Saddleback Ridge Wind, LLC // Natural Resource Protection Act (NRPA) and Site Location of Development Act applications

- *Exhibit 1 (AR-03) Statement of Position by Petitioners and Friends of Maine's Mountains (Proposal to Amend Department of Environmental Protection Rule 375.10 on Citizen Petition Pursuant to 5 M.R.S.A. § 8055.3)*

FMM Ex. 1 AR03

STATE OF MAINE
BOARD OF ENVIRONMENTAL PROTECTION

In Re:

PROPOSAL TO AMEND DEPARTMENT OF ENVIRONMENTAL PROTECTION RULE 375.10 ON CITIZEN PETITION PURSUANT TO 5 M.R.S.A. §8055.3	))))	**STATEMENT OF POSITION BY PETITIONERS AND FRIENDS OF MAINE'S MOUNTAINS**

Friends of Maine's Mountains ("FMM")[1], through counsel, joins with Petitioners in submitting the following Statement of Position on the proceedings before the Board of Environmental Protection (the "Board") for these rulemaking proceedings initiated by a citizen petition for rulemaking pursuant to 5 M.R.S.A. §8055.3 to amend 06-096 CMR Chapter 375.10 (the "DEP Noise Rule").[2]

INTRODUCTION

Sections 484.3 and 484.3B of the Site Location of Development Law, 38 M.R.S.A. §§ 481-490 (the "Site Law"), require an applicant for a wind turbine project to demonstrate that a proposed project will not "adversely affect existing uses" and that it has made "adequate provision for the control of noise." With respect to noise, this is done by the applicant for a wind turbine project submitting to the Department of Environmental Protection (the "DEP") a sound assessment study showing, through predictive modeling, that a proposed project is expected to comply with the Sound Level Limits of the DEP Noise Rule, usually consisting of the "quiet

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1 FMM is a research and educational organization whose mission is to research, formulate and promote effective and reliable energy and power solutions that will protect Maine's natural resources (especially Maine's mountains), as well as Maine's industries and private property owners, while also ensuring that those solutions have a positive environmental and economic impact for Maine people and businesses. FMM advances its mission through various means, including litigation and promotion of regulations, including regulation to prevent excessive noise from wind turbine projects. Together with the Citizens Task Force on Wind Power, it was the primary organization behind the Citizen Petition that initiated these proceedings.

2 The Board acknowledged the Citizen Petition by letter to the undersigned counsel dated January 7, 2011 and the proposed rule was "posted" by the Board at its February 3, 2011 meeting.

area" limits of 50 dBA during the day and 45 dBA at night. *See,* Section 375.10.C (1) (a) (v).[3]

The DEP Noise Rule was last amended 21 years ago in 1989. The Rule makes no reference to wind turbine projects. When the DEP Noise Rule was last amended, the Maine DEP did not have experience with grid scale wind turbine project applications. It is therefore not surprising that the DEP Noise Rule makes no reference to wind turbine projects and does not address any of the specific issues relating to noise generated by such projects or that the DEP Noise Rule is deficient in both predictive modeling and protection against the health risks of wind power noise.

Petitioners and FMM urge the Board to adopt the proposed amendments to the DEP Noise Rule, as revised by the provisions forwarded to the Board by FMM on June 23, 2011 and revised further for typographical errors to this Statement.. For the reasons explained below, FMM believes that (1) wind turbine noise has features that are different from other sources of industrial noise that require special regulation, (2) the existing DEP Noise Rule does not adequately address or protect the public from this kind of noise and (3) the proposed amendments to the Noise Rule, as revised, constitute more protective but still reasonable protections from exposure to excessive wind turbine noise.

I. WIND TURBINE NOISE HAS UNIQUE CHARACTERISTICS THAT DISTINGUISH IT FROM OTHER SOURCES OF INDUSTRIAL NOISE.[4]

It is universally recognized today that noise generated by wind turbine facilities are more annoying than other sources of industrial noise. The internationally renowned expert, Dr. Eja Pederson from Sweden, is most often cited for this proposition. In her peer reviewed article, E.

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[3] The "quiet area" limits apply when the daytime pre-development ambient hourly sound level at a protected location is equal to or less than 45 dBA and/or the nighttime sound level is equal to or less than 35 dBA. This has been the case for all wind power project development so far.

[4] This Position Paper makes several references to studies and reports. All are posted on the BEP website.

Pederson & K. Waye, *Perception and Annoyance Due to Wind Turbine Noise – A Dose-Response Relationship,* 116 J. Acoust Soc. Am. 3460, 3467 (2004), the authors state that "the results [of their study] suggest that the proportions of respondents annoyed by wind turbine noise are higher than for other noise sources *at the same A-weighted SPL* and that the proportion annoyed increases more rapidly". [Emphasis added.] *See also,* John P. Harrison, *Disconnect Between Turbine Noise Guidelines and Health Authority Recommendations* at 1; Janssen, Vos, Eisses and Pedersen, *Predicting Annoyance By Wind Turbine Noise*, Inter-Noise 2010 at 1; Shepherd, McBride, Welsh, Dirks, and Hill, *Wind Turbine Noise and Health Related Quality of Life of Nearby Residents: a Cross-Sectional Study in New Zealand,* Fourth International Meeting on Wind Power Noise, Rome 2009 at 8; Salt and Hullar, *Responses of the Ear to Low Frequency Sounds, Infrasound and Wind Turbines,* 268 Hearing Research 12 (2010).

These conclusions were graphed by Dr. Pedersen as follows:

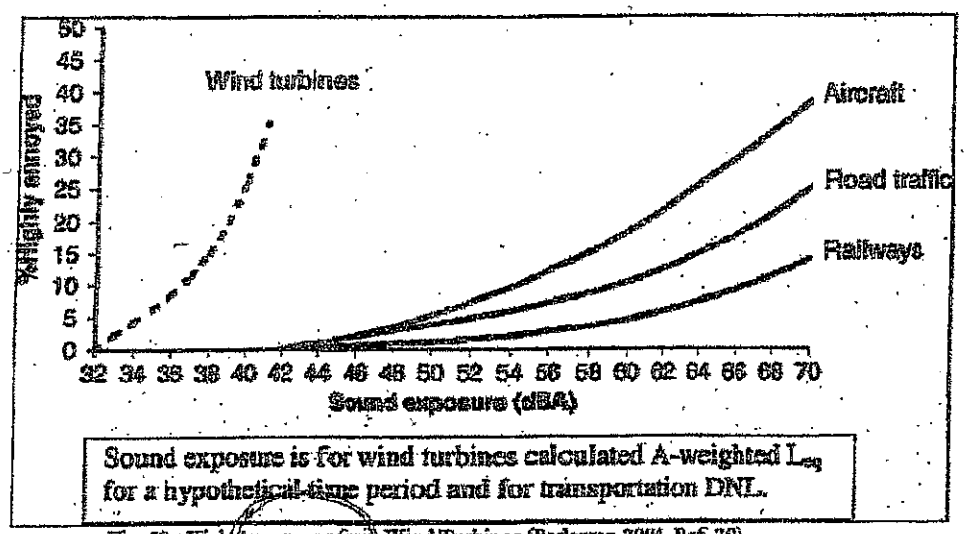


Fig. 13 : High Annoyance from Wind Turbines (Pederson 2004, Ref. 20)

Id. at 3468. This graph shows support for the DEP Noise Rule limit for nighttime noise in quiet

areas at 45 dBA for industrial noise from aircraft, roads and railways, but shows the inadequacy of the sound limit for wind turbine noise as it causes annoyance at much lower limits. The conclusions of Dr. Pederson are reaffirmed in an EU financed study, G.P. van den Berg, Eja Pedersen, Jelte Bouma & Roel Bakker, *WINDFARMperception - Visual and Acoustic Impact of Wind Turbine Farms on Residents*, June 3, 2008 at 61 ("Perhaps the main finding is that wind turbine sound is relatively annoying, more so than equally loud sound from aircraft or road traffic."). The Pederson chart and her findings are frequently cited by others, including Dr. Christopher Hanning, *Wind Turbine Noise*.

A. Because of Amplitude Modulation.

The most common explanation of why wind turbine noise is regarded as more annoying than other industrial sources at the same sound pressure levels is that wind turbine noise is so often characterized by a pulsating, throbbing noise called "amplitude modulation." There is broad consensus on this point. *See,* Pederson & Waye, *Perception and Annoyance, supra,* at 3468:

> "Wind turbine noise was perceived by about 85% of the respondents *even when the calculated A-weighted SPL were as low as 35.0 - 37.5 dB*. This could be due to the presence of amplitude modulation in the noise, making it easier to detect and difficult to mask by ambient noise. This is also confirmed by the fact that the aerodynamic sounds were perceived at a longer distance than machinery noise.". [Emphasis added.]

See also, G.P. van den Berg, *Do Wind Turbines Produce Significant Low Frequency Noise?*,, 11th International Meeting on Low Frequency Noise and Vibration and its Control (2004) at 8; G.P. van den Berg, et als, *WINDFARMperception, supra,* at 57, 60, 61; *Maine State Planning Office, Technical Assistance Bulletin No. 4,* at 10 ("repetitive sounds are more annoying than multiband, constant noises"); George Kamperman & Richard James, *The 'How To' Guide to*

Siting Wind Turbine, at 12 (amplitude modulation is a "characteristic of wind turbine sound that increases sleep disturbance potential above that of other long-term sources"); Eja Pedersen and Kerstin Waye, *Wind Turbines-Low Level Noise Sources Interfering With Restoration?*, Environmental Res. Lett. 3 (2008) ("annoyance with wind turbine noise was highly correlated to the sound characteristics: swishing, whistling, resounding, pulsating/throbbing"); Eja Pedersen, G.P. van den Berg, Roel Bakker & Jelte Bouma, *Response to Noise from Modern Wind Farms in the Netherlands*, 126 J Acoust. Soc. Am. 634, 635 (2009) ("Amplitude – modulated sound is more easily perceived than is a constant – level sound and has been found to be more annoying"); Kerstin Waye. *Perception and Environmental Impact of Wind Turbine Noise,* Inter-Noise 2009; Geoff Leventhall, *Low Frequency Noise: What We Know, What We do not Know and What We would Like to Know,* 28 J. of Low Frequency Noise, Vibration and Active Control, 79, 97 (2009); C. Hanning, *Wind Turbine Noise, supra,* at ¶2.2.4; Lee, Kim, Choi & Lee, *Annoyance Caused by Amplitude Modulation of Wind Turbine Noise,* 59 Noise Control Eng. 38 45 ("The results of the listening test showed that the amplitude modulation of wind turbine noise has a statistically significant effect on noise annoyance"); D. Siponem, *The Assessment of Low Frequency Noise and Amplitude Modulation of Wind Turbines*, Fourth International Meeting on Wind Turbine Noise, Rome, Italy, 2011, at 1.

