

Large Wind Turbine Citizens Committee

# Town of Union

Setback Recommendations Report



Crescent Ridge Wind Farm Illinois

Chairman: Tom Alisankus. Members: Scott McElroy, Cathy Bembinster, Jim Bembinster, Mike Leeder, Sue Pestor. Recording Secretary Renee Exum.  
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# Union Township

## Setback Recommendations

After extensive time, effort, & research, the Citizen Committee for Union Township, Rock County Wisconsin has concluded that in an attempt to assure the continued health and safety of the residents of Union Township, the only solution that eliminates health & safety related problems is to establish sufficient setbacks pursuant 66.0401(1), Wis. Stats. This statute regulates what local restrictions on solar and wind energy systems are permitted, providing they serve the public health or safety interests of the residents. We have developed an ordinance within the framework of the statutes, utilizing extensive research from a variety of resources including the state guide and model draft ordinance, and discussions with multiple experts. Attached are points that assisted in the creation of the Union Township Wind Energy Systems Licensing Ordinance.

### Summary of Key Points

January 12, 2008

The Wisconsin Model Wind Ordinance Reference Guide states: "Local communities within the state of Wisconsin will continue to be faced with proposed wind farms. Most communities in Wisconsin are unprepared for this type of construction. For this reason, the Public Service Commission of Wisconsin (the "PSC"), the Wisconsin Department of Natural Resources and the Division of Energy of the Department of Administration created the Wisconsin Windpower Siting Collaborative to examine these issues." Based on this, I completed an official records request from the Department of Administration and the Public Service Commission of Wisconsin, requesting any/all documentation utilized by the drafters/authors of the 2003 and 2007 large wind energy DRAFT ordinance and guide. As part of my request I specifically requested documentation related to HEALTH AND SAFETY, as utilized by the authors of said Ordinance and draft. I requested any "clinical, medical, or scientific data or research/reports etc., related to health and safety of citizens." The DOA & PSC failed to provide one document that was utilized in the creation of the draft ordinance that was "clinical, medical, or scientific data or research/reports related to health and safety of citizens in relation to wind turbines. In reviewing the documents provided, there was NOT ONE mention of any clinical, medical, and/or scientific: report, study, data, research, etc. related to health and safety that was utilized in the creation of the DRAFT ordinance and guide.

- Wisconsin Model Wind Ordinance Reference Guide DRAFT- 4-23-07: III. PROCESS DISCUSSION: To develop the model ordinance, the subcommittee reviewed a variety of materials. These

included existing and proposed ordinances from other municipalities, both from Wisconsin and from other states, state laws relating to the construction of wind projects, both from Wisconsin and other states, and a number of guides and handbooks regarding wind energy in general, as well as the construction and operation of wind projects.<sup>2</sup> Members of the subcommittee also consulted with experts within various areas of wind energy, such as municipal and state administrators and regulators, developers and vendors, and other wind energy professionals. In addition, the subcommittee utilized the expertise of its members. All of this information was material to be consulted in drafting the current document. After the drafting effort became an effort involving only state employees, the effort was further informed by discussions with land-use authorities and by observing the various siting debates taking place in Wisconsin. DRAFT- 4-23-07, Model Wind Ordinance Reference Guide; REFERENCE GUIDE to the Wisconsin MODEL WIND ORDINANCE.

- National Wind Coordinating Collaborative: In the April 2006 STATE SITING AND PERMITTING OF WIND ENERGY FACILITIES is states: The processes for siting approvals for wind facilities varies significantly by state. These processes fall into five main categories: 1. Mandatory, state-level wind siting statutes; 2. Voluntary guidelines for siting within states; 3. Model ordinances for local governments to apply and use; 4. Local government siting rules; and 5. Voluntary checklists and resources for local governments to recommend. When asked about what they consider a “DRAFT” model ordinance: “I do not have the full legal understanding to definitively answer your question about model ordinances. My general understanding is that model ordinances are made available, often by states, for local jurisdictions to consider. Katie Kalinowski Sr. Outreach Coordinator, National Wind Coordinating Collaborative. Electronic mail communication November 8, 200.
- Wind farms that have been built in Wisconsin, and near other communities around the country, were built using insufficient setbacks.
- It has been well documented that residents living within these insufficient setbacks have experienced health problems caused by noise, and shadow flicker created by the wind turbines.
- The turbines have also exposed residents to unnecessary safety risks from ice throws.
- Residents have won settlements by suing wind energy companies, due to the health problems that have been experienced.
- Stray voltage and ambient voltage/current are also significant issues related to turbines that may affect people and animals.
- In some instances, wind energy companies have purchased residences, which were later demolished to create a barrier of vacant land to surround the turbines.  
Summary of Windpower Development in Wisconsin 1998-2002  
<http://www.renewwisconsin.org/windfarm/windwisconsin.html>
- Invernergy’s Beech Ridge Wind Farm in West Virginia provides residents with setbacks of between one and four miles. Invernergy has publicly stated that at a distance of one-mile, the impacts of noise, shadow flicker, and ice throw “are no longer a legitimate concern.”<sup>1</sup> See page 12 of this report.



## Draft 04-23-07 WI Model Wind Ordinance Reference Guide Highlights

- **HISTORY:** Although Act 204 was only one of a series of legislative initiatives aimed at promoting renewable energy, it was one of the first to cause wind farm developers to approach communities to gain permission for a wind facility. Local communities within the state of Wisconsin will continue to be faced with proposed wind farms. Most communities in Wisconsin are unprepared for this type of construction. For this reason, the Public Service Commission of Wisconsin (the "PSC"), the Wisconsin Department of Natural Resources and the Division of Energy of the Department of Administration created the Wisconsin Windpower Siting Collaborative to examine these issues. The PSC instructed the electric utilities to participate in the Collaborative and interested regulators; representatives of private industry and local governments were included in the discussions. Pp 1
- **STATUTE:** To ensure that its policy goals regarding renewable energy are not unduly hindered, the state legislature has enacted legislation limiting the ability of local governments to prohibit or curtail the development of wind and solar energy systems. (Wis. Stat. § 66.031 (199798; subsequently re-numbered to 66.0401) hereafter "Section 66,0401") prohibits counties, cities, towns or villages from placing any restrictions, directly or indirectly, on the installation of solar or wind energy systems unless the restriction satisfies one of three conditions: (1) the restriction serves to preserve or protect the public health or safety; (2) the restriction does not significantly increase the cost of the system or significantly decrease its efficiency; or (3) the restriction allows for an alternative system of comparable cost and efficiency.... pp2
- In short, under the plain language of Section 66,0401, the municipalities can impose health and safety related restrictions on the construction and operation of wind farms...pp2 Wind turbines are exempt from property tax (state statute 70,111). It is therefore incumbent on the community to negotiate impact fees in lieu of property taxes. If it is possible to obtain a baseline assessment of conditions before the project commences, for example of road condition, it may be helpful to both the developer and the local jurisdiction. Pp3
- **STATE ISSUES:** The Bureau of Aeronautics in the state Department of Transportation must be contacted to review the impact the installation may have on the local airspace and the review the plan for warning beacons. Other state laws may govern a wind turbine installation in the same way that state laws apply to any construction project, including endangered species laws or laws regarding run-off. The Wisconsin Department of Natural Resources, Bureau of Endangered Resources, maintains a National Heritage Inventory, which should be consulted to determine if state protected resources may be affected. pp3
- **FEDERAL ISSUES:** The Federal Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, and the Endangered Species Act all establish federal authority to protect avian species. The Fish and Wildlife Service can choose to initiate enforcement action under any of these laws, should a wind farm be responsible for the deaths or other adverse impacts on the species the laws were enacted to protect. Up to this point, no enforcement actions have been taken against wind farms, but the Service has enforced against transmission lines and other facilities that have violated the Acts. Pp3
- **PROCESS DISCUSSION:** To develop the model ordinance, the subcommittee reviewed a variety of materials. These included existing and proposed ordinances from other municipalities, both from Wisconsin and from other states, state laws relating to the construction of wind projects, both from Wisconsin and other states, and a number of guides and handbooks regarding wind energy in general, as well as the construction and

operation of wind projects." Members of the subcommittee also consulted with experts within various areas of wind energy, such as municipal and state administrators and regulators, developers and vendors, and other wind energy professionals. In addition, the subcommittee utilized the expertise of its members. All of this information was material to be consulted in drafting the current document. After the drafting effort became an effort involving only state employees, the effort was further informed by discussions with land-use authorities and by observing the various siting debates taking place in Wisconsin. Pp 4

- In keeping with the mandate of Section 66.0401, the intent of the model ordinance is to ensure that wind projects are only placed in locations where they do not risk the public health and safety. For that reason, wind facilities as defined in the ordinance should generally not be permitted in most residential zones.... The foremost priority is to preserve the public health and safety, but beyond that, the municipality must heed the other two restrictions of Section 66.0401 pp 6
- If the town has not adopted county zoning, it may wish to adopt a wind ordinance, although a license or permit is simpler. Pp 7
- VISUAL APPEARANCE: Modern wind turbines are very large, and neighboring landowners - as well as the general public - are understandably concerned with the aesthetic impact of wind turbine construction,,
- SETBACKS: Wind turbines are typically required to be set back from property lines and populated areas for a variety of reasons. There are aesthetics concerns, as distance is a substantial factor in both visual and sound disturbance. .... While sound can be hard to measure and human perception of what is loud can be quite subjective and while setbacks help lessen the sound, it should be emphasized that setbacks are not intended to deal with sound concerns.... More important are the safety concerns. In the event of extreme weather conditions or improper construction safety hazards may occur. For this reason, wind turbines are usually required to be set back from property lines and sensitive structures. The setback thresholds are intended to reflect relative risk, The model ordinance requires four different setbacks....pp8
- Likewise, different setbacks for inhabited structures have been proposed, depending on whether the inhabited structure belonged to a landowner who is leasing land to the wind project. Again, this distinction has no bearing on public health or safety, and should therefore not be allowed. In other words, if 1000 feet is necessary to protect one citizen, it is necessary for all citizens, whether or not they are receiving lease payments.
- SOUND LEVELS: Like visual aesthetics, sound level is a common and major issue with the erection of wind turbines Also like visual aesthetics, sound is generally not a threat to the public health and safety, and therefore subject to only limited local restriction. Sound restrictions are very difficult to establish because individuals vary in their tolerance to sound. While turbine specifications include sound levels those levels at the project site are difficult to predict before the turbine is actually operating. Ultimately, however, the only factor truly within the control of the developer that regulates sound levels is distance. The model ordinance, therefore, effectively requires the developer to place the turbines far enough from points of measurement to keep sound level at or below the permitted level. Pp9
- The model ordinance establishes a flat threshold of 50 dBA, measured at residences, schools, hospitals, churches and public libraries, 50 dBA is the standard threshold established by most similar ordinances and laws around the country,. Local officials may want to consider different levels depending upon unique characteristics within their communities. The sound from turbines will carry differently depending upon the wind

direction and speed. Time of day will also influence the perception of sound levels. Some municipalities may want to limit sound levels by restricting the sound that is in addition to existing background sound. Pp 10

- **SIGNAL INTERFERENCE:** The ordinance requires the applicant to minimize or mitigate signal interference. FM radio is not affected, but UHF can be affected within three miles and VHF within 3/4 mile of a large enough turbine. By contrast, interference with microwave repeating stations falls under Federal Communications Commission jurisdiction, A discussion of electromagnetic interference can found in the 1998 edition of Wind Permitting' A Handbook, by the National Wind Coordinating Committee (NWCC). The local jurisdiction may wish to require pre-project testing of television signal strength by a qualified independent entity. On the other hand, it could be argued that such placing such a condition, especially if it involves more than a handful of houses, contradicts the second item in Section 66.0401. pp 10-11
- **SAFETY:** Most of the public health and safety concerns associated with wind energy facilities are related to the turning blades, tower failure and electric and magnetic fields Blade Throw refers to the rare event when a turbine blade or a piece of blade separates from the turbine and is thrown to the ground, Pieces will tend to fall to the base of the tower, i.e. directly down rather than up or out. Falling Ice is a problem that can occur in Wisconsin when the right combination of low temperature and moisture occurs. It is very unlikely that turbine blades will spin when coated with ice because the ice ruins the aerodynamic shape of the blade. The phenomenon is akin to a car driving with four flat tires. Just as the driver would detect a loss of speed and power and pull to the side of the road, the turbine control system detects a loss of power and stops the turbine. Falling ice from blades, nacelle, or tower is a danger directly under the turbine after the rotating blades have been stopped. Tower Failure that results in an entire wind turbine falling to the ground is more likely to occur with small, residential-scale installations that use guyed towers, complete tower failure is almost unheard of with commercial wind turbines; however, it is important that appropriate setbacks be established to protect people from such an eventuality. Pp 11-12
- **SITE RECLAMATION:** Wind turbines have a very long useful life, and it is not unusual for wind projects to have agreements in place for twenty years of operation or more. Nevertheless, to preserve the public health and safety, a county should reasonably expect that a wind turbine that is not in use, for whatever reason, be removed and the site is reclaimed for other use...
- **STRAY VOLTAGE:** Although stray voltage problems associated with a wind farm are very unlikely, both the local jurisdiction and the developer may think it prudent to measure levels of stray voltage before construction and after. Pp16
- **LIGHTNING:** Wind turbines, like trees or other tall objects, may be more likely to intercept nearby lightning strikes, but do not "attract" lightning,
- **WATER WELLS:** Both the Kewaunee moratorium study committee and the Addison CUP require a baseline and remediation.] Some wind turbine foundations may require breaking up and removing bedrock. Nevertheless, it is possible to include language in the ordinance to protect nearby water wells by establishing a baseline prior to excavation and requiring temporary and permanent remedies if a nearby well is contaminated. Pp 18
- **SHADOW FLICKER:** Wind turbines cast shadows when the sun is not obscured. During morning and evening hours, shadows are especially long. During winter, shadows are long during much of the day, but this is mitigated somewhat by increased cloud cover and shorter days compared to summer, When the wind turbine blades are rotating, they cast moving shadows, usually more than one blade shadow passing per second. This is called shadow

flicker, and the strobe-like effect can be annoying to humans, while livestock don't seem to be affected. Pp18

## Wind Turbines Create Harmful Noise:

- GARY HALTAUFDERHEIDE of ECOENERGY: On 9/18/07 at the Magnolia Township Planning & Zoning meeting, a concerned citizen in the crowd asked GARY “what’s in it for me when I am surrounded by wind turbines on each side of my property ?” GARY responded “In every wind project there are winners and losers.”
- WES SLAYMAKER of ECOENERGY: On 10/23/07 at the Magnolia Township Planning & Zoning meeting, admitted to the crowd that the more wind turbines there are, the louder they are.
- ENXCO WIND ENERGY Regional Director John Zimmerman: and one, who presents himself only as the president of Vermont Environmental Research Associates, admitted at a meeting in Lowell, Vt., “Wind turbines don’t make good neighbors.” EnXco, Inc. 63-665 19th Avenue P.O. Box 581043, North Palm Springs, CA 92258  
<http://www.aweo.org/ProblemWithWind.html>
- World Health Organization: “Noise has health effects, can affect sleep, and can affect well being. Noise which disrupts sleep has measurable economic effects through absenteeism from work and school, lost productivity, accidents.” — The World Health Organization Community Noise guidelines recommend that, to avoid sleep disturbance, night noise should not exceed more than 30 dB. World Health Organization Guidelines on Community Noise.  
<http://www.adc40.org/docs/schwela.pdf>
- The Public Service Commission of Wisconsin (“PSCW”) has determined that it is important to site wind energy facilities carefully. The PSCW has also concluded that there is the potential for adverse environmental impacts when wind energy facilities are sited improperly. Public Service Commission of Wisconsin Advance Plan 7 Findings of Fact, pp. 22 - 23.
- Department of Energy website: “There is no dispute that wind energy facilities do pose a public health and safety hazard.” Department of Energy website - “Wind - Frequently Asked Questions,” [www.eren.doe.gov/state\\_energy/technology\\_faqs.cfm?techid=2](http://www.eren.doe.gov/state_energy/technology_faqs.cfm?techid=2)
- Department of Energy website: The Wind turbines make different types of sound, including broadband, infrasonic, impulsive, and tonal sound. The presence of wind turbine sound is dependent on atmospheric conditions, including air flow patterns and turbulence, and the ability to perceive wind turbine sound varies based on the presence of other nearby sources of sound, manmade or otherwise, and site-specific topography.  
[http://www.eere.energy.gov/windandhydro/windpoweringamerica/ne\\_issues\\_sound.asp?&print](http://www.eere.energy.gov/windandhydro/windpoweringamerica/ne_issues_sound.asp?&print)
- National Wind Coordinating Collaborative (NWCC) NWCC’s Permitting of Wind Energy Facilities: The nature of the public health and safety hazard will depend on the proposed location of the wind energy facility and its proximity to existing or planned development. The primary health and safety considerations are related to the movement of the turbine blades and the presence of industrial equipment in areas that are potentially accessible to the public. There are also a variety of other public health and safety considerations including: Fire hazards, Tower Failure, Electromagnetic Fields (EMF), Noise, Air Navigation Safety, and the potential for declining property values, among others. NWCC’s Permitting of Wind Energy Facilities: A Handbook; p.49; Department of Energy website - “Wind

Frequently Asked Questions,”

[www.eren.doe.gov/state\\_energy/technology\\_faqs.cfm?techid=2](http://www.eren.doe.gov/state_energy/technology_faqs.cfm?techid=2)

<http://www.nationalwind.org/publications/wes/wes02.htm>

- National Wind Coordinating Collaborative: Wind generation facilities usually are located in rural or remote areas, away from residences, schools and other potentially sensitive populations, with few nearby residential developments and only intermittent human visitation and use. NWCC's Permitting of Wind Energy Facilities: A Handbook; p.2, 43, 50; Department of Energy website - “Wind - Frequently Asked Questions,” [www.eren.doe.gov/state\\_energy/technology\\_faqs.cfm?techid=2](http://www.eren.doe.gov/state_energy/technology_faqs.cfm?techid=2) <http://www.nationalwind.org/publications/wes/wes02.htm>
- National Wind Coordinating Collaborative: It is well recognized that if residential or commercial development exists or occurs in the vicinity of a wind energy facility or a designated wind resource area, conflicts are likely to occur. NWCC's Permitting of Wind Energy Facilities: A Handbook; p.36
- National Wind Coordinating Committee: could not avoid the conclusion that the noise from wind turbines “may be especially disturbing in the middle of the night when traffic and household sounds are diminished.” <http://www.wind-watch.org/news/2007/10/13/wind-turbines-are-noisy/> <http://www.nationalwind.org/publications/wes/wes02.htm>
- A 2003 study entitled “Effects of the Wind Profile at Night on Wind Turbine Sound” was published in the JOURNAL OF SOUND AND VIBRATION. The study cited that local residents living 500 meters [1,640 feet] and further from their wind farm reacted strongly to the noise. Residents up to 1,900 meters [6,233 feet] from the wind farm expressed annoyance. The actual noise generated by the wind turbines is significantly greater than the original sound assessment. For example, measurements of actual wind speed at the hub height at night were up to 2.6 times higher than expected. These wind speeds caused higher rotational speed of the wind turbines and consequently up to a 15 dB higher sound level (sound levels were expected to be 43 dB but have been measured at 58 dB). The turbines also produce a thumping, impulsive sound, which increases annoyance.
- The Department of Trade and Industry of the United Kingdom. Noise level limits: In the assessment report, noise levels are set to safeguard the amenity at all dwellings. For quiet rural areas such as those around the proposed wind farm site, these levels are described as follows: ‘In low noise environments the daytime level of the LA90, 10 min of the wind farm noise should be limited to an absolute level within the range of 35-40dBA’. A differentiation is made between those dwellings associated with a project, for example a landowner, and those with no associations to the project. For dwellings associated with a project, the assessment report recommends ‘that lower fixed limits can be increased to 45dBA and that consideration should be given to increasing the permissible margin above background where the occupier of the property has some financial involvement in the wind farm’. Therefore, most proposals are usually assessed using the lower limits of 35-40dBA at the nearest dwellings and up to 45dBA at properties where the owners have an interest in the project, although noise levels in the UK are kept to well below this recommended level. <http://www.dti.gov.uk/energy/sources/renewables/planning/onshore-wind/noise/page18728.html>
- The WORLD HEALTH ORGANIZATION (WHO) recommends the level of continuous noise outside a dwelling to be 45 dB or less, and 30 dB or less inside. High levels of noise disturb sleep and can produce a host of effects on health including fatigue, depressed mood or well-being, decreased performance, and increased use of sedatives or sleeping pills. Measured

physiological effects of noise during sleep are increased blood pressure and heart rate, changes in breathing pattern, and cardiac arrhythmias.<sup>2</sup>

- In LINCOLN TOWNSHIP, WI, a University of Wisconsin survey of 233 residents near a 22 turbine installation in 2001, 2 years after construction, documented that 44% of residents 800 ft to ¼ mile from the turbines found noise to be a problem in their households, 52% ¼ to ½ mile away, 32% ½ to 1 mile away, and 4% 1 to 2 miles away. Under certain conditions the turbines could be heard up to 2 miles away.<sup>12</sup> These numbers correspond well to measurements made by Dr. GP van den Berg of the University of Groningen in the Netherlands near a more recent 30 MW, 17 turbine installation on the Dutch-German border, where residents living 500 m (1640 ft, or 0.31 mile) and more from the turbines were reacting strongly to the noise, and residents up to 1900 m (1.2 miles) away expressed annoyance. <sup>3</sup>
- After the wind turbines went online in Kewaunee County, Wisconsin, the Lincoln Township board of supervisors approved a moratorium on new turbine construction. The purpose of the moratorium was to delay new construction of wind turbines for 18 months, giving the township the opportunity to assess the impacts of the 22 turbines installed by Wisconsin Public Service Corporation and Madison Gas & Electric in June 1999.<sup>3</sup>
- Forty-four percent of survey participants living between 800 feet and 1,320 feet from a wind turbine said that noise was currently causing a problem in their household. <sup>3</sup>
- Fifty-two percent of survey participants living between 1,320 and 2,640 feet from a wind turbine said that noise was currently causing a problem in their household. <sup>3</sup>
- In a 2005 survey of 200 adult residents within ¾ mile of the French St. Crepin Windfarm, 83% responded. Of these, 27% considered the noise to be intolerable at night, 58% considered the noise to be disturbing, and 10% considered the noise to be disturbing by day. This is only a 6 turbine, 9 MW installation.
- Meyersdale, PA resident Bob Laravee, who lives 3,000 feet from the windplant, documents how he measured the noise over a 48 hour period. The results showed an average reading of about 75 decibels during that period." "According to the EPA, noise levels above 45dB(A) disturb sleep and most people cannot sleep above noise levels of 70 dB(A)." Turbine noise is so irritating and disconcerting that it often causes people to seek medical attention, as Rodger Hutzell in Meyersdale had to do. Wind leases typically contain "noise easements" to protect the company from liability.  
[http://www.stopillwind.org/lowerlevel.php?content=topten\\_8](http://www.stopillwind.org/lowerlevel.php?content=topten_8)
- Noise from wind turbines is often perceived as one of the more significant environmental impacts (Wagner, Bareis and Guidati, 1996). During the early development of wind energy, in the 1980s, some turbines were rather noisy and this led to justified complaints from those living close to them. However, since then, there has been very considerable development both in techniques for reducing noise from wind turbines and in predicting the noise nuisance a wind farm will create.

The UK document Planning Policy Guidance Note (Department of the Environment, 1993) suggests that:

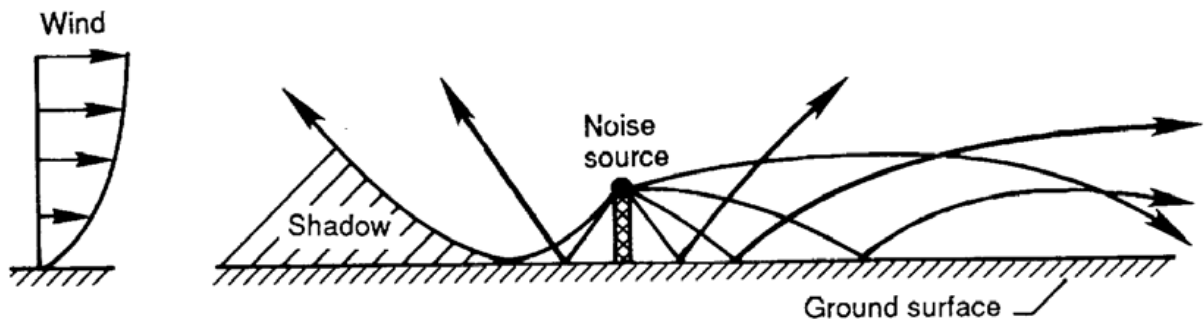
A planning application for any wind-farm development could usefully be accompanied by the following information regarding details of the proposed turbine(s) and predicted noise levels:

- predicted noise levels at specific properties closest to the wind farm over the most critical range of wind speeds;
  - measured background noise levels at the properties and wind speeds outlined above;
  - a scale map showing the proposed wind turbine(s), the prevailing wind conditions, nearby existing developments;
  - Results of independent measurements of noise emission from the proposed wind turbine including the sound power and narrow-band frequency spectrum; in the case of a prototype turbine where no measurements are available, predictions should be made by comparison with similar machines.
  - Source: Wind Energy Handbook, Burton, Sharpe, Jenkins, Bossanyi, Wiley & Sons Ltd, New York, 2001 pg. 528;
- In practice, in most rural areas, my rule of thumb is that the nearest turbine needs to be at least 1¼ miles from any house. However, these are areas where the background noise level can be 20 dBA at night. You suggest that your background noise level could be 30-32dB. This seems a likely figure if you have 350 houses in the area, though I suspect it could be a bit lower than this. On this basis, noise from the wind farm should not exceed 35dBA. If the developers are suggesting that 55 decibels is acceptable, this is quite outrageous. 55dBA is more than four times as loud as your background noise. Most of the Scottish wind farms that have recently been approved have no housing closer than about 1 mile, except where the house belongs to the landowner of the wind farm site. There are a few applications with houses as close as about 2000 feet but these have all either been turned down or withdrawn by the developer.
  - I am not familiar with the GE turbines, but I suspect that they have a sound power level of about 105dBA. In this case, the noise level would be between 45 and 50 dBA at 1400 feet in neutral weather conditions and if the nearest turbines were in full view. (Private communication from Dick Bowdler, New Acoustics Co., Scotland, U.K., to Sue Sliwinski, Oct. 16, 2002, used with permission).
  - Refraction occurs from the change in sound propagation velocity due to atmospheric variability. One source is wind shear, the progressive increase in wind speed above ground and which occurs frequently. Its practical importance in sound propagation in a windy atmosphere is obvious: elevated sound sources are decidedly advantageous in transmitting to windward. (Mechanical Radiation, R. Lindsay, Mc. Graw-Hill, 1960).
  - A second effect that adds to the sound annoyance is that the sound has an impulsive character. The primary factor for this is the well known swishing sound caused by the pressure fluctuation when a wing passes the turbine mast. For a single turbine these 1 - 2 dB broad band sound pressure fluctuations would not classify as impulsive. When several turbines operate nearly synchronously the pulses however may occur in phase: two equal pulses give a doubling in pulse height (+3 dB), three a tripling (+5 dB). ("Wind turbines at night: acoustical practice and sound research", F.G.P. van den Berg, presented at Euronoise 2003, Paper ID 160).
  - Wind turbine generators... are producing electricity both singly and in wind power stations that encompass hundreds of machines. Many installations are in uninhabited areas far from

established residences, and therefore there are no apparent environmental impacts in terms of noise. There is, however, the potential for situations in which the radiated noise can be heard by residents of adjacent neighborhoods, particularly those neighborhoods with low ambient noise levels.

(Wind Turbine Acoustics NASA Technical Paper 3057, H. Hubbard and K. Shepherd, 1990).

- **EPA Identifies Noise Levels Affecting Health and Welfare** **NOTE:** In the past, the Environmental Protection Agency (EPA) coordinated all federal noise control activities through its Office of Noise Abatement and Control. However, In 1981, the Administration at that time concluded that noise issues were best handled at the State or local government level. As a result, the EPA phased out the office's funding in 1982 as part of a shift in federal noise control policy to transfer the primary responsibility of regulating noise to state and local governments. However, the Noise Control Act of 1972 and the Quiet Communities Act of 1978 were not rescinded by Congress and remain in effect today, although essentially unfunded. View more information about resources on noise pollution. <http://www.epa.gov/history/topics/noise/01.htm>. Last updated on Friday, September 21st, 2007).



**Figure 7-20. Effects of wind-induced refraction on acoustic rays radiating from an elevated point source [Shepherd and Hubbard 1985]**

- The “Shadow” zone in the above figure may explain the observed “quietness” experienced by observers when taken to stand near wind farm turbines such as the Fenner, NY wind farm. The noises are masked unless the observer is 2-4x the tower height distance. And it underscores the necessity of comprehensive and accurate engineering studies of complex phenomena. Merely relying on anecdotal “I don’t hear anything” knee jerk responses to a turbine visit is misleading and hardly equivalent to living year round as a saturated “receptor”. (Richard Bolton, physicist, “Wind Turbine Noise”).
- In cold climates, with sustained temperatures below 32° F., atmospheric icing conditions are common. The northeast U. S. has the highest incidence of icing in North America (Bernstein, Ben, Regional and Local Influences on Freezing Drizzle, Freezing Rain, and Ice Pellet Events, Weather and Forecasting, American Meteorological Society Vol. 15, Oct 2000). Due to their aerodynamic shape significant rime ice buildup can occur on turbine blades in cold weather and high humidity conditions. This effect is similar to the rime icing of airplane wings. The ice can build symmetrically and then be extremely difficult to detect. Even a low buildup of ice can disturb the aerodynamics of air passage over the blades and create higher noise emission due to increased turbulence. Generally blade noise



is the predominant noise source and can be increased 3-5 dBA due to this rime ice, or other changes to the airfoil surface as due to insect accretion or dirt accumulation (Seifert, Henry, Technical Requirements for Rotor Blades Operating in Cold Climate, Deutsches Windenergie-Institut, 2003).

- Topographical conditions at site have importance for the degrees to which the noises from wind turbines are masked by the wind. Dwellings that are positioned within deep valleys or are sheltered from the wind in other ways may be exposed to low levels of background noise, even though the wind is strong at the position of the wind turbine [Hayes 1996]. The noise from the turbine may on these conditions be perceived at lower sound pressure levels than expected. Current recommendation state that measures and sound propagation calculations should be based on a wind speed of 8 m/s at 10 meter above the ground, down wind conditions, creating a "worst case" scenario.( Pedersen, E. and Hamstad, H., Noise Annoyance from Wind Turbines - a review, Naturvårdsverket, Report 5308, Swedish Environmental Protection Agency, ISBN 91-620-5308-6.pdf, August 2003).
- The Institute of Environmental Medicine at Stockholm University prepared an extensive volume for the World Health Organization (WHO) on the impact of community noise on people's health. They report that noise exposure can affect sleep in several ways, including:
  - increasing the time needed to fall asleep,
  - altering the cycle of sleep stages, and
  - decreasing the quality of REM sleep.

