbine noise** (all synonyms for "thump" or "swoosh" or "beating" sounds), its characteristic low frequency energy (both audible and inaudible, and also impulsive), health effects of chronic exposure to wind turbine noise (especially at night), in-phase modulation among several turbines in a wind farm (this can triple the impulse sound level when impulses of three or more turbines become synchronized), or some combination of all of these factors best explains the annoyance. One or more of these characteristics are likely present depending on atmospheric and topographic conditions, (especially at night)[6] as is the individual susceptibility of each person to them.

Nevertheless, reports based on surveys of those living near wind farms consistently find that, compared to surveys of those living near other sources of industrial noise, annoyance is significantly higher for comparable sound levels among wind utility footprint residents. In most cases, where relationships between sound level and annoyance have been determined, annoyance starts at sound levels 10 dBA or more below the sound level that would cause equivalent annoyance from the other common community noise sources. Whereas one would expect that people would be annoyed by 45 dBA nighttime sound levels outside their homes in an urban area, rural residents are equally annoyed by wind turbines when the sound levels are 35 dBA independent of the time of day. Given that wind turbine utilities are often permitted to cause sound levels of 40 to 50 dBA at the outside of homes adjacent to or inside the footprint of wind utilities in the states east of the Mississippi the negative reactions to wind turbines from many of those people is understandable. Their reactions provide objective evidence in support of an expectation that a substantial number of people who live near the Oakfield Wind project will complain that the noise level they experience is both causing nighttime sleep disturbance and creating other problems once operation commences.[7] [8]

Although there remain differences in opinions about what causes the amplitude modulation of audible wind turbine noise most of the explanations involve **air turbulence around the turbine blades**[9]. There are a number of explanations that one may apply to this sound. For example, eddies in the wind, wind shear (different wind speeds at the higher reach of the blades compared to the lower reach), slightly different wind directions across the plane of the blades,

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

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

[7] Pedersen (2007); Kamperman and James (2008); James (2009b); Minnesota Department of Health (2009), pp. 19-20.

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

[9] Van den Berg (2006, pp. 35-36); Bowdler (2008), Palmer (2009) and Oerlemans/Schepers (2009).

and interaction among turbines, have each been identified as causes of modulating wind turbine noise from modern upwind turbines.[10]

Consultants for wind utility developers often claim that wind turbine sound emissions inside and adjacent to the project footprint estimated by the sound propagation model's represent "worst-case" conditions. The IEC 61400-11 test procedures used to derive this data states that the turbine's reported sound power levels represent the turbine's sound emissions at or above its nominal operating wind speeds under standardized weather and wind conditions. That is reasonable given that the purpose of these tests is to produce standardized data to permit a prospective buyer of turbines to compare the sound emissions from various makes and models. This needs to be understood as being similar to the US EPA's standardized gasoline mileage tests. One does not get the mileage posted on the vehicle sticker since each person's driving habits are different. The same is true for wind turbines and the environments in which they operate. The IEC test data does not account for the increased noise from turbulence or other weather conditions that cause higher sound emissions. A review of the IEC 61400-11, Wind Turbine Systems-Part 11: Acoustic Noise Measurement Techniques' assumptions in the body and appendices (esp. Appendix A) show that the IEC test data reported to turbine manufacturers is not 'worst case' for real world operations. Weather can introduce additional deviations from model results through independent of the effect of weather and wind on the turbine's noise emissions, ANSI standards for outdoor noise caution that turbulence in the air can increase the downwind sound levels by 6-7 dB or more. It should be clear that any assertions by the acoustical modeler that the models represent "worst case" sound level estimates rely on careful phrasing and ignorance of the underlying standards and methods by the reviewers.

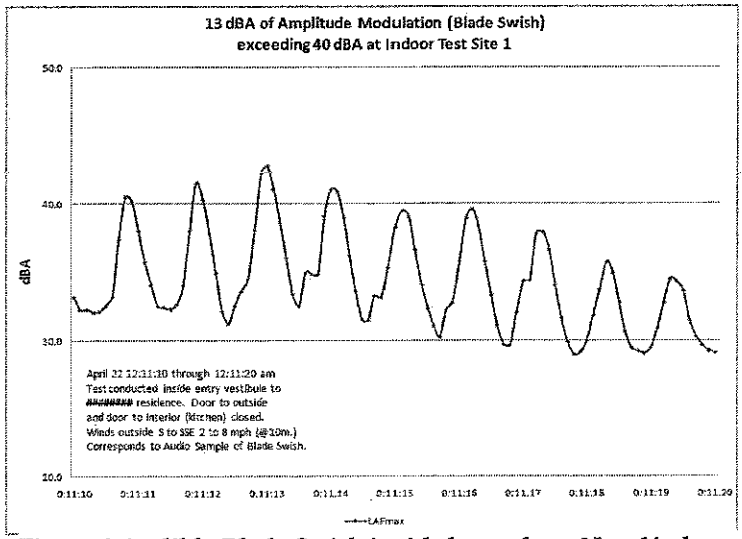

Figure 6-Audible Blade Swish inside home from New York Wind Utility

Impulsive sound was considered more problematic for older turbines that had rotors mounted downwind from the tower[11]. The sound was reduced by mounting the rotor upwind of the tower, common now on all modern turbines[12]. Initially, many presumed that the change from downwind to upwind turbine blades would eliminate amplitude modulated sounds (whooshes and thumps) being received on adjacent properties. However, in a landmark study by G. P. van den Berg now referred to in all