B. Because of the Quiet Rural Settings..

A second explanation as to why wind turbine noise is more annoying than other sources of industrial noise is that wind farms are often located in quiet, rural settings where pre-existing background noise levels are low. There is wide consensus on this point as well. *See*, Pederson & Waye, *Perception and Annoyance, supra*, at 3468: "[a]nother factor that could be of importance for explaining the seemingly different dose-response relationships is that the wind turbine study

was performed in a rural background, where a low background level allows perception of noise sources even if the A-weighted SPL are low." *See also*, Waye, *Perception and Environmental Impact of Wind Turbine Noise, supra,* at 2-3 (ambient sound needs to be about 10 dB above that of wind turbine sound to mask it); Pedersen & Waye, *Wind Turbines-Low Level Noise Sources supra,* at 2; E. Pederson, et als., *Wind Turbine Low Level Noise," supra*, at 4; and Kamperman & James, *The 'How To' Guide supra,* at 13-14.

C. Because of Low Frequency Content

A third reason why wind turbine noise is considered more annoying than other industrial sources is because of its low frequency content. There is broad consensus on this point. Low frequency noise is typically in the range of 10 Hz to 100 Hz, although it can be extended an octave at each end of this to 5 Hz to 200 Hz. Geoff Leventhall, *Low Frequency Noise, supra*, at 79. Wind turbines contain a significant amount of low frequency noise. Kamperman & James, *The 'How To Guide, supra*, at 4-5. This was recognized by the DEP in a Memorandum from Andrew Fisk to Commissioner David Littell, dated January 10, 2008, made part of the *Report of the Governor's Task Force on Wind Power Development* as Exhibit I ("Noise generated from wind turbines does have attributes that warrant particular focus in the review of projects, including low frequency modulating noises generated as turbine blades pass by towers."). Dr. Dora Mills, in her report, *Wind Turbine Neuro-Acoustical Issues* (June 2009), published on the Maine CDC website, www.maine.gov/dhhs/boh/wind-turbines-neuro-acoustical.shtml, states:

> Some have pointed to LFN [low frequency noise] 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 the air than higher frequency sound, so they persist for a longer distance; the amount of sound transmitted from outside to the inside of a building is higher with LFN; and some models for assessing impact of noise do not adequately include LFN.

Id. at 3. [Emphasis added.] *See also,* Harrison, *Disconnect, supra* at 1; Siponem, *The Assessment of Low Frequency Noise and Amplitude Modulation, supra* at 1; van den Berg, *An Overview of Residential Health Effects in Relation to Wind Turbine Noise,* Fourth International Meeting on Wind Turbine Noise, Rome, June 2011, at 3 ("Several publications point to the low frequency character of wind power noise as an aggravating factor.").

Even Geoff Leventhall, a prominent supporter of wind power, in his peer reviewed article, *Low Frequency Noise, supra,* stresses that "annoyance from the low frequency noise [is] greater than that from higher frequency noise at the same A – weighted level", and that "[a]t equal A-weighted levels, *the noise dominated by the low frequency component was perceived as 4-7dB louder and 5-8dB more annoying."Id.* at 86. [Emphasis added.] More recently, in a peer reviewed article by Moller and Sejer Pedersen, *Low Frequency Noise from Large Wind Farms* 129 J. Acoust. Soc. Am. 3727 (2011), the authors state that "it is beyond any doubt that the low-frequency part of the [wind turbine] spectrum plays an important role in the noise at the neighbors and that low-frequency sound must be treated seriously in the assessment of noise from large turbines."

In recent break through research, Dr. Alec Salt has demonstrated that the claim of wind industry supporters that "what you can't hear, can't harm you" is false and that the "fact that hearing is insensitive to infrasound frequencies therefore does not indicate that the entire ear is insensitive to infrasound." Salt and Lichtenhan, *Responses to the Inner Ear to Infrasound,* Fourth International Meeting on Wind Turbine Noise, Rome 2011, at 2. *See also,* Salt and Hullar, *Responses to the Ear to Low Frequency Sounds, supra.* In his Rome paper, Dr. Salt established the incredibly important proposition that the inner ear's response to low frequency sounds biologically causes the ear to interpret high frequency wind turbine noise as amplitude

modulation. Salt and Lichtenhan, *Responses to the Inner Ear, supra at 9.*

The significance of low frequency noise was also addressed by the WHO, *Guidelines on Community Noise* (1999). The 1999 *Guidelines* point out that "[h]ealth effects due to low-frequency components in noise are estimated to be more severe than for community noises in general" and this risk "is sufficiently strong to warrant immediate concern". *Id.* at 35. The 1999 *Guidelines* state that "*[n]oise with low-frequency components requires lower guideline values.*" Id. at xiii. [Emphasis added.] *See also,* Kamperman & James, *The 'How To' 'Guide, supra..*

D. Requiring Special Treatment in Noise Regulations.

Based on the indisputable consensus about how wind turbine noise differs from and is more annoying than other sources of industrial noise, it is clear that "wind turbines should be treated as a new type of source in noise regulation." Janssen, et als, *Predicting Annoyance, supra,* at 1-2. Eja Pedersen goes further to proclaim that the "***need for guidelines for maximum exposure to wind turbine noise is urgent*** ... to avoid possible adverse health effects." Pedersen, van Berg, Bakker & Bouma, *Response to Noise from Modern Wind Turbines in the Netherlands,* 126 J. Acoust Soc. Am. 634 (2009). [Emphasis added.]

II. THE EXISTING DEP NOISE RULE DOES NOT ADEQUATELY PROTECT AGAINST EXCESSIVE NOISE FROM WIND POWER PROJECTS.

The Preamble to the Noise Rule, Section 375.10.A states that the purpose of the rule is to protect the health and welfare of neighbors to projects from excessive noise:

> 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.

These clearly stated purposes have fallen short of achievement with regard to noise from grid

scale wind power projects sited in quiet rural communities. The rule has not kept pace with the rush to license grid scale wind turbine projects, encouraged by federal subsidies and, more importantly for present purposes, by state policy as evidenced by P.L. Chapter 661, "An Act to Implement Recommendations of the Governor's Task Force on Wind Power Development," including provisions in Chapter 34-A for "Expedited Permitting of Grid Scale Wind Energy Development."

Section 375.10.E of the Noise Rule allows the Board "as a term or condition of approval, [to] establish any reasonable requirement to ensure that the developer has made adequate provision for the control of noise from the development and to reduce the impact of noise on protected locations." However, both the DEP and the Board have chosen not to utilize these provisions to protect against the risks of adverse health effects from wind turbine projects in licensing grid scale wind projects, instead relying on the predicted compliance with the Rule's Sound Limitations for Routine Operations" of the exiting rule.

A. The Existing Rule does not Adequately Address Any of the Three Characteristics that Make Wind Turbine More Annoying than Other Sources of Community Noise.

The existing Noise Rule was not designed with wind turbines in mind and therefore it understandably does not adequately address the characteristics of wind turbine noise that distinguish it from other sources of industrial noise.

1. Amplitude Modulation

The only way that the existing Noise Rule addresses amplitude modulation is by requiring a 5 dBA penalty for Short Duration Repetitive Sounds ("SDRS"). Chapter 375.10.Section 10.C (1)(e) (i). However, the way that SDRS is defined in the Noise Rule in Chapter 375.10.G. 19 and the way the DEP has interpreted the SDRS provisions, amplitude

modulation generated by wind turbine projects is rendered unregulated. This needs to be fixed.

The existing Noise Rule defines SDRS as a "sequence of repetitive sounds which occur more than once within an hour, each clearly discernible as an event and causing an increase in the sound level of at least 6 dBA on the fast meter response above the sound level observed immediately before and after the event, each typically less than 10 seconds in duration, and which are inherent to the process or operation of the development and are foreseeable."

Sound assessment studies submitted to the DEP for purposes of applying for a Site Law permit for wind turbine projects typically do not include adjustments for SDRS or amplitude modulation based on arguments from wind project developers that SDRS with peak to valley spikes of 6 dBA or more are not common. Objections have been raised by concerned citizens based on evidence that SDRS of 5-6 dBA is common for wind turbines, with SDRS of 10 to 15 dBA or more observed, especially during periods of turbulence due to weather fronts or topography and during temperature inversions where the wind shear does not follow a simple gradient from ground to heights above the upper reach of the turbine blades, and that these conditions have been documented and reported in research papers by Hubbard and Shepherd in the 1990's (*Wind Turbine Acoustics*, and more recently by van den Berg, *Do Wind Turbines Produce Significant Low Frequency Noise?* 11th International Meeting on Low Frequency Noise and Vibration (2004). *See also.* Christopher Hanning, MD, *Wind Turbine Noise, Sleep and Health* (April 2010), at §3.6. Yet, notwithstanding this literature support for the common occurrence of SDRS at 6 dBA magnitude, the DEP has accepted applications arguing that it is not.

Clearly, then, the Noise Rule bar for SDRS needs to be lowered to 3 dBA peak to valley in order for it to regulate amplitude modulation without debate. Clearly, it is important for the

Noise Rule to account for amplitude modulation that is common for wind turbines and is one of the most prominent of the reasons why it is more annoying than other sources of industrial noises. Redefining SDRS to capture 3 dBA peak to valley is supported by the recent decision in *Hulme and Secretary of State for Communities and RES Developments,* 2011 EWCA Civ. 638, decided May 26, 2011 by the England and Wales Court of Appeals (Civil Division), the highest court in the English legal system short of the Supreme Court of the UK. After years of litigation it was accepted in that case that a 3 dBA peak to valley modulation occurring within a 2 second period occurring 5 times or more in a one minute period would be regarded as "excessive" and that it was reasonable and necessary to regulate such excessive modulation to avoid health problems mediated through loss of sleep. The *Hulme* decision is part of the record in these proceedings.

There is also a more fundamental problem with the existing DEP Noise Rule that renders SDRS irrelevant for purposes of regulating amplitude modulation from wind turbine projects. The problem is that the rule imposes a 5 dBA penalty when SDRS is found to exist, but only for the milliseconds that it is found to exist which are then folded into an hour average to determine whether the Sound Level Limits will be or have been met. The 1 hour averaging swallows up the 5 dBA penalty with the result that there will never be any adjustments in the applicable Sound Level Limits for wind power noise. This needs to be changed. Even Geoff Levethall, a strong advocated for the wind power industry, recognizes that when we average measurements of wind turbine noise over a period of time, we lose information on fluctuations that can be especially annoying. Leventhall, *Low Frequency Noise, supra,* at 97. *See also,* Harrison, *Disconnect, supra,* at 3 ("The problem here is that all jurisdictions use Leq [averaging] in setting their noise limits *and this averages out the modulation.*"). [Emphasis added].