Over extended periods of time, any one of these problems could lead to more serious health issues.

Sleep disturbances have been linked to three characteristics of noise exposure, including:

- the total noise exposure (including daytime exposure)
- the peak noise volume
- for intermittent noise, the number of volume peaks

The study reports that:

- Noise levels of 60 dB wakes 90% of people after they have fallen asleep.
- Noise levels of 55 dB affects REM cycles and increases time to fall asleep.
- Noise of 40-45 dB wakes 10% of people.

WHO recommends that ambient noise levels be below 35 dB for optimum sleeping conditions. These recommendations are significant because of a Dutch study<sup>7</sup> that showed noise from a 30 MW wind farm becomes more noticeable and annoying to

nearby residents at night. This study noted that although the noise is always present, certain aspects of turbine noise, such as thumping and swishing, were not noticeable during the day, but became very noticeable at night. Residents as far as 1900 meters (1.18 miles) from the wind farm complained about the nighttime noise. 7 G.P. van den Berg (2003) Effects of the wind profile at night on wind turbine sound. Journal of Sound and Vibration 277 (2004)955-970

Wind direction also has an influence on sound propagation. Within 900 ft of a sound source, the wind direction does not seem to influence the sound. But after about 900 ft., the wind direction becomes a major factor in sound propagation. Downwind (meaning the wind is moving from the noise source towards the receiver) of the source, sound volume will increase for a time before decreasing. Upwind (the wind is moving from the receiver to the noise source), sound volumes decrease very quickly. 12 Source: Environmental Noise Booklet from Brüel & Kjær Sound & Vibration Measurement A/S. Retrieved from <http://www.nonoise.org/library/envnoise/index.htm>

- The International Standards Organization (ISO) recommends setting a base limit of 35- 40 dB(A) and adjusting the limit by district type and time of day. Table 9 lists the adjusted limits from a base of 35 dB(A).

**Table 9. ISO 1996-1971 Recommendations for Community Noise Limits**

District Type	Daytime Limit	Evening Limit (7 -11 PM)	Night limit (11 PM – 7 AM)
Rural	35 dB(A)	30 dB(A)	25 dB(A)
Suburban	40 dB(A)	35 dB(A)	30 dB(A)
Urban residential	45 dB(A)	40 dB(A)	35 dB(A)
Urban Mixed	50 dB(A)	45 dB(A)	40 dB(A)

Community noise assessment and control is a land compatibility issue which must be carefully addressed. A few years ago, the city of Sterling Hts., MI permitted an outdoor concert venue adjacent to a residential neighborhood. The noise became a nuisance, neighbors filed law suits, and the city spent more than \$31 million trying to settle the conflict. (“Addressing Wind Turbine Noise”, Daniel J. Albert) Daniel J. Alberts is a senior member of the Society for Technical Communication. He holds a BS in Engineering from the University of Michigan and a Master of Science in Technical and Professional Communication from Lawrence Technological University (LTU). Mr. Alberts was a founding member of LTU’s Alternative Energy Student Group and served as the group’s Vice President for the 2004-05 school year.

- 4. Summary: Effects of noise on sleep

Noise-induced sleep interference is one of the critical components of community annoyance. It can produce short-term adverse effects, such as mood changes and decrements in task performance the next day, with the possibility of more serious effects on health and well-being if it continues over long periods. EPA's identified indoor DNL of 45 dB has not been seriously challenged over the past decade, but consensus in this area is lacking. One problem is that different experimenters tend to use a variety of descriptors (DNL, Leq, and maximum single-event levels) and a variety

of methods for evaluating the effects (EEG, EKG, self-report, etc.). Perhaps one reason for the lack of clear-cut criteria is that this is a complex area to research, requiring considerable time and expense. Another is, of course, a need for more field studies in this area. (NWCC Permitting of Wind Energy Facilities: A Handbook 2002, referenced in noise appendix, Sutter, Alice H., "Noise Sources and Effects-A New Look", Sound and Vibration, January 1992).

- A noise measure based only on energy summation and expressed as the conventional equivalent measure, LAeq, is not enough to characterize most noise environments. It is equally important to measure the maximum values of noise fluctuations, preferably combined with a measure of the number of noise events. If the noise includes a large proportion of low-frequency components, still lower values than the guideline values below will be needed. When prominent low-frequency components are present, noise measures based on A-weighting are inappropriate. The difference between dB(C) and dB(A) will give crude information about the presence of low-frequency components in noise, but if the difference is more than 10 dB, it is recommended that a frequency analysis of the noise be performed. It should be noted that a large proportion of low-frequency components in noise may increase considerably the adverse effects on health. (WHO Community Noise).
  
- During clear, cloudless nights a process called radiation cooling takes place whereby the atmosphere next to the ground becomes stable - it decouples from the air mass just above the ground. What is significant about this decoupling is that there can be no wind at ground level, but the wind can be blowing quite hard at the height of a wind turbine. Here then is the worst-case scenario developers should be considering, turbines spinning loudly with no masking sounds close to the ground. Even worse, it can occur on summer nights with our bedroom windows wide open. Thousand Islands Sun, Letters to the Editor, Clif Schneider
  
- Most wind ordinances set 50 decibels as the maximum turbine that can be heard from homes or other places people occupy, Slaymaker said. EcoEnergy, however, tries to stay below 45 decibels he said. To do that, EcoEnergy uses noise modeling to help determine where a turbine should go. Turbine noise fluctuates based on the distance from the turbine but also the topography. If you're in a hollow, the sound might be amplified, Slaymaker said. Sound studies aren't exact, but the company knows that in most cases noise is below 45 decibels a quarter-mile from a turbine. When the sound approaches 45 decibels, EcoEnergy increases the setback and reruns the model, Slaymaker said. Forty-five decibels is often compared to a quiet conversation. (Wes Slaymaker, Ecoenergy, Janesville Gazette Extra, Monday November 26, 2007).
  
- In modeling wind turbine sound very relevant atmospheric behaviour has been 'overlooked'. As a consequence, at low surface wind speeds such as often occur at night, wind turbine noise immission levels may be up to 15 or 18 dB higher than expected. The discrepancy between real and modeled noise levels is greater for tall wind turbines. International models used to assess wind turbine noise on dwellings should be revised for this atmospheric effect. A discrepancy between noise forecasts and real noise perception, as a result of limited or even defective models, cannot always be avoided, even not in principle. Its consequences can however be minimized if immission levels are measured at relevant times and places. This relevancy is also determined by observations of those affected. It should always be possible to check noise forecasts by measurement. For wind turbine noise (and other noise sources) standard measurement procedures require cooperation of the operator to be able to check emission sound levels. This introduces an element of partiality to the advantage of the noise producer. This is also generally a weak point in noise assessment: the source of information is usually the noise producer. There should always be a

procedure to determine noise exposure independent of the noise producer. (Wind Turbines at Night: acoustical practice and sound research, Fritz G.P. van den Berg).

“This study was started after complaints of residents that the sound of a wind farm was louder and more annoying than predicted, especially when there was little wind in the evening or at night. The explanation appeared to be the occurrence of another wind profile than that used to predict the noise impact (the wind profile describes how the wind velocity increases with height). There are probably several reasons why this was not found earlier: 1) because wind turbines become taller, there is a growing discrepancy between prediction and practice; 2) measurements are usually done in daytime when the wind profile resembles more closely the commonly used standard profile; 3) based on the sound that occurs in daytime, it is hard to imagine the sound can be so different at night; 4) “there are always people complaining”, so complaints are not always a reason for a thorough investigation; 5) at least some wind energy proponents prefer to downplay the disadvantages rather than solve them”. “From this study one can conclude that through the use of a restricted model of reality, viz. a forever neutral atmosphere, experts have lost sight (temporarily) of the true reality in which a neutral atmosphere is not very prevalent. It is precisely the occurrence of complaints that may indicate such errors”. “To conclude, it can be stated that with respect to wind turbine sound an important phenomenon has been overlooked: the change in wind after sunset. This phenomenon will be more important for modern, tall wind turbines and in view of the many wind farms that are planned. If this problem is not recognized and solved it will hamper the expansion of wind energy”. (The sound of high winds: the effect of atmospheric stability on wind turbine sound and microphone noise, Fritz G.P. van den Berg).

- Atmospheric Effects in ISO 9613-2 This paper describes how refraction by wind, temperature, and humidity gradients in the atmosphere can dramatically impact sound propagation and therefore play an important role in determining annoyance from noise emissions. When refraction is upward, lower annoyance is expected because the sound energy is directed away from ground-based receivers. Downward-refracting conditions, on the other hand, tend to raise near ground sound levels and therefore potentially lead to higher annoyance. Besides refraction, the atmosphere produces other important effects on sound propagation, such as temperature and humidity dependent absorption, scattering of sound energy into refractively and topographically formed shadow regions, and random variations in received sound levels. Although the basic physical mechanisms affecting sound propagation in the atmosphere are thought to be well understood, it has proven difficult to develop and agree upon comprehensive, workable engineering approaches to quantify the propagation effects. Among the many reasons for this state of affairs, perhaps the following are most important: (1) many complex interacting phenomena affect the propagation, and it is exceedingly difficult to develop good models for these phenomena working in conjunction. For example, although good theoretical solutions exist for sound diffraction over a barrier in a homogeneous atmosphere, in practice these solutions have limited applicability because of interaction of the atmospheric flow with the barrier, varying ground surfaces in the vicinity of the barrier, etc; (2) for all but very simple scenarios, the physical equations governing the propagation cannot be practically solved across a broad range of frequencies, even with modern computational capabilities; (3) the structure of the real-world environment (atmosphere, terrain, and man-made objects) is quite complicated and cannot typically be characterized with the resolution necessary to predict propagation accurately; and (4) the atmosphere varies over time scales from seconds to seasons (and longer), and therefore it is difficult to extrapolate or generalize the results of a few calculations. (Pp 851-860 Wilson, D. Keith, Figures (7); References (8), Noise-Con 04. The 2004 National Conference on Noise Control Engineering).

- EMD <http://www.emd.dk/WindPRO/WindPRO%20Modules,%20Decibel>

#### Decibel Function

Calculates and documents the noise impact from a wind turbine/wind farm.  
Calculation module

At present, the module can carry out calculations based on ten models:

- ISO 9613-2 International Standard
- ISO 9613-2, Germany
- ISO 9613-2, UK
- Denmark; The Guidelines of the Dept. of Environment (Miljøstyrelsen)
- The Netherlands guidelines of 1999
- Sweden: Ljud från landbaserade vindkraftverk, Naturvårdsverket, 2002.
- Sweden: Ljud från havsbaserade vindkraftverk, Naturvårdsverket, 2002.
- Former German guideline VDI 2714
- Former Netherlands guidelines: IL-HR-13-01
- Former Swedish codes
- Necessary Input Data (Objects)

Please note that the objects are entered in the WindPRO module BASIS. Please read the description of the WindPRO module BASIS for further details.

**Wind Turbine:** One or more wind turbines are entered (position and type). Usually, the wind turbine can be found in the wind turbine catalogue, which contains more than 500 different types and models. If no noise emission data, LWA<sub>ref</sub>, is given for the actual WTG in the catalogue, this data can be entered manually at the beginning of the calculation.

**Noise Sensitive Areas:** Noise sensitive areas and/or positions are entered graphically on an on-screen map. For each area/position, a minimum distance to the nearest wind turbine and the maximum allowable noise impact in dB(A) can be entered.

#### Description

The WindPRO module DECIBEL for Noise Impact Calculation makes noise calculations an easy task. Both existing and new wind turbines are included, and it is possible to define Noise Sensitive Positions (spots) as well as areas described by polygons. These polygons can be drawn directly on the background map using the mouse. The program calculates based on the noise emission data (Lwa or octave data) the point on the polygon line with the highest noise impact and prints the coordinates and noise level for the point

in the report. Differences in elevations between wind turbines and neighbors are included in the calculations since the coordinates for the wind turbines and the noise sensitive areas/positions all are given in 3D. The program can automatically calculate these elevations if digital maps are used. For each polygon/position, the maximum allowable noise level can be entered. In this way, it is possible to simultaneously carry out, for example, calculations relative to the nearest neighbor based on a 45 dB level and a nearby urban area at another distance based on a 40 dB level. Also it is possible to enter the initial background noise level without turbines if this is known and then calculate the additional noise inflicted by the wind turbines.

It is also possible to link a DECIBEL calculation to a project layout so a noise isoline map is automatically updated in the project window when changes are made. This makes it easier to find the optimal layout with regards to noise impact.

Calculations Report Main Printout, with assumptions including a map rendering the wind turbines and noise sensitive areas. For each noise sensitive area, coordinates and calculated noise level are printed out for the point with the highest noise impact. Finally, a table is included which shows the distances between the wind turbines and the noise sensitive areas in a matrix. Detailed Result: for each noise sensitive area or point every part of the noise from each WTG and all noise parameters are listed (only when calculating with the ISO standard). Maps: See the reverse page for an example of a map printout from a DECIBEL calculation. Data to file: Print of noise Isolines in an Arc View GIS package format (Shape files).

- Wind Energy Systems by Dr. Gary L. Johnson October 10, 2006

A stable atmosphere may have abrupt changes in wind speed at a boundary layer. The winds may be nearly calm up to an elevation of 50 or 100 m, and may be 20 m/s above that boundary. A horizontal axis wind turbine which happened to have its hub at this boundary would experience very strong bending moments on its blades and may have to be shut down in such an environment. An unstable atmosphere will be better mixed and will not evidence such sharp boundaries.

Measurements at intermediate heights will indicate some height where there is no diurnal cycle. A site at which the wind speed averages 7 or 8 m/s is a good site, especially if it is relatively steady. This again indicates the importance of detailed wind measurements at any proposed site. Two very similar sites may have the same surface winds, but one may have a well developed nocturnal jet at 20 m while the other may never have a nocturnal jet below 200 m. The energy production of a wind turbine on a tall tower at the first site may be nearly double that at the second site, with a corresponding decrease in the cost of electricity. We see that measurements really need to be taken at heights up to the hub height plus blade radius over a period of at least a year to clearly indicate the actual available wind.

- Addressing Wind Turbine Noise, Revised Oct. 2006 by Daniel J. Alberts

Daniel J. Alberts is a senior member of the Society for Technical Communication. He holds a BS in Engineering from the University of Michigan and a Master of Science in Technical and Professional Communication from Lawrence Technological University (LTU). Mr. Alberts was a founding member of LTU's Alternative Energy Student Group and served as the group's Vice-president for the 2004-05 school year. Mr. Alberts can be reached through <http://www.daniel-alberts.info> or [dja1701@nethere.com](mailto:dja1701@nethere.com).

Wind turbines generate two types of noise: aerodynamic and mechanical. A turbine's sound power is the combined power of both. Aerodynamic noise is generated by the blades passing through the air. The power of aerodynamic noise is related to the ratio of the blade tip speed to wind speed.

Depending on the turbine model and the wind speed, the aerodynamic noise may seem like buzzing, whooshing, pulsing, and even sizzling. Turbines with their blades downwind of the tower are known to cause a thumping sound as each blade passes the tower. Most noise radiates perpendicular to the blades' rotation. However, since turbines rotate to face the wind, they may radiate noise in different directions each day. The noise from two or more turbines may combine to create an oscillating or thumping "wa-wa" effect.

Wind turbines generate broadband noise containing frequency components from 20 - 3,600 Hz. The frequency composition varies with wind speed, blade pitch, and blade speed. Some turbines produce noise with a higher percentage of low frequency components at low wind speeds than at high wind speeds.

The amount of annoyance that wind turbine noise is likely to cause can be related to other ambient noises. One study in Wisconsin<sup>4</sup> reported that turbine noise was more noticeable and annoying at the cut-in wind speed of 4 m/s (9 mph) than at higher wind speeds. At this speed, the wind was strong enough to turn the blades, but not strong enough to create its own noise.<sup>4</sup>

<http://www.ecw.org/ecw/productdetail.jsp?productId=508&numPerPage=100&sortA>

- Sound from Wind Turbines, A white paper Prepared by the Renewable Energy Research Laboratory Department of Mechanical and Industrial Engineering University of Massachusetts at Amherst, MA 01003 413-545-4359 [www.ceere.org/rerl](http://www.ceere.org/rerl)

## Sound from Wind Turbines

### Sources of Wind Turbine Sound

There are four types of sound that can be generated by wind turbine operation: tonal, broadband, low frequency, and impulsive:

**Tonal:** Tonal sound is defined as sound at discrete frequencies. It is caused by components such as meshing gears, non-aerodynamic instabilities interacting with a rotor blade surface, or unstable flows over holes or slits or a blunt trailing edge.

**Broadband:** This is sound characterized by a continuous distribution of sound pressure with frequencies greater than 100 Hz. It is often caused by the interaction of wind turbine blades with atmospheric turbulence, and also described as a characteristic "swishing" or "whooshing" sound.

**Low frequency:** Sound with frequencies in the range of 20 to 100 Hz is mostly associated with downwind rotors (turbines with the rotor on the downwind side of the tower). It is caused when the turbine blade encounters localized flow deficiencies due to the flow around a tower.

**Impulsive:** This sound is described by short acoustic impulses or thumping sounds that vary in amplitude with time. It is caused by the interaction of wind turbine blades with disturbed air flow around the tower of a downwind machine.

The sources of sounds emitted from operating wind turbines can be divided into two categories: 1) Mechanical sounds, from the interaction of turbine components, and 2) Aerodynamic sounds, produced by the flow of air over the blades. A summary of each of these sound generation mechanisms follows, and a more detailed review is included in the text of Wagner, et al. [1996].

#### Mechanical Sounds :

Mechanical sounds originates from the relative motion of mechanical components and the dynamic response among them. Sources of such sounds include:

- Gearbox
- Generator
- Yaw Drives
- Cooling Fans
- Auxiliary Equipment (e.g., hydraulics)

Since the emitted sound is associated with the rotation of mechanical and electrical equipment, it tends to be tonal (of a common frequency), although it may have a broadband component. For example, pure tones can be emitted at the rotational frequencies of shafts and generators, and the meshing frequencies of the gears. In addition, the hub, rotor, and tower may act as loudspeakers, transmitting the mechanical sound and radiating it. The transmission path of the sound can be air-borne or structure-borne. Air-borne means that the sound is directly propagated from the component surface or interior into the air. Structure-borne sound is transmitted along other structural components before it is radiated into the air. For example, Figure 6 shows the type of transmission path and the sound power levels for the individual components for a 2 MW wind turbine [Wagner, et al., 1996]. Note that the main source of mechanical sounds in this example is the gearbox, which radiates sounds from the nacelle surfaces and the machinery enclosure. Figure 6: Components and Total Sound Power Level of a Wind Turbine, showing structure-borne (s/b) and airborne (a/b) transmission paths [Wagner, 1996].

#### Aerodynamic Sounds :

Aerodynamic broadband sound is typically the largest component of wind turbine acoustic emissions. It originates from the flow of air around the blades. As shown in Figure 7, a large number of complex flow phenomena occur, each of which might generate some sound. Aerodynamic sound generally increases with rotor speed. The various aerodynamic sound generation mechanisms that have to be considered are shown in Table 1 [Wagner, et al., 1996]. They are divided into three groups:

1. Low Frequency Sound: Sound in the low frequency part of the sound spectrum is generated when the rotating blade encounters localized flow deficiencies due to the flow around a tower, wind speed changes, or wakes shed from other blades.
2. Inflow Turbulence Sound: Depends on the amount of atmospheric turbulence. The atmospheric turbulence results in local force or local pressure fluctuations around the blade.



3. Airfoil Self Noise: This group includes the sound generated by the air flow right along the surface of the airfoil. This type of sound is typically of a broadband nature, but tonal components may occur due to blunt trailing edges, or flow over slits and holes.

#### Infrasound from Wind Turbines:

When discussing infrasound from wind turbines, it is particularly important to distinguish between turbines with downwind rotors and turbines with upwind rotors. Some early wind turbines did produce significant levels of infrasound; these were all turbines with downwind rotors. The downwind design is rarely used in modern utility-scale wind power turbines. Upwind rotors emit broad band sound emissions, which include low frequency sound and some infrasound. Note that the “swish-swish” sound is amplitude modulation at blade passing frequencies of higher frequency blade tip turbulence and does NOT contain low frequencies.

#### Noise Standards and Regulations:

There are standards for measuring sound power levels from utility-scale wind turbines, as well as local or national standards for acceptable noise power levels. Each of these is reviewed here. As of this writing (February 2005), there are no sound measurement standards for small wind turbines, but both the American Wind Energy Association and the International Electrotechnical Commission (IEC) are working on future standards.

#### Turbine Sound Power Measurement Standards:

The internationally accepted standard to ensure consistent and comparable measurements of utility-scale wind turbine sound power levels is the International Electrotechnical Commission IEC 61400-11 Standard: Wind turbine generator systems - Part 11: Acoustic noise measurement techniques [IEC, 2002]. All utility-scale wind turbines available today in the US comply with IEC 61400-11. It defines:

- The quality, type and calibration of instrumentation to be used for sound and wind speed measurements.
- Locations and types of measurements to be made.
- Data reduction and reporting requirements.

The standard requires measurements of broad-band sound, sound levels in one-third octave bands and tonality. These measurements are all used to determine the sound power level of the wind turbine at the nacelle, and the existence of any specific dominant sound frequencies. Measurements are to be made when the wind speeds at a height of 10 m (30 ft) are 6, 7, 8, 9 and 10 m/s (13-22 mph). Manufacturers of IEC-compliant wind turbines can provide sound power level measurements at these wind speeds as measured by certified testing agencies. 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.

#### Conclusions and Recommendations

Modern, utility-scale wind turbines are relatively quiet; still, when sited within residential areas, noise is a primary siting constraint. The following are

recommendations for standards, regulations and siting practices:

#### Turbine Standards:

Utility-scale turbines: Any incentives to promote wind energy should be provided only to turbines for which the manufacturer can provide noise data based on IEC standards or for turbines which are to be located at sites where there will clearly be no problem.

#### Noise Regulations:

Community noise standards are important to ensure livable communities. Wind turbines must be held to comply with these regulations.

#### Wind turbine siting practice:

In order to comply with state noise regulations and to fit within community land use, the siting of wind turbines must take sound levels into consideration.

If a wind turbine is proposed within a distance equivalent to three times the blade-tip height of residences or other noise-sensitive receptors, a noise study should be performed and publicized.

## Professional Opinions of Wind Turbines Noise Effects On People:

- Professor MARIANA ALVES-PEREIRA Department of Environmental Sciences & Engineering The New University of Lisbon (Portugal) a principal researcher on Vibro-Acoustic Disease (VAD) Her findings 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. [http://www.ninapierpont.com/pdf/Branco\\_&\\_Alves-Pereira\\_Vibroacoustic\\_Disease.pdf](http://www.ninapierpont.com/pdf/Branco_&_Alves-Pereira_Vibroacoustic_Disease.pdf)
- RICHARD BOLTON, physicist, Rushville, NY. Evaluation of Supplemental Environmental Noise Analysis for “Cohocton Wind Power Project” January 2007. Recommends 1 mile setback for turbines from residences.
- DR. NINA PIERPONT testified before New York Legislature March 7<sup>th</sup>, 2006, and author of several studies on Wind Turbines. (Testimony offered via teleconference in Chilton, Wed. August 1<sup>st</sup>.) additional work cited/available at: <http://www.ninapierpont.com>
- DR. NINA PIERPONT: Wind Turbine Syndrome: Noise, shadow flicker, and health by Nina Pierpont, MD, PhD August 1, 2006: Many individual accounts from across the world support the same set of symptoms (in submitted material and clinical interviews she has performed as part of a study in progress). Based on accounts and interviews, and in discussion with Dr. Harry, Dr. Pierpont has defined the Wind Turbine Syndrome, as a complex of symptoms which 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: • Sleep problems: audible noise or physical sensations of pulsation or pressure make it hard to go to sleep and cause frequent awakening. • Headaches which are increased in frequency or severity. • Dizziness, unsteadiness, and nausea. • Exhaustion, anxiety, anger, irritability, and depression. • Problems with concentration and learning. • Tinnitus (ringing in the ears). Not everyone

near turbines has these symptoms. This does not mean people are making them up; it means there are differences among people in susceptibility. These differences are known as risk factors. Defining risk factors and the proportion of people who get symptoms is the role of epidemiologic studies, which are in progress. Chronic sleep disturbance is the most common symptom. Exhaustion, mood problems, and problems with concentration and learning are natural outcomes of poor sleep. Sensitivity to low frequency noise is a potential risk factor. Available at <http://www.ninapierpont.com>

- Professor TERRY MATILSKY, Department of Physics and Astronomy, Rutgers University: Even more of an issue is noise. The wind developers refuse to acknowledge the very real problem that noise has become in installations around the world. Their big "mistake" is assuming a logarithmic wind profile, in which they claim that when the turbines spin a full speed, there will also be noise at the ground, since the wind is blowing there, as well. This is not true in many cases! Living within a half mile of these things will still allow you to hear them on hot summer nights, where radiative cooling effects cause the wind to be blowing like crazy at the height of the turbines, yet have it quiet enough to hear a pin drop at ground level. This phenomenon has been well documented now, but it has been completely ignored by the developers. I am not sure that even 1/2 mile setbacks will be adequate. 500 feet would be an impossible situation; I guarantee that. 1350 meters (4429 feet) seems like a good compromise, considering everything we know at this point. (November 8, electronic mail communication.)
- Professor John Ffowcs Williams, professor of engineering at Cambridge University and a world expert on acoustics and noise reduction: (1) "It is obviously a lie to say they make NO noise. That is absolute and definite and it is not true. They don't make MUCH noise but some people are very sensitive and can be highly disturbed by things that don't bother the average. That is the context in which the wind turbine fiasco should be discussed." (2) that the regulations as they are, are outdated and in ways inadequate and that it is known that modern, very tall turbines do cause problems and many think the current guidelines fail adequately to protect the public."  
<http://www.publications.parliament.uk/pa/cm200506/cmselect/cmwelaf/876/876we30.htm>  
November 2005
- Dr. Bridget Osborne from Moel Maelogan, A village in North Wales: Three turbines were erected in 2002 has presented a paper to the Royal College of General Practitioners detailing a "marked "increase in depression amongst local people. She says there is a perception that wind power is "green" and has no detrimental effect on the environment but these turbines make low- frequency noise that can be as damaging as high -frequency noise. She said that Wind power developers measure the audible range of noise but never the infrasound measurement—the low frequency noise that causes vibrations that you can feel through your feet and chest, This frequency resonates with the human body—their effect being dependant on body shape. For some, she said this is incredibly disturbing.  
<http://www.publications.parliament.uk/pa/cm200506/cmselect/cmwelaf/876/876we30.htm>  
November 2005
- GENE TIPLER, M.D. calumet County Wisconsin: presently serves on the board of directors of the Calumet Area Community Health Foundation, the board of directors of Calumet Medical Center, as medical director of Calumet Medical Center, and is a physician member for the county health department oversight committee. Dr. Tipler has been a practicing physician for 24 years in Calumet Co. Dr Tipler suggests one potential option related to Wind Turbine siting: "To state there is not adequate proof of safety and take a more conservative approach be either temporarily stopping construction and studying the effects on the people close to the turbines which are going up near here or by increasing the setback from peoples' homes to 1/2 -1 mile away as some studies suggest cause less problems with their health."

- NATURAL RESOURCES CANADA: Chris Padfield, Director Renewable and Electrical Energy Division, Natural Resources Canada sent notice (August 1, 2007) to Mr. Charles Demond, the president of the windfarm at Pubnico Point in Nova, that there is a "noise issue at Pubnico Point Wind Farm". The Canadian Federal government has accepted that it is a noise problem, and immediate action is ordered. (attached letter) See attached letter. (See DANIEL d'ENTREMONT) below.
- The JOURNAL OF SOUND AND VIBRATION, published in September 2004, G. P. Van den Berg, a physicist at the University of Groningen in the Netherlands, believes that he has at last explained the mystery of why modern onshore wind turbines can cause noise problems for residents at distances of a mile or more. For his article, "Effects of the wind profile at night on wind turbine sound" (Journal of Sound and Vibration, 277 (2004), 955-970), Van den Berg measured sound around the Rhede wind-farm (an installation of 17 turbines), on the Dutch/German border. "Residents living 500 m and more from the park have reacted strongly to the noise; (and) residents up to 1900m distance expressed annoyance" particularly at night. Yet, conventional wind industry calculations have assumed that turbines would present no noise problem over 500m.
- Letters of Concern:

December 13, 2007 Page 1 of 4

Joint Statement to Wisconsin Task Force on Wind Siting Reform

By: George Kamperman, INCE Bd. Cert., and Richard James, INCE

To: Wisconsin Task Force on Wind Siting Reform

Subject: Comments on Electric Generation and Supply templates

Re: Wind Siting Reform Policy

Dear Sirs:

Please let me take this opportunity to briefly introduce ourselves. We are noise control consultants with many years of experience in community noise and related land-use planning issues. Mr. Kamperman has over 50 years of experience and was active in the early 1970's assisting the US EPA, states such as Illinois, and many communities in setting their community noise standards and guidelines. Mr. James has over 35 years of experience in the same field and has represented many of the largest corporations in the US on community noise issues and litigation. He has also served on the S12 Working Group for the American National Standards Institute, which has oversight on standards related to acoustics including community noise and works to coordinate ANSI standards with those of ISO and other standards organizations. We are currently involved with assisting some of the communities in Wisconsin with understanding and addressing wind turbine developments proposed for their communities.

We are writing this joint letter to the Task Force because we have mutual concerns about the impact of the work of the Task Force on the communities in Wisconsin that are under consideration for wind farm development. These concerns are a result of our work with those communities and our review of the Task Force's recent draft Policy documents and the Draft Model Wind Ordinance for Wisconsin (Feb. 7, 2007) and its associated reference guide.

Our review finds substantial errors of fact and understanding regarding community noise and the impact of noise on land-use planning and the safety and health of citizens that would be affected by these policies. We do not intend to address all of them but several of the more egregious errors are addressed in this letter.

It appears to us that there has been little or no input into the work of the Task Force from un-biased and experienced professionals from our profession. Nor does it appear that there has been much, if any input from the medical and research professionals. Mr. Kamperman suggests that one way to resolve this

lack of expertise on the Task Force panel would be to include someone with his experience on the Task Force panel. Please consider the offer in the Post Script below.

We would like to address two major errors and failures of understanding in the Task Force's documents.