[10] Bowdler (2008)
[11] Rogers (2006, p. 10)
[12] *Id.*, pp. 13, 16; Van den Berg (2006), p. 36.

serious discussions of wind turbine noise[13], it was shown that the impulsive swishing sound increases with size because larger modern turbines have blades located at higher elevations where they are subject to higher levels of "wind shear" during times of ground level "atmospheric stability." This results in sound fluctuating 3-5 dBA between beats under moderate conditions and 10 dBA or more during periods of higher turbulence[14].

This author has confirmed amplitude modulation (blade swish) at every wind project he has investigated. During periods of high turbulence he has measured levels of blade swish of 10-13 dBA. Figure 6's graph shows the rise and fall of the A-weighted sound levels from blade swish measured inside a closed entry vestibule to a home. This test site is approximately 1500 feet from two (2) turbines with sound emission characteristics similar to the turbines proposed for the Evergreen Wind Power II, LLC. project. It should be noted that other tests measured sound levels exceeding 40 dBA inside the home in the rooms facing the turbines with a window partly open.

To compensate for the added annoyance of fluctuating or impulsive sound, the convention is to add a penalty of 5 dBA[15] to computer model estimates of average sound levels to account for the increased annoyance from sort term fluctuations in sound levels.[16] The RSE report argues against applying this penalty claiming that the fluctuations in sound are only 2-3 dB and definitely not the 6 dB needed to trigger application of the penalty. The evidence collected by this reviewer as demonstrated in Figure 6 shows that this claim is not supported by evidence. It is the days and nights when the amplitude modulation is at its worst, not the 2-3 dB of a summer afternoon, but the 6-9 dB of a late evening or the 10 -14 dB during weather conditions common in winter months and during weather that creates significant vertical and horizontal turbulence in other seasons.

Frequency of Conditions that Cause Blade Swish

The phenomenon of wind shear coupled with ground level atmospheric stability refers to the boundary between calm air at ground level and turbulent air at a higher altitude. *"A high wind shear at night is very common and must be regarded a standard feature of the night time atmosphere in the temperate zone and over land."*[17] A recent paper presented at the 2009 Institute of Noise Control Engineers, Noise-Con 2009 conference in Ottawa, Canada on background noise assessment in New York's rural areas noted: *"Stable conditions occurred in 67% of nights and in 30% of those nights, wind velocities represented worst-case conditions where ground level winds were less than 2 m/s and hub-height winds were greater than wind turbine cut-in speed, 4 m/s."*[18]

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

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[13] Van den Berg (2006, p. 36)

[14] *Id.*,

15 In the Kamperman/James criteria, this penalty is already included in its recommendation for a maximum allowable sound level at the receiving property of 35 dBA.

[16] Van den Berg (2006), p. 106; Minnesota Department of Public Health (2009), p. 21. *See also* Pedersen (2007, p. 24) ("Amplitude-modulated sound has also been found to be more annoying than sound without modulations."

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

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

> *"the wind velocity at 10 m[eters] follows the popular notion that wind picks up after sunrise and abates after sundown. This is obviously a 'near-ground' notion as the reverse is true at altitudes above 80 m. . . . after sunrise low altitude winds are coupled to high altitude winds due to the vertical air movements caused by the developing thermal turbulence. As a result low altitude winds are accelerated by high altitude winds that in turn are slowed down. At sunset this process is reversed.*[19]"

In other words, when ground-level wind speed calms after sunset, wind speed at typical hub height for large wind turbines (80 meters, or 262 feet) commonly increases. As a result, turbines can be expected to operate, generating noise, while there is no masking effect from wind-related noise where people live. "*The contrast between wind turbine and ambient sound levels is therefore at night more pronounced.*[20]" As the turbine's blades sweep from top to bottom under such conditions the blade encounters slightly different wind velocities creating unexpected turbulence that results in rhythmic swishing noise[21]. Such calm or stable atmosphere at near-ground altitude accompanied by wind shear near turbine hub height occurred in the Van den Berg measurements 47% of the time over the course a year on average, and most often at night[22].