In order to effectively account for amplitude modulation, a 5 dBA penalty should be assessed to lower the Sound Level Limits by that amount whenever SDRS, according to the modified definition, occurs more than once in an hour. *See*, van den Berg, *An Overview of Residential Health Effects, supra*, at 2; Harrison, *Disconnect, supra*, at 4; Palmer, *A New Explanation for Wind Turbine Whoosh- Wind Shear*, Third International Meeting on Wind Turbine Noise, Denmark (2009) at 12 ("The existence of this condition [amplitude modulation] as shown in this report reinforces the need to apply a penalty to the average sound received from wind turbines at night because the cyclic "Woosh" produced during stable atmospheres makes them particularly noticeable and annoying, compared to other noise sources.").

2. Quiet Rural Settings.

'There is an expectation of 'peace and quiet' when living in a rural area and most choose to live in rural areas for this reason." Shepherd, et als, *Wind Turbine Noise and Health Related Quality of Life of Nearby Residents*, *supra*, at 8. "Furthermore, those who live in rural areas have different expectations about community noise than those living elsewhere." *Id.* These expectations are among the reasons why wind turbine, when placed in such settings, are more annoying than other sources of noise as explained above.

There is clear consensus that noise should be more strictly regulated with lower limits when an industrial facility is sited in a rural, quiet, area. The existing Noise Rule in fact recognizes this principle by lowering nighttime noise limits to 45 dBA when pre-development background noise is measured at 35 dBA at night. Chapter 375.10.C(1) (a)(v). The Basis Statement for the 1989 amendments to the DEP Noise Rule at Comment 12 expressly adopted the concept that quiet area locations need stricter noise limits:

> We [the DEP] believe that areas with low background levels need to be regulated differently since *an increase in*

> *20 decibles would have a significant impact on existing noise levels and to individuals living near a development.* [Emphasis added.]

Later in Comment 14 to the 1989 amendments to the DEP Noise Rule the DEP commented that "[w]e have amended the rule so that developments will produce, in most cases, no more than a 15 dB increase in ambient sound levels at protected locations." The comment recognized that some areas might have background noise at 30 or below, but thought that "relatively few inhabitated areas in the State have ambient noised levels this low." [Emphasis original.]

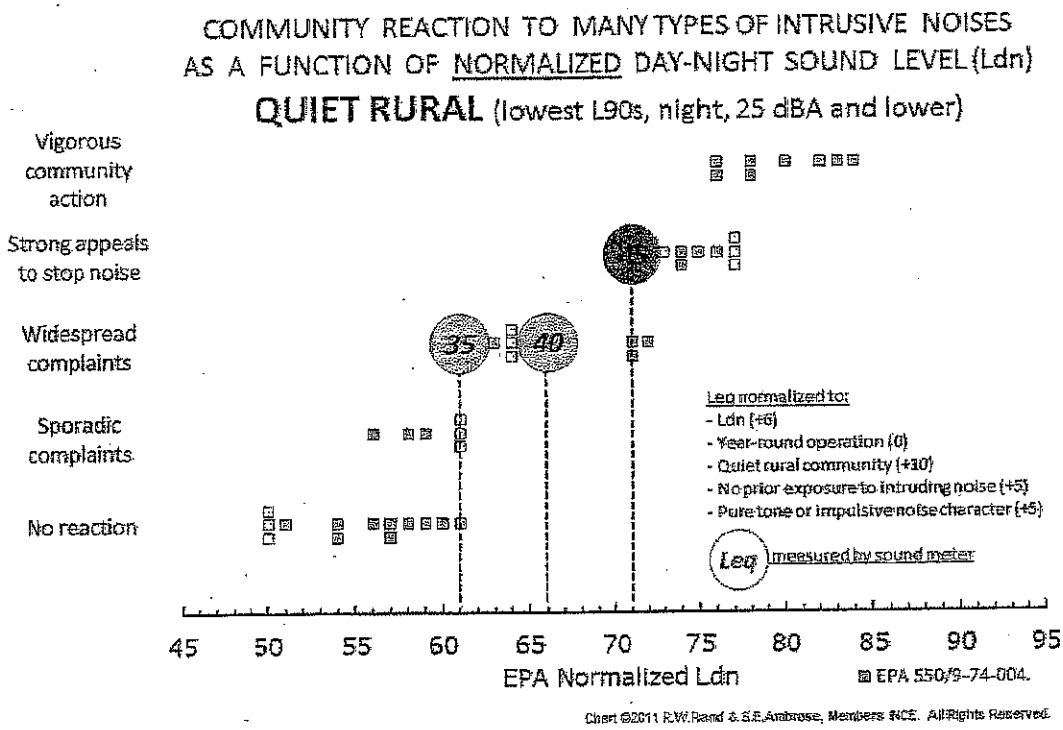
The DEP's 1989 assessment of the impact of noise impacts, at least from wind turbine projects, needs to be reassessed. For one thing, noise levels of 20-25 are common for rural areas that are *inhabited.* Richard James Testimony; Rand and Ambrose, *Noise Impact Study of Saddleback Ridge,* at 6. The State Planning Office identifies 20 dBA as common for rural nighttime. *Technical Assistance Bulletin No. 4, supra,* at 2. Comment 14 was clearly in error when it suggested that most rural areas with low pre-development noise were uninhabited. This is not true for Rollins, Record Hill, Oakfield, or Saddleback Ridge.

Moreover, there is wide consensus that a wind power project or any noise source that increases noise levels by 20 dBA or more over ambient will be regarded by a community as intolerable. This will result in noise four times as loud as without the turbines. SPO *Bullentin No. 4 , supra,* at 3; New York State Department of Environmental Conservation, *Assessing and Mitigating Noise Impacts,* at 13-14, 15 (perceived at "very objectionable to intolerable"); Harrison, *Disconnect, supra,* at 2, 3 ("an intrusion of 10 dBA causes widespread complaints").

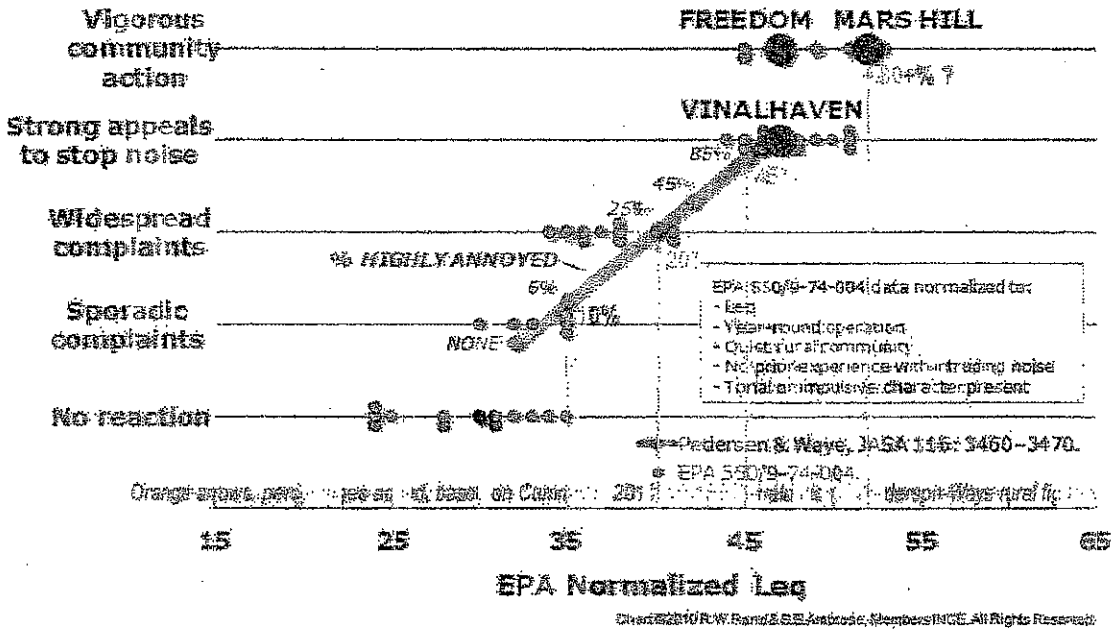
Robert Rand and Stephen Ambrose, acoustical engineers who have devoted themselves to studying wind power noise issues in this State in the past few years, validate these conclusions by reference to the United States Environmental Protection Agency's *Levels Document,* created

in 1974 pursuant to the Noise Control Act of 1972[5] and comparing the studies in that document to their literature review and measurements of current projects in Maine. The EPA's *Levels Document* sets forth a matrix for assessing the community reactions to environmental noise by identifying predicted or actual sound level measurements and then making adjustments ("normalizing") for aggravating factors. The adjustment factors are set forth in Table D-7 at D-18 of the *Levels Document* and the Community Reaction Matrix is found in Figure D-7 at D-20 of the *Levels Document.* It is remarkable that the adjustment factors in Table D-7, to a large extent, mirror the very same factors that make wind power a unique source of noise, namely, adjustments for (1) introducing a new sound source into a community (5 dB) , (2) for location in a quiet, rural area (10 dB) and (3) for amplitude modulation (5 dB). The Community Reaction Matrix (Figure D-7) is expressed in day/evening/nighttime (Ldn) terms. To convert Ldn to Leq used in DEP Noise Rule, Rand and Ambrose subtracted 6 dBA. Then they applied the cumulative 20 dB adjustment factors to the Matrix. With these adjustments, Rand and Ambrose predicted that sound levels of 45 dBA, the nighttime limit in the DEP Noise Rule for quiet neighborhoods, would produce "strong appeals to local officials to stop noise/threats of legal action." At the hearings, Rob Rand will explain what he did by reference to the following graph:

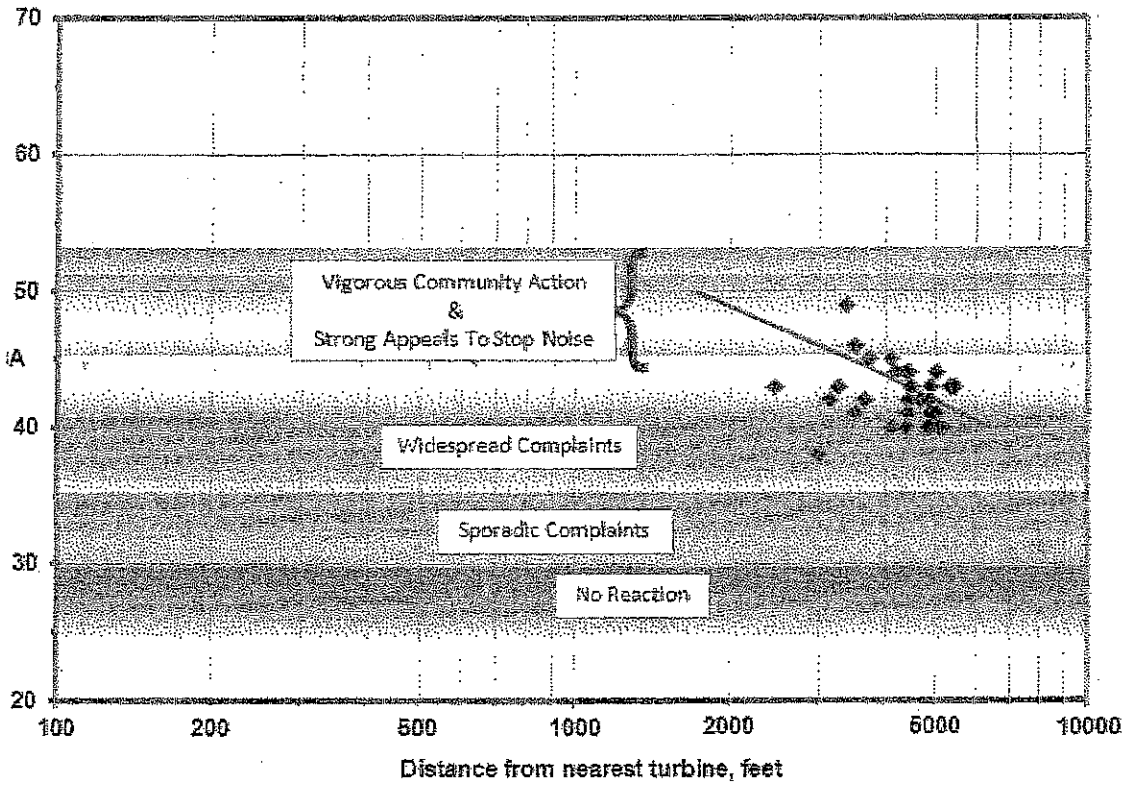
[5] This document was made part of the 1989 rulemaking record when the Noise Rule was last amended.



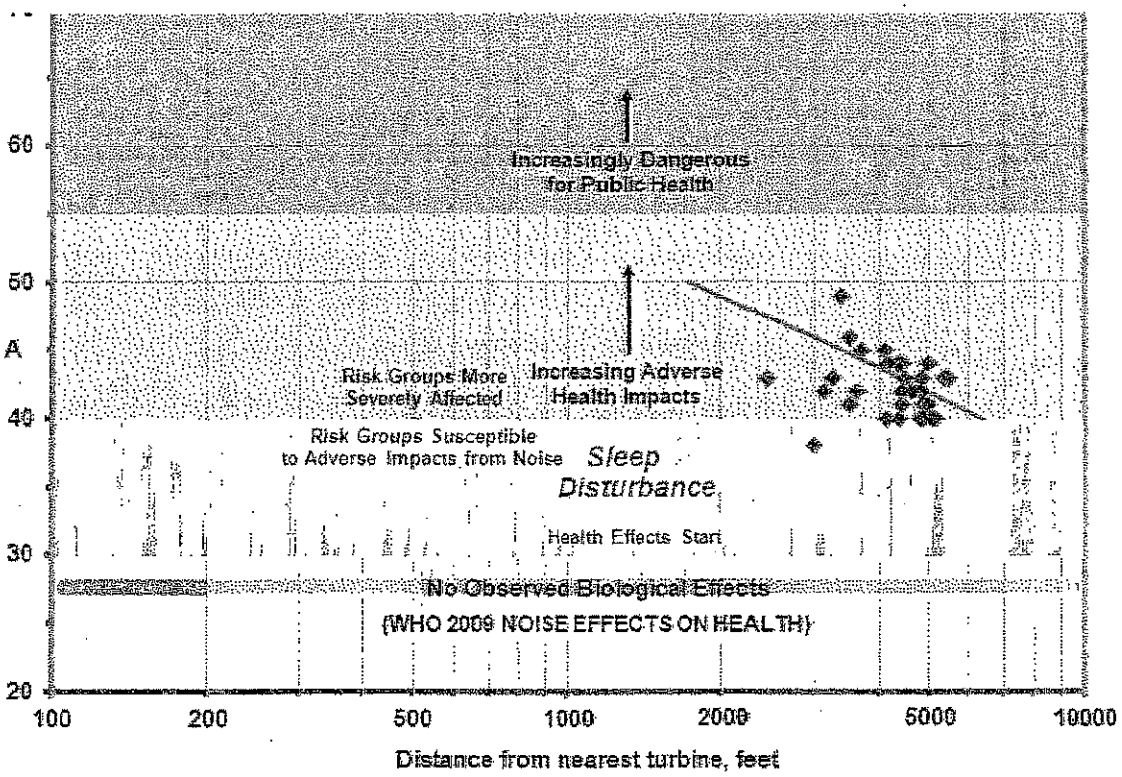
He also will explain in his testimony how this chart overlays studies by Eja Pedersen and the experienced noise levels at Mars Hill, Freedom sand Vinalhaven:



He also used the same principles to predict community reaction in relation of the proximity to wind turbines as follows:



Finally , he used his community reaction matrix to graph predicted health responses using findings from the *WHO Night Time Noise Guidelines for Europe (2009):*



Based on the consensus discussed above and the principles recognized in the existing Noise Rule, our own State Planning Office suggests limiting increases over pre-development to 5 dBA. *Technical Bulletin No. 4* at 8-9. New York's policy is to look carefully at any project that raises pre-development background noise levels by 6 dBA. NYDOEC, *Assessing and Mitigating Noise Impacts, supra* at 13-14. *See also*, Massachusetts Regulation 310 CMR 7.10 and Division of Air Quality Control Policy, and Iowa Regulation 340-035-0035 (1)(b)(B)(IV)), providing for no more than 10 dBA over ambient, and New Zealand's new wind turbine regulations, NZS 6808: 2010 limit increases to 5 dB or 35 dB, whichever is greater.

3. Low Frequency.

Low frequency noise is not regulated at all in the existing Noise Rule. Under the DEP Noise Rule all noise measurements are A-weighted, which filters out low frequency sound. Leventhall, *Low Frequency Noise, supra*, at 95 ("Unfortunately, conventional methods of

dealing with environmental noise stressors are A-weighted, which means that the presence of disturbing low frequency noise may not be detected."). *See also*, Siponen, T*he Assessment of Low Frequency Noise and Amplitude Modulation*, *supra* at 1. Clearly the Noise Rule needs to be amended to require measurements and sound limits for low frequency noise.

B. Deficiencies in the Existing Noise Rule on Modeling and Other Pre-Licensing Requirements.

In addition to amending the Noise Rule to take into account the three features of wind turbine noise that are different and more annoying than other sources of industrial noise, attention needs to be given to deficiencies in modeling and other pre-licensing requirements.

1. The Absence of any Requirements for Uncertainty Factors in the Existing Noise Rule.

Assessment studies submitted to the DEP by applicants for permits under the Site Location of Development Law for wind turbine facilities uniformly use Cadna/A operating in ISO 9613-2 mode as software for sound prediction modeling. This prediction modeling software is not designed for wind turbines: it is not designed for (1) sound sources at a height of a ridgeline, such as that proposed for a project, or (2) for receiver points more distant than 1000 meters, or (3) for wind speeds above what ISO 9613-2 recommends, or (4) for sound sources that are in a string of turbines making "line source" measurements necessary.

Kenneth Kaliski, an acoustical engineer doing business as Resource Systems Group, identifies many of these limitations in his article, *Propagation Modeling for Wind Turbine Projects,* Sound & Vibration (2008). In his article, Kaliski attempts to make adjustments to account for the inadequacies of ISO 9613-12, but these adjustments are so numerous that clearly uncertainty factors need to be incorporated into prediction models using the software. Other studies addressing the limitation in the software for modeling projections include Frank H.

Brittain & Marlund E. Hale, *Some Limitations of Ray-Tracing Software for Predicting Community Noise from Industrial Facilities*, NOISE-CON, Dearborn, Michigan (July 28-30, 2008) explaining that ISO 9613 estimates the accuracy for A-weighted sound propagation of noise for distances only up to 1 km, but is routinely used for distances greater than that. *See also,* Palmer, *A New Explanation for Wind Turbine Whoosh- Wind Shear, supra*, at 8 pointing out that IEC 61400-11 does not provide for atmospheric stability, increasing sound levels and creating pulsation from wind shear, as discussed below.

The current practice of the DEP is to request developers submitting applications for grid scale wind turbine to incorporate in their sound assessments an "uncertainty factor" of 5 dBA, 2 dBA to account for uncertainties in manufacturer's power specifications and 3 dBA for uncertain in modeling. However, this practice is not required, as evidenced by the absence of such factors in the licensing of a small scale wind project in Vinalhaven, which has had compliance issues for excessive noise from the outset of its operations.

2. The Need to Model for "Predictable Worst Case" Conditions.

Under the current Noise Rule, the DEP has engaged in the practice of requiring post-construction monitoring for predictable worst case conditions rather than mandating that the sound assessments take into account such conditions in the licensing phase. For example, the DEP typically addresses the possibilities of increased noise propagation from atmospheric stability and SDRS by requiring post-construction monitoring in place of pre-construction modeling. The assumption of the DEP apparently is that if the predictable worst case conditions in fact occur, compliance with noise limits can be achieved by requiring Noise Reduction Operations ("NRO"). An alternative practice occurring in recent licensing, such as for Spruce Mountain, is to approve a project where the modeling shows that the Noise Rule Sound Level

Limits will be exceeded by the modeling subject to the condition that the project operate in specified NRO mode at night. It is ironic that the DEP requires proof of compliance after construction based on worst case conditions, but not pre-construction modeling. We suggest this turns common sense on it head , creating unacceptable risks of exposure of nearby residents to excessive noise, all in the name of expediting wind turbine projects.

These assumptions and practices violate the principle of modeling to predictable worst case conditions and create risks that there will be difficult compliance problems from excessive noise once operations begin that cannot be fixed after the fact. There is an absence of field studies showing that projects operating in NRO mode achieve sound level projections at the level predicted by turbine manufacturers when turbines noise is enhanced by turbulence or wind shear. The experience of the DEP in Vinalhaven in connection with the Fox Island Wind Project shows that operating in NRO has not worked so far as predicted. Also, there are limits to NRO, which max out at NRO 4 supposedly to reduce sound levels by 4 dBA.

If NRO does not work, then there will be serious problems in addressing compliance issues after a project is built, as evidenced in Mars Hill where the Department ended up giving the licensee a 5 dBA variance, and there will be enormous resistance by the licensee to take any action that will reduce the power production of the project, as again evidenced by Vinalhaven.