December 13, 2007 Page 2 of 4

Joint Statement to Wisconsin Task Force on Wind Siting Reform

By: George Kamperman, INCE Bd. Cert., and Richard James, INCE

First, the limits and guidelines set forth fail to adequately consider the health and safety of the people who will be living in the communities in which the wind energy systems are to be located. For example, there is no scientific evidence currently available from independent medically qualified authorities to support a statement that the 50 dBA sound pressure level to which residents may be subjected on a 24/7/365 basis is safe and healthful for all people including children and those with special needs.

The World Health Organization has found<sup>1</sup> that sound levels during nighttime and late evening hours should be less than 30 dBA during sleeping periods to protect children's health. They noted that a child's autonomous nervous system is 10 to 15 dB more sensitive to noise than adults. Even for adults, health effects are first noted in some studies when the Lmax sound levels exceed 32 dBA, 10-20 dBA lower than the levels needed to cause awakening. The WHO researchers found that sound levels of 50 dBA or more strongly disrupted hormone secretion cycles. For sounds that contain a strong low frequency component, which is typical of wind turbines, WHO says that the limits may need to be even lower than 30 dBA to not put people at risk.<sup>2</sup> ANSI standards recommend that no sound pressure levels exceed 65 dB (e.g. No weighting) in the lower frequency ranges to avoid structural vibrations and potential damage. 50 dBA would not protect against this situation, yet studies have shown that wind turbine sounds at residences sometimes exceed 65 dB in the frequency range below 20 Hz.

The recent conference held in Lyons France for the purpose of addressing wind turbine noise and health concerns demonstrated that wind turbine sound emissions of the types routinely experienced by people living close to wind farms may have significant cardio-vascular health effects after long term exposure. Again, we caution the Task Force that there is no scientific or medical basis for equating a 50 dBA limit for Wisconsin communities with health and safety.

Both the policy statement and supporting Model Ordinance are woefully lacking any scientific evidence supporting the sound limits and other recommendations that impact the acoustical environment. There is no un-biased evidence presented that the people living near wind turbine installations will not be forced to accept industrial scale operations that could introduce new risks into a community against the will of its citizens. Further, the statements in these documents that 50 dBA is based on review of other statutes and standards adopted by communities with wind farms shows only that the other

communities also did not properly research the issues of community noise and

1 Report on the second meeting on night noise guidelines, WHO, Dec. 6-7 2004

2 Community Noise (Berglund et al., 2000)

December 13, 2007 Page 3 of 4

Joint Statement to Wisconsin Task Force on Wind Siting Reform

By: George Kamperman, INCE Bd. Cert., and Richard James, INCE

its effects on health and safety. There is no objective argument for considering these other standards as a reason to adopt a similar set of limits. The documents provided by the promoters of wind energy that support the methods and limits proposed by the Task Force that we have seen would not pass a peer review by professionals in our field. They, also, should not be used as the basis for

guidelines in Wisconsin.

Second, to suggest the use of L10 as a descriptor of background sound levels is an egregious mistake. On what scientific basis has this recommendation been made? L10 is not a descriptor of background sound; L90 is the proper descriptor for background sound. L10 is a descriptor of noisiness from transient events. The wind turbines will produce steady sound emission for protracted periods of time. They should not be judged against transient events, but against the steady background sounds that occur during the periods of the day when quiet is expected.

Wind turbine siting guidelines for noise in Europe and many other parts of the world have adopted L90 to define the sound levels in communities prior to construction of wind farms. In New Zealand, L95 is used. The International Energy Agency (IEA) recommends the use of either L90 or L95 to define background sound levels.<sup>3</sup> L90 has been accepted and incorporated into documents developed by wind industry groups. For example, the British Wind Industry Association (BWEA) recommends that turbine sound levels should be kept to within 5 dBA of the average existing evening or nighttime background noise level and defines background noise level as the L90 sound level.<sup>4</sup> It should be noted that even when these stricter guidelines are followed that experiences in Europe, Britain and New Zealand show that residents near the wind farms are often subjected to turbine noise that are considered objectionable. Finally, if the mission of the task force is to enable the mission of the DNR:

“To provide a healthy, sustainable environment and a full range of outdoor opportunities.

“To ensure the right of all people to use and enjoy these resources in their work and leisure.

“To work with people to understand each other's views and to carry out the public will.”

Then, the views of the communities and citizens of Wisconsin who look to the State for guidance on what amounts to the industrialization of rural Wisconsin  
3 Recommended Practices for Wind Turbine Testing, Chapter 10.

4 BWEA Wind Turbine Noise Working Group Guidelines.

December 13, 2007 Page 4 of 4

Joint Statement to Wisconsin Task Force on Wind Siting Reform

By: George Kamperman, INCE Bd. Cert., and Richard James, INCE

should be considered as positive and constructive efforts. Their concerns about noise and other new risks being introduced into their communities are valid.

They should not be discredited by labeling their concerns as some form of NIMBYism or obstructionism as was implied in earlier drafts of the policy documents. Doing so devalues the input of Wisconsin's citizens to the State's efforts to promote renewable energy.

We appreciate the Task Force taking the time to consider our concerns and hope that they are taken in the most constructive light possible.

Sincerely,

Kamperman Associates, Inc.

312 Washington Avenue

Wisconsin Dells, WI 53965, USA

Telephone (608) 254-5656

george@kamperman.com

E-Coustic Solutions

P.O. Box 1129

Okemos, MI 48805

Tel: (517) 507-5067

rickjames@e-coustic.com

George Kamperman, P.E.

Bd. Cert. Member Institute of Noise Control Engineers

Member National Council Acoustical Consultants

Fellow Member, Acoustical Society of America

Richard R. James

Full Member, Institute of Noise Control  
Engineers

Member, Acoustical Society of America (past)

P.S. from George Kamperman

I feel the wind turbine siting issues are so critical in many areas that I would welcome an opportunity to be a part of the PSC committee responsible for determining wind turbine siting guidelines for the State of Wisconsin. If the State is interested in my involvement in this endeavor I offer my services at no cost.



Natural Resources Canada    Ressources naturelles Canada

Ottawa, Canada  
K1A 0E4

August 1, 2007

Mr. Charles Demond, President  
Pubnico Point Wind Farm Inc.  
P.O. Box 812  
Yarmouth, NS  
B5A 4K4

**SUBJECT:** Mitigation measures at Pubnico Point Wind Farm (PPWF)

Mr. Demond:

I am writing in follow up to discussions and written exchanges over the past year with Denis Zborowski and other members of my staff on the noise issue at Pubnico Point Wind Farm. Considerable time has elapsed since the release of the Howe Gastmeier Chapnik noise study.

As per Article 8 of the contribution agreement, Pubnico Point Wind Farm Inc. (PPWF) must implement the following mitigation measure: to configure the Pubnico Point Wind Farm such that wind turbine numbers 13 and 14 do not, during all times that the wind is moving in a direction between 170 and 190 degrees southerly, engage and produce power until the wind speed reaches 7 m/s. This mitigation measure must be implemented immediately upon confirmation of receipt of this letter.

Natural Resources Canada (NRCan) does not accept your contention that no monitoring of the mitigation measure is necessary. Without monitoring it will be impossible to verify the effectiveness of the mitigation. Therefore, to measure the effectiveness of re-configuring turbine numbers 13 and 14 as a noise level mitigation measure, PPWF must submit a monitoring plan to be approved by NRCan and initiated by no later than September 30, 2007. In order to review and approve or comment on the monitoring plan, NRCan requires that it be submitted no later than August 24, 2007.

Failure to immediately implement the aforementioned mitigation measure and/or to submit an acceptable monitoring plan to NRCan to be initiated by September 30, 2007, will result in the forfeiture of the Wind Power Production Incentive as per Articles 8 and 13 of the contribution agreement between both Parties dated January 31, 2005.

.... /2

Canada



- 2 -

Regards,

A handwritten signature in black ink, appearing to read "Chris Padfield". The signature is written in a cursive, flowing style with a large initial "C".

Chris Padfield  
Director  
Renewable and Electrical Energy Division

NINA PIERPONT M.D. PH.D.



Letter from Dr. Pierpont to a resident of  
Ontario, Canada,  
re. Wind Turbine Syndrome

---

Autumn 2007

Dear Mr. Lever,

Yes, there are indeed medical problems caused by noise and vibration from current, upwind, three bladed industrial wind turbines. I am in the process of preparing a paper for publication in a medical journal documenting the consistency of these problems from family to family, the study subjects being a collection of families in several countries who have been driven from their homes by problems with sleep, headaches, tinnitus, equilibrium, concentration, memory, learning, mood, and child behavior—problems which started when the turbines went into operation and which resolve when the family is away from the turbines. These problems all occur in proximity to recently built industrial turbines, put into operation in 2005, 2006, and 2007.

The ear is indeed the most sensitive receptor for noise and vibration. This does not mean, however, that if you cannot hear it, it cannot hurt you. The ear does more than hear. A number of the effects of noise and vibration from wind turbines appear to be mediated by the inner ear, which is a complex organ, only one of whose functions is detecting certain sorts of vibration as noise. The inner ear also detects movement, acceleration, and position relative to gravity. Inner ear (vestibular signals) ramify throughout the central nervous system, influencing brain functions related to sleep, vision, hearing, movement, digestion, thinking, and learning and memory. My data indicate that one of the principal effects in Wind Turbine Syndrome is vestibular detection of either airborne pressure waves or solid-borne vibration (via bone conduction) which is influencing the vestibular system as if the body or head were moving, when it's not.

People disturbed by noise and vibration from industrial wind turbines generally can hear the

19 Clay Street  
Malone, New York 12953

(518) 483-6481

Fax: (518) 483-6481

pierpont@westelcom.com  
[www.ninapierpont.com](http://www.ninapierpont.com)

noise when it bothers them, though it may not seem particularly loud. Several people I have interviewed speak favorably of living next to an elevated urban train line, compared to living at their rural home next to wind turbines. They can sleep with traffic or train noise, but not with the wind turbine noise/vibration. They consistently described a penetrating and intrusive quality to the wind turbine noise, several describing in different ways a very disturbing feeling that the noise is somehow inside their bodies. This latter effect suggests detection of vibration in body cavities, especially since people who say this generally localize the feeling to their chest or their head.

Published research from Sweden (doctoral thesis by Pedersen and published papers incorporated into the thesis) shows that the percentage of annoyed people (which include people who move out or undertake major house renovations to try to do something about the noise) goes up at 37.5-40 dBA.<sup>1</sup> This is probably because A-weighted noise representations are not capturing the parts of the wind turbine noise and vibration spectrum which are disturbing. The Pedersen studies are also based on modeled noise, not actual measurements, though there is a close correlation between actual dBA measurements and the Swedish governmental modeling protocols, the author says. Even if we do not know exactly what parts of the noise and vibration spectrum are bothersome, and to what extent these are represented in a dBA measurement, we have in the Pedersen research clear evidence that when noise is modeled prior to wind turbine construction, the allowed levels of noise should not be over 37.5 to 40 dBA outside of dwellings. Because the noise level is especially important at night, and it is at night that there tends to be a "stable atmosphere," with cool, still air at ground level and a brisk wind at turbine hub height, modeling of noise prior to wind turbine construction should use both a 37.5 to 40 dBA ceiling of tolerability, and van den Berg's models of noise propagation in a stable atmosphere.<sup>2</sup>

You are welcome to use anything on my website, though my current research results are not yet posted on the website.

Sincerely,



Nina Pierpont, MD, PhD

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<sup>1</sup> Eja Pedersen, "Human response to wind turbine noise: Perception, annoyance and moderating factors," PhD. Dissertation, Occupational & Environmental Medicine, Department of Public Health and Community Medicine, Institute of Medicine, The Sahlgrenska Academy, Goteborg University, 2007, 86 pp.

<sup>2</sup> G.P. van den Berg, "Effects of the wind profile at night on wind turbine sound," *Journal of Sound and Vibration* 277 (2004):955-970.

- Scott George, Evansville Utility Superintendent: In August 2007, when asked about the Wind Turbines being planned for the West side of Evansville, potentially within 1 mile of his current home, Scott George advised the following: “ the biggest problem with these Wind Turbines is stray voltage because they are up and down.” “I can move, I don’t plan on living there forever.” “We all are going to have to sacrifice.” “I am not for or against wind power.”

## Samples of Letters Contributing to Our Report:

- Letter to Gordon Whitehead B.S., M.A., Aud(C), Audiologist

Mr. Whitehead,

I am looking for information that I can present to the town board that shows the effect that a temperature inversion has on the noise from a turbine and how it can be bounced back to the ground some distance away. This will help the person who has heard the soft whoosh during the day that at night can turn into the sound of a freight train that can be heard miles away from the turbine. I found two small articles on the NWS one pertains to smoke and air quality and the other explains how the sound of thunder can be refracted back to the ground and heard 10 miles away from the lightning strike. I am also trying to research aerodynamic modulation and how it will cause a turbine blade to produce low frequency noise and infrasound. If you can point me in the right direction with either of these areas it would be a great help.

Thanks for your time,

Jim Bembinster  
Evansville, Wi.  
17 October 2007

- Dear Mr. Bembinster,

Your question on the effect of temperature on sound transmission is quite an involved one! Several variables need to be considered when discussing the effect.

1. Temperature. When temperature increases (becomes warmer), air molecules expand to the point that they are farther apart; therefore they are less efficient in acting as a sound carrier. Warm temperatures do not carry sound as far as cooler air, and the sound travels more slowly. When temperature decreases (becomes cooler), air molecules contract to the point that they are closer together; therefore they become more efficient in acting as a sound carrier. Cool temperatures carry sound farther than warm air, and the sound travels more rapidly.

Therefore, cooler air may cause more sound-related problems, such as at night or in the fall/winter. On the other hand, these cooler conditions during which house windows are more likely to be closed, may somewhat mitigate a turbine’s middle and upper frequency sound perception. Very low-frequency sound can travel through the ground and house structure, and it often does not change much whether windows are opened or closed. Sound may be perceived as louder when the windows are closed as the closed window will block out some other sounds that might have at least partially

covered up the low-frequency sound.

2. Humidity. When humidity increases, including times when it is raining or fog is present, additional water vapor is present between air molecules, making the volume of air/moisture more dense (less space between molecules). Therefore, when humidity levels are higher, sound travels more efficiently, travels a greater distance, and is louder than in low humidity conditions.

Therefore, moister air may cause more sound-related problems, such as during high humidity, rain and/or fog. On the other hand, during rain, especially with wind present, the sound of the rain and/or wind might at least partially cover up other sounds.

3. Geology, plant growth, and man-made features. Reflection (re-direction) of sound and absorption (decrease in loudness) of sound, especially middle and upper frequencies can be influenced greatly by these actions. Geological features such as hills, rocky ground, bodies of water, ice, etc. can reflect sound towards or away from specific locales, thus increasing or decreasing loudness. Geological features such as wooded areas, planted fields, snow, etc. can absorb sound and decrease its loudness in specific locales. Similarly, man-made features such as buildings, billboards, paved roads/parking lots/ sidewalks, retaining walls, etc., can reflect sound towards or away from specific locales, thus increasing or decreasing loudness. Most man-made features are hard and reflect sound, but a few constructions such as parks, garden areas, sports fields, etc., may absorb sound and decrease its loudness in specific locales.

In addition to the above three considerations are the interactions that can occur between any 2 or 3 of them. You see, it can become very complicated . . . ! Temperature and/or humidity inversions can create reflective or absorptive air and/or moisture layers at different altitudes that can increase or decrease sound loudness and travel distance. This can explain your analogy of thunder, as such layers are more efficient at reflecting/refracting lower frequency sounds. Sometimes such conditions can absorb and decrease weaker, shorter-wavelength sounds. Lightning and thunder, however, have the potential of creating even louder sound than wind turbines, but are present only for significantly shorter time periods. In Nova Scotia, where we are never too far from the ocean, cool air and moist, foggy conditions create more problems with sound loudness and travel distance. It should also be noted that things sound louder at night, in general, because ambient (background) noises are usually less (less traffic, fewer aircraft, less construction and maintenance sound, yard work, etc.). Less ambient noise allows the unwanted noise to appear more intrusive, as it covers it up less. This is why progressive communities that have general sound bylaws with decibel levels included, set a lower acceptable sound intensity at night.

Regarding how turbines can produce low-frequency sounds and infrasound. Infrasound is basically low-frequency sound that we cannot actually “hear” as sound with our ears, but we may be able to detect them as vibration or with the balance mechanism in the ears. Turbines can produce these lower frequency sounds in several ways, including:

- Sound produced by the turbine’s gearbox.
- Chopping of wind, by the revolving turbine blades, into sound; this is basically how the human voice produces sound, with the vocal folds doing the “chopping”.
- The aerodynamic features of the turbine blade, itself, also can influence the sound it produces. Greater blade pitch can move more air per revolution.

Other wind characteristics created at the blade/air interface can also contribute to the overall sound frequency make-up.

- Wind effects as wind blows past the actual tower structure.
- “Beats”. This phenomenon is well-known to most musicians. When two or more things, such multiple wind turbines, are producing low frequency sounds that are almost the same frequency (but not exactly the same), the human ear hear as well as perceiving the difference frequency between them.
- Ground vibration, as the above potential causes direct the low-frequency sounds down the tower and into the ground. This is increased if the structure touches bedrock. This ground vibration can then travel to house foundations and up the structural members of the building and into living spaces. It is important that the turbine/tower structure be as vibration- isolated from the ground as possible. There are engineering approaches available to decrease this problem.

I hope the information contained in this letter will be of some help to you.

Sincerely yours,

Gordon Whitehead

B.S., M.A., Aud(C), Audiologist

Adjunct Professor (retired)

E-mail address: [gordon.whitehead@ns.sympatico.ca](mailto:gordon.whitehead@ns.sympatico.ca)

- PAT WALSH: Department of Biological Systems Engineering, University of Wisconsin-Madison/Extension. “Not being a health professional, I have a hard time sorting through all the opposing views on utility scale wind. The most recent review of the environmental and health effects of wind turbines is a report from the National Academy of Sciences, National Research Council. This is the most balanced look at all the conflicting claims.” (Note: The NRC recommends setbacks be ½ mile or so).  
NAS(wind)http://books.nap.edu/catalog.php?record\_id=11935  
Electronic response from Pat Walsh on Tuesday, October 09, 2007 11:22 AM  
referred to by: Scott Sanford M.Engr, Senior Outreach Specialist  
Rural Energy Program / Focus on Energy, Biological Systems Engineering  
University of Wisconsin - Madison. Referred to by Doug Zweizig re: Albany Farm Days.

Woodtech Industries

From: "Scott McElroy" <calfman22@yahoo.com>

To: "Woodtech Industries" <woodtech@tds.net>

Sent: Thursday, October 11, 2007 7:51 AM

Subject: Re: Fw: Request for Ordinance information

Page 1 of 2

10/11/2007

----- Original Message -----

From: Patrick Walsh

To: Woodtech Industries

Sent: Tuesday, October 09, 2007 11:22 AM

Subject: RE: Request for Ordinance information

Ms. Bembinster,

Not being a health professional, I have a hard time sorting through all the opposing

views on utility scale wind. The most recent review of the environmental and health effects of wind turbines is a report from the National Academy of Sciences, National Research Council. This is the most balanced look at all the conflicting claims. I do not have a copy of the study, but you can view it at the site below. The site also provides a way to purchase it.

I hope this is helpful.

Pat Walsh

NAS (wind) [http://books.nap.edu/catalog.php?record\\_id=11935](http://books.nap.edu/catalog.php?record_id=11935)

At 10:58 AM 10/9/2007, you wrote:

Dear Mr. Walsh,

I am following up on an email I had previously sent to Mr. Sanford. I was asked by our ordinance committee if I had heard from you. Perhaps this isn't really something you can help us with but maybe you can give me some advice on where I can obtain this information.

Thank You for your time.

Sincerely,

Cathy Bembinster

----- Original Message -----

From: Scott Sanford

To: 'Woodtech Industries'

Cc: 'Patrick Walsh'

Sent: Monday, September 24, 2007 5:44 PM

Subject: RE:

Pat Walsh, who is on the faculty here at UW-Madison- Biological Systems Engineering, has experience in the renewable energy field and will work on digging up the information you requested.

Scott Sanford M. Engr

Senior Outreach Specialist

Rural Energy Program / Focus on Energy

Biological Systems Engineering

University of Wisconsin - Madison

608-262-5062

[sasanford@wisc.edu](mailto:sasanford@wisc.edu)

[www.bse.wisc.edu](http://www.bse.wisc.edu)

[www.uwex.edu/energy](http://www.uwex.edu/energy)

From: Woodtech Industries [<mailto:woodtech@tds.net>]

Sent: Friday, September 21, 2007 7:53 AM

To: [sasanford@wisc.edu](mailto:sasanford@wisc.edu)

Subject:

Dear Mr. Sanford,

I understand your department had a informative display at the Farm Technology Days in Albany, Wi. Unfortunately I wasn't able to attend, but the acting Chairman of our Union Township's Planning Commission in regard to Industrial Wind Turbine Ordinance development, Doug Zweizig did and referred you to me. I am part of an appointed Citizen's Commission whose purpose is to research information concerning responsible siting of Industrial Wind Turbines in our Township. Our job is to recommend to the

Township's Planning Commission what setback distances should be from a citizen's home to the location of the Industrial Wind Turbine based on health and safety information. We have been collecting and reading volumes of reports. The first place to investigate is the Draft Model Wind Ordinance for Wisconsin. We had asked our local Representative and his staff to locate the scientific data that supports the 1000 foot setback in the area of the Draft Model Wind Ordinance for Wisconsin. They cannot seem to find this information through the Legislative Legal Department. We also were trying to locate the scientific data that supported the 50 dBA noise limit under "Noise", and are interested in why a C weighted decibel limit wasn't listed. There were numerous studies available in the year 2000 when they first started on the Ordinance, and much more when it was finalized in 2004. I guess with this lengthy introduction, my question would be to you, how do you as a researcher sort through the volumes of information and write recommendations that would be deemed "credible"? The challenge that every Township has been facing is that the Draft Model Wind Ordinance for Wisconsin and its guardians do not acknowledge any "credible" health issues in reference to Wind Turbine siting so therefore there aren't any. I've attached a copy of the Draft Model Wind Ordinance for Wisconsin. From my interpretation it appears that all requirements of safety and noise are addressed after the Wind Turbines have been installed which is too late.

I am anxious to hear some advice from someone who does this every day.

Sincerely

Cathy Bembinster  
Town of Union  
Evansville, WI  
Patrick Walsh  
Department of Biological Systems Engineering  
University of Wisconsin-Madison/Extension  
460 Henry Mall, Room 115  
Madison, WI 53706  
(ph) 608-265-8152  
(fax) 608-262-1228  
Page 2 of 2  
10/11/2007

Cathy,

Unfortunately I am not sure which resource cited in the Permitting Handbook is the source of the pg. 23 citation that you are inquiring about. References are listed at the end of each chapter and Appendix B has more information about turbine sound. I also recommend the proceedings from NWCC's 2005 siting technical meeting for additional information on sound impacts of wind development; the proceedings and presentations are online at <http://www.nationalwind.org/events/siting/default.htm>. You may also be interested in our document on how different states approach siting guidelines, available at [http://www.nationalwind.org/publications/siting/Siting\\_Factsheets.pdf](http://www.nationalwind.org/publications/siting/Siting_Factsheets.pdf). I hope this information is helpful.

Regards,  
Katie

Katie Kalinowski



Sr. Outreach Coordinator, National Wind Coordinating Collaborative  
RESOLVE ♦ 1255 23rd St NW, Suite 275, Washington, DC 20037  
Phone: 202.965.6383 Fax: 202.338.1264  
[kkalinowski@resolv.org](mailto:kkalinowski@resolv.org) ♦ [www.nationalwind.org](http://www.nationalwind.org) ♦ [www.resolv.org](http://www.resolv.org)

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From: Cathy Bembinster [mailto:[cathyjimb@eishome.com](mailto:cathyjimb@eishome.com)]  
Sent: Sunday, December 02, 2007 7:28 AM  
To: Katie Kalinowski  
Subject: Permitting of Wind Energy Facilities

Dear Ms. Kalinowski,

I am a member of a committee, appointed by our Town Board to develop an ordinance for Industrial Wind Turbines in our township. As I was reading through the "Permitting of Wind Energy Facilities, A Handbook Revised 2002", I came across a statement that doesn't appear to have a footnote to the source.

On page 23, under noise considerations, at the end of paragraph 3, it states, "Under most conditions, modern turbines are quiet, generating primarily broad-band sound levels no higher than those of a moderately quite room at distances of 750 to 1000 feet (about 230-300m).

Could you please help direct me to the source that supports that statement? Again, there isn't a footnote noted on that page.

Thanking you in advance for your help,

Cathy Bembinster  
email: [cathyjimb@eishome.com](mailto:cathyjimb@eishome.com)

Gordon Whitehead  
B.S., M.A., Aud(C), Audiologist

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210 Windsor Drive, Stillwater Lake, Nova Scotia B3Z 1G5

12 October 2007

Dear Mr. McElroy:

Thank you for the ordinance information that you forwarded. Yes, suspicious is probably a very good word to describe what is occurring with Wisconsin Model Ordinance!

Before I get into that, here are some other very interesting items (that you might already have, but if not, very worthwhile):

1. Please read the following paper, written by Professor Terry Matilsky, who is with the Department of Physics and Astronomy at Rutgers University, in New Jersey. Don't try to follow the math; I didn't! Just read the descriptions and conclusions. In essence, ice and wind turbine debris can (and has) been thrown 1,700 feet from the base of turbines. The website address is:

[www.physics.rutgers.edu/~matilsky/windmills/throw.html](http://www.physics.rutgers.edu/~matilsky/windmills/throw.html)

2. Please also read "CLOWD: Accident Data, at:

[www.clowd.org.uk/pages/clowdAccidentData.htm](http://www.clowd.org.uk/pages/clowdAccidentData.htm)

I have attached to this letter the "full accident data" from this source, in PDF form. I have read over the full 84 pages of accident reports, and I would have to say this is one of the most disturbing and scary things I have ever read in my 64 years! Please read all of it. It is in easily read chart form, and details about 330 wind turbine accidents around the world, including about 45 in the U.S., including one in Lincoln Township, Wisconsin (page 25, item 126), where lightning caused blade failure which caused damage to nearby homes and property. This collection of wind turbine accident data shows that the Wisconsin setback values are woefully inappropriate, in my opinion.

I have read, thoroughly, the following papers:

- A. DRAFT-4-23-07 Model Wind Ordinance Reference Guide.
- B. Draft Model Wind Ordinance for Wisconsin - October 22, 2003
- C. Draft Model Wind Ordinance for Wisconsin - February 7 2007

In the Reference Guide "A", above, it notes that this document has been assembled with input from the "electric utilities . . . and interested regulators; representatives of private industry and local governments were included in the discussions." It would be interesting to know how many local governments and other stakeholders actually knew of the effort or were involved in the effort? Under section "A. Wisconsin" it states: "To ensure that its policy goals regarding renewable energy are not unduly hindered, the state legislature has enacted legislation limiting the ability of local governments to prohibit or curtail the development of wind and solar energy systems. . . . prohibits counties, cities, towns or villages from placing any restrictions, directly or indirectly, on the installation of solar or wind energy systems unless the restriction satisfies one of three

Telephone: 902-826-7370 Fax: 826-7061  
E-Mail: gordon.whitehead@ns.sympatico.ca

2.

. . . Mr. Scott McElroy, continued . . .

conditions: (1) the restriction serves to preserve or protect the public health or safety . . .  
.” Well, the model ordinances for Wisconsin, in my opinion, do not have adequate sound  
intensity limits or setback standards to “protect the public health or safety”.

In this letter I will note only two topics within the ordinance, (a) setbacks and (b) noise.  
Setback refers to the minimum distance allowed from the turbines to the property of  
others. If the setback is great enough, danger from ice and debris throw, and noise from  
the units will not become an issue.

SETBACKS: The setback distance for both the “B” (2003) Draft Model Wind Ordinance for  
Wisconsin and the “C” (2007) Draft Model Wind Ordinance for Wisconsin are identical; that  
is, the greater of 2 times the total turbine height or 1,000 feet, whichever is greater. With  
current typical turbine heights, this would mean the ordinance would enforce a setback of  
1,000 feet. This is not enough for protecting the public health or safety, as history shows  
that ice and debris throw (including turbine parts as unit destruction occurs) potentially  
and in recorded fact. Please refer to the websites and attached documents accompanying  
this letter for related history.

NOISE: The noise section of the two documents, “B” (2003) Draft Model Wind Ordinance  
for Wisconsin and the “C” (2007) Draft Model Wind Ordinance for Wisconsin, contain some  
significant differences. The 2003 document refers to “noise”, while the 2007 document  
refers to “sound”.

The identical Section 5.3-1) states “Audible noise/sound (2003/2007) due to Wind Energy  
Facility operations shall not exceed fifty (50) dBA for any period of time . . .” The  
Definitions section of the Ordinance does not define “for any period of time.” This is  
critical. I have had involvement in one instance where the wind turbines exceeded the  
noise limit 63% of the time, and the government has not, to date, ruled this as  
unacceptable! Without a specific guideline, this noise “limit” becomes completely  
unenforceable.

In Section 5.3-2) the 2003 Ordinance states “In the event audible noise . . . shall be  
reduced by five (5) dBA.” In Section 5.3-2) the 2007 Ordinance states “In the event  
audible sound . . . shall not exceed forty-five (45) dBA . . .” The 50dBA and 45dBA  
mean the same level, it is just a different way of expressing the same thing.

The remainder of Section 5.3-2) has been altered significantly, however, between the 2003  
and 2007 Ordinance. Basically, the 2003 definition of a pure tone is more stringent than  
the 2007 definition, in that the noise in the lower frequencies has to be louder, overall, in  
the 2007 Ordinance in order to be considered a “steady” pure tone, because utilizing the  
db”A” weighting scale filters out significant amounts of low-frequency sound. The 2007  
Ordinance is easier for the developers to meet. The 2007 Ordinance also uses the wording  
“for any period of time”, while the 2003 Ordinance does not contain that statement. This  
wording is ambiguous and makes the limit much harder to enforce; this is advantageous to  
the developer.

In Section 5.3-3), the 2003 Ordinance wording is clear and easy to measure in defining  
“ambient noise level”. It also gives a time frame for exceeding the limit, that is by more  
than 5 minutes per hour. The 2007 Ordinance, however, does not state a time frame for

exceeding the noise, and is expressed in what appears to me to be very poorly worded and confusing language on how to

3.

. . . Mr. Scott McElroy, continued . . .

compute the value. The 2007 Ordinance also mixes “dBA” and “dB” in its sentences, which are two entirely different ways of measuring sound.

Basically, I find it almost humorous that if the turbines cannot meet the noise limit in 1), then one can enforce the limit and require a decrease in turbine intensity only if the turbine sound meets the definition of a pure tone. What do you do if the turbine noise is excessive but does not meet the definition of a pure tone? This is a very possible scenario. And then if the ambient noise is higher than the turbine noise, well you can adjust the turbine noise limit upwards to equal the ambient noise! Again, this appears to have been written in favor of the developer.