Infra and Low Frequency Sounds

The level of annoyance produced by noise also increases substantially for **low frequency sound,** once it is perceived, than the more readily audible mid-frequency sounds. Sound measured as dBA is biased toward 1,000 Hz, the center of the most audible frequency range of sound pressure. Low frequency sound is in the range below 200 Hz and is more appropriately measured as dBC or using instrumentation that can provide 1/3 octave band resolution of the spectrum sound pressure levels. Sound below 20 Hz, termed **infrasound**, is generally presumed to not be audible to most people. *See* Leventhall (2003, pp. 31-37); Minnesota Department of Public Health (2009, p. 10); Kamperman and James (2008, pp. 23-24). However, if these criteria are evaluated for the 10% most sensitive people, the thresholds drop approximately 12 dB. That puts the infra and low frequency sound pressure levels measured on receiving properties and inside homes above the threshold of perception for 1 out of 10 people. For many years it has been presumed that only infra and low frequency sounds that reached the threshold of audibility for people posed any health risks. Many acoustical engineers were taught that <u>if you cannot hear a sound, it cannot harm you</u>.

Recent research has shown that the human body is more sensitive to infra and low frequency noise (ILFN) and that the organs of balance (vestibular) and cardio-vascular systems respond at levels of sound significantly lower than the thresholds of audibility. [23] Dr. Nina Pierpont has

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

[20] *Id.*, p. 60

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

[22] Van den Berg 2006, p. 96

[23] Alves-Pereira, Marianna and Nuno A. A. Branco (2007a). *Vibroacoustic disease: Biological effects of infrasound and low-frequency noise explained by mechanotransduction cellular signalling*, 93 PROGRESS IN BIOPHYSICS AND MOLECULAR BIOLOGY 256–279, available at <u>http://www.ncbi.nlm.nih.gov/ pubmed/17014895</u>><

conducted a peer reviewed study of the effects of infra and low frequency sound on the organs of balance that establishes the causal link between wind turbine ILFN and medical pathologies. The new research is not from the traditional fields that have provided guidance for acoustical engineers and others when assessing compatibility of new noise sources and existing communities. This research is coming from the field of medical research into how our bodies respond to external energies at the cellular level. Numerous studies are now available showing how the body responds to extremely low levels of energy not through the traditional organs of auditory and balance, but at the level of cell activity.

To get a idea of just how outdated our understanding is of the way our bodies interact with the energies and forces around us I would like to share a short piece that was sent to me by Eileen Mulvihill, a genetic biologist who received her Ph.D. in Molecular Biology from the Université Louis Pasteur, Strasbourg, France. She holds six patents for discoveries she made during her career. Her point is to demonstrate how our body's cells and molecules function as sensory receptors that augment the sensory organs, like our auditory and vestibular organs.

Most of us learned that we have primary sensory organs and they perform all the needed functions for sensing the world around us (especially those who have not remained current with research in the field of molecular and cellular biology). It is this, now outdated view-point, that leads some of the wind industry acoustical experts to still claim that 'If you can't hear it, it can't hurt you." In other words, they believe that because our auditory function (outer, middle, and inner ear) is not as sensitive to infra and low frequency sounds (rumble) as it is to mid and high frequency sounds (where speech occurs); and, that the infra and low frequency sounds from wind turbines are not loud enough to be heard by most people, there is no potential for adverse health effects. Dr. Mulvihill recently provided a good example of research that shows how our body can sense external forces. In other words, she describes other ways we sense acoustic energy, like low frequency sounds, through cellular level mechanisms not related to dedicated sensory organs. She offered the following example using a paper by Dr. D. Ingber:

> "Anyone who is skilled in the art of physical therapy knows that the mechanical properties, behavior and movement of our bodies are as important for human health as chemicals and genes. However, only recently have scientists and physicians begun to appreciate the key role which mechanical forces play in biological control at the molecular and cellular levels.
>
> "An article by Dr. D. Ingber, who first described the model of tensegrity, describes what his team has learned over the past 30 years as a result of their research focused on the molecular mechanisms by which cells sense mechanical forces and convert them into changes in intracellular biochemistry and gene expression-a process called "mechanotransduction".
>
> "Ingbers Prog Biophys Mol Biol. 2008 Jun-Jul;97(2-3):163-79. Epub 2008 Feb 13 work has revealed that molecules, cells, tissues, organs, and our entire bodies use "tensegrity" architecture to mechanically stabilize their shape, and to seamlessly integrate structure and function at all size scales. Through the use of this tension-dependent building system,

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and, Alves-Pereira, Marianna and Nuno A. A. Branco (2007b). *Public health and noise exposure: the importance of low frequency noise*, Institute of Acoustics, Proceedings of INTER-NOISE 2007,

> mechanical forces applied at the macroscale produce changes in biochemistry and gene expression within individual living cells.
>
> **"This structure-based system provides a mechanistic basis to explain how application of physical impacts, such as low frequency sound, influences cell and tissue physiology."** (Emphasis added)

What Dr. Mulvihill is describing is the process by which low levels of energy can affect hormone production and other cellular processes which by their actions result in adverse health effects. There are many more and smaller receptors for sensory input that than just our dedicated organs. Because these receptors are so small they may be far more sensitive to low amplitude, low frequency sound than the studies conducted focusing on the auditory and vestibular organs only would reveal. Low frequency sound penetrates into our body with little attenuation in the same way that it passes through the walls and roofs of our homes. Thus, receptors deep in our muscles, bones, and other organs can still receive and react to it.