Every single wind turbine project that has been built and is now operating near residences has produced noise levels that are intolerable to the neighbors. The Board should heed the lessons from Mars Hill, Freedom and Vinalhaven -- all the projects now operating in Maine with nearby residences -- that projects sited so close to residences in the real world conditions result in serious noise complaints from routine operations. One can say that different rules were applied for the licensing at Mars Hill and Vinalhaven, neither of which applied the "uncertainty factors"

addressed above and that there was no licensing of the Freedom project. But there is no assurance that the use of uncertainty factors would have eliminated problems in licensed projects near homes in these operating projects. If there are conditions that can lead to noise levels greater than those predicted in modeling, such as atmospheric stability or other conditions leading to turbulence, or amplitude modulation, even if the chances of these conditions are not substantial, they should be made part of the prediction and not left to measurement after a project is built. A greater cushion should be required to protect the local population.

Even if predictive modeling incorporates a 5 dBA uncertainty factor as addressed above, the noise assessment can fail to account for excessive noise if it does not take into account predictable conditions that cause noise to exceed what is otherwise predicted. The existing noise rule contains no such requirement. Some of the conditions that need to be included in pre-licensing sound assessments include the following:

a. Atmospheric Stability

The prediction modeling used in applying for wind turbine permits under the Site Law typically does not take into effect atmospheric stability. Atmospheric stability occurs at night when the land cools and vertical air movement disappears, and where wind can be calm on the ground but continue to blow at hub-height, creating wind shear. When this occurs, wind turbine sounds are more noticeable, since there is little masking of background noise, and more importantly, because the high wind shear amplifies noise when the turbine blades cut across the wind gradient. Palmer, *A New Explanation for Wind Turbine Whoosh- Wind Shear,* Third International Meeting on Wind Turbine Noise, Denmark (2009). As explained by Pedersen, et als, *Response to Noise From Modern Win Farms, supra* at 642:

> A large portion of respondents in the present study reported hearing wind turbine sound more clearly at night, an observation supported

> by previous findings that, due to atmospheric conditions ...nighttime immission levels can be higher than estimated from 10 m wind speeds using a neutral wind speed profile ... and also because the average hub height wind speed at night is higher than the same wind speed in day time. In contrast, the near surface wind speed at night is often weaker in conditions that favor stronger high altitude winds, resulting in less wind induced background sound levels from vegetation ... with less capacity to mask the wind turbine sound or even distract attention for it. **Taken together, this implies that nighttime conditions should be treated as crucial in recommendations for wind turbine noise limits.** [Emphasis added.]

The flaws in wind turbine predictions that do not take into account atmospheric stability have been recognized at least since 2003, in the peer reviewed study of G.P. van den Berg, *Effects of Wind Profile at Night on Wind Turbine Noise.* van den Berg estimates that atmospheric stability can add as much as 15 dBA to the sound levels modeled. *See also,* R Kochanow & N. Mackenzie, *Atmospheric Stability Specific Noise Criteria and Noise Predictions for Wind Farms,* Acoustics 2008.

The DEP practice of allowing a developer to assess the effects of atmospheric conditions only after a project is built should be changed. Unless a developer can credibly establish that there is no practical possibility for atmospheric stability to occur at the site of the proposed project, this condition should be taken into account in application for wind turbine permits under the Site Law.

b. Turbulence.

As explained in Harrison, Disconnect, *supra*, at 7:

> The additional aerodynamic noise arising from the rotation of wind turbine blades in turbulent wind is not yet included in noise limits of any jurisdictions. .... **Regulating authorities need to request turbulent intensity measurements and associated noise estimates in the impact assessments required before approval of wind plants.** [Emphasis added.]

Sound assessments submitted to the DEP in support of wind turbine licenses typically overlook

that there are multiple sources of turbulence that can create amplitude modulation, including not only atmospheric stability addressed above, *see also,* McCabe, *Detection and Quantification of Amplitude Modulation, supra,* at 13-14 (also explaining that it is possible to integrate a metric for modulation into wind turbine software so that operations can be automatically curtailed when amplitude modulations occurs), but also, updrafts, cross drafts and wake interference. Wake turbulence occurs when turbines are not properly aligned. For example, GE designs their wind turbine projects to have 5 rotor diameters of distance between wind turbines in the non-dominant wind direction and 7 to 10 rotor diameters in the direction of prevailing winds. Projects designed with turbines closer than this should be considered a likely cause of wake induced turbulence and increased wind turbine noise and amplitude modulation.

c. Accounting for Coherence

The sound assessments for wind turbine noise typically assume that each noise source is different ("incoherent") such that each does not reinforce the other at a receiving location. However, wind turbine noise emissions are not incoherent. They have similar frequency and temporal characteristics as the sounds emitted by other wind turbines. This makes wind turbine noise 'coherent' and the result is that the noise travels father and is louder. This phenomenon needs to be incorporated into the modeling for wind turbines to accurately predict their impact on nearby residents.

d. Point Source and Line Source.

The sound propagation from wind turbines occurs partially as a "point source," causing sound levels to attenuate at the rate of 6 dBA for every doubling of distance from the source, and partially as a "line source," where attenuation occurs at half that rate, at 3 dBA per doubling. There is clear scientific consensus on this issue. *See,* NASA, Hubbard & Shepherd, *Applied*

Acoustics Handbook at 27 and C.E. Ebbing, *Applied Acoustics Handbook* at 2-8 through 2-10. The NASA study, *supra,* at 27, explains that the line source and point source produce similar results only at distances that exceed the length of the line. There are no provisions for cylindrical spreading (line source) in ISO 9613-2, which uses spherical spreading (point source). Both line source and point source should be used for modeling purposes, which is not currently addressed in the existing Noise Rule.

3. Noise Easements.

The Noise Rule creates an exemption for protected location where the owner of the property has conveyed a noise easement to the developer. Chapter 375.10.C.(5)(s). This provision creates an incentive for a developer to approach landowners near a proposed project to offer compensation to obtain an easement. These easements typically do not disclose the level of noise that the property owner will be exposed to or the potential effects of the noise on the owner's health or welfare. Yet they do provide typically that the property owner may not challenge noise levels from the operation of the project and, if this covenant is violated, the property owner must pay the attorneys fees for the project owner to defend the suit. Because the DEP creates an incentive for these kinds of easements, and gives effect to them for regulatory purposes, the Department has a responsibility to require the applicant for a wind turbine license make a proper and fair disclosure before these easements will be deemed effective.

C. The Existing Noise Rule's Sound Level Limits Do Not Adequately Protect the Health and Welfare of Nearby Residents.

In the last three appeals from the issuance of wind project licenses by the DEP (Record Hill, Oakfield and Spruce Mountain) the Board has "recognize[ed] that noise emitted from the proposed project has the potential to be heard at an audible level from protected locations and that noise generated by the project may be found to be an annoyance by some people." *See,*

Spruce Mountain Board Order at 12. In each case the Board denied the appeal, notwithstanding its acknowledgement of annoyance, based on the absence of evidence of *direct* health effects from wind turbine noise.

Based on the credible literature in the field and the testimony of Dr. Michael Nissenbaum who has studied and done epidemiological studies on the subject for Mars Hill and Vinalhaven, we hope to persuade the Board that there is sufficient risk of *indirect* health effects from wind turbine noise secondary to sleep deprivation to justify – indeed to mandate – more protective sound levels risks. However, before addressing this proposition, it is helpful to understand how the issue has not been properly framed. Even in the absence of proof of indirect, objectively defined adverse health impacts, there is a need for the Noise Rule to be amended to lower acceptable sound level limits.

1. Health Related Quality of Life Issues.

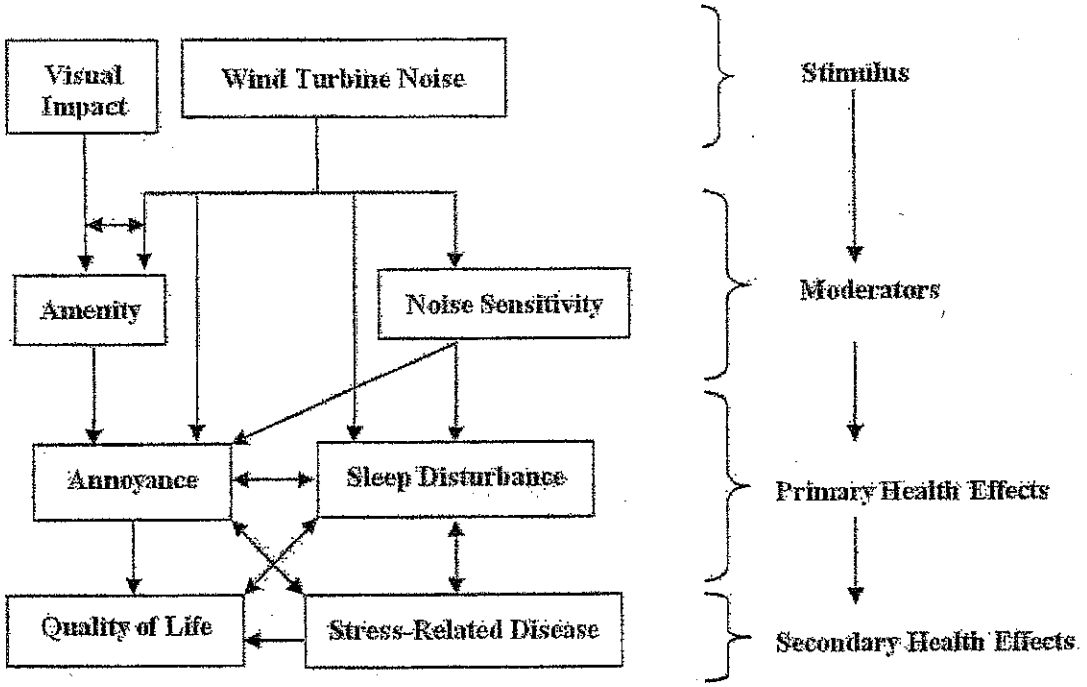
When one speaks of "annoyance," many think of a condition that slightly irritates or bothers, an inconvenience, usually temporary in nature. However, in the context of wind turbine noise those kinds of associations are misleading. "[I]n contemporary medicine, annoyance exists as a precise technical terms describing a mental state characterized by distress and aversion, which if maintained, can lead to deterioration of health and well being." Shepherd, et als., *Wind Turbine Noise and Health Related Quality of Life*, at 8, citing Dr. Alice Sutton' s report, *Noise and Its Effects*, prepared for the Administrative Conference of the United States in 1991, found at www.nonoise.org/library/suter/suter.htm:

> 'Annoyance' has been the term used to describe the community's collective feelings about noise ever since the early noise surveys in the 1950s and 1960s, although some have suggested that this term tends to minimize the impact. While "aversion" or "distress" might be more appropriate descriptors, their use would make comparisons to previous research difficult. It should be clear,

> however, that annoyance can connote more than a slight irritation; it can mean a significant degradation in the quality of life.