A note about ambient noise; ambient noise is the regular noise level that resides in an area, when the turbines are not operating. Ambient noise values should not be utilized in an ordinance, as they are meaningful only if the turbine produces a sound identical to the ambient noise in its frequency make-up. This would be exceptionally rare, as the two sounds are usually quite different in sound quality. An example would be listening to common classroom noise at 50dBA, and then a student drags their fingernails over the chalkboard at 40dBA. The fingernail screech would stand out quite strongly even though it is 10dBA quieter. Yet, according to the Ordinances, you could scratch the chalkboard even louder, up to 50dBA to equal the ambient noise!

In conclusion, I can make a few statements of opinion:

1. I do not know why the State government keeps changing which Ordinance it is going to enforce. The 2007 version appears more wind farm developer friendly. But the ambiguity and confusion and use of approaches not generally utilized in the 2007 Ordinance may make it more vulnerable in a court of law . . .

2. Although the 2003 version is more people friendly, neither version is really people friendly.

3. Neither version protects the “public health or safety”.

4. The biggest issue is that of an adequate setback. A proper, sensible setback would eliminate most noise complaints. A proper, sensible setback would eliminate most of the danger from ice throw and/or debris throw. With an unrealistic 1,000 foot setback, it is only a matter of time before someone is killed, or seriously injured. Read the literature on the attached Accident Data attached to this letter. Look especially at Germany’s abysmal record. The U.S. record is nothing to brag about, either. This isn’t speculation, these are recent historical facts: people are being injured, people are dying, ice and turbine debris is damaging and destroying homes and cars, and debris is landing in schoolyards, ice and turbine debris are closing highways for hours or days, oil fires from lightning and other causes are destroying turbines and burning up to 80 to 100 hectares as the ignited oil is thrown over a wide area, fire departments cannot fight these fires because of their height above the ground, police are having to assist people in evacuating their homes until things are brought under control. What do we have to do? Wait until debris hits a school or school bus and kills dozens of children? Or kills people in their homes? Enforce a setback of at least 1.5 to 2 miles, and watch the majority of problems disappear! The solution is so simple!

. . . Mr. Scott McElroy, continued . . .

To reiterate the last paragraph on page one of this letter, a quotation from A. DRAFT-4-23-07 Model Wind Ordinance Reference Guide: "To ensure that its policy goals regarding renewable energy are not unduly hindered, the state legislature has enacted legislation limiting the ability of local governments to prohibit or curtail the development of wind and solar energy systems. . . . prohibits counties, cities, towns or villages from placing any restrictions, directly or indirectly, on the installation of solar or wind energy systems unless the restriction satisfies one of three conditions: (1) the restriction serves to preserve or protect the public health or safety . . ." Sensibly developed wind turbine installations can coexist peacefully with the public, and everyone wins, the public, the wind farm developers, and the government. Why do anything else?

It has been proven, it is not speculation, setback and noise changes are needed to preserve and protect the public health and safety. If the government does nothing significant, the government is not representing the views and welfare of its citizens, and that becomes a government of tyranny, not democracy . . .

Sincerely yours,

Gordon Whitehead  
B.S., M.A., Aud(C), Audiologist  
Adjunct Professor (retired)

Don, Kendall & Jim –

Knowing you're all interested/involved with the wind farm issue in Union township, Brett asked me to check into the definitions of "public health & safety" in state statutes as they apply to things like wind farms. The following is the response I received from our Legislative Council which, as stated, is intentionally vague:

---

From: Lovell, David  
Sent: Friday, July 06, 2007 12:28 PM  
To: Busch, Jason  
Cc: Rep.Davis; Bacher, Luke  
Subject: RE: Question regarding wind farms

Jason,

I think it is safe to say that "public health and safety" is an intentionally ambiguous term. The statutes do not define or give any specific guidance regarding its meaning. "Health and safety" appears 115 times in the statutes, and in 4 notes in the statutes; there are an additional 52 occurrences of "health, safety, and welfare," several of which also refer to "life." They all refer to the health and safety of someone, either "the public" or a specified group of people. In every case, these phrases are used in a general sense. For example, in the statutes regarding child welfare and crimes against children, there are numerous statements that "the juvenile's **health and safety** are the paramount concerns." Also, the statutes regarding hazardous substances state:

100.37 (2) (b) If the department finds that the requirements of this section are not adequate for the protection of the public **health and safety** in view of the special hazards presented by any particular hazardous substance, it may by rule establish such reasonable variations or additional requirements as it finds necessary for the protection of the public **health and safety**.

The reason these terms are intentionally ambiguous is that they involve judgments. They apply to situations either too various or too detailed as to be anticipated and dealt with specifically in laws. Where they apply to governmental bodies, such as the development of a wind ordinance by the Board of the Town of Union, they provide general guidance but intentionally leave the hands of the board members free to design an ordinance that meets the needs of that community, so long as the ordinance is reasonable. ("Reasonable" is another ambiguous term, but it is the primary consideration in reviewing many kinds of governmental actions.)

If the Town of Union Board members are uncomfortable with this ambiguity and need further guidance, they should seek legal advice. They may want to talk to Rick Stadelman of the Wisconsin Towns Association; Rick is an extremely knowledgeable and helpful person.

I hope this is helpful to you. Let me know if you have further questions, or if you or Representative Davis would like to discuss this.

Best regards,

David Lovell

---

David L. Lovell, Senior Analyst

Wisconsin Legislative Council Staff

608/266-1537

Hopefully this is of some value to you guys.

Please let myself or Brett know if there's anything else we can do to assist you with this issue or any other.

Regards,

Jason Busch

Legislative Assistant

Rep. Brett Davis

80th Assembly District

608-266-1192

[Jason.Busch@legis.wi.gov](mailto:Jason.Busch@legis.wi.gov)

From: "Gordon Whitehead" <gordon.whitehead@ns.sympatico.ca>  
To: <calfman22@yahoo.com>  
Subject: Wind energy reply  
Date: Tuesday, August 14, 2007 1:44 PM

14 August 2007

Dear Mr. Scott McElroy:

Thank you for your letter. I know Evansville. I was born in Janesville, Wisconsin, and lived there for a number of years, and have many relatives in Janesville, Edgerton and Stoughton.

The letter to which you refer, to Mr. Jeff Roberts, was sent to him 30 July 2007. I am uncertain which parts of my letter (or its authenticity) you have read, so the basic letter is being inserted here, with some modifications to more accurately reflect your situation.

I will open by saying that I am a big supporter of wind energy, in general, and would like to see it expand, but only if it is done in a sensitive manner that will not negatively impact on the quality of people's lives or on the property on which they live. Unfortunately, my experience has suggested to me that most governments appear almost ignorant of the issues/scientific information available.

The following is my opinion: ["Installing the larger wind turbines within 1 mile of Evansville's (or any other community's) city limits would be a major mistake. Installing them within 1,000 feet of residences and roadways would be an even bigger mistake. This setback is not enough. I believe a setback equivalent to 1.5 miles would be adequate in most situations, and I think in most situations a setback of this distance is possible. The potential noise, and/or vibration, and/or light flicker and/or mechanical safety issues are very real.

Firstly, noise: loud, low-frequency noise/vibration can interfere with the balance mechanism (the vestibular system) in humans. Some people are more sensitive to this than others; often those with motion sickness (seasickness) are more susceptible. If loud enough it can interfere with verbal communication (through what we audiologists call the "upward spread of masking"), something to consider when schools, daycares and nursing homes are nearby, not to mention homes. The presence of an almost constant, obvious noise and/or vibration can interfere with sleep, and can also be responsible for numerous psychological responses. When the windows in the home or school or workplace are open, the effect can be worse. Anyone who tells you that there are no potential negative health effects as a result of wind turbines installed too close to human-occupied buildings is either lying to you or ignorant of facts.

Secondly, light flicker: During any time the revolving wind turbine

blades are between the sun and a person's eyes, one experiences light flicker, like a strobe light. It can be extremely disorienting, and in cases of susceptible people can cause epileptic seizure activity.

Thirdly, mechanical safety issues: It has been documented that the turbine blades can throw ice chunks weighing hundreds of pounds at least 1,650 feet; this is certainly enough to destroy cars, school buses and the children in it, not to mention passing right through a house . . . The potential for death is very real. You certainly have the weather/conditions in winter, in Wisconsin, to cause this type of problem. A turbine blade thrown during destructive weather and/or wind turbine tower collapse would easily travel those distances, and weather has destroyed wind generators in multiple areas, including in the United States!"]

I am ignoring the esthetics of wind turbines, because some people love the sight of them, and some people don't; individual tastes differ. You might want to consider the esthetics, though, if the viewplane is one important to the tourist industry.

Regarding noise (and vibration), a regulation that states the unit should not produce sound in excess of 5dBA above the ambient background noise level is inappropriate, as well. First of all, many governments are woefully ignorant of the fact that their regulations are expressed in dBA, and such "A" scale filters out a very large amount of low frequencies, some of the very frequencies of interest! (Measurements in dBC or dBLinear would be much more appropriate). 5dB or so might not be noticeable if the wind generator noise contained the same frequency content as the ambient background noise, but it doesn't. If you played a CD of fingernails scraping on a chalkboard in your home, and adjusted it to 5dBA above the home's ambient noise, you wouldn't be able to tolerate it!

I am totally unaware of any situation where legislators have approved such an installation where it would impact upon their homesites . . .

The solution is so simple and achievable: a setback of at least 1.5 miles would generally eliminate more than 99% of the problems associated with windfarm installations.

The reports/information you mention are appended to this e-mail, and consist of:

1. My report is of an installation of 17 large-scale wind turbines in Nova Scotia, Canada. Its file is entitled "pubnicowindfarm.doc", and is in Microsoft Word format.
2. The HGC Engineering report of the same facility commissioned by our federal government, Natural Resources Canada, is the one I received from the government. Its file is entitled "06 10 30 Final Pubnico P...sment.pdf", and is in PDF format.
3. A letter I wrote comparing the two reports, is entitled "windfarmcomparison.doc", and is in Microsoft Word format. As I noted in that letter: "My report and the HGC report both agree, essentially, on the sound levels present. There were some differences in our



interpretations in that my report drew its conclusions based upon audiological/human auditory system principles, while the HGC report drew its conclusions based on engineering principles."

4. I have included an excellent article with reference to distance, written by Nina Pierpont, M.D. Its file is entitled "Pierpont-healtheff...50301.pdf", and it in PDF format.

Mr. McElroy, I also have several concerns about your specific situation, and I think they are similar. I wish you the very best of success in your endeavors. Feel free to use the information that I have generated.

Sincerely yours,

Gordon Whitehead

5 September 2007

Dear Cathy Bembinster,

Apologies for the delay in responding to your letter of 2 September 2007.

I am enclosing 3 attachments:

1. my report that you have requested.
2. a letter comparing my report results (#1, above) to the federal government-funded report by HGC Engineering.
3. a letter from Natural Resources Canada to the windfarm in question in my report; this is a strongly-worded report that I feel sets quite a precedent, consider:
  - A. I think it is a very important break-through. A director of Natural Resources Canada (Chris Padfield) has said in writing that there is a "noise issue at Pubnico Point Wind Farm".
  - B. Chris Padfield states that Pubnico Point Wind Farm "must implement the following mitigation measure . . ." They have to, it is not optional!
  - C. The director then states that "Natural Resources Canada (NRCan) does not accept your" (Mr. Demond's) contention that no monitoring of the mitigation measure is necessary." That is a very strong slap in the face to Mr. Demond's attempt to minimize the issue!
  - D. Chris Padfield states, in no uncertain terms, that failure to implement the mitigation measure will result in the forfeiture of the financial incentives the Pubnico Point Wind Farm has received from the government. I have no details, but my guess is that such incentive was quite significant, financially.
  - E. The letter starts out "Mr. Demond", and not "Dear Mr. Demond", which suggests to me an effort has been made in the letter to show him that the letter is a demand, and not optional.

It is an extremely strongly-worded letter. And it demands follow up measurement and monitoring. If the mitigation procedures don't work, the monitoring should show that.

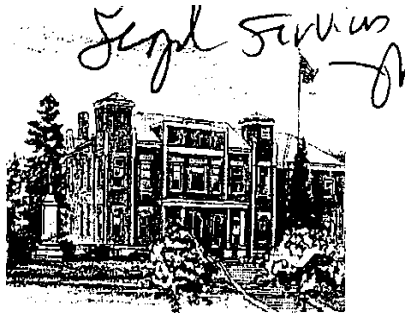
I think Mr. Demond and Company should be very concerned about their non-cooperation with the Federal Government; Natural Resources Canada is not to be trifled with, they exert a lot of control over the development.

I wish you success in your endeavor. It is a worthwhile one.

Sincerely yours,

Gordon Whitehead  
B.S., M.A., Aud(C), Audiologist  
Adjunct Professor (retired)

**Lincoln Township Letters of Concern and Noise Study After the Wind  
Turbines Were Installed:**



Office of the  
Corporation Counsel  
Kewaunee County

Elma E. Anderson  
613 Dodge Street Kewaunee,  
Wisconsin 54216 920-388-7173 FAX 920-388-3139  
email [anderson.elma@mail.da.state.wi.us](mailto:anderson.elma@mail.da.state.wi.us)

July 9, 2001

Hon. James Doyle  
Attorney General  
State of Wisconsin  
P O Box 7857  
Madison WI 53707-7857

RE: Request for Formal Opinion Concerning the Applicability of Wis. Stats, sec.  
66.0401 to Commercial Wind Energy Facilities committee.

~~DEPT. JUSTICE~~

Dear Mr. Doyle:

4 JUL 01 10:21 am submitting this request for an Opinion of the Attorney General on behalf of Kewaunee County officials. Is Wis. Stats. sec. 66.0401 applicable to local government review and regulation of commercial wind energy facilities?

Does the March 2001 Court of Appeals decision on *Numrich v. Mequon*, 2001 WL 220710 (Ct. App. 2001), apply to all wind generators sited in the state? *Numrich* is a case that concerned a residential-size wind generator. Does Wis. Stats. sec. 66.0401 (formerly Wis. Stats. sec. 66.031), also apply to commercial wind energy projects? The statute referenced in *Numrich* and other statutes in which wind energy is specifically mentioned, such as Wis. Stats. secs. 60.61(2)(i), 60.65(5), 59.694(7)(d), and 236.292(2), do not make a distinction.

Attached to this request are various documents assembled by the local study

Yours truly,

A handwritten signature in black ink, appearing to read "Elma E. Anderson". The signature is fluid and cursive, with the first name "Elma" being more prominent.

Elma E. Anderson  
Corporation Counsel

WISCONSIN LAWS FAVORING  
CUSTOMER OWNED WIND  
SYSTEMS

Citation	Authority	Says...
1.12(3)(b)	WI Statutes	Favors "all new installed capacity for electric generation in the state be based on renewable energy resources."
66.031	WI Statutes	Limits restrictions to "health and safety" considerations
70.111(18)	WI Statutes	Exempts wind generators, towers, and associated equipment from residential property taxes
Schedule PG-4 COGS 1(c)	PSCW	"Net metering" law

99-00 Wisconsin Statutes

Citation		Says...
66.0401		Authority to restrict systems limited
66.0403		Solar and wind access permits + definitions
60.61(2.i)		Town general zoning authority; provide adequate access...
60.65(5)		Board of adjustment; powers and duties per 59.694
59.694(7.d)		County zoning, board of adjustment; powers of board; to grant special exceptions...
236.292(2)		Certain restrictions void



STATE OF WISCONSIN  
DEPARTMENT OF JUSTICE

PEGGY A.  
LAUTENSCHLAGER  
ATTORNEY GENERAL

Daniel F. Bach  
Deputy Attorney General  
March 27, 2003

114 East, State  
Capitol  
P.O. Box 7857  
Madison, WI 53707-  
7857

Ms. Elma Anderson  
Corporation Counsel  
Kewaunee County  
613 Dodge Street  
Kewaunee, WI 54216

Dear Ms. Anderson:

You ask whether the prohibitions on municipal regulation found in Wis. Stat. § 66.0401(1) are applicable to municipal regulation of commercial wind energy systems.

It is my informal opinion that the answer is yes.

Wisconsin Stat. § 66.0401(1) provides:

(1) AUTHORITY TO RESTRICT SYSTEMS LIMITED. No county, city, town or village may place any restriction, either directly or in effect, on the installation or use of a solar energy system, as defined in s. 13.48(2)(h)l.g., or a wind energy system, as defined in . . . [66.0403(l)(m)], unless the restriction satisfies one of the following conditions:

- (a) Serves to preserve or protect the public health or safety.
- (b) Does not significantly increase the cost of the system or significantly decrease its efficiency.
- (c) Allows for an alternative system of comparable cost and efficiency.

Wisconsin Stat. § 66.0403(l)(ni) provides: "'Wind energy system' means equipment that converts and then stores or transfers energy from the wind into usable forms of energy."

Wisconsin Stat. § 66.0403(12)(a) provides: "This section may not be construed to

require that an owner obtain a permit prior to installing a solar collector or wind energy system." In *State ex rel. Numrich v. City of Mequon*, 2001 WI App 88, 242 Wis. 2d 677, 15-17, 626 N.W.2d 366, review denied, 2001 WI 88, 246 Wis. 2d 167, 630 N.W.2d 220, the court of appeals construed what are now Wis. Stat. §§ 66.0401 and 66.0403 in the following fashion:

We draw the following conclusions from the statutory scheme .... First, the owner of an energy system does not need a permit... to construct such a system. Therefore, barring any other enforceable municipal restrictions, an owner may construct such a system without prior municipal approval....

Second, unlike most land use regulations that require a permit and which are designed to protect the public and nearby property owners by placing restrictions on the permittee, WIS. STAT. § [66.0403] operates largely in the reverse. It serves to benefit and protect the owner of a solar or wind energy system permit....

Third, WIS. STAT. § [66.0401] represents a legislative restriction on the ability of local governments to regulate solar and wind energy systems. Local restrictions are permitted only if they serve the public health or safety, do not significantly increase the cost or decrease the efficiency of the system, or allow for an alternative system of comparable cost and efficiency. Beyond those, no other restrictions are allowed. The statute is not trumped, qualified or limited by § [66.0403] or by a municipality's zoning and conditional use powers.

(Italics in original.)

In *Numrich*, the court of appeals did not discuss the purpose of municipal zoning ordinances. The purpose of county zoning ordinances is to "promote the public health, safety, convenience and general welfare." See Wis. Stat. § 59.69(1). See also Wis. Stat. § 60.61(1), which states that the purpose of town zoning ordinances is to "promote the public health, safety and general welfare." Given these statutes, *Numrich* does not construe Wis. Stat. § 66.0401(1) so as to invalidate all county or town zoning regulations concerning solar or wind energy projects.

It remains to be seen how closely the courts will parse local zoning regulations in an effort to ascertain whether they are limited to public health and safety considerations. For example, general zoning regulations limiting residential uses to residential districts and commercial uses to commercial districts may well promote public health and safety. See, e.g., *Village of Euclid, Ohio v. Ambler Realty Co.*, 272 U.S. 365 (1926); *Willow Creek Ranch v. Town of Shelby*, 2000 WI 56, 235 Wis. 2d 409, 44, 611 N.W. 2d 693; *State v. Quality Egg Farm, Inc.*, 104 Wis. 2d 506, 516, 311 N.W.2d 650 (1981). Cf *Clark v. Winnebago County*, 817 F.2d 407, 409 (7th Cir. 1987).

Your concern is whether the restrictions upon the exercise of local authority in Wis. Stat. § 66.0401(1) are applicable to commercial wind energy systems. Wisconsin Stat. § 66.0403(l)(m) defines "wind energy system" to mean "equipment that converts and then stores or transfers energy from the wind into usable forms of energy." "If the language of the statute clearly and unambiguously sets forth the legislative intent, we apply that intent to the case at hand and do not look beyond the legislative language to ascertain its meaning." *Lincoln Savings Bank S.A. v. DOR*, 215 Wis. 2d 430, 441, 573 N.W.2d 522 (1998), citing *Kelley Co., Inc. v. Marquardt*, 172 Wis. 2d 234, 247, 493 N.W.2d 68 (1992). There is no exception or qualification

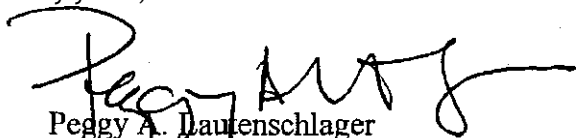
that limits this definition to residential properties. On its face, the statute applies to commercial as well as residential properties.

Extrinsic materials may be examined to see if they support the conclusion that the language of the statute is plain. See *State v. Martin*, 162 Wis. 2d 883, 897 n.5, 470 N.W.2d 900 (1991); *State ex rel. Hill v. Zimmerman*, 196 Wis. 2d 419, 427 n.5, 538 N.W.2d 608 (Ct. App. 1995). The drafting file to chapter 351, Laws of 1981, indicates that the bill attempted to integrate Iowa House Bill 766 with Assembly Substitute Amendment 1 to 1981 Assembly Bill 62. The drafting file contains a March 4, 1982 Milwaukee Sentinel newspaper account summarizing the actions taken by the Senate following the Assembly's passage of 1981 Assembly Bill 62. The article summarizes that bill as one which would "help homeowners and businesses make certain that access to the sun or wind needed in energy systems is not shut off" (emphasis supplied). Although legislation including wind energy systems was not enacted until 1993 Wisconsin Act 414, sec. 417 was passed, there is nothing in the legislative history limiting the application of chapter 351, Laws of 1981, solely to residential properties.

I therefore conclude that the prohibitions on municipal action found in Wis. Stat. § 66.0401(1) are applicable to municipal regulation of commercial wind energy systems.

I am also enclosing a copy of 77 Op. Att'y Gen. Preface (1988) for your future use and consideration in submitting opinions to this office.

Very truly yours,



Peggy A. Dautenschlager  
Attorney General

PAL:FTC:cla

<creeronft\opinions\anderson-\vindenergy.doc>  
010725006





STATE OF WISCONSIN  
DEPARTMENT OF JUSTICE

PEGGY A. LAUTENSCHLAGER  
ATTORNEY GENERAL  
Daniel P. Bach  
Deputy Attorney General

17 W. Main Street  
P.O. Box 7857  
Madison, WI 53707-7857  
[www.doj.state.wi.us](http://www.doj.state.wi.us)  
Paul L. Barnctt  
Assistant Attorney General  
[barnettp@doj.state.wi.us](mailto:barnettp@doj.state.wi.us)  
608/266-5366  
FAX 608/267-2778  
August 16, 2006

Mr. James C. Fleming  
Executive Vice President and General Counsel  
Wisconsin Energy Corporation  
231 West Michigan Street  
Milwaukee, WI 53203

Re: Solicitation of Local Government Officials for Wind Energy Contracts

Dear Mr. Fleming:

The Public Integrity Unit of the Wisconsin Department of Justice recently concluded an investigation in Manitowoc County involving the solicitation by wind energy companies of local government officials to enter into lease option contracts concerning the potential construction of wind turbines on real estate owned by these officials. Our investigation explored whether actual or potential conflicts of interest existed under Wisconsin law by virtue of the solicitation of these local officials and the payment, in some instances, of a contract signing bonus and/or an agreement to make future lease payments. We concluded that wind energy company representatives contacted and negotiated, or attempted to negotiate, contracts with local government officials while proposed local legislative action on ordinances to govern wind farms and wind turbines was being drafted, considered or adopted.

Section 19.59(l)(b) of the Wisconsin statutes provides as follows:

(b) No person may offer or give to a local public official, directly or indirectly, and no local public official may solicit or accept from any person, directly or indirectly, anything of value if it could reasonably be expected to influence the local public official's vote, official actions or judgment, or could reasonably be considered as a reward for any official action or inaction on the part of the local public official. This paragraph does not prohibit a local public official from engaging in outside employment.

Mr. James C. Fleming  
August 16, 2006  
Page 2

A violation of this provision is punishable by a fine of not less than \$100 nor more than \$5,000 or imprisonment for more than one year, or both. Section 19.58(l)(a) of the Wisconsin statutes.

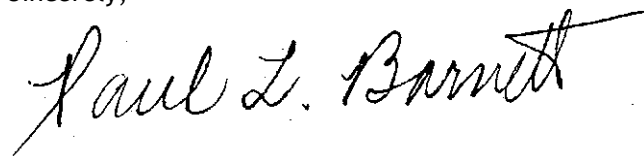
In our opinion, the offer to pay, or actual payment of, any substantial sum of money to a local government official, either as a contract signing bonus or as annual lease payments in the event one or more wind turbines are constructed on the official's property, all while action remains pending on a local ordinance or other related matters in which the wind energy companies are clearly interested, violates the provision quoted above. A reasonable fact-finder could justifiably conclude that the potential or actual receipt of such sums would be expected to influence the local official's vote or other official actions or judgment regarding such matters.

We understand that Wisconsin Energy Corporation may be involved in wind energy projects elsewhere in Wisconsin. We write in order to put you on notice of our position regarding application of Wisconsin's conflict of interest statute. We urge your company to review existing contracts and to make the necessary inquiries to confirm that these contracts do not violate this statute in the manner described above. We also strongly recommend that your company review and revise its current solicitation practices to ensure that your company does not solicit or enter into contracts in the future with local government officials while decisions relating to the installation of wind turbines, related zoning ordinances or similar topics remain pending or are reasonably foreseeable in the jurisdiction involved.

We invite you or your representative to contact us to discuss any questions or additional information requests you may have in light of this correspondence.

Thank you for your attention to this important matter.

Sincerely,

A handwritten signature in black ink that reads "Paul L. Barnett". The signature is written in a cursive, flowing style with a prominent flourish at the end.

Paul L. Barnett  
Assistant Attorney General

PLB:kw

Lincoln Wind Energy Project  
Acoustic Sound Measurement Report  
**Final / Summary Report March 2001**



**Prepared For:**

Wisconsin Public Service Corporation 700 North Adams Street Green Bay, WI 54307

**Prepared By:**

Gonzalo Sanchez Sanchez Industrial Design Inc. 3510WBeltlineHwy Middleton, WI 53562

Christopher Bajdek Harris Miller Miller & Hanson Inc. 15 New England Executive Park Burlington, MA 01803

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## **EXECUTIVE SUMMARY**

Wisconsin Public Service (WPS) has received several noise complaints due to the operation of the wind turbines in Lincoln Township. In response to community concerns, a noise measurement program was undertaken to document and evaluate noise levels due to the wind turbines during each of the four seasons. The objective of the measurement program is to evaluate the noise levels from the wind turbines with respect to the established noise limits set forth in the Conditional Use Permit with Lincoln Township. In summary, audible noise from the WPS wind turbines are not to exceed 50 dBA for any period of time when measured at any occupied building. Additional requirements are placed on pure tones, repetitive impulsive sounds, and infrasound (sounds in the lower frequencies).

For this study, noise levels due to the turbines were measured at a total of eight sites in Lincoln Township. Long-term (unattended) noise measurements were conducted at four sites around the wind turbines. Data collected at the unattended sites included hourly noise levels and one-second equivalent sound levels. Short-term (attended) noise measurements were conducted at four additional sites for periods of up to 1 Vz hours. Data collected at the attended sites included one-minute sound levels, one-second equivalent sound levels, spectral data, and a log of noise events. During each of the attended short-term noise measurements, the turbines were turned off (parked) for approximately 1 hour. Measured noise levels with the turbines ON were compared to measured levels with the turbines OFF to determine the contribution of the turbines to ambient noise levels. One important note is that these measurement results included all of the sounds that occurred at the site and not just the sounds from the wind turbines.

In general, sites closer to the wind turbines experienced higher noise levels than sites further from the turbines. Wind conditions also were observed to affect the measured sound levels at each site. In general, higher sound levels were measured when the site was downwind of the turbines, and lower levels were measured when the site was upwind of the turbines. During periods of sustained wind speeds in excess of 15 to 20 mph, the effectiveness of the dual-stage windscreen was diminished due to unwanted wind noise caused by turbulence over the outer windscreen.

The results of the short-term measurements indicated that events unrelated to the turbines generated noise levels that were higher than the turbine noise levels. In addition, these human-related sounds and other noise sources that occur in the natural environment were observed to exceed 50 dBA in many cases.

The unattended long-term noise measurements indicate a diurnal pattern of noise levels, with the highest sound levels occurring during the day and the lowest during the night. This trend, based on observations at both the long-term and short-term sites, suggests that human-related activities such as farming and local road traffic caused most of the sound level increases in L10 during the daytime hours. It is unlikely that the wind turbines caused these transient events since noise from the turbines is relatively steady, i.e. unvarying in time for a given wind speed and direction.

In conclusion, the results of both the long-term and short-term noise measurements show that the noise levels due to the turbines are within the limits for audible noise that are contained in the Conditional Use Permit. In addition, the results of the frequency analysis show that low frequency sound levels generated by the turbines are within the limits established by the Conditional Use Permit. Furthermore, the wind turbines were not observed to produce any pure tones, nor were they observed to produce any repetitive or impulsive sounds.

## 1 INTRODUCTION

Sanchez Industrial Design Inc. (SID) along with Harris Miller Miller & Hanson Inc. (HMMH) measured noise levels due to wind turbines that are owned and operated by Wisconsin Public Service Corporation (WPS). The objective of this study is to evaluate and quantify noise levels created by the wind turbines located in Lincoln Township, and to determine if noise levels due to the wind turbines are within the limits set by the Conditional Use Permit. This permit requires that wind turbine noise levels shall not exceed 50 dBA for any period of time. Furthermore, if noise due to the wind turbines contains a pure tone and/or repetitive impulsive sounds, a 5-dBA penalty will be applied to the standards for audible noise contained within the Conditional Use Permit.

Noise measurements were conducted at eight locations in the vicinity of the Lincoln wind turbines during four different seasons over the course of a year. The purpose of this report is to summarize the results of each set of measurements at each of the eight sites. More detailed information for the eight measurement sites is provided in the Site Reports.

The following report presents a description of the applicable noise metrics and the relevant criteria, a summary of the measurement results on a site-by-site basis, and a summary of conclusions.

## 2 NOISE METRICS

Environmental noise is made up of a conglomeration of noise sources, both distant and near, which provides a varying background sound called "natural ambient". Superimposed on the ambient is a succession of transient noisy events that are short or long in duration which cause the noise levels to fluctuate from moment to moment. Noise metrics have been developed to quantify the complex sound environment in terms of amplitude, pitch and time variation.

Sound is measured using a sound level meter with a microphone that responds accurately to all audible frequencies. However, humans can not hear all frequencies equally. For example, our hearing is not very sensitive to low frequency sounds below approximately 400 Hz and high frequency sounds above 10,000 Hz. To accommodate the way humans hear, a filter is built into sound level meters to approximate the way a person interprets sound. Measurements done with this filter are reported as A-Weighted Sound Pressure Levels and are expressed in A-Weighted decibels (dBA).