We are also finding that new research tools not available to the researchers who are frequently quoted by wind developers in their defense are showing that our auditory and vestibular organs themselves are more sensitive than previously known. In Dr. Pierpont's forthcoming study, Wind Turbine Syndrome, she cites the research of Drs. Todd, Rosengrenm, and Colebatch in their paper "Tuning and sensitivity of the human vestibular system to low-frequency vibration" published in Neuroscience Letters 444 (2008) 36–41. In this paper they present the findings of a study in the abstract as:

> "Mechanoreceptive hair-cells of the vertebrate inner ear have a remarkable sensitivity to displacement, whether excited by sound, whole-body acceleration or substrate-borne vibration. In response to seismic or substrate-borne vibration, thresholds for vestibular afferent fibre activation have been reported in anamniotes (fish and frogs) in the range −120 to −90 dB re 1 g. In this article, we demonstrate for the first time that **the human vestibular system is also extremely sensitive to low-frequency and infrasound vibrations** by making use of a new technique for measuring vestibular activation, via the vestibulo-ocular reflex (VOR). We found a highly tuned response to whole-head vibration in the transmastoid plane with a best frequency of about 100 Hz. At the best frequency we obtained VOR responses at intensities of less than −70 dB re 1 g, which was **15 dB lower than the threshold of hearing** for bone-conducted sound in humans at this frequency. Given the likely synaptic attenuation of the VOR pathway, human receptor sensitivity is probably an order of magnitude lower, thus approaching the seismic sensitivity of the frog ear. These results extend our knowledge of vibration-sensitivity of vestibular afferents but also are remarkable as they indicate that the **seismic sensitivity of the human vestibular system exceeds that of the cochlea for low-frequencies.**" (Emphasis added)

These examples are provided as just two of many similar studies. Together they demonstrate that there is sufficient evidence to present a causal link between ILFN and adverse health effects. Acoustical engineers in the Heating, Cooling and Air Conditioning (ASHRAE) field have suspected since the 1980's and confirmed in the late 1990's that dynamically modulated, but inaudible, low frequency sound from poor HVAC designs or installations can cause a host

of symptoms in workers in large open offices[24]. The ASHRAE handbook devotes considerable attention to the design of systems to avoid these problems and has developed methods to rate building interiors (RC Mark II) to assess them for these low frequency problems[25]. However, the typical acoustical consultant that does not practice in that field, may not be as aware of the problems of amplitude modulated, in-audible low frequency sound as the ASHRAE engineers. Many have not caught up on these new understandings of how our bodies respond to infra and low frequency sound levels. These levels were only a few years ago considered too low to cause any physical response. Once we understand that what you cannot hear, can hurt you; acoustical consultants will be in a better position to develop the procedures and criteria to permit safe use wind turbines as a renewable energy resource. Until the time when the necessary studies have been completed it is appropriate to follow the precautionary principle and not expose the public to a potential health risk.

Wind turbine noise includes a significant low-frequency component, including inaudible infrasound as shown in Figures 3 through 5. For example, according to the manufacturer, under ideal test conditions at a distance of 200 meters (656 feet), a single 2.5 MW Nordex N80 wind turbine generates 95 decibels at 10 Hz[26]. This is at the threshold of human hearing for the average person and above the threshold for the most sensitive individuals.[27] The Nordex study also showed that sound pressure levels were highest at the blade passage frequency (between 1 and 2 Hz) and dropped off with increasing frequency. Thus, we can expect that below 10Hz sound pressure levels were higher than 95 dB.

Although low frequency sound is in the less-audible or inaudible range, it is often felt rather than heard. Unlike the A-weighted component, the low-frequency component of wind turbine noise *"can penetrate the home's walls and roof with very little low frequency noise reduction.*[28]*"* Further, as discussed in the 1990 NASA study the inside of homes receiving this energy can resonate and cause an increase of the low frequency energy over and above what was outside the home. Acoustic modeling for low frequency sound emissions of ten 2.5 MW turbines indicated *"that the one mile low frequency results are only 6.3 dB below the 1,000 foot one turbine example.*[29]*"* This makes the infra and low frequency sound immissions from wind turbines a potential problem over an even larger area than the audible sounds, such as blade swish and other wind turbine noises in the mid to high frequency range.