See also, Leventhall, *Low Frequency Noise, supra*, at 84 ("Annoyance brings feelings of disturbance, aggravation, dissatisfaction, concern, bother, displeasure, harassment, irritation, nuisance, vexation, exacerbation, discomfort, uneasiness, distress, hate etc. some of which combine to produce the adverse reaction.")

As properly defined in the context of wind turbine noise, "annoyance" constitutes a degradation of health as defined by the World Health Organization in 1948, which is "still the guiding principle in public health work." Pedersen, *Health Aspects Associated with Wind Turbine Noise, supra* at 47. *See also Sutton, supra,* at 27; Pederson & Waye, *Wind Turbine Low Level Noise, supra* at 20, and Shepherd, et als., *Wind Turbine Noise and Health Related Quality of Life, supra* at 2. The 1948 WHO definition of health is a "state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." Preamble of the Constitution of the World health Organization as adopted by the International Health Conference, 19-22 June 1948, WHO New York (1948). The two paths to secondary adverse health effects, one through annoyance and the other through sleep disturbance are illustrated by Shepherd, et als, supra at 3 as follows:



The Board should protect citizens in this State against the intrusion of unwanted and unconsented industrial noise that is annoying to them in the sense that it deprives them of well being, even in the absence of proof that it causes secondary health effects from sleep disturbance. The Preamble of the DEP Noise Rule, after all, states a mandate to protect the "welfare" of the citizens of this State as well as their "health" in the more traditional sense of the word. Put another way, wind turbine developers have no right to unilaterally deprive property owners of their right to peacefully enjoy their property, to rob them of their wellbeing while residing on their property. The literature reviewed at the outset of this Statement of Position makes it clear that wind turbine noise is uniquely more annoying than other forms of industrial noise cause and causes annoyance for a larger number of people at lower sound pressure levels than other sources and thus there is a compelling need to lower the Sound Level Limits in the Noise Rule to reflect this.

2. Wind Turbine Noise Creates Risks of Sleep Disturbance and Adverse Health Effects Secondary Thereto at the Existing Sound Level Limits.

Dr. Eja Pederson, the world renowned Swedish expert on the subject of wind turbine noise, recently warned that "the public concern regarding the possible health risks among people living in the vicinity of wind turbines should be treated seriously". E. Pederson, *Effects of Wind Turbine Noise on Humans,* Third International Meeting on Wind Turbine Noise, June 17-19, 2009 at 2. We ask the Board to treat the concerns raised in these proceedings seriously and provide greater protection to residents exposed to unwanted noise from nearby wind projects.

Dr. Michael Nissenbaum will address this issue in his presentation to the Board at the rulemaking hearings. Dr. Nissenbaum is an expert in the medical effects of exposure to excessive wind turbine noise. He developed an interest in the health effects of wind turbine projects after becoming aware of complaints related to an industrial wind turbine project in Mars Hill, Maine and subsequently investigating the widespread and serious health effects suffered by most of the residents of Mars Hill within 1400 meters or so of a linear arrangement of industrial wind turbines. Following a small pilot study in 2009 at Mars Hill, he undertook a larger, standardized study in 2010 in the towns of Mars Hill and Vinalhaven (Fox Island Wind Project) Maine using validated questionnaires regarding sleep disorders and physical and mental health, in addition to attitudinal questions in 2010. The study followed a strict protocol including subject and control selection criteria, with raw data segregated from and not handled by the principal investigator. [6] The outcome of the Study is that subjects at Mars Hill and Vinalhaven living within 1400 meters

[6] Data analysis was carried out by a professional epidemiologist, who did not interact with either subjects or controls and who used, in part, analysis software provided by Quality Metrics, developers and licensors of the SF-36v2 questionnaire, one of the validated questionnaires utilized in the study. Other validated questionnaires included the Epworth Sleep Scale and the Pittsburgh Sleep Quality Index, which evaluated effects upon sleep and resultant dysfunction. The material is being prepared for publication in a peer reviewed journal. *Id.*

(.8 mile) had worse sleep quality, were more sleepy, and worse mental health summary scores than those living 3000m (1.7 miles) - 6000m (3.7 miles) away. Psychiatric symptom scores (irritability, stress, anger, hopelessness and anxiety) were significantly greater in the group living closer to the turbines, as was a composite mental health score. They were also more likely to report headaches, nausea and to wish to move away (73.7% v 0%). *Id.* Dose response curves of health scores against distance from the turbines were plotted and were significantly related even after controlling for gender, age and household clustering. In all cases, there was a sharp increase in effect between 1 and 2km. However, the scores were still declining and had not reached steady values at 6000m. From the foregoing, he concluded that industrial wind turbines adversely affect health, in particular sleep, at distances of at least 2000m (1.2 miles) and probably beyond. The health impacts he anticipates were:

> a) Sleep disturbances/sleep deprivation and the multiple illnesses that cascade from chronic sleep disturbance. These include cardiovascular diseases mediated by chronically increased levels of stress hormones, weight changes, and metabolic disturbances, including the continuum of impaired glucose tolerance up to diabetes.
>
> b) Psychological stresses which can result in additional effects including cardiovascular disease, chronic depression, anger, and other psychiatric symptomatology.
>
> c) Increased headaches.
>
> d) Unintentional adverse changes in weight.
>
> e) Auditory and vestibular system disturbances.
>
> f) Increased requirement for and use of prescription medication.

See also, Salt and Timothy Hullar, *Responses of the Ear to Low Frequency Sounds, Infrasound and Wind Turbines*, 268 Hearing Research 12 (June 2010), a peer review funded by the National Institute of Health. Based on his research, Dr. Nissenbaum urges the Board to adopt the amended Sound Level Limits proposed in the Petition before the Board.

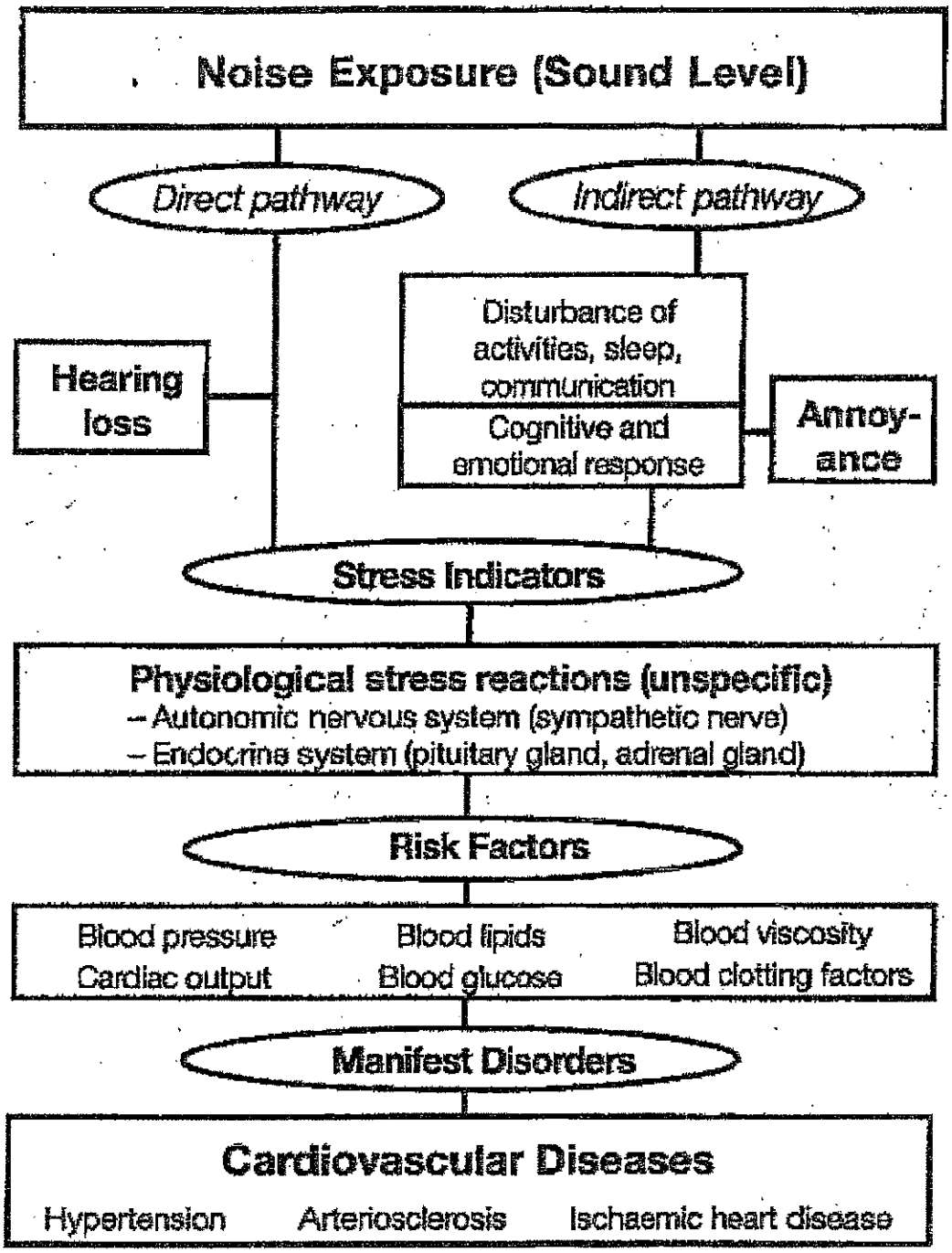
Dr. Nissenbaum's findings are supported by Dr. Christopher Hanning, a sleep disturbance expert, in his report, *Wind Turbine Noise, Sleep and Health* (November 2010), reviewed and approved by a panel of professionals. Dr. Hanning concludes based on his research, literature review and his expertise in sleep disorders, that "[t]here can be no reasonable doubt that industrial wind turbines whether singly or in groups ('wind farms') generate sufficient noise to disturb the sleep and impair the health of those living nearby and this is now widely accepted."Section 2.1.1 at 6. He explains that noise interferes with sleep by preventing the onset of sleep, by arousals and sleep fragmentation. Sections 2.2.4 through 2.3.4. He further explains that inadequate sleep has been associated not only with fatigue, sleepiness and cognitive impairment, but also with risk of obesity, impaired glucose tolerance (risk of diabetes), high blood pressure, heart disease, depression, cancer, and impaired immunity. Section 2.2.2 at 7. *See also,* van den Berg, et als. in the EU financed study, *WINDFARMperception, supra,* ,where the authors point out that "the stress scores, difficulties to fall asleep and sleep interruption were associated with annoyance due to wind turbines ..." *id.* at 55, *see also id.* at 57 ("wind turbine sound leads to annoyance for some people; annoyance that in turn possibly hinders psycho-physiological restoration and increases the level of stress."); Pederson & Waye, *Wind Turbine – Low Level Noise supra* at 1 ("the prevalence of noise annoyance [is], apart from the sound pressure level, strongly related to disturbed rest" and "[i]nhibited restoration or hindrance of psychological stress recovery due to disturbance from noise sources is today believed to have an important impact on not only mood but more long term health consequences."); E. Pederson, *Effects of Wind Turbine Noise, supra,* at 10 ("Stress was in these studies not directly associated with A-weighted sound pressure levels, but with noise annoyance. There was a remarkable consistency among the studies for the relationship between feeling tense or stressed and

annoyance."), E. Pedersen, *Health Aspects Associated With Wind Turbine Noise, supra*, at 48 (beyond quality of life issues, annoyance can be "a measurable indicator of enhanced risk for chronic imbalance that could lead to more severe states, such as high blood pressure, and if prolonged, to cardiovascular disease."), 50 (the increase in respondents who reported sleep interruption appeared at approximately 40 dB), 51 (" a sharp increase around 40 dB in the first Swedish study), and 51 ("There was a remarkable consistency among the studies in the relationship between feeling tense or stressed and annoyance.") Based on this study, Dr. Pedersen said there must be a "call for political action." *Id.*