The measure of noise exposure over a period of time is called the "equivalent level" (Leq). Leq expresses in a single number the sound energy content of time varying sound over a specified time period, e.g. hour, minute or second.

For monitoring noise variations throughout the day such as road traffic, work, etc., the "hourly equivalent sound level" (Leq-lhr) is used. For events that are very short in duration or for monitoring sound level changes in fine detail, the "1-minute equivalent

sound level" (Leq-lmin) and the "1-second equivalent level" (Leq-lsec) are used respectively. Statistical noise descriptors provide useful information about the fluctuating sound level during the measurement period, and are denoted with numerical subscripts (e.g. L10, L90). These descriptors represent a noise level that is exceeded a certain percentage of the measurement period. For example, the hourly L10 is the noise level exceeded for 10% of the measurement hour—that is, the fluctuating sound level is louder than this L10 for only 6 minutes out of the hour. Therefore, the L10 is nearly the highest sound level that occurred during the hour. On the other hand, L90 is the sound level exceeded 90% of the time; the sound level is lower than this for only 6 minutes out of the hour. The L90 often represents the "background" or ambient sound level.

### 3 RELEVANT CRITERIA

Noise levels due to the operation of the WPS wind turbines in Lincoln Township are subject to the noise limits established by the Conditional Use Permit. The relevant criteria for evaluating the measured noise levels due to the turbines are summarized below.

The Conditional Use Permit includes the following limits for measured noise levels at residences, schools, hospitals, churches, or public libraries:

- Audible noise due to the wind turbines shall not exceed 50 dBA for any period of time.
- Low frequency noise shall not exceed the following limits:

1/3 Octave Band Center Frequency (Hz)	Sound Pressure Level (dB)
2 to 1	70 (each band)
20	68
25	67
31.5	65
40	62
50	60
63	57
80	55
100	52
125	50

The Conditional Use Permit also states that if noise due to the wind turbines contains a pure tone and/or repetitive impulsive sounds, a 5-dBA penalty will be applied to the standards for audible noise. The relevant sections of the Conditional Use Permit that are related to noise are reproduced in Appendix A.

## **4 NOISE MEASUREMENT RESULTS**

### **4.1 Overview of Noise Measurement Program**

Long-term (unattended) noise measurements were conducted at four sites (Sites 1 to 4) to obtain the hourly fluctuations in the A-weighted noise levels. Larson Davis Model 870 and 820 Sound Level Meters were used to measure noise levels for 1-hour periods on a continuous basis. Each noise monitor was programmed to sample and store the following noise data for each 1-hour interval; Leq, L10, and L90 (for the equivalent noise level, the noise level exceeded 10 percent of the time, and the noise level exceeded 90 percent of the time, respectively). The noise monitors also were programmed to store continuous 1-sec Leqs for the entire duration of the measurements.

At four additional sites (Sites 5 to 8), short-term (attended) noise measurements were conducted to obtain continuous time histories of the A-weighted noise levels, as well as spectral data. A Larson Davis Model 820 Sound Level Meter was used to sample and store the Leq, L10, and L90 for each 1-minute interval and also 1-sec Leqs. Tape recordings were made with either a Sony Digital Audio Tape recorder or a TEAC 130 Digital Audio Tape Recorder. The recorded signals were processed to obtain several samples of spectral data at each short-term site both with the wind turbines ON and OFF.

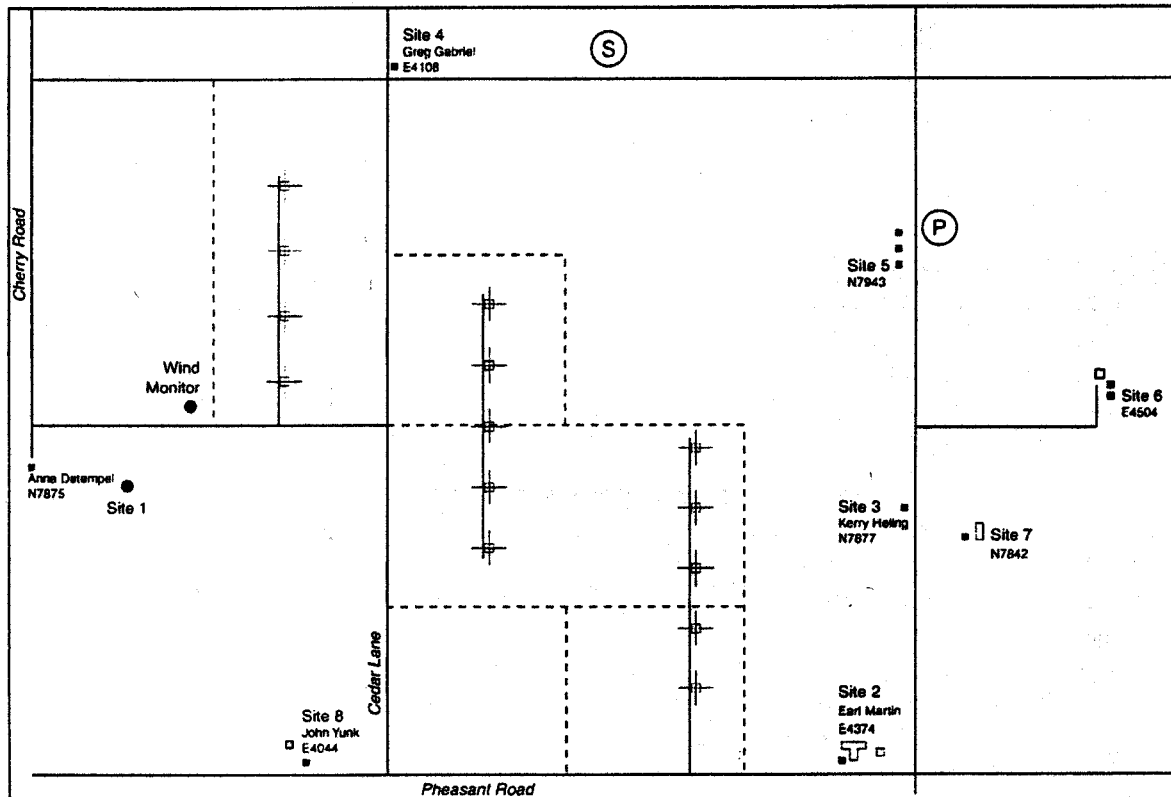
The effect of wind on measured noise levels was an important consideration in this study. Wind at sufficient speeds can mask the sounds produced by wind turbines. Two components of wind noise that can adversely affect noise measurements are wind turbulence over the microphone windscreen and pressure fluctuations at the microphone diaphragm. To minimize these unwanted effects of wind noise, special 30-inch two-stage windscreens were used at each of the measurement sites.

Figure 1 shows the locations of the noise measurement sites, as well as the location of the wind monitor. For each of the eight measurement sites, Table 1 provides a summary of the measurement period, the type of data collected, and observed noise sources.



**Figure 4.1-1. MONITOR**  
**LOCATIONS OF NOISE MEASUREMENT SITES AND WIND**  
 Sanchez Industrial Design Inc.

Harris Miller Miller & Hanson Inc.



**Table 4.1-1. SUMMARY OF NOISE MEASUREMENT SITES**

Site No.	Location	Long-term or Short-term	Type of Data
1	675 feet East of N7875 Cherry Road	Long-term	Hourly L10, Leq, L90, 1-sec Leq.
2	E4374 Pheasant Road	Long-term	Hourly L10, Leq, L90, 1-sec Leq.
3	N7877 County P	Long-term	Hourly L10, Leq, L90, 1-sec Leq.
4	E4108 County <b>S</b>	Long-term	Hourly L10, Leq, L90, 1-sec Leq.
5,5a	N7943 County P	Short-term	1-minute L10, Leq, L90, 1-sec Leq & spectral data
6,6a	E4504 County P	Short-term	1-minute L10, Leq, L90, 1-sec Leq & spectral data
7,7a	N7842 County P	Short-term	1-minute L10, Leq, L90, 1-sec Leq & spectral data
8,8a, 8b	E4044 Pheasant Road	Short-term	1-minute L10, Leq, L90, 1-sec Leq & spectral data

#### 4.2 Results for Site 1: East of Cherry Road 4.2.1 Audible Noise at Site 1

Site 1 was located off a private road in a roughly plowed field with a small stand of trees to the north and a larger stand of trees to the southwest. This site was approximately 1,310 feet from the closest turbines and had direct lines of sight to many of the turbines. Dominant noise sources at this site included the wind turbines and wind in the trees. Table 4.2-1 provides a summary of the major noise sources that were observed during each measurement period.

**Table 4.2-1 NOISE SOURCES AT SITE 1**

Measurement Period	Noise Sources <sup>1</sup>
March 2000	Wind turbines, wind in the trees, thunderstorm, and traffic on Cherry Road.
June 2000	Wind turbines, wind in the trees, tractor traffic on dirt road and traffic on Cherry Road.
October 2000	Wind turbines, wind in the trees and traffic on Cherry Road.
January 2001	Wind turbines and drifting snow.
Notes:  1.) Wind noise at the microphone windscreen was present whenever wind speeds exceeded 15 mph.	

Long-term (unattended) noise measurements were conducted at this site during each of the four seasons. Table 4.2-2 provides a summary of the hourly A-weighted noise levels that were measured at this site including, the L10, the Leq, and the L90.

Although the measured data from Site 1 contain noise events that exceed 50 dBA, these noise levels were triggered by sources that were not related to the turbines. For example, sustained winds of 34 mph that were recorded during the March measurements caused the measured L90 to reach a maximum valued of 59 dBA. At wind speeds approaching 15 to 20 mph, the effectiveness of the dual-stage windscreen is diminished.

Throughout each of the measurement periods, the turbines were observed to meet the limits for audible noise at Site 1.

Table 4.2-3 provides a summary of the wind speeds and directions that were recorded during each of the four seasons.

**Table 4.2-2 SUMMARY OF HOURLY A-WEIGHTED NOISE LEVELS: SITE 1**

Measurement Period	Range of L10 (dBA)	Range of Leq (dBA)	Range of L90 (dBA)
March 2000	69.8–38.5	73.9–36.7	59.2–28.6
June 2000	71.8–37.6	68.9–36	61.4–29.7
October 2000	58.6–24.5	55.2–23.0	49.1–21.3
January 2001	70.0–31.9	67.2–29.4	64.0–19.9

**Table 4.2-3 WIND SPEEDS AND DIRECTIONS AT SITE 1**

Measurement Period	Range of Wind Speed (mph)	Range of Wind Direction <sup>1</sup>
March 2000	5 to 34	South to southwest. One day from the north.
June 2000	3 to 33	Southeast to west.
October 2000	1 to 20	South to west.
January 2001	2 to 26	South to west. One day from the east
Notes:  1.) Winds from the east constitute a downwind condition for this site.		

#### **4.3 Results for Site 2: E4374 Pheasant Road 4.3.1 Audible Noise at Site 2**

Site 2 was located north of the house and bam at E4374 Pheasant Road with direct lines of sight to the closest turbines that were at a distance of approximately 990 feet from the microphone. Dominant noise sources at this site included the wind turbines and traffic on Pheasant Road and County P. Table 4.3-1 provides a summary of the major noise sources that were observed during each measurement period.

**Table 4.3-1 NOISE SOURCES AT SITE 2**

Measurement Period	Noise Sources <sup>1</sup>
March 2000	Wind turbines, cattle, thunderstorm, traffic on Pheasant Road and County P.
June 2000	Wind turbines, cattle, rain, road construction on County P and traffic on Pheasant Road and County P.
October 2000	Wind turbines, wind in the tall grass, farm equipment and traffic on Pheasant Road and County P.
January 2001	Wind turbines and traffic on Pheasant Road and County P.
Notes:  1.) Wind noise at the microphone windscreen was present whenever wind speeds exceeded 15 mph.	

Long-term (unattended) noise measurements were conducted at this site during each of the four seasons. Table 4.3-2 provides a summary of the hourly A-weighted noise levels that were measured at this site including, the L10, the Leq, and the L90.

Although the measured data from Site 2 contain noise events that exceed 50 dBA, these noise levels were triggered by sources that were not related to the turbines. For example, strong winds (up to 33 mph) from the south and southwest generated noise levels that exceeded 50 dBA. During periods of light winds, the turbines were observed to meet the limit for audible noise in the Conditional Use Permit.

At the request of the homeowner, additional measurements were conducted in the backyard at the house in October 2000 (Site 2a). The backyard was surrounded by several buildings and was completely shielded from the wind turbines. The measurement results indicated that the sound levels in the backyard were approximately 5 dBA lower than the levels at the microphone location behind the barn.

Table 4.3-3 provides a summary of the wind conditions that were recorded during each of the four seasons.

**Table 4.3-2 SUMMARY OF HOURLY A-WEIGHTED NOISE LEVELS: SITE 2**

Measurement Period	Range of L10 (dBA)	Range of Leq (dBA)	Range of L90 (dBA)
March 2000	73.2–372	68.1–34.7	47.8–263
June 2000	69.7–40.5	82.4–38.3	56.0–22.8
October 2000	55.7–22.8	58.2–22.3	51.0–19.5
January 2001	69.7 –30.6	78.3–29.4	63.7–20.9

**Table 4.3-3 WIND SPEEDS AND DIRECTIONS AT SITE 2**

Measurement	Range of Wind	Range of Wind Direction <sup>1</sup>
Period	Speed (mph)	

March 2000	5 to 34	South to southwest. One day from the north.
June 2000	3 to 33	Southeast to west.
October 2000	1 to 20	South to west.
January 2001	2 to 26	South to west. One day from the east
Notes:  1.) Winds from the northwest constitute a downwind condition at this site.		

#### 4.4 Results for Site 3: N7877 County P 4.4.1 Audible Noise at Site 3

Site 3 was located southwest of the house at N7877 County P with direct lines of sight to the closest turbines. The terrain along the western boundary of the backyard shielded the microphone from the farthest turbines. Dominant noise sources at this site included the wind turbines and traffic on County P. Table 4.4-1 provides a summary of the major noise sources that were observed during each measurement period.

**Table 4.4-1 NOISE SOURCES AT SITE 3**

Measurement Period	Noise Sources
March 2000	Wind turbines, thunderstorm, activities at the house, other distant human-related activities and traffic on County P.
June 2000	Wind turbines, activities at the house, other distant human-related activities, road construction equipment and traffic on County P.
October 2000	Wind turbines, activities at the house, other distant human-related activities and traffic on County P.
January 2001	Wind turbines and traffic on County P.
Notes:  1.) Wind noise at the microphone windscreen was present whenever wind speeds exceeded 15 mph.	

Long-term (unattended) noise measurements were conducted at this site during each of the four seasons. Table 4.4-2 provides a summary of the hourly A-weighted noise levels that were measured at this site including, the L10, the Leq, and the L90.

Although the measured data from Site 3 contain noise events that exceed 50 dBA, these noise levels were triggered by sources that were not related to the turbines. For example, heavy rain that accompanied a thunderstorm on June 18<sup>th</sup> generated noise levels that exceeded 50 dBA due to the raindrops that struck the plywood base of the dual-stage windscreen. During periods without any other intrusive noise sources, the turbines were observed to meet the limit for audible noise in the Conditional Use Permit. •

At the request of the homeowner, the microphone was placed in the backyard about 12 feet closer to the house for the June, October, and January measurements.

Table 4.4-3 provides a summary of the wind conditions that were recorded during each of the four seasons.

**Table 4.4-2 SUMMARY OF HOURLY A-WEIGHTED NOISE LEVELS: SITE 3**

Measurement Period	Range of L10 (dBA)	Range of Leq (dBA)	Range of L90 (dBA)
March 2000	72.5–30.4	67.9–28.5	46.2–23.4
June 2000	68.3–38.6	71.3–37.6	56.3–23.6
October 2000	65.6–35.9	68.7–33.6	45.7–22.4
January 2001	63.0–31.7	60.4–32.8	56.1–23.4

**Table 4.4-3 WEATHER CONDITIONS AT SITE 3**

Measurement Period	Range of Wind Speed (mph)	Range of Wind Direction <sup>1</sup>
March 2000	5 to 34	South to southwest. One day from the north.
June 2000	3 to 33	Southeast to west.
October 2000	1 to 20	South to west.
January 2001	2 to 26	South to west. One day from the east
Notes:  1.) Winds from the west constitute a downwind condition at this site.		

#### 4.5 Results for Site 4: E4108 County S 4.5.1 Audible Noise at Site 4

Site 4 was located northwest of the house at E4108 County S with partially obstructed views of the northernmost turbines. Dominant noise sources at this site included the wind turbines and traffic on County S and County P. The diurnal pattern of hourly noise levels coincided with the traffic patterns and other human-related activities that were observed at this site. Table 4.5-1 provides a summary of the major noise sources that were observed during each measurement period.

**Table 4.5-1 NOISE SOURCES AT SUE 4**

Measurement Period	Noise Sources
March 2000	Wind turbines, thunderstorm, traffic on County S and County P, cattle and a dog.
June 2000	Wind turbines, traffic on County S and County P, cattle and ATVs.
October 2000	Wind turbines, traffic on County S and County P and a go-kart.
January 2001	Wind turbines and traffic on County S and County P.
Note:  Wind noise at the microphone windscreen was present whenever wind speeds exceeded 15 mph.	

Long-term (unattended) noise measurements were conducted at this site during each of the four seasons. Table 4.5-2 provides a summary of the hourly A-weighted noise levels that were measured at this site including, the L10, the Leq, and the L90.

Although the measured data from Site 4 contain noise events that exceed 50 dBA, these events were not related to the turbines. During periods without any other intrusive noise sources, the turbines were observed to meet the limit for audible noise in the Conditional Use Permit.

At the request of the homeowner, the microphone was placed in the backyard about 45 feet east of the house and 30 feet from the road for the October measurements (Site 4a). The purpose of these measurements was compare the sound levels at Site 4a with simultaneous noise measurements at Site 4 to determine whether there would be a difference in the measured noise levels on different sides of the house. The results of the comparison indicated that noise levels at Site 4a were approximately 3 dBA lower than the noise levels at Site 4.

Table 4.5-3 provides a summary of the recorded wind speeds and directions for Site 4.

**Table 4.5-2 SUMMARY OF HOURLY A-WEIGHTED NOISE LEVELS: SITE 4**

Measurement Period	Range of L10 (dBA)	Range of Leq (dBA)	Range of L90 (dBA)
March 2000	71.9-40	71.4-38.3	56.5-26.3
June 2000	73.3-38.3	69.7-40.4	56.3-29.7
October 2000	63.1-27.7	60.7 - 26.7	47.2-25.4
January 2001	66.6-40.3	66.9-38.9	60.0 - 23.7

**Table 4.5-3 WIND SPEEDS AND DIRECTIONS AT SITE 4**

Measurement Period	Range of Wind Speed (mph)	Range of Wind Direction <sup>1</sup>
March 2000	5 to 34	South to southwest. One day from the north.
June 2000	3to33	Southeast to west.
October 2000	1to20	South to west.
January 2001	2 to 26	South to west. One day from the east
<p>Notes:</p> <p>1.) Winds from the south constitute a downwind condition at this site.</p>		

#### 4.6 Results for Site 5: N7943 County P 4.6.1 Audible Noise at Site 5

Site 5 was located to the south of the residence at N7943 County P, and was partially shielded from the northernmost turbines by other buildings on the property. This site also was partially shielded from the southern turbines by the intervening terrain. Short-term (attended) noise measurements were conducted at this site during each of the four seasons. During each measurement program, a time-log was kept of individual noise events and noise sources.

Because this site was approximately 1,970 feet from the closest turbine, measured noise levels were affected by other sources, such as wind in the trees and traffic on County P. Table 4.6-1 provides a summary of the different noise sources that were observed during each of the measurement periods. As shown in the table, many additional noise sources were observed during the March 2000 measurements because these measurements were conducted during normal daytime hours (between 10 AM and 11 AM). During the other two measurement periods (October 2000 and January 2001), the noise measurements were conducted during nighttime hours when there was less overall activity.

**Table 4.6-1 NOISE SOURCES AT SITE 5**

Measurement Period	Noise Sources
March 2000	Wind turbines, traffic on County P, wind in the trees, wind in the ear, birds and a dog.
June 2000	N/A
October 2000	Wind turbines, traffic on County P and dogs.
January 2001	Wind turbines.
Note:  Wind noise at the microphone windscreen was present whenever wind speeds exceeded 15 mph.	

Table 4.6-2 provides a summary of the measured one-minute Leq, L10 and L90 at Site 5 during each of the measurement periods. While measured sound levels are shown to exceed 50 dBA during the March 2000 measurements, these sound levels were caused by sources other than the turbines. During the March 2000 measurements, one-second Leqs due to the turbines ranged from 36 to 47 dBA, while car passbys on County P generated noise levels that ranged from 54 to 63 dBA (refer to the appropriate Site Reports for details).

**Table 4.6-2 SUMMARY OF ONE-MINUTE A-WEIGHTED NOISE LEVELS: SITES 5 & 5a**

Measurement  Site/Period	Range of L10 (dBA)		Range of Leq (dBA)		Range of L90 (dBA)	
	Turbines ON	Turbines OFF	Turbines ON	Turbines OFF	Turbines ON	Turbines OFF
March 2000	56.3-37.8	43.2-32.7	51.7-36.2	41.0-31.7	43.5-33.8	39.7-30.3
June 2000	N/A	N/A	N/A	N/A	N/A	N/A
October 2000	-	50.8-21.8	—	46.4-21.3	—	29.2-20.7



October 2000	41.5–37.6	48.1–28.8	40.5–37.5	43.9–27.3	39.4–34.7	30.0–24.9
January 2001	37.1–34.5	25.4–22.0	36.4–34.0	23.5–21.9	35.3–33.6	22.2–21.6

The measured one-minute sound levels in Table 4.3-2 indicate some seasonal variation. In general, noise levels with the turbines ON were highest during the March measurements, and lowest during the January 2001 measurements. This variation in measured sound levels was primarily due to the different wind speeds and directions that were observed during each measurement period. In March 2000, the winds were from the west at speeds from 13 to 16 mph, representing a strong downwind condition for this site. In comparison, the wind speeds were only 5 to 6 mph out of the southwest during the January 2001 measurements, representing less of a downwind condition than was observed in March 2000. Table 4.6-3 provides a summary of the observed wind speeds and directions at Site 5.

**Table 4.3-3 WIND SPEEDS AND DIRECTIONS AT SITE 5**

Measurement Period	Range of Wind Speed (mph)	Range of Wind Direction*
March 2000	13 to 16	West
June 2000	N/A	N/A
October 2000	2 to 3	Southwest
October 2000	8 to 11	Southwest
January 2001	5 to 6	Southwest
Notes:  1.) Winds from the west and southwest constitute a downwind condition for this site.		

#### 4.6.2 Low Frequency Noise and Pure Tones at Site 5

Spectral data were analyzed for five different one-minute periods with the turbines both ON and OFF; tape recordings at Site 5 were made in March and October 2000, and in January 2001. One-minute periods with little or no intrusion from non-turbine events were selected for the spectral analysis. For each one-minute interval, spectral data were analyzed for the 1/3-octave bands from 16 Hz to 10 kHz. These spectra were evaluated with respect to the limits for low frequency noise, and then for the presence of pure tones.

Fifteen samples of spectral data obtained at Site 5 (over three seasons) were found to meet the limits for low frequency noise as contained in the Conditional Use Permit (subsection 6, subparagraph b).

The spectral data obtained during each of the three measurement periods at Site 5 did not contain any pure tones with the turbines ON (as defined in subsection 6, subparagraph c of the Conditional Use Permit). However, during the March 2000 measurements, a pure tone in the 1/3-octave band centered at 3.15 kHz was observed during a one-minute interval starting at 10:30 with the turbines OFF. During this one-minute interval, wind in the trees was the dominant source.

Appendix B provides plots of the spectral data for Site 5 with the turbines ON. 4.7 Results for Site 6:

#### E4504 County P 4.7.1 Audible Noise at Site 6

Site 6 was located to the west of the residence at E4504 County P, and was shielded from the wind turbines by trees and the intervening terrain. Short-term (attended) noise measurements were conducted at this site during each of the four seasons. During each measurement program, a time-log was kept of individual noise events and noise sources.

Because this site is approximately 2830 feet from the closest turbine, measured noise levels were affected by other sources, such as wind in the trees and traffic on County P. Table 4.7-1 provides a summary of the different noise sources that were observed during each of the measurement periods. As shown in the table, many additional noise sources were observed during the March 2000 measurements because these measurements were conducted during normal daytime hours (between 2:15 PM and 3:30 PM). During the other measurement periods, the noise measurements were conducted during nighttime hours when there was less overall activity.

Table 4.7-1 NOISE SOURCES AT SITE 6

Measurement Period	Noise Sources <sup>1</sup>
March 2000	Wind turbines, traffic on County P, wind in the trees, wind in the ear, birds, dogs and people.
June 2000	Wind turbines, wind in the trees and a car.
October 2000	Wind turbines and wind in the trees.
January 2001	Wind turbines, furnace and dogs.
Note:	
1.) Wind noise at the microphone windscreen was present whenever wind speeds exceeded 15 mph.	

Table 4.7-2 provides a summary of the measured one-minute Leq, L10 and L90 at Site 6 during each of the measurement periods.

During the March 2000 measurements, the wind turbines were barely audible at Site 6 because other sources tended to "mask" or cover-up the noise from the wind turbines. In particular, noise due to the wind in the trees dominated the measurements during this time period. With the turbines ON, the measured L90 ranged from 32 to 41 dBA, whereas with the turbines OFF, the measured L90 remained unchanged and ranged from 32 to 42 dBA - turbine noise levels were less than background levels during this period.

During the three other seasons, noise measurements were conducted at night when there were fewer instances of intrusive noise sources that were not related to the turbines. Consequently, during these nighttime periods, the wind turbines were more noticeable.

For example, in January 2001, the measured L90 with the turbines OFF ranged from 21 to 24 dBA, whereas with the turbines ON, the measured L90 ranged from 31 to 32 dBA -i.e., the turbines increased background noise levels by approximately 8 to 10 dBA.

**Table 4.7-2 SUMMARY OF ONE-MINUTE A-WEIGHTED NOISE LEVELS: SITE 6**

Measurement Period	Range of L10 (dBA)		Range of Leq (dBA)		Range of L90 (dBA)	
	Turbines <b>on</b>	Turbines <b>off</b>	Turbines <b>on</b>	Turbines <b>off</b>	Turbines <b>on</b>	Turbines <b>off</b>
March 2000	47.0-36.3	50.2 -36.6	44.8 -35.0	45.4 -34.7	41.4-32.4	41.6-32.2
June 2000	44.5-40.0	83.5-31.2	42.8-39.1	78.6-30.1	40.2-38.0	52.9-28.6
October 2000	40.4-36.7	38.7-28.9	39.3 -36.2	35.3 -28.3	38.0-35.1	33.3 -27.2
January 2001	36.5 - 32.8	31.8-22.0	34.4-32.1	27.9-21.5	32.4-31.1	24.3-21.1

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In all cases, the measured one-minute L10, Leq, and L90 noise levels were all below the limit for audible noise that are contained within the permit application. Further evaluation of the one-second Leqs, show that other sources exceed 50 dBA at times, while the turbine noise was always below this limit (refer to the appropriate Site Reports for more detail).

The measured one-minute sound levels in Table 4.7-2 indicate some seasonal variation in the noise environment. In general, noise levels with the turbines ON were highest during the March measurements, and lowest during the January 2001 measurements. This variation in measured sound levels was primarily due to the different wind speeds and directions that were observed during each measurement period. In March 2000, the winds were from the west at speeds from 7 to 14 mph, representing a strong downwind condition for this site. In comparison, the wind speeds were only 5 to 8 mph out of the southwest during the January 2001 measurements, representing somewhat less of a downwind condition than was observed in March 2000. Table 4.7-3 provides a summary of the observed wind speeds and directions at Site 6.

**Table 4.7-3 WIND SPEEDS AND OBJECTIONS AT SITE 6**

Measurement Period	Range of Wind Speed (mph)	Range of Wind Direction <sup>1</sup>
March 2000	7 to 14	West
June 2000	3 to 8	Southwest
October 2000	8 to 10	West
January 2001	5 to 8	Southwest
Notes:		
1.) Winds from the west constitute a downwind condition at this site.		

#### 4.7.2 Low Frequency Noise and Pure Tones at Site 6

Spectral data were analyzed for five different one-minute periods with the turbines both ON and OFF during each measurement period; tape recordings at Site 6 were made in

each of the four seasons. One-minute periods with little or no intrusion from non-turbine events were selected for the spectral analysis. For each one-minute interval, spectral data were analyzed for the 1/3-octave bands from 16 Hz to 10 kHz. These spectra were evaluated with respect to the limits for low frequency noise, and then for the presence of pure tones.

Twenty samples of spectral data obtained at Site 6 (over four seasons) were found to meet the limits for low frequency noise as contained in the Conditional Use Permit (subsection 6, subparagraph b).

At Site 6, the spectral data obtained during the March 2000 measurements contained a pure tone in the 1/3-octave band centered at 8 kHz with the turbines ON; however, this pure tone also was present in the background spectra when the turbines were OFF. Consequently, the tone was not due to the operation of the turbines; during this measurement period wind in the trees was the dominant source of noise. During each of the three other measurement periods, the turbines were not observed to generate any pure tones.

Appendix B provides plots of the spectral data for Site 6 with the turbines ON. 4.8 Results for Site 7:

#### N7842 County P 4.8.1 Audible Noise at Sites 7 and 7a

Site 7 was located on the south side of the house at N7842 County P, whereas Site 7a was located on the driveway to the west of the house in front of the garage. Short-term (attended) noise measurements were conducted at these sites during each of the four seasons. During each measurement program, a time-log was kept of individual noise events and noise sources.

Both sites are 1,500 feet or more from the closest wind turbine. At this distance, measured noise levels were affected by other sources, such as wind in the trees and traffic on County P. Table 4.8-1 provides a summary of the different noise sources that were observed during each of the measurement periods.

As shown in Table 4.8-1, many additional noise sources were observed during the March measurements at Site 7 because these measurements were conducted during normal daytime hours (between 4:00 PM and 5:20 PM). Although the wind turbines were mostly audible at Site 7 for this period, other noise sources occasionally masked the noise from the wind turbines. During the other measurement periods, the noise measurements were conducted during nighttime hours when there were fewer occurrences of intrusive noise sources that were unrelated to the turbines.

**Table 4.8-1 NOISE SOURCES AT SITES 7 & 7a**

Measurement Site & Period	Noise Sources <sup>1</sup>
Site 7; Mar-00	Wind turbines, traffic on County P, wind in the trees, wind in the ear, birds, dogs, squirrels and gun shots.
Site 7a; Mar-00	Wind turbines, and a single car passby.
Site 7a; Jun-00	Wind turbines and cars.
Site 7a; Oct-00	Wind turbines, wind in the trees and car traffic.
Site 7a; Jan-01	Wind turbines.
Note:  1.) Wind noise at the microphone windscreen was present whenever wind speeds exceeded 15 mph.	