4) Background Sound Levels

Apart from the distinctive characteristics of wind turbine noise, including its low

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

25 It also notes that the study showed that NC curves are not able to predict rumble. RSG uses NC curves to show that infra and low frequency sounds will not negatively affect homes near the turbines. This use of NC curves was disproved in the 1997 Persson Waye, Leventhall study. Use of the RC Mark II procedures is more appropriate for this use.

[26] Nordex (2004, p. 4).

[27] Rogers et al. (2006, p. 9, table 5)

[28] Kamperman and James (2008), p. 3.

[29] *Id.*, p. 12

frequency component, the quiet soundscapes found in rural and semi-wilderness areas accentuate the perceived annoyance and potential for sleep disturbance. The MDEP rules regarding the need for measurement of the pre-operational background sound levels were designed for the types of communities in which the more traditional power generating utilities and industrial noise sources are located. They have not been adequate for wind utilities located in quiet communities and appear to be more of a loop-hole than a rule to protect quiet areas from noisy industrial development. It is not in the scope of this report to anticipate any needed changes, but the discussion above relative to the potential issues related to infra and low frequency sound does imply that some method of assessing and controlling the lower frequency sounds is warranted.

It has been the experience of this reviewer that the sound levels during the night hours in rural communities are between 20 and 30 dBA depending on whether there are nearby highways or other routes with traffic late at night. Other studies of background sound levels in rural communities confirm these results. For example, similarly low background sound levels were also reported in the study by Mr. Clifford Schneider[30]. Schneider reported that the median L_{A90} sound level for approximately 20 test locations in northern New York was 25.5 to 26.7 dBA. This reviewer has also found that in rural areas background sound levels are typically less than 30 L_{A90}. When sampling is conducted during the evening hours when community activities are at a minimum the L_{Aeq} and the L_{A90} are usually within 5 dB of each other. It is during this time that the sounds from the wind turbines will be most apparent and it is against those low background sound levels that land-use compatibility should be assessed.

For Oakfield, the RSE study does not include an assessment of the nighttime background sound levels that would be expected during the times when the wind turbines would be most clearly audible. This may comply with the MDEP rules but it leaves out an important piece of information that should be considered for industrial noises in a rural area.

Table 3. Summary of the relation between night noise and health effects in the population

$L_{night,outside}$ **up to 30 dB**	Although individual sensitivities and circumstances differ, it appears that up to this level no substantial biological effects are observed.
$L_{night,outside}$ **of 30 to 40 dB**	A number of effects are observed to increase: body movements, awakening, self-reported sleep disturbance, arousals. With the intensity of the effect depending on the nature of the source and on the number of events, even in the worst cases the effects seem modest. It cannot be ruled out that vulnerable groups (for example children, the chronically ill and the elderly) are affected to some degree.
$L_{night,outside}$ **of 40 to 55 dB**	There is a sharp increase in adverse health effects, and many of the exposed population are now affected and have to adapt their lives to cope with the noise. Vulnerable groups are now severely affected.
$L_{night,outside}$ **of above 55 dB**	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a high percentage of the population is highly annoyed and there is some limited evidence that the cardiovascular system is coming under stress.

End of WHO 2007 Guideline Excerpts

While on the topic of nighttime sound levels it should be noted that the World Health Organization (WHO) revised its guidelines for nighttime noise in 2007. The revised

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

guidelines supersede the guidelines commonly referenced from 1999 and before.[31] These guidelines provide the definition of what is required for a causal link to be established between a exterior forcing agent like wind turbine sounds and public health. They state:

*"**Sufficient evidence:** A causal relation has been established between exposure to night noise and a health effect. In studies where coincidence, bias and distortion could reasonably be excluded, the relation could be observed. The biological plausibility of the noise leading to the health effect is also well established.*

*"**Limited evidence:** A relation between the noise and the health effect has not been observed directly, but there is available evidence of good quality supporting the causal association. Indirect evidence is often abundant, linking noise exposure to an intermediate effect of physiological changes which lead to the adverse health effects."*

In Table 3 of the 2007 Guidelines, WHO presents the maximum sound levels that should be permitted outside the walls of a home to prevent adverse health effects. The new criteria are based on recent research into nighttime noise and health that was not available when the 1999 guidelines were published. The outdoor criteria ($L_{night\text{-}outside}$) represent the long term conditions, not a single night's exposure. Table 3 shows that nighttime sound levels of 30 dBA and under pose no health risks. However, nighttime sound levels of 40 to 50 dBA as projected for homes in the footprint of Oakfield would result in "a sharp increase in adverse health effects, and many of the exposed population are now affected and have to adapt their lives to cope with the noise. In a more recent 2009 WHO Guideline the upper limit for healthful sleep is set at 40 $L_{night\text{-}outside}$ (dBA). WHO is clear that sound levels above 40 $L_{night\text{-}outside}$ pose a public health risk.[32]