These conclusions find further support in the peer reviewed World Health Organization ("WHO") *Night Time Noise Guidelines for Europe* (2009), which concluded that "[t]here is plenty of evidence that sleep is a biological necessity, and disturbed sleep is associated with a number of health problems". *Id.* at XI. Also, it concludes that "noise induced sleep disturbance is viewed as a health problem in itself (environmental insomnia)". *Id.* at XII. It further concludes that sleep disturbance also leads to further consequences for health and well-being". *Id.* In Section 2 of the *Guidelines* the consequences of sleep deprivation are summarized. *Id.* at 23 (Table 2.4). Some of the short term consequences are sleepiness, mood changes, irritability and nervousness, impairment of function, increased metabolic rate and thyroid activity, and immune function impairment. Some of the long term consequences are depression/mania, violence, difficulty learning new skills, increased sensitivity to pain and susceptibility to viral illnesses. Based on the extensive research done, the 2009 WHO *Guidelines* conclude that **sleep disturbance from noise occurs between 30 to 40 dB.** *Id.* at XIII (table 1) and XVI-XVII (including Tables 3 and 4). Based on these findings, the 2009 WHO *Guidelines* recommend that noise levels at night should not exceed 40 dB during the night "[f]or the primary prevention of

subclinical adverse health effects". *Id.* at XVIII.

The WHO *Guidelines* do not address wind turbine noise. However, that fact does not detract from the significance of its findings. To the contrary, it makes the report especially more compelling because wind power noise poses a *greater risk factor* than other sources of industrial noise addressed in the WHO *Guidelines*. The 2009 WHO *Guidelines*, *supra*, 62, while not addressing wind turbine noise, do explain the general principle that annoyance plays a prominent role in the indirect pathways to adverse health effects from noise, as illustrated in the following chart:



The wind industry seeks to marginalize the WHO *Guidelines* by focusing on the differences between the recommended nighttime sound levels at the façade of a protected

location in comparison to the DEP Noise Rule which measures 500 feet from the residence, and comparing the 1 hour Leq measurement in the Noise Rule against a yearlong measurement provided for in the WHO *Guidelines*. These arguments confuse the science that the WHO *Guidelines* reveal with the politics of enforcement. We invite the Board to focus on the science, that sleep disturbance begins between 30 and 40 dB and to formulate rules that protect homeowners near wind projects from exposure to such levels with a margin of safety.

D. The Existing Noise Rule Does Not Adequately Provide For Post-Construction Compliance.

The DEP is has little experience with compliance issues in routine operations of approved wind projects because it has granted licenses to only two projects with turbines near homes, Mars Hill and Vinalhaven. It dealt with Mars Hill by granting a variance. It has been struggling for a year and a half with Vinalhaven, found to be out of compliance months ago. The project owner in Vinalhaven has aggressively resisted efforts by the DEP to bring the project into compliance, refusing to collaborate in good faith. The result of the process has revealed several shortcomings in the existing Noise Rule concerning compliance in routine operations. These include the lack of clear requirements on the affirmative duty on the part of a licensee to demonstrate compliance at all times under all conditions and just how this should be accomplished, the duty to maintain and to transmit to the DEP contemporaneous records on operational sound data and meteorological records for period when a complaint is made so that it can be analyzed, the need for procedures for citizen complaints that are not burdensome and what happens after a complaint is filed. The DEP responded to these and other deficiencies by developing protocols for Vinalhaven to show compliance and for citizen complaints. The revised draft rule amendment simply incorporates these protocols for general use.

III. THE PROPOSED AMENDMENT TO THE NOISE RULE, AS REVISED ARE REASONABLE AND NECESSARY.

The Proposed Noise Rule Amendments as set forth in the Citizens Petition, revised as set forth in the attachment to this Statement of Position, are designed to address the various special features of wind turbine noise that distinguish it from other sources of industrial noise and the deficiencies in the DEP Noise Rule in addressing these issues in three basic ways..

First, the modeling issues are addressed in Section I(2)(a)-(e) and Section I(4) of the proposed amendments by a requirement that applicants for wind turbine licenses must predict "predictable worst case" conditions, with line source and point source as appropriate,. and including adjustments for atmospheric stability, turbine wake, other forms of turbulence, and coherence. The proposed revisions also formalize the uncertainty factors the DEP is already using and, perhaps most important of all, redefine SDRS to bring it in line with amplitude modulation of the kind experienced by those living near wind projects which causes this kind of noise to be particularly annoying. There is an urgent need to lower the Sound Level Limits by 5 dBA where a project will propagate amplitude modulation. As part of the application process, the Board should reform practices of developers who seek exemptions from the Noise Rule for properties under easements by making sure the developer is fairly disclosing what citizens are asked to allow.

Second, and most importantly, the revisions seek to provide more protective sound limits, as set forth in Section I(3)(a)-(d) of the proposed amendments. The standards are all interrelated in the sense that they all are designed to accomplish the same thing, namely to reduce dBA limits for quiet rural areas to a point where there is no significant annoyance (in the technical sense of the word associated with health related quality of life) and health risks. Of the four limits, the one most commonly adopted outside of Maine is the 5 or 10 dBA over pre-development

background noise, as used in Massachusetts, New York, Iowa, and New Zealand and others. This is what Richard James proposes. *Simple Guidelines, supra* at 6, and the "*How To Guide," supra,* at 15, together with a 35 dBA limit. The "background plus" limit requires a proper long term background study before construction, provisions for which are set forth in Section I(1)(b) of the Proposed Revisions. The "background plus" test would produce a nighttime limit of 35 dBA assuming background measurements of 30 dBA or, if the 10 dBA plus is used, it would produce the same 35 dBA if background measured out at 25 dBA, which the evidence supports to be common. If a 1 mile setback is used, in all likelihood the 35 dBA and the background plus tests would be satisfied as well. In the literature and testimony, Dr. Nissenbaum recommends 1.2 miles, Dr. Hanning recommends a setback of 1.5 km, *Wind Turbine Noise, supra,* at 52, together with a 35 dBA limit at well, *id.* at 51. Dr. Salt recommends a 2 km (1.4 miles) setback, Salt, *Infrasound, Your Ears "Hear" It But They Don't Tell Your Brain;* Shepherd, *Wind Turbine Noise, supra,* at 9 (the same); Harrison recommends 1 to 1.5 km, *Disconnect, supra,* at 7 (and also references several other suggested setbacks from others); Pedersen, *Effects of Wind Turbine Noise on Humans, supra,* at 10 ("Annoyance due to wind turbine noise should in the future be avoided by applying proper regulations for shortest distance between turbines and dwellings in the surroundings."). For surveys of other countries, see James, *Simple Guidelines, supra,* at 6, and the "*How To Guide," supra,* at 3. The dBC limits are derived from Richard James, *Simple Guidelines, supra,* at 6 and the "*How To Guide," supra,* at 15.

Third, standards developed by the DEP recently for use in for Fox Islands Wind for post construction compliance are recommended in Section I(6) of the Proposed Amendment so that the standards can be used to enforce effective compliance in the context of a non-cooperating licensee.

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Respectfully submitted.

/Rufus E. Brown/

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Exhibit A

REVISED
PROPOSED NOISE RULE AMENDMENT
(6/30/11)

The Department of Environmental Protection Rule 06 CMR Ch. 375, Section 10 (the "DEP Noise Rule") is amended by adding the following new Section I:

I. Sound Level Limits and Measurements for Wind Turbine Projects.

(1) Applicability:

The terms of this section shall apply to grid-scale wind energy developments as defined by 35-A M.R.S.A. §3451.6 and small-scale wind energy developments governed by 35-A M.R.S.A. §3456, hereinafter referred to as "Wind Turbine Projects," and shall supersede any provisions in Section 10.A through 10.H. of this Rule inconsistent with the terms set forth below.

(2) Modeling:

(a) The computer model shall be designed to represent the "predictable worst case" noise impact on properties. The "predictable worst case" noise assessment shall represent the maximum rated output of the wind utility operating during nighttime stable atmospheric conditions with high wind shear above the boundary layer and all other conditions that affect the in-flow airstream that can exceed the design limits for normal operation of the turbines. The sound propagation rate shall reflect a point or line source (6 dB vs. 3 dB decay rates), or combination thereof, as is most appropriate for the proposed arrangement of wind turbines.

(b) Long-Term Background Sound Measurements:

(i) All data recordings shall be a series of contiguous ten (10) minute measurements. The measurement objective is to determine the quietest ten minute period at each location of interest. Nighttime test periods are preferred unless daytime conditions are quieter. The following data shall be recorded simultaneously for each ten (10) minute measurement period: dBA data includes LA90, LA10, LAeq and dBC data includes LC90, LC10, and LCeq. Record the maximum wind speed at the microphone during the ten minutes, a single measurement of temperature and humidity at the microphone for each new location or each hour whichever is oftener shall also be recorded. A ten (10) minute measurement contains valid data provided: Both LA10 minus LA90 and LC10 minus LC90 are not greater than 10dB and the maximum wind speed at the microphone is less than 2 m/s during the same ten (10) minute period as the acoustic data.

(ii) Site selection, weather/wind conditions during tests, instrumentation use, calibration, etc. shall comply with ANSI S12.9 Part 3 "Short Term Measurements with and Observer Present;" S12.9 Part 1 "Quantities and Procedures for Description and

Measurement of Environmental sound." Long Term Background sound is defined here-in as residual sound (5.1.14; and S12.18 Procedures for Outdoor Measurement of Sound Pressure Level" Method 1 to the extent practicable. If Long term un-observed monitoring is substituted for Short term observed measurements the protocol shall comply with one of the three sampling protocols and account for spatial and temporal uncertainty in the manner required by S12.9 Part 2, Measurement of long term wide area sound.