Table 4.8-2 provides a summary of the measured one-minute Leq, L10 and L90 at Sites 7 and 7a during each of the measurement periods. Although the one-minute A-weighted noise levels for March and June were shown to exceed 50 dB during periods with the turbines ON, these noise levels were due to events that were unrelated to the turbines. Traffic on County P and other human-related activity generated several noise events at the microphone location that exceeded 50 dBA, while turbine noise levels ranged from 45 to 47 dBA in March and from 42 to 47 dBA in June. (Refer to the corresponding Site Reports for more detail.)

The measured one-minute sound levels in Table 4.8-2 indicate some seasonal variation in the noise environment. In general, noise levels with the turbines ON were highest during the March measurements, and lowest during the January 2001 measurements. This variation in measured sound levels was primarily due to the different wind speeds and directions that were observed during each measurement period. In March 2000, the winds were from the west at speeds from 13 to 21 mph, representing a strong downwind condition for this site. In comparison, the wind speeds were only 5 to 8 mph out of the southwest during the January 2001 measurements, representing somewhat less of a downwind condition than was observed in March 2000. Table 4.8-3 provides a summary of the observed wind speeds and directions at Site 7.

**Table 4.8-2 SUMMARY OF ONE-MINUTE A-WEIGHTED NOISE LEVELS: SITES 7 & 7a**

Measurement Site & Period	Range of L10 (dBA)		Range of Leq (dBA)		Range of L90 (dBA)	
	Turbines ON	Turbines OFF	Turbines ON	Turbines OFF	Turbines ON	Turbines OFF
Site 7; Mar-00	52.1 -39.9	55.2-33.2	49.1-39.0	49.3 -32.0	45.0-35.4	43.2-30.5
Site 7a; Mar-00	55.6-44.8	N/A	51.8-44.1	N/A	45.5 -43.3	N/A
Site 7a; Jun-00	68.6-36.0	566.3-24.7	63.6-33.5	60.4-23.8	52.1-30.4	40.0-23.1
Site 7a; Oct-00	44.9 - 42.7	39.2-30.5	43.6-41.6	35.3-29.6	42.9-40.4	33.8-28.6
Site 7a; Jan-01	46.8-39.8	24.8-22.2	43.5-38.9	24.0-21.8	41.0-38.0	23.3-21.5

**Table 4.8-3 WIND SPEEDS AND DIRECTIONS AT SITES 7 & 7a**

Measurement Site & Period	Range of Wind Speed (mph)	Range of Wind Direction <sup>1</sup>
Site 7; Mar-00	4 to 14	West
Site 7a; Mar-00	13 to 21	West
Site 7a; Jun-00	4 to 9	Southeast
Site 7a; Oct-00	9 to 11	West
Site 7a; Jan-01	5 to 8	Southwest
Notes:  1.) Downwind conditions for this site would be winds from the west.		

#### 4.8.2 Low Frequency Noise and Pure Tones at Site 7

Spectral data were analyzed for five different one-minute periods with the turbines both ON and OFF; tape recordings at Site 7 were made in March and October 2000, and in January 2001. One-minute periods with little or no intrusion from non-turbine events were selected for the spectral analysis. For each one-minute interval, spectral data were analyzed for the 1/3-octave bands from 16 Hz to 10 kHz. These spectra were evaluated with respect to the limits for low frequency noise, and then for the presence of pure tones.

Fifteen samples of spectral data obtained at Site 7 (over three seasons) were found to meet the limits for low frequency noise as contained in the Conditional Use Permit (subsection 6, subparagraph b).

The spectral data obtained during each of the three measurement periods at Site 7 did not contain any pure tones with the turbines ON (as defined in subsection 6, subparagraph c of the Conditional Use Permit).

Appendix B provides plots of the spectral data for Site 7 with the turbines ON. 4.9 Results for Site 8:

#### E4044 Pheasant Road 4.9.1 Audible Noise at Site 8

Site 8 was located to the northeast of the house at E4044 Pheasant Road, whereas Site 8b was located to the northwest of the house. Short-term (attended) noise measurements were conducted at these sites during each of the four seasons. During each measurement program, a time-log was kept of individual noise events and noise sources.

Both sites had unobstructed views of the turbines and were 1,980 feet or more from the closest wind turbine, and only 100 to 200 feet from Pheasant Road. At these distances, measured noise levels were affected by sources other than the turbines, such as traffic on Pheasant Road and farm equipment. Table 4.9-1 provides a summary of the different noise sources that were observed during each of the measurement periods.

Table 4.9-1 NOISE SOURCES AT SITES 8 & 8b

Measurement Period	Noise Sources
March 2000	Wind turbines, traffic on Pheasant Road, wind in the trees, thunder, heavy rain, birds, cattle and farm equipment
June 2000	N/A
October 2000	Wind turbines and traffic on Pheasant Road.
January 2001	Wind turbines and furnace.

As shown in Table 4.9-1, many additional noise sources were observed during the March measurements at Site 8 because these measurements were conducted during normal daytime hours (between 2:00 PM and 5:00 PM). Because the wind turbines were only somewhat audible due to an upwind condition, when other noise sources were present they tended to mask the noise from the wind turbines. During the other measurement periods, the noise measurements were conducted during nighttime hours when there were fewer occurrences of intrusive noise sources that were unrelated to the turbines.

Table 4.9-2 provides a summary of the measured one-minute Leq, L10 and L90 at Sites 8 and 8b during each of the measurement periods. Although the one-minute A-weighted noise levels for March were shown to exceed 50 dB during periods with the turbines ON, these noise levels were due to events that were unrelated to the turbines. For example, a thunderstorm triggered noise events with one-minute Leqs that exceeded 50 dBA, 60 dBA, and then 70 dBA, as this fast-moving storm approached the microphone. Prior to the passing thunderstorm, noise levels due to the turbines were generally less than 40 dBA with winds from the west (an upwind condition for this site).

**Table 4.9-2 SUMMARY OF ONE-MINUTE A-WEIGHTED NOISE LEVELS: SITES 8 & 8b**

Measurement Period	Range of L10 (dBA)		Range of Leq (dBA)		Range of L90 (dBA)	
	Turbines ON	Turbines , OFF	Turbines ON	Turbines OFF	Turbines ON	Turbines OFF
March 2000	88.0-36.7	66.4-38.4	85.8-35.8	62.8-37.5	50.2-33.1	56.9-35.2
March 2000	51.4-33.1	61.4-28.9	46.8-32.3	56.2-27.9	33.6-30.7	32.6-24.3
June 2000	N/A	N/A	N/A	N/A	N/A	N/A
October 2000	45.0-33.9	52.8-27.7	40.9-33.1	49.0-26.8	34.1-32.1	27.8-25.7
January 2001	35.3-33.0	33.8-22.9	34.2-32.7	33.1-22.2	33.1-32.1	32.2-22.0

For both the October and January measurements, this site was generally under an upwind condition since the prevailing winds were from the west and south-southwest, respectively. During the October 2000 measurements, background noise levels with the turbines OFF ranged from 25 to 31 dBA, whereas noise levels with the turbines ON ranged from 33 to 37 dBA. Although turbine noise levels increased by approximately 6 to 8 dBA over nighttime background noise levels, turbine noise levels were well below the limit for audible noise.

**Table 4.9-3 WIND SPEEDS AND DEFLECTIONS AT SITES 8 & 8b**

Measurement Site & Period	Range of Wind Speed (mph)	Range of Wind Direction <sup>1</sup>
Site 8; Mar-00	13 to 18	West
Site 8; Mar-00	11 to 14	North
Site 8; Jun-00	N/A	N/A
Site 8; Oct-00	6 to 8	West
Site 8; Jan-01	5 to 7	Southwest
Notes:  1.) Winds from the north constitute a downwind condition for this site.		

#### 4.9.2 Low Frequency Noise and Pure Tones at Site 8

Spectral data were analyzed for five different one-minute periods with the turbines both ON and OFF; tape recordings at Site 8 were made in March and October 2000, and in January 2001. One-minute periods with little or no intrusion from non-turbine events were selected for the spectral analysis. For each one-minute interval, spectral data were analyzed for the 1/3-octave bands from 16 Hz to 10 kHz. These spectra were evaluated with respect to the limits for low frequency noise, and then for the presence of pure tones.

Fifteen samples of spectral data obtained at Site 8 (over three seasons) were found to meet the limits for low frequency noise as contained in the Conditional Use Permit (subsection 6, subparagraph b).

The spectral data obtained in March 2000 contained a pure tone in the 1/3-octave band centered at 4 kHz during a single one-minute interval; this tone was due to wind in the trees.

The spectral data obtained in January 2001 contained a pure tone in the 1/3-octave band centered at 400 Hz during several one-minute intervals; this tone was due to the operation of the homeowner's furnace, and was present when the turbines were OFF.

During each of the other measurement periods at Site 8, the measured spectra did not contain any pure tones with the turbines ON (as defined in subsection 6, subparagraph c of the Conditional Use Permit).

Appendix B provides plots of the spectral data for Site 8 with the turbines ON. 5 CONCLUSION

The results of both the long-term and short-term noise measurements show that the noise levels due to the turbines are within the limits for audible noise that are contained in the Conditional Use Permit. In addition, the results of the frequency analysis show that low frequency sound levels generated by the turbines are within the limits established by the Conditional Use Permit. Furthermore, the wind turbines were not observed to produce any pure tones, nor were they observed to produce any repetitive or impulsive sounds.



## **Appendix A - Conditional Use Permit: Noise Limits**

6. Noise.

a. Audible noise due to wind turbine operations shall not exceed fifty (50) dBA for any period of time, when measured at any residence, school, hospital, church, or public library existing on the date of approval of this Permit.

b. Low frequency noise or infrasound from wind turbine operations shall not exceed the following limits when measured at any residence, school hospital, church, or public library existing on the date of approval of this Permit.

One-third Octave Band Center Frequency (Hz)	Sound Pressure
2 to 1	70 (each band)
20	68
25	67
31.5	65
40	62
50	60
63	57
80	55
100	52
125	50

c. In the event audible noise due to wind turbine operations contains a steady pure tone, such as a whine, screech, or hum, the standards for audible noise set forth in Subparagraph a of this subsection shall be reduced by five (5) dBA. A pure tone is defined to exist if the one-third (1/3) octave band sound pressure level in the band, including the tone, exceeds the arithmetic average of the sound pressure levels of the two (2) contiguous one-third (1/3) octave bands by five (5) dBA for center frequencies of five hundred (500) Hz and above, by eight (8) dBA for center frequencies between one hundred and sixty (160) Hz and four hundred (400) Hz, or by fifteen (15) dBA for center frequencies less than or equal to one hundred and twenty-five (125) Hz.

d. In the event the audible noise due to wind turbine operations contains repetitive impulsive sounds, the standards for audible noise set forth in

Subparagraph a of this subsection shall be reduced by five (5) dBA. "Repetitive impulsive sounds", as used in this Section shall refer to mechanical sounds, such as clanking, jarring, hammering, pounding or whistling

e. In the event the audible noise due to wind turbine operations contains both a pure tone and repetitive impulsive sounds, the standards for audible noise set forth in Subparagraph a of this subsection shall be reduced by a total of five (5) dBA.

f. In the event the ambient noise level (exclusive of the development in question) exceeds one (1) of the standards given above, the applicable standard shall be adjusted so as to equal ft ambient noise level. For audible noise, the ambient noise level shall be expressed in terms of the highest whole number sound pressure level in dBA which is exceeded for more than five (5) minutes per hour. For low frequency noise or infrasound, the ambient noise level shall be expressed in terms of the equivalent level (Leq) for the one-third (1/3) octave band in question, rounded to the nearest whole decibel. Ambient noise levels shall be at the exterior of potentially affected existing residences, schools, hospitals, church", or public libraries, Ambient noise level measurement techniques shall employ all practical means of reducing the effect of wind-generated noise at the microphone. Ambient noise level measurements may be performed when wind velocities at the proposed project site are sufficient to allow wind turbine operation, provided that the wind velocity does not exceed thirty (30) mph at the ambient noise measurement location.

g. Any noise level failing between two (2) whole decibels shall be the lower of the two (2). <sup>1</sup>

h. In the event the noise levels, resulting from the Project, exceed the criteria listed above, a waiver to said levels may be granted by the Town Zoning Administrator provided that the following has been accomplished:

i. Written consent from the affected property owners has been obtained stating that they are aware of the Project and the noise limitations Imposed by this Permit, and that consent is granted to allow noise levels to exceed the maximum limits allowed.

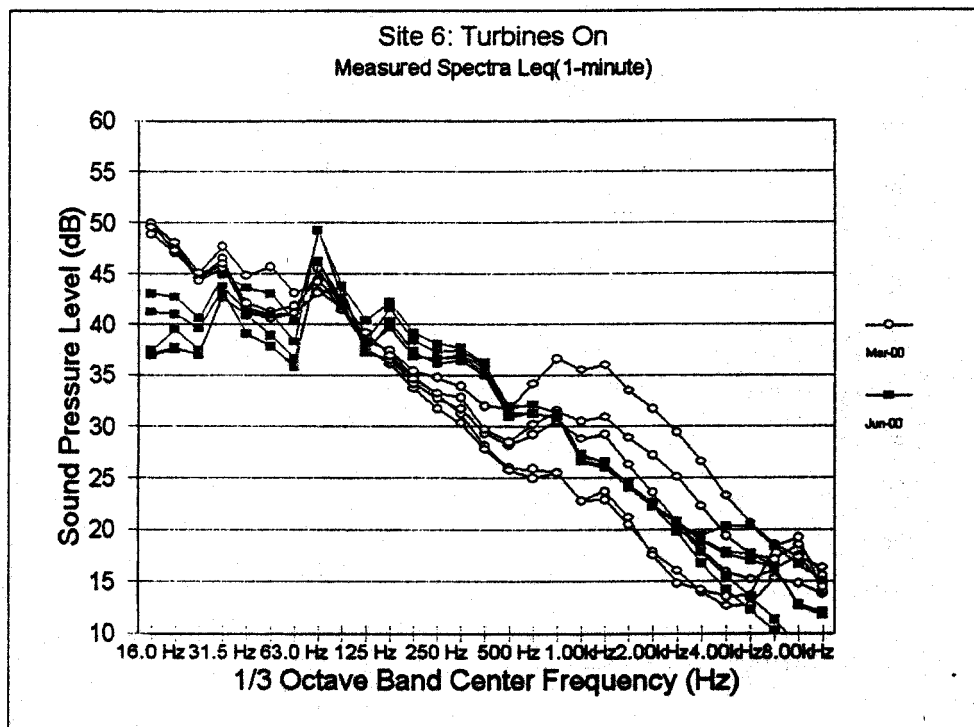
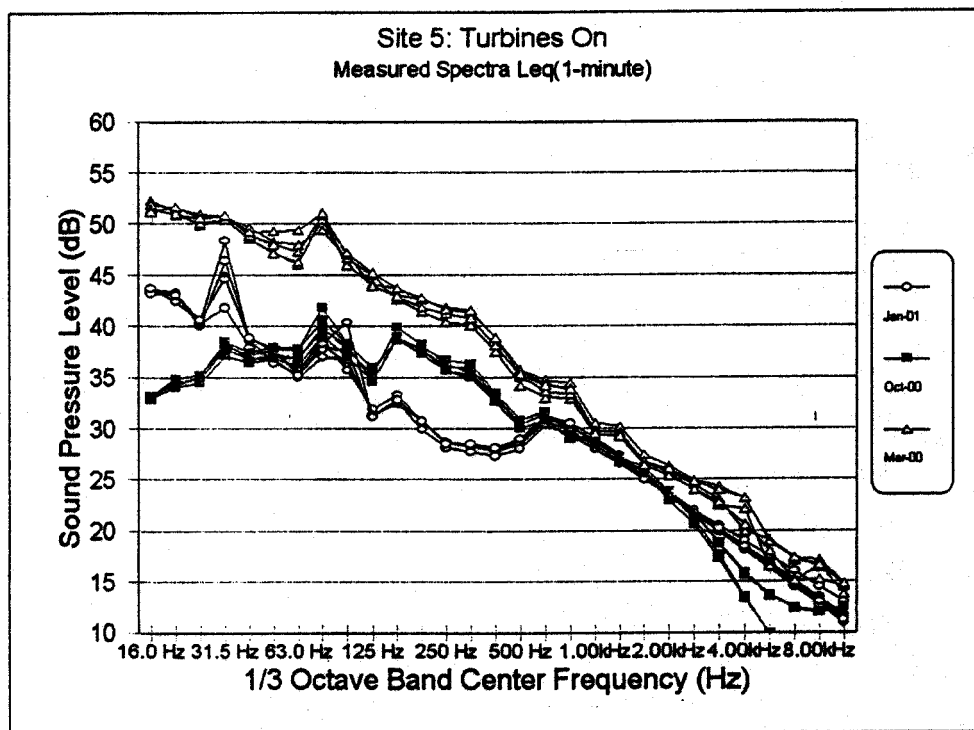
ii. If WPS wishes the waiver to apply to succeeding owners of the Property, a permanent noise impact casement has been recorded in the Office of the Kewaunee County Register of Deeds which describes the benefited and burdened properties and which advises all subsequent owners of the burdened property that noise levels in

excess of those permitted by this Permit may exist on or at the burdened property,

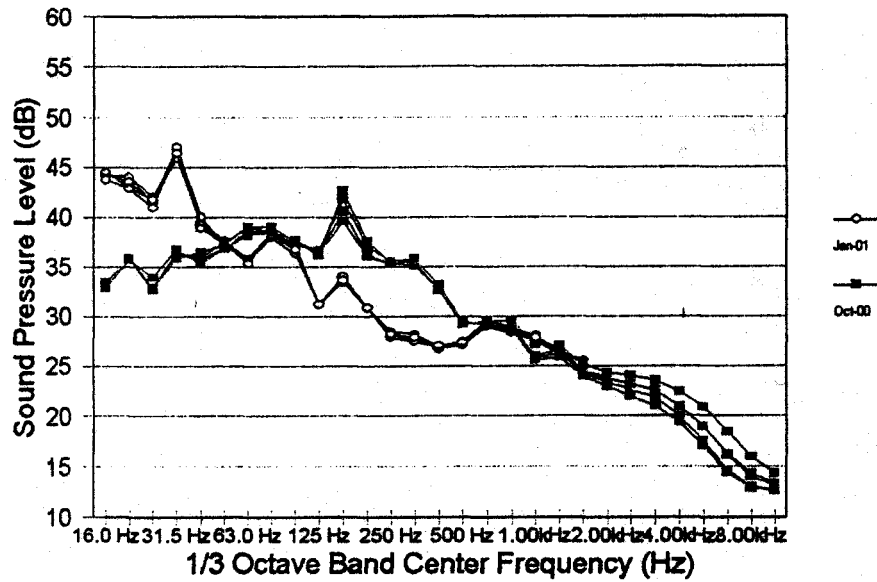
**APPENDIX B - PLOTS OF SPECTRAL DATA WITH TURBINES  
"ON"**

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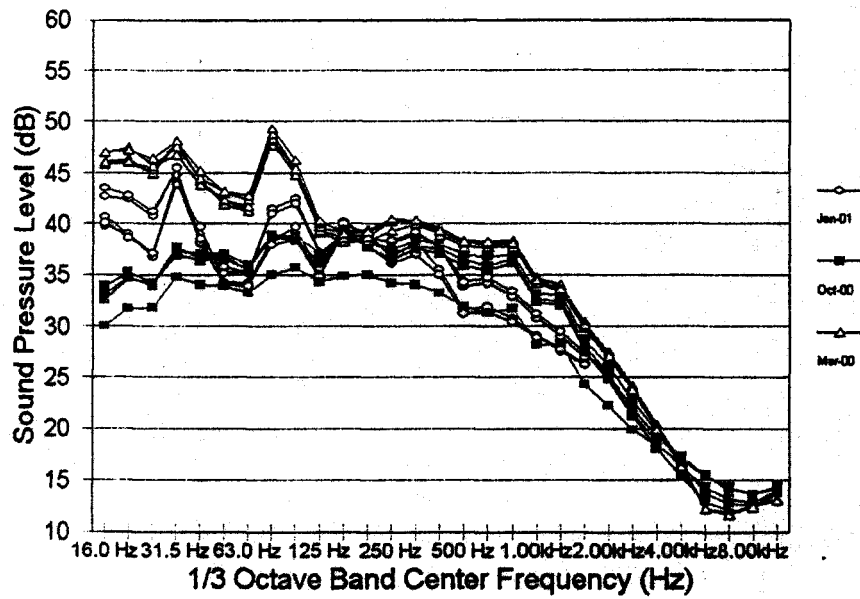
Sanchez Industrial Design Inc.  
**harris miller miller & hanson inc.**



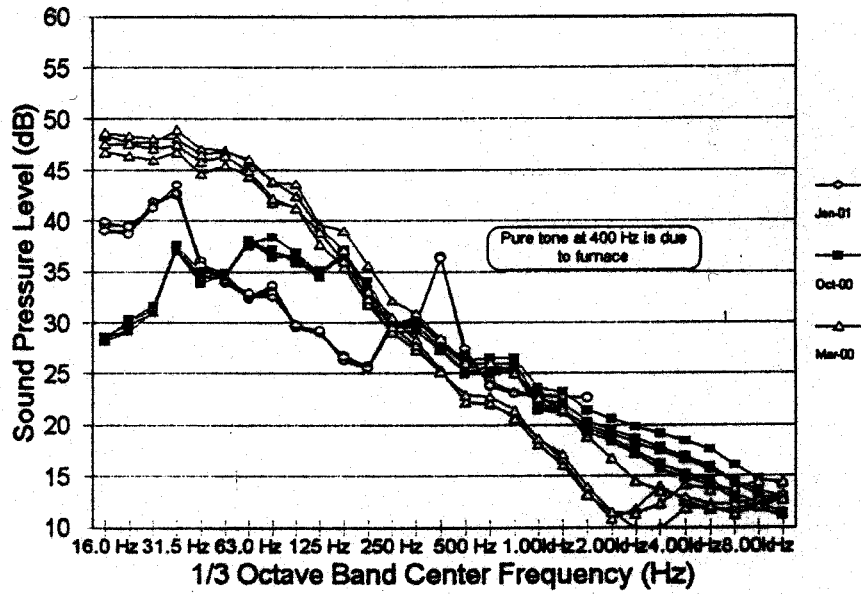
Site 6: Turbines On  
Measured Spectra Leq(1-minute)



Site 7: Turbines On  
Measured Spectra Leq(1-minute)

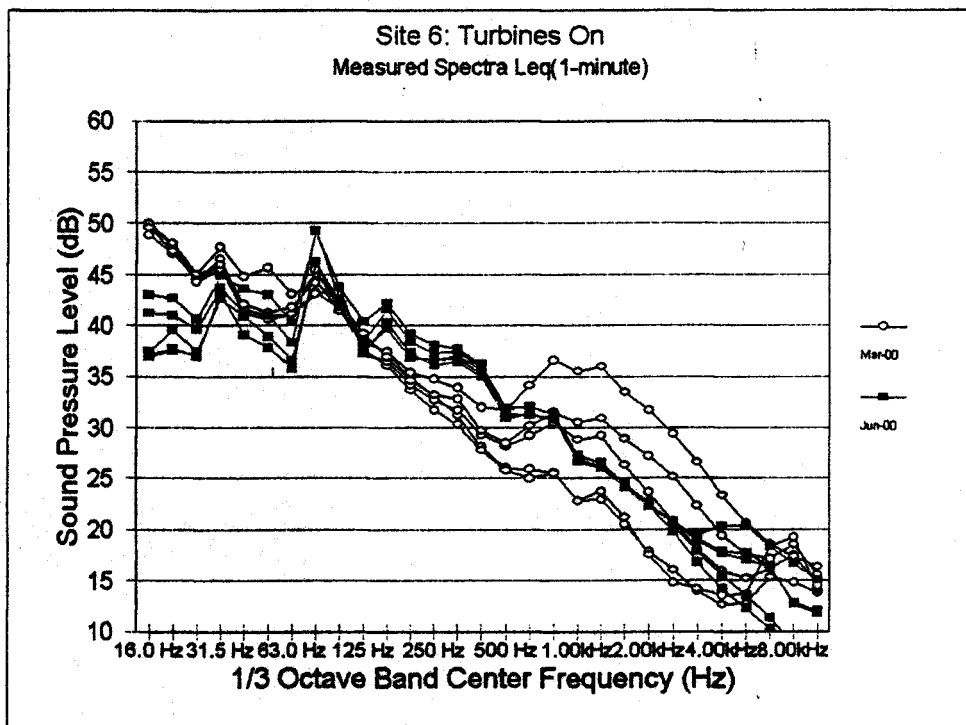
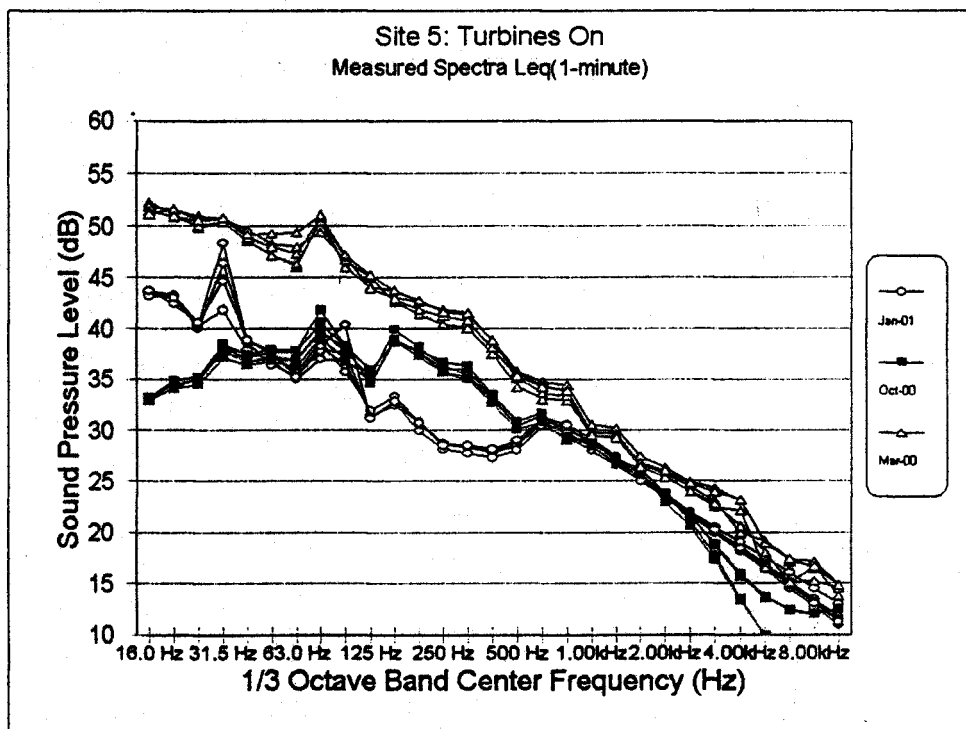


Site 8: Turbines On  
Measured Spectra Leq(1-minute)



Sanchez Industrial Design Inc.

**Harris Miller Miller & Hanson Inc.**





## Wind Turbines Sites Visited:

### WIND TURBINE FACILITY VISITS

- Member: Scott McElroy and Family  
Location: Montfort, Wi.  
Date: July 21, 2007 8:00 PM  
Conditions: Clear sky, corn fields  
Comments: Scott and his family observed the turbines from several locations. They were as close a 600' and observations were made as far as ½ mile. The low frequency noise created by the blade passing the tower was clearly heard by all from every location. The turbines were rotating at 12 RPM even though it was calm at ground level. No leaves on nearby trees were moving. This condition indicates a temperature inversion and helps explain why the turbines could be heard clearly at ½ mile. A check of local weather conditions indicated 1MPH SSW at Mineral Point and calm at Dodgeville. Wind readings are recorded at 33' (10M). Scott stopped and talked to a farmer and was told he was lucky because they had just turned the turbines on. This would also indicate a temperature inversion. As they were leaving the area they saw emergency vehicles responding to a car accident at an intersection near the turbine field. It is unknown if the rotating blades caused the drivers to be distracted.
- Member: Cathy & Jim Bembinster  
Location: Montfort, Wi.  
Date: August 19, 2007 1:00 PM  
Conditions: Overcast, low ceiling, corn fields  
Comments: We watched the turbines from several locations. When we arrived the tip of the turbine blades were hidden by the low ceiling. I walked up to the turbine closest to Anderson Rd. and found two pieces of a broken blade. The tip was as big as the hood of our truck. The turbine rotation speed was variable from 14 to 16 RPM. The turbine blade noise was clearly heard even though the corn field was providing a lot of masking sound. The yaw systems were working to keep the blades optimized and it is rather loud. The yaw system sounds like an air raid siren running at about half speed. Sound measurements were variable between 48 to 53dBA, and 62 to 73 dBC. Wind speed was 7 MPH SW to SSW with gusts to 12 MPH at Mineral Point. Wind speeds were recorded at 33' (10M).
- Member: Cathy & Jim Bembinster  
Location: Paw Paw Il.  
Date: August 25, 2007 10:30 AM  
Conditions: Partly cloudy, corn fields  
Comments: We entered the Mendota Hills wind facility from the North. We followed German Rd., Snyder Rd. and Steward Rd., among others. These are Gamesa 880KW turbines and are 214' tall. They make a distinct buzzing sound. The turbines were rotating at 15 RPM. Wind speed was variable 5 to 7 MPH from the N, NW. Wind speeds were recorded at 33' (10M). The yaw system is very loud and it seems that one is always turning to catch the most wind. Observations were made from 225 yards to 376 yards both up wind and down wind. At all locations the turbine buzz was clearly heard. At this location the turbines are scattered everywhere so the noise comes from all directions. The interesting thing about Mendota Hills is that most of the homes within the turbine field appear to be abandoned. As we drove thru the area we saw homes with all the windows covered with shades including the garage windows. There is nothing outside these homes to indicate that anyone lives inside. There are no flowers, lawn furniture, garden tools, and no people or

pets. The out buildings with doors are closed with the windows covered and open buildings are empty. On Snyder Rd. we found a man mowing his grass and we stopped to talk with him. He told us he owned this farm and had 19 turbines on his land. He receives a payment of \$4000.00 for each turbine. When I asked him about noise he said they make plenty of noise. I asked about breakdowns and he said they break all the time. During the last storm two turbines had damaged blades. He said they have a warehouse around the corner where they keep the blades, it looks like a house but that's where they store the blades. He told us that after one storm 14' was missing from a blade on his property. He and a few friends looked for this piece for quite some time because he did not want to get it caught in his Combine during the harvest. They never found any parts of that 14' section of blade. He also told us that the new turbines on the South side of this turbine facility were not working because of blade problems. I asked him if he live on the farm and he said he did. This farm looked like the others that appeared to be abandoned. He also said he has had confrontations with local residents that complain about the noise but are unable to move away. As we worked our way South we did see the new turbines and they were not turning.