5) Computer Model Predictions

Studies on behalf of Evergreen Wind Power II, LLC presenting computer simulations that purportedly estimate the "worst-case" sound levels that will be received in the community should be viewed with serious skepticism. Reasons for this skepticism have been clearly summarized in the letter from Mr. Rufus Brown to Mr. Mark Margerum. This reviewer supports his concerns. Review of the references submitted by Mr. Brown provides the details supporting these concerns. Models of the type used by RSE must be understood as very simplified representations of complex interactions between noise emitters, and their surrounding environment. Models are not precise instruments, and are not any better than the

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[31] WHO Night Noise Guidelines (2007)

[32] An article in Noise and Health by Dr. Leventhall addresses these coping mechanisms for people exposed to noise.[32] It deserves careful reading by the MDEP. It describes the coping mechanisms and other adaptations to life style that people adopt when exposed to ILFN over long periods of time. It is interesting to note that many of the coping mechanisms in that article are used by people who are now living in the footprint of wind utilities like Oakfield. Indeed, there has been an ongoing debate between Dr. Leventhall and Dr. Pierpont about the risks of exposure to wind turbine sounds that seem to be contradicted by the statements of Dr. Leventhall in this article. If it can be assumed that the causal link between wind turbine noise exposure and the ILFN from wind turbines is established by the new medical research referenced earlier, and the levels of ILFN required to initiate a response from our bodies is lower than previously thought, then the disagreement between them appears to resolve in favor of Dr. Pierpont's research.

input data used to represent the noise source and accuracy of the algorithms used to represent how sound decays with increasing distance from the location of each source. For specific situations of modeling wind turbines in complex terrain, such as ridges and valleys, acoustical models are seriously challenged. The ability of the model to accurately replicate how the sounds are blocked by terrain or reflected by terrain is especially weak. Errors in models of wind turbine noise propagation located on flat terrain have been shown to have errors of 5 to 10 dB or more when studied by independent acoustical engineers (See RSG's studies by Kaliski). A review of Kaliski's studies for wind turbines on flat farm land (not on a ridge top with a valley below) show that there are so many options and variables that one can find some combination that will support a claim that the real world data matches the model's predicted sound levels. This 'matching' is more likely a case of seeking the variables that support the conclusion than it is any sign that models are accurate. It should be expected that errors of 5 dBA or higher would be found in models of more complex terrain such as is found in the community near Evergreen Wind Power II, LLC's footprint if the follow up study was done by independent experts and the models assumptions for the state of turbine power generation, wind speed and direction are carefully matched. There are models that are accepted as being accurate enough for planning purposes used by the Federal Highway Administration and the Federal Aviation Administration. Those models have undergone much development for specific noise sources and have been independently validated by experts not involved in creating the models. When errors in the model are identified by projects that do follow the models predictions the models are revised or cautions for the circumstances that lead to those errors are available. This is not true for wind turbine project models. Each wind project model is unique and validation attempts to date have been flawed by poor protocols and documentation.

An error range of 5 or more dB in sound levels is understandable, given the discussion earlier in this report about the assumptions in the modeling process and also in the input data used to replicate the more important interactions as the wind turbine's sound propagates into the community. First, the model estimates a single number at a receiving site. This is an average value, representing a yearly estimate of the sound immissions at the receiving site. It also does not reflect all of the conditions that can lead to higher sound immissions from blade swish and other weather induced effects on the turbine's noise.[33]

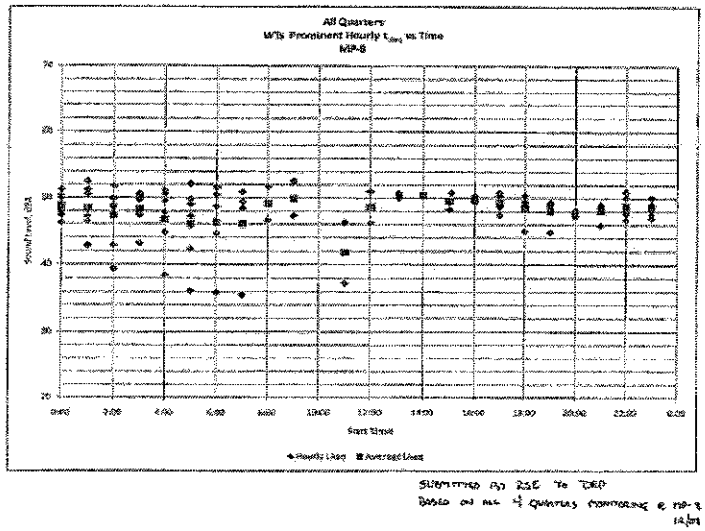

Figure 7-Chart showing range of sound levels at one Mars Hill test site from four quarterly sound studies