(c) Coherence and turbine wake:

Predictive modeling shall include the effect of combining sounds of multiple turbines with similar spectral and temporal content and turbulence caused by the wake of other nearby turbines.

(d) Atmospheric stability:

Modeling shall include predictive sound levels at night under conditions of atmospheric stability.

(e) Uncertainty factors:

Sound level estimates for predictive monitoring shall add a (i) a 2 dBA uncertainty factor to the manufacture's rated operating sound level at full turbine power (IEC 61400-11) and (ii) a 3 dBA uncertainty factor for sound propagation predictions using ISO 9613-2. The modeling shall also exclude attenuation factors except for atmospheric absorption. Ground absorption shall be 0 and there should be no attenuation due to ground cover or vegetation.

(3) Sound Limitations:

Sound from Wind Turbine Projects during routine operations during the nighttime, as measured at protected locations, shall meet all of the following requirements:

(a) The predicted or measured Leq (from turbine's sound immissions) in dBA shall be no louder than 5 dB above the A-weighted pre-operation nighttime background LA90; and

(b) The predicted or measured Leq (from turbine's sound immissions) in dBC shall be no louder than 20 dB above the C-weighted pre-operation nighttime background LC90; and

(c) The maximum noise from wind turbines during nightime shall be no greater than 35 dBA and 55 dBC (Leq) at any non-participating receiving property; and

(d) The nearest turbine to a protected location is no closer than 1 mile.

(4) SDRS; Tonality Measurements.

(a) In determining whether a sequence of repetitive sounds constitutes Short Term Duration Repetitive Sounds, the lowest sound level in a sequence will be compared to the highest sound level in the sequence.

(b) If there are more than 2 sequences where peak to valley is 3 dBA or more in an hour, or any one sequence that lasts five minutes or more, a 5 dB penalty shall be applied against the sound level limitations as set forth in subsection 3 above.

(c) Tonal sounds shall be measured in accordance with ANSI S1.13-2010 Annex A, Identification and evaluation of prominent discrete tones.

(d) If tonal sounds are predicted or found in post-constructional monitoring, the overall sound level limitations shall be reduced by 5dBA. If the tone occurs at a frequency below 500 Hz the penalty shall also apply to dBC limits.

(e) If there is substantial uncertainty as to whether SDRS or tonal sounds will occur in the routine operations of the wind turbine project, the Department will apply the 5 dbA penalties as described above, subject to removal if post-construction compliance testing shows the absence of SDRS or tonal sounds.

(5) Noise Easements:

Noise Easements will be given effect under Section 10.C.5(s) only if the applicant submits to the Department a written statement of the disclosures given to the resident or owner executing the noise easement which adequately discloses the public health risks associated with the noise expected to be propagated in relation to the property that is the subject of the easements.

(6) Post-Construction Compliance:

(a) Compliance Assessment:

i The licensee shall affirmatively demonstrate that it is in compliance with the hourly sound level limits in Chapter 375 §10 under all routine operating conditions regardless of meteorological conditions or time of year and regardless of prior submissions by the licensee showing compliance or determinations by the Department.

ii. Non-compliance is defined as sound levels from the licensee exceeding the sound level limits in Chapter 375.10 for 6 contiguous 10 min. intervals (1 hr Leq) or (9) 10 min. intervals in a single 12 hour period (7AM to 7PM) or (7PM to 7AM).

iii The compliance testing period shall be specified in the license as representative of the time of year and meteorological conditions most likely to result in excessive noise. Such designation shall not mean that licensee is not under an obligation to be in compliance for other times of the year or meteorological conditions.

iv. Noise and meteorological compliance monitoring equipment shall be installed at the compliance testing locations specified in the license and shall remain in place and must collect continuous data 24 hours per day, 7 days per week during all periods when the facility's turbines are turning and generating electricity.

v. Results shall be reported, based on 1-second integration intervals, and be reported synchronously with hub level and sound level measurements at 10 minute intervals. Both the wind speed average and wind speed maximum shall be reported from surface stations.

vi. The licensee shall submit monthly compliance reports to the Department for the compliance testing period specified in the license during the first year of facility operation and thereafter shall submit annual reports for the life of the project on the anniversary date of the commencement of operations. All compliance reports shall include a summary analysis of the operational, meteorological, and sound data collected during the report period. The final compliance report for a compliance testing period shall summarize all previous reports.

vii. Compliance reports shall, at a minimum, provide analysis of all operational conditions that exhibit atmospheric turbulence, including but not limited to wind shear conditions. Wind shear analysis shall be provided for those times in which the compliance data collected indicate the following conditions existed: Maximum 10 min. mean hub level wind speed > 7 meters per second (ms) at each turbine. Maximum 10 min. mean hub level wind speed is defined as the greatest 10 min. mean wind speed as recorded at each turbine. No greater than 6 mph mean 10 m surface wind speed.

viii. The licensee shall include the following in each compliance report for all periods when the facility's turbines are turning and generating electricity:

- Audio (.wav) data files will be required from the approved compliance testing locations and must be time stamped to coincide with the sound and meteorological data collection sequence and be of sufficient quality to allow analysis of obvious gross extraneous noise. Should any sound data collection be conducted with an attendant per Chapter 375.10, the attendant's notes and observations may be substituted for the audio files during that period;

- All surface and 80 m wind speed/direction data;
- All meteorological, sound, windscreen and audio instrumentation specifications and calibrations;
- All data (sound & meteorological) surface and hub level wind speed requirements shall be reported both chronologically at 10 min. intervals and binned for compass quadrants (S-W, W-N, N-E, E-S);
- All concurrent time stamped turbine operational data. The date, time and duration of all activations of the new 2 dBA NRO setting must be specifically highlighted;
- All A-weighted equivalent sound level;
- All 10/90% exceedance levels;
- All ten 1- minute 1/3 octave band linear equivalent sound levels (dB);
- All amplitude modulation repetitive events binned by amplitude integers beginning at 6 dBA and greater with number of events per amplitude. Where amplitude is defined as the peak event amplitude minus the mean minima sound levels immediately before and after the event, as measured at an interval of 50 ms or less, A-weighted and fast time response, i.e. 125 ms; and
- Calculation and application of short duration repetitive sound (SDRS) and tonal sound penalties.

ix. All compliance data reported shall be free of obvious gross extraneous noise including, for example; traffic, aircraft flyovers, morning chorus (birds), evening chorus (frogs), and residential sounds. The compliance testing locations shall be maintained free of vegetation and other material greater than 2 feet in height for a 75-foot radius around the noise and meteorological monitoring equipment. The licensee shall inspect and demonstrate by photographs, compliance with this requirement with each biweekly compliance report.

x. If the Department determines that the licensed facility is out of compliance with the noise standards as outlined in Chapter 375.10, the Department shall issue a notice of violation (NOV) for the alleged non-compliance and shall grant licensee 30 days to submit a revised operation protocol to the Department in the form of an application to permanently amend the license or certification. Upon notification of non-compliance, the licensee shall take all reasonable and necessary actions to temporarily mitigate the issue(s) identified pending final approval of a revised operation protocol. If the licensee fails to take such measures, the Department reserves the right to order the licensee to immediately cease operation of the project

under the specific conditions present during the period of non-compliance and other conditions similar to those present during non-compliance that the Department determines are likely to result in non-compliance provided that the Department makes findings as provided in 38 M.R.S.A. §347-A.3.

xi. If the Department issues a determination that the applicant has demonstrated compliance with sound limitations during routine operations as a result of post-construction monitoring, it shall give notice thereof to any party that has been an interested party in the application process to give those who qualify as aggrieved parties to file an appeal to the Board of Environmental Protection or to the courts as provided by law.

(b) Complaint Procedure:

i. The intent of the sound complaint response and resolution protocol is to provide a transparent process for reporting sound complaints to the licensee, provide a consistent approach to documenting and resolving complaints and to inform subsequent compliance testing efforts, provide a process for informing the Department and interested persons of sound complaints, and when necessary, cease the operation of the facility so that a further revised operation protocol can be put in place.

ii. The licensee shall provide a contact 24 hour "hotline" telephone number, Email address, or website to receive complaints regarding sound from the project. Contact information along with a copy of this protocol will be mailed to all abutters, consistent with the definition of abutters set forth in Chapter 2 of the Department regulations. In addition, a sign shall be posted at the main gate to the facility notifying the public of the presence of the Complaint Response and Resolution Protocol and directing the general public to the hotline, Email address, or website.

iii. The licensee shall ensure that a standardized set of information is collected for each complaint in order to facilitate its analysis and review by the Department. The following information shall be required from the complainant, either by phone or by written form, in order to process the complaint:

- Name and address of complainant;
- Date, time and duration or periods of the sound event;
- A description of the sound event, for example, the complainant may provide relative amplitude, source of annoyance, steady or fluctuating, low/mid/high or mix of frequencies/pitch, noticeable vibration, indoor or outdoor, and specific location; and
- A description of other audible sounds from sources outside and, as applicable, inside the dwelling of the complainant.

iv. In addition, the licensee shall record, from the data collected at the facility's compliance testing locations the following information in relation to the complaint:

- The mean hub level wind speed/s in ms at during the complaint period;
- The 10 m surface wind speed/s in mph during the complaint period at approved compliance testing sites ;
- The wind direction during the complaint period by compass quadrants (S-W, W-N, N-E, E-S);
- A-weighted 10 min equivalent sound level/s unadjusted for extraneous sounds during the complaint period;
- 10 min 10/90% exceedance levels during the complaint period; and
- Hourly 1/3 octave band sound pressure levels (dB) for the complaint period.

v. The licensee shall maintain complaint logs for a period of two years from the date a complaint was received. The complaint log shall include all the complaint specific information provided by the complainant and the licensee as described above and a description of the final disposition or resolution provided by the licensee. The licensee shall post the complaint log including associated data in a place accessible to the general public via the internet and shall update the complaint log monthly. FIW shall notify all residents abutting the facility and the Department of how to access the complaint log. Notification may be achieved by direct mailing or posting in a newspaper of local distribution. In addition, the licensee shall ensure that a copy of the complaint disposition or resolution record for each complaint received is sent directly to the complainant and department within 30 days of receiving a complaint unless otherwise approved by the department.

vi. If the Department determines that there is a consistent pattern of complaints that suggests that sound levels from the project may be exceeding the applicable sound levels limits in Chapter 375.10, the licensee shall undertake a formal compliance assessment following the procedures outlined in Section a. above to determine if the facility is in compliance with Chapter 375.10, and, if necessary, develop and implement an appropriate modification to the operating protocol for ensuring that the project continues to meet applicable sound level limits. The licensee shall provide a copy of the formal compliance assessment to the Department for review and concurrence prior to the implementation of any corrective action.

vii. If, after a compliance assessment, the Department determines that the licensee is not operating in accordance with Chapter 375.10, procedures set forth in a.x above shall be followed.