Member: Cathy & Jim Bembinster  
Location: Princeton, IL.  
Date: August 25, 2007 2:00 PM  
Conditions: Clear, corn fields  
Comments: This is the Crescent Ridge wind facility. The turbines are Vestas 1.65MW. These turbines are similar to the one EcoEnergy would like to install in the town of Union. They are 400' tall with the large rotor. We could see these turbines 7 miles away. These turbines sound like you are near a busy airport where the jet aircraft never stop landing or taking off. It must be a combination of the extra height and the larger rotor diameter that makes these turbines sound like jet aircraft. Once again the yaw system is very loud. Winds were 10 MPH with gusts to 17 MPH from the SE. The turbines were rotating at 15 RPM. We took sound measurements from several locations. Upwind at 450' we recorded 58dBA and 76 dBC. At 1000' parallel with the rotor we recorded 52 dBA and 67 dBC. Downwind at 950' we recorded 47dBA and 60 dBC. The wind and the noise from the corn field did not seem to provide the masking sound required to overpower the sound of these large turbines. Again in this area lots of farms and homes look empty or abandoned. We did see a Landscaping Co. crew of three men mowing and trimming at one home. The turbines at this facility are scattered so the noise comes from all directions. Not all of these turbines are turning and we did see three maintenance trucks drive away from one of the inoperative turbines. We were told that these turbines are also having blade problems. These turbines are not able to run at full speed because of cracked blades. Responsibility for replacement of the blades is in litigation.

Member: Jim Bembinster  
Location: Wasco, Or  
Date: September 22, 2007 11:00 AM  
Conditions: Clear, harvested wheat fields  
Comments: This is the Klondike I, II, III wind facility in the State of Oregon. The wind was 4MPH gusting to 14 MPH from the WNW.

There are a lot of turbines here probably over 100. They stretch out as far as you can see. These turbines are GE 1.5MW and are 325' tall with a 230' rotor diameter. I could hear the yaw systems working everywhere. This is a very large open area with miles of wheat fields or natural brush. The town is 5 miles away. As far as I can see in all directions there is not one home. About 1 mile away I can see a grain storage building and that is the only building. The turbines here make a lot of noise. There are so many of them it is impossible to single out one and take a sound reading. The sound measurements I took were all 52 to 58 dBA and 67 to 72 dBC. I don't think that this turbine facility would bother anyone. These turbines are responsibly sited away from homes and towns. Unlike

Wisconsin, Oregon does have a wind resource by having the open land and enough wind. This is the facility where a worker was killed when a tower collapsed during routine maintenance in the summer of 2007.

Member: Cathy & Jim Bembinster  
 Location: Montfort, Wi.  
 Date: November 9, 2007 8:00 AM  
 Conditions: Cloudy, harvested corn fields  
 Comments: When we arrived the shadows from the blades were crossing Anderson Rd. The shadows are so large and travel so fast that they almost seem like a solid object is coming at you, it is very distracting. Winds were 3 MPH gusting to 9 MPH from NNW. The yaw systems are very loud and run often. The corn has been picked now so there is very little to mask the turbine noise. All noise measurements were above 50 dBA and 65 dBC.

## Wind Speed Data:

### WIND DATA

2007	MAGNOLIA MET TWR.	NEWARK TOWNSHIP	BRODHEAD AIRPORT
MAY	12.81	2.0	4.2
JUNE	9.35	1.1	3.7
JULY	8.76	1.0	3.5
AUGUST	7.99	0.7	3.4
SEPTEMBER	10.18	1.5	3.7
OCTOBER	12.0	2.2	5.2
NOVEMBER	12.79	2.9	7.0
DECEMBER	9.12	1.7	4.7
JANUARY 2008			
FEBRUARY			
MARCH			
APRIL			
MAY			
JUNE			
JULY			
AUGUST			

## Wind Turbine Construction May Affect Ground Water Quality:

- GROUND WATER: To ensure the protection of surface and ground water resources surrounding a wind project area, the following tests are recommended: Groundwater investigation, survey, fate and impact analysis of identified contaminants relative to identified wells, and wetland impact analysis. Nicholas Pressly Environmental Projects Manager, Pressly & Associates, Inc. Cherry Valley, NY Available at <http://otsego2000.org/documents/NikPressleyReport.pdf>
- BLASTING FOUNDATIONS is a serious issue/problem that may affect drinking well water and damage underwater aquifers: “One of the issues unique to this region (Kewaunee) is contamination of drinking wells. Since the topsoil is so thin, it is possible that fracturing the rock below the soil may allow seepage into the aquifer. This was the reason blasting the holes for the foundation was not allowed. One of the constraints was that the foundations had to be dug without the use of blasting. Workers had to use pneumatic hammers, rather than blasting. Quoted from the PUBLIC SERVICE COMMISSION of WISCONSIN, Wisconsin Wind Power Siting Collaborative, January 26, 1999 minutes.
- The nearly 100 percent increase of road runoff within the project area increases potential contaminant migration into surface water and wetlands resulting from:
  - turbidity (due to land clearing, excavation),
  - pH changes due to concrete spills and infiltration into groundwater
  - road deicing,
  - herbicide use, and
  - dust suppression chemical use.

Pressly and Associates, Jordanville, NY - SEIS Review

## Wind Turbines Create Harmful Shadow Flicker:

- WES SLAYMAKER, ECOENERGY, advised a group at the Magnolia Town Board meeting (July 17, 2007) that blade flicker can be observed at ½ mile and maybe further in hilly areas. Wes indicated they Ecoenergy would plant vegetation or provide new window shades/blinds if blade or shadow flicker was a problem.
- WIND ENERGY HANDBOOK: A minimum spacing (setback) from the nearest turbines to a dwelling of 10 rotor diameters is recommended to reduce the duration of any nuisance due to light flicker (Taylor and Rand, 1991). (2665 feet for eco-energy proposed project). Wind Energy Handbook, Burton, Sharpe, Jenkins, Bossanyi, Wiley & Sons Ltd, New York, 2001 pg. 527;

- Wind turbines, like other tall structures, will cast a shadow on the neighboring area when the sun is visible. If one lives very close to the wind turbine, it may be annoying if the rotor blades chop the sunlight, causing a flickering (blinking) effect while the rotor is in motion.<sup>3</sup>
- Wind Engineers Inc. was requested by Zilkha Renewable Energy to evaluate the predicted shadow flicker impacts at the proposed Wild Horse Wind Power Project near Kittitas, WA. The proposed wind project consists of 136 wind turbines at 65-meter hub height [213 feet]. Because the distance between the turbines and residences is larger than 1,000 meters [3,280 feet], there were no significant impacts at any of the residences.<sup>4</sup>
- After the wind turbines went online in Kewaunee County, Wisconsin, the Lincoln Township board of supervisors approved a moratorium on new turbine construction. The purpose of the moratorium was to delay new construction of wind turbines for 18 months, giving the township the opportunity to assess the impacts of the 22 turbines installed by Wisconsin Public Service Corporation and Madison Gas & Electric in June 1999.<sup>3</sup>
- Thirty-three percent of survey participants living between 800 feet and 1,320 feet from a wind turbine said that shadow flicker was currently causing a problem in their household. <sup>3</sup>
- Forty-one percent of survey participants living between 1,320 and 2,640 feet from a wind turbine said that shadow flicker was currently causing a problem in their household. <sup>3</sup>
- Since a new rule about calculation of shadow impact, which states that the calculation should be made for the building lot (garden), instead of window, has been introduced by the Swedish building authority (Boverket), the time for shadow impact in Klintehamn has been calculated for both lot and façade. There is a statistically significant moderate connection between shadow minutes/day on facade and annoyance. Wind PowerEnvironmental Impact of Wind Power Station Siting, (VINDKRAFTENS MILJÖPÅVERKAN FALLSTUDIE AV VINDKRAFTVERK I BOENDEMILJÖ), A. Widing et al, Centrum för Vindkraftsinformation Institutionen för naturvetenskap och teknik, Gotland University, Sweden, 2004.
- 76. Shadow flicker can be mitigated by siting wind turbines at sufficient distance from residences likely to be affected. Flicker effects have been proven to occur only within ten rotor diameters of a turbine. Therefore if the turbine has 80m diameter blades, the potential shadow flicker effect could be felt up to 800m from a turbine. (3000')Planning for Renewable Energy, A Companion Guide to PPS22, Office of Deputy Prime Minister, Queen's Printer and Controller of Her Majesty's Stationery Office, 2004.
- On Näsudden there is no connection between calculated duration of shadow impact and annoyance. There is however a moderate-strong connection between the distance to the closest turbine and annoyance from shadows. This could indicate that the geometrical model for shadow impact calculation is not accurate when there are several turbines at large distances from a building, since the shadow impact from distant turbines are included, although the shadows, according to a recent study, have a maximum extension of approximately 1 km (.67 miles)(Freund 2002).
- Three things can prevent a turbine from casting a flickering shadow: a cloudy day, a windless day and the orientation of the turbine to the home, Slaymaker said. During the siting process, EcoEnergy uses a model to determine the annual maximum hours shadow flicker could be cast on a home. There are no requirements for the maximum theoretical hours, but EcoEnergy tries to stay below 100 hours annually, Slaymaker said. In the EcoDane project, the maximum theoretical number turned out to be less than 75 hours, he said. Homes within a half-mile were computed to have shadow flicker from fewer than 10 hours to 20-plus hours, he said. Because the siting process includes public input, plans can be modified to address serious concerns, he said. (Wes Slaymaker, Ecoenergy, Janesville Gazette, Monday November 26, 2007).

- <http://www.emd.dk/WindPRO/WindPRO%20Modules,%20Shadow>

## Shadow Function

Calculation and documentation of flickering effects in terms of hours per year during which a neighbor or an area would be exposed to flickering from nearby WTG rotors. Also maximum minutes per day are calculated. SHADOW can calculate the Worst Case results (sun always shining in daytime, WTG always rotating and wind direction "worst case") or the "real expected values", based on assumptions on solar statistics and operating hours divided by wind direction.

## Calculation model

Calculations can be made either for a set of shadow recipients (e.g. windows) or for a user defined area. The calculation engine then performs a complete simulation of the sun path throughout a whole year in user definable time steps. The size and orientation of shadow recipients as well as the raster size for an area calculation can be freely chosen. Results are presented in form of calendars, cumulated hours with flicker or - for the area calculation - as maps of flicker hour isolines. If a digital height contour map is available, the terrain levels can be taken into consideration.

## Necessary Input Data (objects)

Please note that the objects are entered in the WindPRO module BASIS. Please read the description of the WindPRO module BASIS for further details.

## Wind Turbines (WTGs):

One or more WTGs are entered (position and type). The WTG can normally be found in the WTG catalogue, which contains more than 500 different WTG types. The hub height and rotor diameter are used in the calculation.

## Shadow recipients:

The shadow recipients are positioned where a calculation of the potential shadow impact is required. As many shadow recipients as needed can be included in the same calculation.

## Description

The WindPRO module SHADOW for shadow impact calculation makes it possible to calculate the annual hours of shadow impact for a given area which one or more wind turbine rotors generates. A worst-case calculation based on worst weather conditions or real values (statistic values) can be calculated based on entered solar statistics and operating hours per wind direction sector. The latter can even be auto-calculated when energy calculation data are present. At present there are often no exact rules regarding the allowable amount of shadow impact hours, but documentation has been required in several cases. Also, a shadow impact calculation can be used for constructive discussions with neighbors during the planning stage of a project. Often, even small adjustments in the siting of the turbines can change the level of shadow impact from unacceptable to acceptable.



## Calculation report

The calculation report includes the following four printout options:

Main printout: Prints the main assumptions including a map segment showing the positions of

WTGs and the shadow recipients. For each shadow recipient, the potential amount of hours with shadow impact is printed.

Calendar (tabular and graphic): for receptors: Shows the exact days, the time of the day, the duration and origin of possible shadow impact. At the bottom line for each month, the deduction due to solar statistics and operating hours will appear. The graphic version shows the impact of the shadow clearly arranged for intuitive understanding.

Calendar (tabular and graphic): for the turbines: These are calendars giving the date, time and duration for the flickering caused by each turbine. This is useful for planning if and when to stop the turbines to protect against flickering.

Map: A map with isolines for potential shadow impact is plotted for areas with WTGs. This way it is possible to reveal the extent of the possible shadow nuisance, e.g. for areas where future development is planned. The user can adjust the values of the isolines to be printed, the line colors and the line widths. Also map with raster graphic showing the values by color scheme is available. Height contour levels can be taken into account when calculating the map.

## Wind Turbines are Capable of Throwing Ice /Parts at Dangerous Speeds and Distances:

- **ACCIDENTS: Summary of Wind Turbine Accident data to December 31<sup>st</sup>, 2006.** These accident statistics are copyright Caithness Windfarm Information Forum 2006. The data may be used or referred to by groups or individuals, provided that the source (Caithness Windfarm Information Forum) is acknowledged and our URL [www.caithnesswindfarms.co.uk](http://www.caithnesswindfarms.co.uk) quoted at the same time. Caithness Windfarm Information Forum is not responsible for the accuracy of Third Party material or references.
- The attached data includes all documented cases of wind turbine related accidents which could be found and confirmed through press reports or official information releases up to December 31<sup>st</sup>, 2006. The wind industry is extremely reluctant to make such data available to the public, and because of this, data has been extremely difficult to obtain. Several Consultants from the UK and US wind industry have confirmed difficulty in obtaining such data, and CWIF believe that this compendium of accident information may be the most comprehensive put together to date.
- Data obtained in the report is by no means comprehensive - it includes little data from Denmark and Holland - two of the biggest wind turbine operators in the world. However, the data gives an excellent cross-section of the types of accidents which can and do occur, and their consequences. It is noticeable that since about 1999/2000 data has been easier to find - presumably since the wide distribution of media via the internet. Numbers of accidents in the data reflect this, with an average of 33.6 accidents found per year from 1999 to 2006 inclusive, and only an average of 5.4 accidents found per year in the previous nine years (1990-1998 inclusive). With few exceptions, before about 1997, only data on fatal accidents has been found. Total number of accidents recorded is 327. Data attached is presented chronologically. It can be broken down as follows: Fatal, Human Injury, Blade Failure, Fire, Structural failure, Ice Throw, transport, Environmental Damage, Other. [Caithness Windfarm Information Forum](http://www.clowd.org.uk/pages/clowdAccidentData.htm)  
<http://www.clowd.org.uk/pages/clowdAccidentData.htm>
- GENERAL ELECTRIC, a leading manufacturer of wind turbines, recognizes that the risk of ice throw must be taken into account during both project planning and wind farm operation. To mitigate these risks, GE recommends locating turbines a safe distance from any occupied structure, road, or public use area. In the absence of a site-specific assessment, GE offers the formula of  $1.5 \times (\text{hub height} + \text{rotor diameter})$ . In addition, GE recommends a setback of no less than 1,000 feet from inhabited structures, road, or other type of access. 9 This equals 762 feet of proposed turbine.
- SEARSBURG VERMONT: "During a windstorm in Searsburg Vermont there was a lightning strike that caused a turbine blade to fall off - the largest piece, weighing 20 pounds - was found 250 feet away

from the tower. The smallest piece was found one thousand feet from the tower." Remarks Delivered To The Assembly Committee On Energy And The Subcommittee On Renewable Energy, Examining Policy and Implementation Plans For the RPS Program, March 7, 2006 by Ad Hoc Coalition Of Local Community Groups In Upstate New York <http://www.windwatch.org/documents/1913>

- In an article written in January 1996 Professor Otfried Wolfrum, professor of applied geodesy at Darmstadt University, wrote of a significant number of blade failures in Germany, detailing four particularly severe ones where fragments of blade weighing up to half a tonne were thrown up to 280 m. Professor Wolfrum wrote: Apart from the danger of blades becoming detached or disintegrating, there is a risk that lumps of ice can form, and then be thrown significant distances when the wind rises and the blades begin to move. "Some ice layers 150mm thick have been detected and their mass has been as high as 20 - 23 kg/m". He demonstrated that these fragments could travel up to 550 m and land with impact speeds of 170 mph. This has led to "Falling Ice" warning notices at some wind turbine sites. Proceedings BORKAS 11, Helsinki, 1994, p219) [http://www.aandc.org/research/wind\\_pec\\_present.html](http://www.aandc.org/research/wind_pec_present.html)
- Broken blades: When they have broken off they have planed up to 400 metres (1200 feet) (9 Dec 1993, Cemmaes, Wales). At Tarifa, Spain, blades broke off on two occasions in Nov. 1995 - the first in gusty, high winds, the second in only light wind (report, Windpower Monthly, Dec. 1995). [http://www.aandc.org/research/wind\\_pec\\_present.html](http://www.aandc.org/research/wind_pec_present.html) <http://www.physics.rutgers.edu/~matilsky/>
- April 2000, three UK wind farms were reported as being closed for safety reasons, apparently because of metal fatigue in the turbine towers. The sites in question are at Cold Northcott in Cornwall and Cemmaes and Llangwryfon in Wales . <<http://www.windfarm.fsnet.co.uk/brecon.html>> and <http://www.landskapsskydd.nu/vind/vind035.htm>
- Professor TERRY MATILSKY, Department of Physics and Astronomy, Rutgers University actually calculated the potential distance of ice throws at up to one half mile. "But it seems like it would be quite reasonable to take about one half mile as the canonical number for the maximum range of a projectile launched with the above wind turbine parameters."10 <http://www.physics.rutgers.edu/~matilsky/>
- Professor TERRY MATILSKY, Department of Physics and Astronomy, Rutgers University: I have come to believe that blade throw is more of an issue than ice throw, and there, the likelihood of say, a half mile range, is quite possible, since the blades are designed to "fly". Also, note that the turbines will NOT necessarily shut down when ice accumulates on the blades. Rime ice coats the blades uniformly so that the blades tend to keep spinning. There has even been acknowledgment of this (rarely) by the developers, but they still insist that it is not a problem, although they cannot provide any evidence of this being the case. I am not sure that even 1/2 mile setbacks will be adequate. 500 feet would be an impossible situation; I guarantee that. 1350 meters (4429 feet) seems like a good compromise, considering everything we know at this point (November 8, electronic mail communication.)
- In Germany, in 2003, parts landed 1,650 feet from a wind-tower base after brakes failed in high winds and a blade hit the tower. [http://www.pbase.com/wp/wind\\_turbine\\_photos&page=1](http://www.pbase.com/wp/wind_turbine_photos&page=1)
- US Dept. of Energy's National Renewable Energy Laboratory Report: Quotes: "Ice and Snow the Winds Will Blow": "Ice is an issue" "[Ice] increases safety risk for the staff and public" "The latest on ice throw – an inexact science" (page 4) "Little data has been collected in the US on impacts of cold and ice." (page 7) "de-icing technology is a work in progress" (pages 7-14) – Meredith Comprehensive Plan, 2006, final draft, p. 7 Presented February 6, 2006, To the Town of Meredith Planning Board by Kenneth Jaffe, MD. <http://www.nationalwind.org/events/siting/presentations/baring-gould.pdf>
- OSHA Report, US Dept of Labor: Such an object hitting a human in the head or chest carries a high risk of death. Ice detection and removal from turbines is a very complex process. Workers have been killed by falling ice. OSHA Report, US Dept of Labor, page 38. Meredith Comprehensive Plan, 2006, final draft, p. 7 Presented February 6, 2006, To the Town of Meredith Planning Board by Kenneth Jaffe, MD. <http://www.mollica.com/windfarm/ICE%20-0WACHUSETT%20EENF%20COMM.pdf>



- American Wind Energy Ass'n: Pieces of ice falling from blades vary in size from tiny to hundreds of pounds. American Wind Energy Ass'n correspondence, page 35.  
<http://www.mollica.com/windfarm/ICE%20-%20WACHUSETT%20EENF%20COMM.pdf>
- SIMONE KAISER and MICHAEL FRÖHLINGS DORF: The Dangers of Wind Power: Many insurance companies have learned their lessons and are now writing maintenance requirements requiring wind farmers to replace vulnerable components such as gearboxes every five years -- directly into their contracts. Gearbox replacement can cost up to 10 percent of the original construction price tag, enough to cut deep into anticipated profits. Indeed, many investors may be in for a nasty surprise. "Between 3,000 and 4,000 older facilities are currently due for new insurance policies," says Holger Martsfeld, head of technical insurance at Germany's leading wind turbine insurer Gothaer. "We know that many of these facilities have flaws." Flaws And Dangers And the technical hitches are not without their dangers. For example: In December of last year, fragments of a broken rotor blade landed on a road shortly before rush hour traffic near the city of Trier. \* Two wind turbines caught fire near Osnabrück and in the Havelland region in January. The firefighters could only watch: Their ladders were not tall enough to reach the burning casings. \* The same month, a 70-meter (230-foot) tall wind turbine folded in half in Schleswig-Holstein -- right next to a highway. \* The rotor blades of a wind turbine in Brandenburg ripped off at a height of 100 meters (328 feet). Fragments of the rotors stuck into a grain field near a road. At the Allianz Technology Center (AZT) in Munich, the bits and pieces from wind turbine meltdowns are closely examined. "The force that comes to bear on the rotors is much greater than originally expected," says AZT evaluator Erwin Bauer. Wind speed is simply not consistent enough, he points out. "There are gusts and direction changes all the time," he says. But instead of working to create more efficient technology, many manufacturers have simply elected to build even larger rotor blades, Bauer adds. "Large machines may have great capacity, but the strains they are subject to are even harder to control," he says. Even the technically basic concrete foundations are suffering from those strains. Vibrations and load changes cause fractures, water seeps into the cracks, and the rebar begins to rust. Repairs are difficult. "You can't look inside concrete," says Marc Gutermann, a professor for experimental statics in Bremen. "It's no use just closing the cracks from above." The engineering expert suspects construction errors are to blame. "The facilities keep getting bigger," he says, "but the diameter of the masts has to remain the same because otherwise they would be too big to transport on the roadways." September 10, 2007, (New York Times) WUTHERING HEIGHTS
- The Problem -it's not a Winter Wonderland
  - Ice is an issue
  - Site assessment and monitoring
  - Higher maintenance
  - Increased downtime
  - Higher loading on components
  - Increase safety risks for staff and the public

And it's more common than most people think

Projects located throughout the North from the Pacific to the Atlantic are in areas where ice, snow, and cold temperatures can impact the assessment and operation of wind plants. In all cases these impacts should be assessed at the start of the project, accounted for in project development and supported through long term assessment and consideration.

#### Icing Events

It is not enough to know if icing occurs, you need to know when, how much and how long it will last. Because icing events will impact:

- Turbine structural loads
- Forced downtime
- Energy capture
- Increased and more difficult maintenance
- Higher project risk
- Site accessibility
- Cost of ice mitigation strategies
- (NREL National Renewable Energy Laboratory).

## Wind Turbine Health and Safety Lawsuit Settlement:

- Case Number: 02CV55; plaintiffs: Mike Washecheck, Nancy Larson, Ken Loeber, and Dona Look; defendant: Wisconsin Public Service Corporation (WPS).

### Facts:

- In 1999, WPS obtained conditional use permits from the Town of Lincoln in Kewaunee County, for the construction of wind turbines. The wind turbines were constructed near the plaintiffs residences and could easily be seen and heard. The WPS turbines have caused strobe light/shadow effects and noisy conditions.
- In 2001, WPS purchased several nearby residential properties that were similarly affected. After purchasing these properties, WPS removed the residences and other buildings and has since maintained the properties as vacant, open land.
- In 2001, WPS made a purchase offer to the plaintiffs, which they rejected. WPS later offered a settlement to end the lawsuit.

## Other Legal Issues/Cases Related to Wind Turbines Ruled a “Nuisance”:

- In a 2007 West Virginia Case , the court allowed a private nuisance claim against a wind development to proceed without yet deciding specific issues. Burch v. Nedpower Mount Storm, LLC, No. 33201, slip op. (W.Va. June 8, 2007) (not published yet)
- A court ruled Noise may constitute a private nuisance if it interferes with health and safety and comfort of ordinary people in the area. Alois Valerian Gross, Annotation, Windmill as Nuisance, 36 A.L.R.4<sup>th</sup> 1159 (1985)

- In a 1982 New Jersey case, the turbine was held to be a nuisance because, among other factors, it produced a distinctive sound that exceeded the limits set by the local zoning ordinance. *Rose v. Chaikin*, 453 A.2d 1378,1384 (N.J. 1982)

SOURCE: Farmers Guide to Wind Energy, Legal issues in farming the wind. June 2007. Published by the Framers Legal Action Group, St. Paul Minnesota ISBN - 13: 978-1-890508-09-8 ISBN - 10: 1-890508-09-8

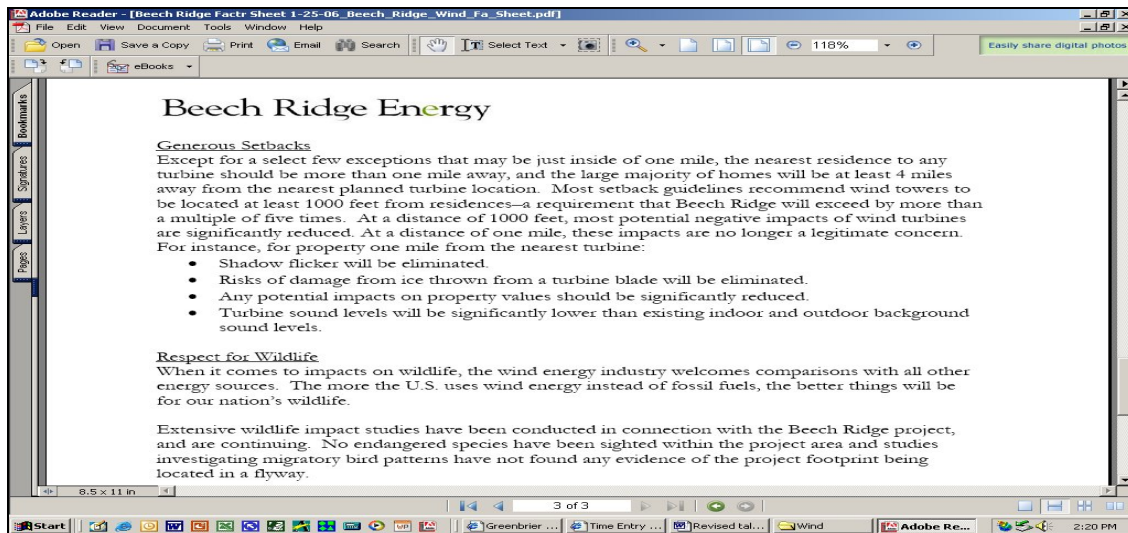
## Financial Compensation Paid to Residents Living near Wind Turbines Neighbor Easement Agreements:

- INVENERGY: who has developments in Wisconsin and Michigan, makes it a standard practice to financially compensate people living within one-third mile of their wind turbines. Invenergy, the developer for the Summit Ridge wind farm project, has been paying residents living within one-third mile of turbines at the company's other wind farm projects and often pays homeowners who live near its turbines \$800 to \$1,000 per year in compensation, says Invenergy's senior development manager, Joel Link."<sup>5</sup> "Under Invenergy's compensation plan, property owners who live within one-third of a mile of one turbine would receive \$500 per year, while property owners who are within one-third mile of two turbines would receive \$750 annually." 11
- INVENERGY: Chicago-based Invenergy will pay landowners who are within one-third mile of turbines, under a proposal accepted by town boards in Byron and Oakfield in Fond du Lac County. Under Invenergy's compensation plan, property owners who live within one-third of a mile of one turbine would receive \$500 a year, while property owners who are within one-third of a mile of two turbines would receive \$750 annually, he said. Landowners who host a wind turbine will receive easement payments of about \$4,200 a year, as well as compensation for crops they would not be able to sell because of the easement. Invenergy's decision to pay property owners who don't host turbines was praised by Michael Vickerman, executive director of the non-profit group Renew Wisconsin, which advocates for greater use of renewable power. "Renew has been encouraging wind developers to channel wind power's economic benefits to a broader group of landowners in the area of wind farms," Vickerman said in a statement." Invenergy's decision sets the standard for other Wisconsin wind developers." Wind power projects can be controversial in part because neighbors who don't have a wind farm on their property have to look at the turbine and know that their neighbor is enjoying a financial gain by selling easements to host the wind farm. Already the largest wind power project in state history, the Forward Wind Energy Center this week chalked up another first: It will become the first wind development to compensate property owners who have to look at wind turbines but haven't sold easements to put them on their land. Posted: Oct. 27, 2005 Milwaukee Journal Sentinel [http://www.windcows.com/files/WI-Invenergy\\_to\\_pay\\_landowners\\_within\\_sight\\_of\\_wind\\_turbines.mht](http://www.windcows.com/files/WI-Invenergy_to_pay_landowners_within_sight_of_wind_turbines.mht)
- ZILKHA Renewable Energy 1001 McKinney Street, Suite 1740, Houston, Texas 77002 uses a "Memorandum of Wind Farm Neighbor Easement agreement" and pays non participating neighbors \$ 500.00 in compensation if they reside within 2500 feet of a wind turbine. Copy available upon request.
- LEMPSTER WIND LLC.: "Lempster Neighbor Agreement." Lempster WIND LLC, a Delaware Limited Liability Company, c/o Iberdrola Renewable Energies USA, Ltd., 201 King of Prussia, Suite 500 Radnor PA 19087. Lempster pays non participating landowners \$ 1000.00 up front and 1,000.00 per year to waive all noise, setbacks, construction inconvenience, etc. for 30 years. <http://www.windaction.org/documents/11985>
- MERIDIAN ENERGY paid an undisclosed sum of Money to the Bolton Family in August 2005 due to intolerable noise and vibration levels created from wind turbines.