Sometimes it is easier to

[33] Ebbing, C. E. Some Limitations and Errors in Current Turbine Noise Models, Report for Appeal of Record Hill Wind decision in Maine.

understand this variability visually. The chart in Figure 7, was presented to the citizens of Mars Hill, Maine in December of 2008 by the Director of the Maine Bureau of Land and Water Quality which includes the Dept. of Environmental Protection. Maine's MDEP had commissioned a four quarter study of the sound levels under various operating conditions and seasonal variations that was conducted by RSE. This chart shows the 'best' of the data that was hand selected to represent only sound levels when wind turbines were operating and clearly audible. The test site is over 2000 feet from the nearest wind turbine, a 1.5MW upwind model. Note that the sound levels range from a low of about 35 dBA to a high of just over 52 dBA. All of these represent wind turbine sounds and not wind or other artifacts. The initial model estimated that the sound levels at this site would be 47.5 dBA. This is about 5 dBA lower than the highest level in the MDEP chart and 12 dB over the lowest level which was identified as wind turbine sound. Sound levels higher than 52 dBA were observed, but not included on the chart because winds prevented accurate measurement of the turbines as separate noise source.

Assuming that wind and other factors can result in a 17 dB range of sound levels for this operating wind utility, and that measurements during the highest noise conditions were precluded by wind speeds at the microphone exceeding the limits of the wind screen, how can any study of a operating wind utility claim that the levels estimated by the model were found during a single series of field tests. If the model reflects 'worst-case' wind speeds for the turbine, how can the follow-up study claim that test results for operating conditions that were not part of the model's assumptions demonstrate the model is accurate? The truth of the matter is that when the person who constructs the model is permitted to assess its accuracy the results should be viewed with suspicion. It is in that light that this reviewer views the results of the model presented in the April 2009 study by RSE. The MDEP should view the estimates of sound propagation in the same way. Models are at best a guide to estimate how the sound will affect the community, but to imply that the results have a high degree of accuracy is to stretch the credulity of the reviewer.

Furthermore, studies that use models normally disclose the strengths and weaknesses of the models and also disclose the input data and other important assumptions. They give appropriate cautions and disclose error tolerances for all possible known conditions that the model does not consider. This is not done in the Evergreen Wind Power II, LLC study for Oakfield. The model is poorly documented and missing important data if the study is to be critically reviewed by others competent to do so.

Much could be said again about the flaws in computer modeling of sound in complex situations but that evidence has been previously submitted by Mr. Brown. The arguments are academic and not something that most non-engineers would care to review. Therefore, the easiest way to establish that wind turbine models underestimate sounds at properties adjacent wind utilities is to look at existing wind projects. Since most, if not all, follow-up sound studies in Maine were conducted by acoustical consultants with strong ties to the wind utility developers it is reasonable to look at projects outside of Maine. This reviewer has conducted studies of operating wind utilities in many different states, and in Ontario. In all cases the projects were granted permits based on sound studies presented wind turbine sound model estimates of levels in the low to mid 40 dBA range at the nearest properties. Note how close the parallel is to

what Evergreen Wind Power II, LLC has presented for the Oakfield wind utility under consideration.

What has happened at those locations? The promises of compatibility with existing community sound levels, of no potential for nighttime sleep disturbance or low frequency 'vibrations' have been replaced with numerous complaints about noise and health to the local Boards and environmental agencies. In some cases this has escalated to threats of litigation. Given that track record, it is a safe assumption to consider the Evergreen Wind Power II, LLC models to be estimates of turbine noise under optimum operating conditions and nothing more.

6) Comments on Health Risks and Wind Turbines

Recent studies link low frequency noise impacts to impairment of the vestibular system or other organs.[34] This new link between health and noise should be considered along with studies showing that wind utility noise from turbines operating at distances of up to one mile is a cause of sleep disturbance for a vulnerable minority, and chronic sleeplessness results in adverse health effects.

Information provided earlier in this report demonstrated that wind turbines do produce ILFN and that new research, not well known by acoustical engineers, show that the levels of acoustical energy are in the range of perception for at least a small segment of the exposed population. With respect to whether wind turbines emit ILFN, consider that if one totals the acoustic energy of a wind turbine across the entire frequency spectrum from 16Hz up to the speech frequencies, the difference in the sum of the energy below 200 Hz is often 10-15 dB higher than the sum of the energy at 200 Hz and above. It is clear that wind turbines are primarily producers of noise in the ILFN range.

Even if only 5-10% of the people living in the footprint of an operating wind utility are susceptible, that is still a large number and given the fast rate at which wind utilities are being constructed this number will continue to increase. When solving one problem, the need for clean energy, it is not appropriate to expose people to a second problem, a potential health risk. It is hoped that the discussion about the causal links between ILFN and adverse health effects can help the debate between those that are concerned about health effects and those who continue to deny need for such caution can now progress beyond the 'if you can't hear it, it can't hurt you' stage of argument. When, new information of the type disclosed by Dr. Pierpont and others is made available, wind turbine manufacturers and reasonable experts should try to understand it before rejecting it in favor of their former beliefs. Until the extent of the links between nighttime sleep disturbance from audible sounds; and vestibular and cardio pathologies from audible sound or ILFN are known, it is best to error on the side of safety and health.

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[34] See Alves-Pereira and Branco, 2007; (linking the low-frequency component of wind turbine noise to abnormal growth of collagen and elastin in the blood vessels, cardiac structures, trachea, lungs, and kidneys of humans and animals exposed to infrasound (0–20 Hz) and low-frequency noise (20–500 Hz), in the absence of an inflammatory process). See also Pierpont "Wind Turbine Syndrome" study (2009) and Minnesota Department of Public Health (2009), pp. 7-8.

The symptoms reported by Dr. Pierpont for people exposed to dynamically modulated ILFN from wind turbines have been viewed by some in the wind industry as biased or otherwise deficient research. However, her findings are not that different from the symptoms reported by Kirsten Persson Waye in collaboration with Dr. Leventhal in their 1997 paper "*Effects On Performance And Work Quality Due To Low Frequency Ventilation Noise,*"[35] This study compared the performance and other factors for a work group that was exposed to dynamically modulated low frequency sound to that of a work group exposed to more normal HVAC system sound spectrum with lower levels of LFN and no modulation. This study reported that the group exposed to LFN reported:

> 1. Subjective estimations of noise interference with performance were higher for the low frequency noise (exposed group)
>
> 2. The exposure to low frequency noise resulted in lower social well-being ('96 words) "more disagreeable, less co-operative, helpful and a tendency to lower pleasantness "more bothered, less contented as compared to the mid frequency noise (exposed group)
>
> 3. Data may indicate that the response time during the last part of the test was longer in the low frequency noise exposure e.g. cognitive demands were less well coped with under the low freq. noise condition.
>
> 4. The effects seemed to appear over time
>
> 5. The hypothesis that cognitive demands are less well coped with under the low frequency noise condition needs to be further studied.

They also reported that a "few previous studies indicate that low frequency noise may reduce performance at levels that can occur in such occupational environments. Some of the symptoms that are related to exposure to low frequency noise such as:

1. Mental tiredness,
2. Lack of concentration and
3. Headache related symptoms,

Could be associated with a reduced performance and work satisfaction."

> "The reported symptoms and effects on mood were apart from tiredness in accordance with earlier findings on effects after exposure low-frequency noise. The subjects reported a feeling of pressure on the head rather than headache and lower social orientation and pleasantness after low-frequency noise exposure (Persson-Waye 1995)."

The HVAC industry's studies of workplaces identified adverse health effects from dynamically modulated LFN that is similar in level to what is experienced inside the homes of people living near turbines. The symptoms listed in Dr. Pierpont's report for people living near wind turbines are very similar to those reported in the HVAC studies. Since there are well accepted adverse health precedents from the HVAC industry's experience with low frequency sounds below the thresholds of perception for the average listener to Dr. Pierpont's findings; claims that Pierpont's research is flawed may be best understood as defensiveness on the part of some

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[35] *Journal of Sound and Vibration* (1997), 205(4), 467-474

in the wind industry and not valid accusations. It is time the wind industry embraces the new medical studies and Dr. Pierpont's research as a possible consequence of locating wind turbines too close to homes.

7) Final Conclusions for Oakfield Wind Project

Several conclusions follow from the discussion above on modeling and health effects. Based on the above, the Evergreen Wind Power II, LLC project, as proposed, will, with a high degree of certainty, expose people to noise and health impacts that are significant. More specifically:

1. RSE's conclusions that the project meets MDEP regulations are based on flawed procedures and assumptions; and cannot be accepted for the purpose of determining whether the MDEP noise regulations have been complied with. The 5 dBA penalty for short duration fluctuating sounds should be applied to the 45 dBA level permitted during night-hours on protected properties to reduce the criteria to 40 dBA for nighttime protected properties, the computer model should be redone to use line-source modeling methods for the wind turbines that are aligned in rows along the ridge; and the input data and other settings should be disclosed in the report on the results. In addition, a greater safety factor should be required by MDEP for model results based on post-construction complaints that have demonstrated the unreliability of this model in prior projects.
2. In addition, the noise assessment and other representations of Evergreen are deficient and should not be accepted because they fail to consider the health risks associated with long term exposure to low frequency sounds. Given the failure to disclose these health effects in the noise assessment it should be presumed that this information was also not disclosed to the ten residents that signed easements. And, if that is the case, those ten residents cannot be excluded for purposes of determining compliance with the MDEP regulations.

End of Report Narrative

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