- AIRTRICITY Inc.: North America, headquartered in Chicago, 401 North Michigan Avenue, Suite 1720 Chicago, IL 60611. Local landowners are being asked to sign contracts stating: “(X) hereby accepts such nuisance and waives their right to object to such nuisance.” Airtricity contract, clause 9, page 10. Meredith Comprehensive Plan, 2006, final draft, p. 7 Presented February 6, 2006, To the Town of Meredith Planning Board by Kenneth Jaffe, MD
- BP WIND ENERGY NORTH AMERICA Inc. BP Wind Energy North America Inc. 700 Louisiana Street, Suite 700 Houston, TX 77002. This is a 23 page contract where several items are “waived” as part of the agreement. The document is marked “Confidential” throughout....<http://www.windaction.org/documents/11774>
- HAYS WIND LLC, a Delaware limited liability: “Wind Farm Neighbor Agreement” This Wind Farm Neighbor Agreement (“Agreement”) is entered into as of the date set forth below, between (i) Hays Wind LLC, a Delaware limited liability company authorized to do business in State of Kansas (“Hays Wind”) and solely owned by Iberdrola Renewable Energies USA. The agreement contains language included but not limited to: Noise Easement, Light and Shadow Easement, Television reception, Construction Impact, miscellaneous, and Confidentiality requirement. Payments are as initial sum paid in the amount of \$3,000.00: Then annual payments based on electrical usage. Term is for 35 years.  
<http://www.windaction.org/documents/11807>
- Elroy Swope, age 75, has four windmills on his Compton farm that are part of Mendota Hills project in Lee County. Elroy Swope, states: “I wouldn’t do it again,” “It just didn’t turn out the way it was supposed to.” Swope said he was told he would receive about \$1,000 per year per windmill, but after one year, he has not received anywhere near \$4,000. He declined to say how much he has been paid. “Mr. Swope is a difficult person to keep happy,” said Christopher, Moore, managing director of the Minneapolis, MN based developer Navitas Energy, Inc. Still, Moore acknowledged that farmers were not paid as much as they expected in 2004. “2004 was a poor wind year and because it was the first facility, the first part of the year was what I would call startup. We didn’t get as much production as we hoped.” 2005 was better, but Moore declined to provide statistics about the wind farm’s production in 2005, and has not responded to multiple voice messages and e-mails requesting this information.  
<http://www.protectillinoisenvironment.com/quotes.htm> gave it’s OK to a Milwaukee-area company’s request for a conditional use permit to build an eight-turbine wind farm.
- Shirley Wind LLC of Hubertus, a division of Emerging Energies, wants to build eight 492-foot-tall turbines on several parcels of property owned by four families in Glenmore. The sites on land owned by Mark Mathies, 5982 Fairview Road; Dan Mathies, 4157 Shirley Road; Dan and Tina Zeamer, 3384 School Road; Rodney and Sue Leiterman, 4611 Shirley Road; and several parcels on Glenmore Road. Each landowner requested permission for two turbines on their property. Shirley Wind would give more than \$2.1 million to Brown County, Glenmore and homeowners within one mile of the project over the 30-year tenure of the project. The homeowners — about four or so — would stand to receive a total of \$900,000 combined over 30 years, distributed equally as a “good neighbor gesture,” said representatives of Shirley Wind. But those who live nearby but not within a mile stand little to gain and everything to lose, said resident Jeffrey Jens of 6187 Dickinson Road. “I’m sick of them shoving this down our throat,” he said, adding that he intends to voice his discontent at the Feb. 26 public hearing. Jens was among a group of residents who said they felt their property values would plummet. In February 1998, two 600-kilowatt turbines were built on a farm on Shirley Road, a quarter-mile east of Morrison Road in Glenmore, at an installation cost of \$2.1 million. The experimental, two-turbine project was intended to provide enough clean, renewable electricity to serve about 450 average Wisconsin homes a year. At least one of the turbines has been out of order for several months, residents said. Jens said that contrary to Shirley Wind representatives’ claims that the 24-kilowatt project would produce less sound than an average conversation, the two turbines in Glenmore are noisy. “It’s not nice to have to open your door and hear that all of the time,” he said. The matter will go to the Town Board for final decision on March 5. By Lee Reinsch, [lreinsch@greenbaypressgazette.com](mailto:lreinsch@greenbaypressgazette.com)

## Precedence for Larger Setbacks:

- As seen in Figure 1, Invenenergy's setbacks for the Beech Ridge Wind Farm located in West Virginia are between one and four miles from residences. "At a distance of 1,000 feet, most potential negative impacts of wind turbines are significantly reduced. At a distance of one mile, these impacts are no longer a legitimate concern."<sup>13</sup> Figure 1 - Beech Ridge Energy Project Details



- National Wind Power, a company that builds turbines, recommends that they are erected at least 600 yards (1800 feet) from human habitation. January 25, 2004  
<http://www.telegraph.co.uk/news/main.jhtml?xml=/news/2004/01/25/nwind25.xml> Home: <http://www.natwindpower.co.uk/homepage/index.asp>
- German Turbine Company RETEXO-RISP, Altenburger Str. 31 D-04617 Rositz /Thuringan since 1994, recommends turbines be built on coastal sites, on open land without forests or high hills within a range of about 15 km and, of course, on hill tops. Buildings, particularly
- housing, should not be nearer than 2 (1.24 miles) km to the wind farm. Available at: <http://www.retexo.de/english/wind/seite5a.htm>
- British Wind Energy Association (BWEA): When asked about siting a 400 foot wind turbine near residences, David responded: "Different developers use different distances. We would typically site them 700 metres (2296 feet) from the nearest residences. David Farrier, Renewables Development Manager, British Wind Energy Association. Received in an electronic email 10-24-08.
- The National Wind Coordinating Committee in depth case study on: Blue Canyon Comanche County, Oklahoma Wind Facility is located approximately 15 miles northwest of Lawton, Oklahoma, in Comanche County. Comanche County has a population of about 113,900 people. Noise was addressed primarily through community outreach efforts. The only landowner living in the vicinity of the turbines (one-half mile away) was sent to a wind farm in Texas to observe how an operational site looks and sounds, and he told the NWCC's interviewer that he has no complaints about the noise and that he considered the turbines to be relatively quiet. Wind Power Facility Siting Case Studies: Community Response For the National Wind Coordinating Committee, c/o RESOLVE, 1255 23<sup>rd</sup> Street, NW Suite 275 Washington, DC 20037. [http://www.nationalwind.org/publications/siting/Wind\\_Power\\_Facility\\_Siting\\_Case\\_Studies.pdf](http://www.nationalwind.org/publications/siting/Wind_Power_Facility_Siting_Case_Studies.pdf)
- Second International Meeting On Wind Turbine Noise

Lyon France September 20 -21 2007

Country	Commercial		Mixed		Residential		Rural	
	Day	Night	Day	Night	Day	Night	Day	Night
Germany	65	50	60	45	55	50	50	35
Netherlands (EPA)			50	40	45	35	40	30
Denmark (EPA)					45		40	
Australia	65	60			52	45	47	40
Ghana	75	65	65	60	65	48		
USA	No federal noise regulations, US-EPA established guidelines. Most states (including VA) do not have noise regulations. Local governments have noise ordinances (Rogers and Manwell, 2002).							

## Conclusions

Sound generated by wind turbines has particular characteristics and it creates a different type of nuisance compared to usual urban, industrial, or commercial noise. The interaction of the blades with air turbulences around the towers creates low frequency and infrasound components, which modulate the broadband noise and create fluctuations of sound level. The low frequency fluctuations of the noises described as “swishing” or “whooshing” sound, creating an additional disturbance due to the periodic and rhythmic characteristic.

A set of permissible limits for windmill noise that can be uniformly applicable over the nation is not available in the USA. Instead of imposing standard noise limits, the US Environmental Agency (US-EPA) suggests local governments developing their own noise regulations or zoning ordinances. Many countries developed national noise limits applicable to wind turbines.

Specific noise limits need to be developed by considering the characteristics of wind turbine noise. Especially the low frequency sound components and the modulation of the background noise resulting must be considered to represent the activity interference of the wind turbine sound. Adequate criteria to assess the wind turbine sound will greatly help the development of the wind industry by reducing the community reaction based on subjective opinions.

<http://www.wind-watch.org/documents/committee-notes-on-wind-turbine-noise/>

Larger Setback Summary Chart

Organization/country	Setbacks from Residences	Mile(s)
National Research Council; USA	Past ½ mile or so	½ +
France National Academy of Medicine	1.5 KM	.93 mile
Burton, Sharpe, Jenkins, Bossanyi (Authors) Wind Energy Handbook. Wiley & sons LTD. 1991	10 rotor Diameters = 2,665 feet	½ +
Holland	1 KM	.62 mile
UK Noise Association	1 mile	1 mile
Scotland	½ mile	½ mile
RETEXO-RISP: German Turbine developer	2KM	1.24 miles
Germany	1600 meters or 1.6 KM	1 mile
Riverside County, CA	2 miles	2 miles
Town of Wilton, WI	1 mile	1 mile
Professor Terry Matilsky; Rutgers	1350 meters/4429 feet	.838 miles
Dr. Amanda Harry	1.5 miles	1.5 miles
Dr. Nina Pierpont (Physician)	1.5 - 3 miles	1.5 - 3
Dr. Richard Bolton (Physicist)	1 mile	1 mile
Dr. Gordon Whitehead (Audiologist)	1.5 miles	1.5 miles
Barbara Frey & Peter Hadden	2 km	1.25 miles

\*Source: <http://windwisefairhaven.com/>

\*\* Germany, which has more wind turbines than any country in the world, has a 1.6 km or 1 mile

setback for all turbines. These regulations are for one or more turbines. The proponents of wind turbines will try to attack this data by saying that they are for wind farms. Go to google: wind turbine setbacks. WE NEED TO DO THIS PROJECT THE RIGHT WAY-OR NOT DO IT AT ALL.

■ Summary on Health Issues From Dr. Nina Pierpont

Wind Turbine Syndrome is the clinical name I have given to the constellation of symptoms experienced by many (though not all) people who find themselves living near industrial wind turbines: sleep problems (insomnia), headaches, dizziness, unsteadiness, nausea, exhaustion, anxiety, anger, irritability, depression, memory loss, eye problems, problems with concentration and learning, tinnitus (ringing in the ears).

As industrial windplants proliferate close to people's homes and anywhere else people regularly congregate (schools, nursing homes, places of business, etc.), Wind Turbine Syndrome likely will become an industrial plague.

Wind energy companies routinely deny that their 40-story-high turbines, with massive propellers sweeping acres of air, make any noise or create shadow flicker, or strobing—caused when the sun is positioned behind the blades, resulting in acres of landscape being swept by blade shadow. With setbacks from homes being typically a quarter mile, even half a mile, or even up to a mile, these pulsed shadows "strobe" through the windows of one's home and drive people to distraction. (Not to mention what they do when you walk outside and see your landscape seemingly moving before your eyes.) Many people get vertigo and nausea. Anyhow, the wind energy companies deny noise and shadow flicker, yet they discreetly insert clauses in their contracts acknowledging them.

Q. Are there health and safety issues associated with living close to industrial wind turbines which I should be concerned about?

Here is the October 10, 2007 response to this question by Dr. Nina Pierpont, MD, PhD, who has conducted some of the most intensive medical studies on the effects of wind turbines on human health and safety: "Yes, there are indeed medical problems caused by noise and vibration from current, upwind, three bladed industrial wind turbines. I am in the process of preparing a paper for publication in a medical journal documenting the consistency of these problems from family to family, the study subjects being a collection of families in several different English-speaking countries who have been driven from their homes by problems with sleep, headaches, tinnitus, equilibrium, concentration, memory, learning, mood, and child behavior -- problems which started when the turbines went into operation and which resolve when the family is away from the turbines. These problems all occur in proximity to recently built industrial turbines, put into operation in 2005, 2006, and 2007. The ear is indeed the most sensitive receptor for noise and vibration. This does not mean, however, that if you cannot hear it, it cannot hurt you. The ear does more than hear. A number of the effects of noise and vibration from wind turbines appear to be mediated by the inner ear, which is a complex organ, one of whose functions is detecting certain sorts of vibration as noise. The inner ear also detects movement, acceleration, and position relative to gravity, has direct feedback onto eye movement, and has established linkages with anxiety centers in the brain. People disturbed by noise and vibration from industrial wind turbines generally can hear the noise when it bothers them, though it may not seem particularly loud. Several people I have interviewed speak favorably of living next to an elevated urban train line, compared to living at their rural home next to wind turbines. They can sleep with traffic or train noise, but not with the wind turbine noise/vibration. They consistently described a penetrating and intrusive quality to the wind turbine noise, several describing in different ways a very disturbing feeling that the noise is somehow inside their bodies. This latter effect suggests detection of vibration in body cavities, especially since people who say this generally localize the feeling to their chest or their head. Published research from Sweden (thesis by Pedersen and published papers incorporated into the thesis) shows that the percentage of annoyed people (which include people who move out or undertake major house renovations to try to do something about the noise) goes up at 37.5-40 dBA. This is probably because A-weighted noise representations are not capturing the parts of the wind turbine noise and vibration spectrum which are disturbing. The Pedersen studies are also based on modeled noise, not actual measurements, though there is a close correlation between actual dBA measurements and the Swedish governmental modeling protocols, the author says. Even if we do not know exactly what parts of the noise and vibration



spectrum are bothersome, and to what extent these are represented in a dBA measurement, we have in the Pedersen research clear evidence that when noise is modeled prior to wind turbine construction, the allowed levels of noise should not be over 37.5 to 40 dBA outside of dwellings. Because the noise level is especially important at night, and it is at night that there tends to be a "stable atmosphere," with cool, still air at ground level and a brisk wind at turbine hub height, modeling of noise prior to wind turbine construction should use both a 37.5 to 40 dBA ceiling of tolerability, and van den Berg's models of noise propagation in a stable atmosphere.

Sincerely,

Nina Pierpont, MD, PhD

My conclusions:

I am a physician and scientist; my expertise lies in clinical and environmental matters. Whether or not wind proves to be a viable source of power, it is absolutely essential that windmills not be sited any closer than 1.5 miles from people's homes or anywhere else people regularly congregate. (Highways are also a problem for motorists with seizure and migraine disorders and motion sensitivity, from the huge spinning blades and landscape-sweeping shadow flicker.) I consider a 1.5 mile set-back a minimum figure. In hilly or mountainous topographies, where valleys act as natural channels for noise, this 1.5 mile set-back should be extended anywhere from 2-3 miles from homes. Let me be clear: there is nothing, absolutely nothing, in the wind energy proposition that says windmills must be sited next door (often 1000 feet) to people's homes and workplaces. Siting, after all, is the crux of the issue. Irresponsible siting is what most of the uproar is about. Corporate economics favor building wind turbines in people's backyards; sound clinical medicine, however, does not.

Nina Pierpont, M.D., Ph.D., FAAP  
19 Clay St.  
Malone, NY 12953  
(518) 483-6481 phone and fax  
pierpont@westelcom.com  
www.ninapierpont.com  
July 5, 2006

## Professional Recommendations Substantiating Larger Setbacks:

- NATIONAL RESEARCH COUNCIL, Environmental Impacts of Wind energy projects May 2007, 2007 NRC Report: recommendation of setback ½ mile or so. Available at: [http://books.nap.edu/openbook.php?record\\_id=11935&page=109](http://books.nap.edu/openbook.php?record_id=11935&page=109) and <http://sites.nationalacademies.org/nrc/index.htm>
- The U.K. NOISE ASSOCIATION: Studied the issue and recommends a 1-mile setback. John Stewart, "Location, Location, Location: An Investigation into Wind Farms and Noise by the Noise Association," July 2006 (see [http://www.ninapierpont.com/pdf/UK Noise Association. PDF](http://www.ninapierpont.com/pdf/UK%20Noise%20Association.pdf))
- The FRENCH NATIONAL ACADEMY OF MEDICINE recommend halting wind turbine construction closer than 1.5 km (.932 miles) from residences. Chouard, Claude-Henri. 2006. <<Le retentissement du fonctionnement des éoliennes sur la santé de l'homme>> ("The repercussions of wind turbine functioning on human health"), Académie Nationale de Médecine (French National Academy of Medicine).

- THE WORLD HEALTH ORGANIZATION (WHO) recommends that threshold standards for noise in communities be set lower than 30dB (as measured with the standard “A” filter) whenever the noise has a substantial low-pitched component—as it does from wind turbines. Again, this is because low-pitched noise is more disturbing and has a greater impact on health at low levels than higher-pitched noise. When measuring such noise, a “C” filter will give a more accurate reading of loudness by including more of the low-frequency sounds. 2
- Centerville MI Township Windmill Ordinance Committee, July 10, 2006: Setback from residence should be ten times the rotor diameter (2665 feet for eco-energy proposed project). “A minimum spacing from the nearest turbines to a dwelling of 10 rotor blades diameters is recommended to reduce the duration of any nuisance due to light flicker (Taylor and Rand, 1991). However, a spacing of this magnitude is likely to be required in any event by noise constraints and to avoid visual domination.” This is cited verbatim in Wind Energy Handbook, Burton, Sharpe, Jenkins, Bossanyi, Wiley & Sons Ltd, New York, 2001 pg. 527;
- WIND ENERGY HANDBOOK: A minimum spacing (setback) from the nearest turbines to a dwelling of 10 rotor diameters is recommended to reduce the duration of any nuisance due to light flicker (Taylor and Rand, 1991). However, a spacing of this magnitude is likely to be required in any event by noise constraints and to avoid visual domination. (2665 feet for eco-energy proposed project). Wind Energy Handbook, Burton, Sharpe, Jenkins, Bossanyi, Wiley & Sons Ltd, New York, 2001 pg. 527;
- The CATHARINE M. LAWTON: “Wind turbines should not be sited anywhere near (closer than 2+ miles) residential development.” ( Catherine M. Lawton, Town of Barton, Washington County, Wisconsin: Commercial Wind Energy Facility, & Wind Access Model Ordinance)
- AUDIOLOGIST GORDON WHITEHEAD: 23 May 2006 Report on Pubnico Point Wind Farm, Lower West Pubnico, Nova Scotia, states: I believe a setback equivalent to 1.5 miles would be adequate in most situations, and I think in most situations a setback of this distance is possible. The potential noise, and/or vibration, and/or light flicker and/or mechanical safety issues are very real. You mentioned that in one area the windfarm site is 549 feet from a highway. It has been documented that the turbine blades can throw ice chunks weighing hundreds of pound at least 1,650 feet; this is certainly enough to destroy a school bus and the children in it, not to mention passing right through a house. The solution is so simple and achievable: a setback of at least 1.5 miles would eliminate more than 99% of the problems associated with wind farm installations. Report Prepared for: Mr. Daniel D’Entremont Lower West Pubnico, Nova Scotia Prepared by: Gordon Whitehead, B.S., M.A., Aud(C), Audiologist 210 Windsor Drive, Stillwater Lake, Nova Scotia B3Z 1G5. 23 May 2006
- The DR. OGUZ A. SOYSAL Ph.D., Professor and Chairman of the Dept. of Physics and Engineering at Frostburg State University in Maryland, measured sound levels over half a mile away from the Meyersdale, PA, 20-turbine wind farm. Typical audible (A-weighted) dB (decibel) levels were in the 50-60 range, and audible plus low-frequency (C-weighted) dB were in the 65-70 range. 65-70 dB is the loudness of a washing machine, vacuum cleaner, or hair dryer. A difference of 10 dB between A and C weighting represents a significant amount of low-frequency sound by World Health Organization standards. Acoustic Noise Generated by Wind Turbines Presented at the Lycoming County, PA Zoning Board Hearing on 12/14/2005 Available at <http://www.windaction.org/documents/1503>
- DR. NINA PIERPONT, MD, PhD: Wind turbines should not be built within 1.5 miles of people’s homes. Let it be understood, however, that there will still be health and life quality problems caused by wind turbines beyond this radius. People living 1.5 to 3 miles from a proposed turbine site should be notified of potential health and life quality effects, and for this they should be appropriately compensated. Health Effects of Wind Turbine Noise, Nina Pierpont, March 2, 2006 Available at <http://www.ninapierpont.com>
- DR. AMANDA HARRY, MD, a British physician: DR. AMANDA HARRY, found (near a 16-turbine installation in 2003) that 13 out of 14 people surveyed reported an increase in headaches, and 10 reported sleep problems and anxiety. Other symptoms included migraine, nausea, dizziness, palpitations, stress, and depression. Dr. Harry recommends no turbines be built within 1.5 miles of any Home. Wind Turbines noise and health, February 2007. Dr. Harry summarizes her report: There are many people living near wind turbines who are suffering from problems with their health. The

noise produced from wind turbines is an extremely complex one, and I feel that it is the complexity of the noise and vibration which causes the disturbance. From my discussions with people suffering from ill health who live near wind farms, it seems that the symptoms suffered can occur up to a mile from the wind farm. Until further independent medical and epidemiological research has been carried out, I would suggest that no wind turbines should be sited closer than 1.5 miles away from the nearest [home]. ' Amanda Harry, MD, "Wind Turbines, Noise, and Health," February 2007 (see <http://www.ninapierpont.com/pdfAmandaHarry.pdf>). See Nina Pierpont, MD, PhD, "Wind Turbine Syndrome: Testimony before the New York State Legislature Energy Committee," March 7, 2006 (see [http://www.ninapierpont.com/pa/Wind turbine syndrome, NYS Energy Committee 3-7-06,pdt](http://www.ninapierpont.com/pa/Wind%20turbine%20syndrome,%20NYS%20Energy%20Committee%203-7-06.pdt)).

- Professor ALVES-PEREIRA and her colleague, NUNO CASTELO BRANCO, M.D., have written a paper titled "In-Home Wind Turbine Noise Is Conducive to Vibroacoustic Disease," which they presented 1 September 2007, in Lyons, France, at the Wind Turbine Noise Conference WTN 2007.
- RICHARD BOLTON: Physicist, Rushville, NY. Evaluation of Supplemental Environmental Noise Analysis for "Cohocton Wind Power Project" January 2007. Recommends 1 mile setback for turbines from residences.  
<http://www.ventdecolere.org/archives/nuisances/Noise%20Analysis%20of%20Local%20Law%20,%20Bolton.pdf>
- BARBARA J. FREY and PETER J. HADDEN (researchers), recently published a 137-page report on "Noise Radiation from Wind Turbines Installed near Homes: Effects on Health, with an Annotated Review of the Research and Related Issues" (February 2007). See <http://www.windturbinenoisehealthhumanrights.com/> this may be the best single source on health issues and industrial turbines. After presenting voluminous evidence, the authors recommend at least 2 km (1.25 miles) of setback from people's homes for turbines up to 2MW installed capacity, and even larger setbacks for any turbines over 2MW.
- DR. VAN DEN BERG, a physicist at the University of Groningen in The Netherlands, published his research, which is available on line at: <http://dissertations.ub.rug.nl/faculties/science/2006/g.p.van.den.berg/>; van den Berg, GP. 2006. "The sound of high winds: The effect of atmospheric stability on wind turbine sound and microphone noise." PhD dissertation, University of Groningen, The Netherlands. <http://irs.ub.rug.nl/ppn/294294104> van den Berg, GP. 2005. "The beat is getting stronger: The effect of atmospheric stability on low frequency modulated sound of wind turbines." *Journal of Low Frequency Noise, Vibration, and Active Control*, 24(1):1-24. van den Berg, GP. 2004. "Effects of the wind profile at night on wind turbine sound." *Journal of Sound and Vibration* 277:955-970.
- DR. VAN DEN BERG, a physicist at the University of Groningen in The Netherlands: Residents living up to 1,640 feet and more have reacted strongly to the noise; residents up to 6,200 feet (1.2 miles) distance expressed annoyance. Frits van den Berg, studied noise levels around a German facility of 17 turbines. In a paper published in the November 2004 *Journal of Sound and Vibration*, he found that at night, because the surface air is often more still than the air at the height of the blades, the noise from the turbines is 15 to 18 dB higher than during the day and carries farther. He noted that residents 1.9 kilometers (6,200 feet or 1.2 miles) away expressed strong annoyance with noise from the facility.
- International research: showed it was "general protocol" to allow for a 2km buffer, even with smaller turbines. In New Zealand there were no consented wind energy developments with more than a handful of houses closer than 2km. NICK CHURCHOUSE 15 November 2005 "Turbines 'too close to homes'" [http://www.windcows.com/files/NZ-Turbines\\_too\\_close\\_to\\_homes\\_.mht](http://www.windcows.com/files/NZ-Turbines_too_close_to_homes_.mht)
- DAVID MICHAEL MANLEY PhD BSc (Hons) MIEE MIOA F Inst P C.Dip AF FICDDS C.Eng Chartered Acoustician, Physicist and Engineer member: UKNA COMMITTEE "SOME ACOUSTIC EFFECTS OF WIND TURBINES"  
Dr. David Manley, Chartered Physicist, Acoustician and Engineer states:  
Much work has been done by me near wind farms to evaluate the acoustic effects. It is found that people living within five miles of a wind farm cluster can be affected and if they are sensitive to low frequencies, they may be disturbed. I am currently working in conjunction with Dr Amanda Harry a

practicing physician in this subject and she has over fifty examples of people affected by LF wind farm noise.

What is happening is the high velocities of the large turbines wind foils cause aerodynamic noise modulated by the regular dynamic pulse when the wind foil passes the base of the turbine.

It has been found that an extensive seismic signal passes through the earth and may well at night affect people's sleep. It is admitted by fellow acousticians that much more research in this subject is needed and that none has been done since 1996 by the DTI. At many inquiries, wind farm promoters will not accept there is an acoustic problem.

We are getting much data from Europe as well to paint a more accurate picture and feel that no more wind farms giving an alternative to power stations should be built. I gave two talks as an invited 'Speaker' at the recent successful Saddleworth Conference. These talks were about the evidence of "hot lines" from clusters of turbines which will at times cause much higher LF signals than first thought.

Available at: <http://makaraguardians.orcon.net.nz/whatsnew.htm> August 2005

- Meridian Energy Limited : Meridian does not have a specific setback distance in relation to turbines and private dwellings. There are several aspects of the development process that need to be taken into consideration before the final distances can be determined between the turbine/turbines and a dwelling or dwellings. In general terms, the project team needs to consider the following aspects of the project and its related location:

- The regional/local body plans and provisions;
- The turbine types and sizes being considered;
- The number of potential turbine locations;
- The sound power levels of the proposed turbines;
- The background noise levels at the dwellings;
- The orientation of the turbines in relation to the dwellings;
- The landscape that the turbines and dwellings are located in.

Once the project team has taken all of the above into consideration it is able to understand what the final turbine/s to dwelling/s distance will be. In summary, there is no set formula that can be applied across all projects to determine a separation distance. With the intention at all times to separation distance can be known. Carolyn Wylie Senior Project Relationship Manager Meridian Energy Limited

Level 5, Creo House, 57-59

Courtenay Place, P O Box 10840, Wellington.

P. 04 381-1295 F. 04 381-1201 M. 021 24 555 00

W. [www.meridianenergy.co.nz](http://www.meridianenergy.co.nz) September 18, 2007 (Electronicmail response.)

- **Australia** - To avoid adverse noise impacts on the amenity of the surrounding community, wind farm developments should include sufficient buffers or setbacks to noise sensitive premises. As a guide, the distance between the nearest turbine and a noise sensitive building not associated with the wind farm is to be 1km. (Source-Guidelines for Wind Farm Development, Planning Bulletin, Western Australia)  
<http://windfarms.wordpress.com/2007/01/25/wind-turbine-setbacks/>
- Low-frequency infrasound can reach a dwelling predominantly through the ground as vibration. In Noise and Vibration From Wind Farms (Hawke's Bay, Australia-Today, February 18, 2006), engineer Dr. Ken Mosley states: "The foundations of modern turbines create vibrations in the ground when they are

moving, and also sometimes when they are not moving, Dr. Mosley says. This vibration is transmitted seismically through the ground in a similar manner to earthquake shocks and roughly at similar frequencies. Generally, the vibrations cannot be heard until they cause the structure of a house to vibrate in sympathy, and then only inside the house. The effects inside appear as noise and vibrations in certain parts of a room. Outside these areas, little is heard or felt.

- Bovina Township, Delaware County, New York. BOVINA TOWN BOARD VOTES TO BAN WIND TURBINES March 13th, 2007 - In an historic vote on March 13, 2007, after months of controversy and research, the Bovina Town Board banned wind turbines from this scenic Catskill town. Bovina is the first town in the Catskills to take a clear position against industrial wind development. The Bovina vote follows a twelve-month moratorium during which residents made their views known to town officials through open meetings sponsored by the board, hundreds of letters, a town survey, a petition, and a poll sponsored by industrial wind opponents. The vote was three in favor of a ban, one opposed. About sixty people attended the public hearing before the vote.  
<http://www.allianceforbovina.org/html/bovina-wind-news.html#BanWindinBovina>
- Andes Township Delaware County, New York: March 13th, 2007 - Planning Board's Wind Turbine Decision OK'd By Andes Town Board Industrial Towers Banned; April 10 Public Hearing Will Complete Process A decision made recently [on Feb. 28] by the planning board in the town of Andes concerning wind turbines has been approved by the Andes town board. At the town board's March 13 meeting, Supervisor Martin A. Donnelly commented that a resolution concerning the matter will be drafted by Town Attorney David Merzig. He also announced that a public hearing will be held on Tuesday, April 10, at noon, and that copies of the resolution will be available before that date. The planning board, after many months of study, decided that industrial wind turbines, which drew considerable opposition from town residents, would be banned. Smaller turbines would be allowed for private use, Donnelly indicated. The planning board's decision has been commended by those who have voiced opposition to the larger turbines. At the conclusion of the meeting, town resident Fred Cubero, who has often criticized board actions, told the board, "This is the best decision you have ever made, because it shows that you are looking out for the best interest of the people of this town." From an article in the March 14, 2007 edition of The Walton Reporter: <http://www.allianceforbovina.org/html/delaware-county-wind-news.html>

## Noise Effects Testimonials From Those Living Near Wind Turbines:

- CHILTON Presentation: Wed. August 1st . A variety of presentations given by people affected by wind turbines. WENDY TODD, DANIEL d'ENTREMONT, MIKE WASHECHECK.
- DANIEL d'ENTREMONT formerly lived within 1,000 feet a turbine in Canada. (Testimony offered in person in Chilton, Wed. August 1<sup>st</sup>.) Daniel has since moved from his house and has been unable to sell the house. "Wind farm noise drives family from home;" Man claims inaudible sound made family sick HALIFAX - Giant wind turbines spin next to Daniel d'Entremont's home in a tiny rural community in southwestern Nova Scotia. The large house in Lower West Pubnico is now empty and abandoned, Mr. d'Entremont says, because inaudible sound from the 17-turbine wind farm made his family sick. "The noise is unbearable," he says from Abrams River, the nearby community he recently relocated to with his wife and four of his six children. "It's like a surround sound - you can't avoid it, you can't ignore it. It just comes right into your head." Mr. d'Entremont blames the turbines for sending low-frequency sound into his old house, located about 400 metres from the nearest turbine. He says his family couldn't sleep, his children were constantly tired and suffering headaches, and nobody in the house could concentrate. He finally moved in February after receiving the same advice from a U.S. pediatrician who has studied the effects of wind turbines on children. The complaints from the d'Entremont family have prompted the federal Natural Resources Department to order new noise testing, which will measure the low-frequency



sound in Lower West Pubnico. (SEE NATURAL RESOURCES CANADA; letter) above: May 12, 2006  
Telegraph-Journal By James Keller Canadian Press

- JOHN YUNK, LINCOLN TOWNSHIP Board Supervisor: His personal testimony on July 10, 2007 via telephone. Reports turbines are LOUD and cause him and his family extreme difficulty in trying to sleep at night. John recommends turbines be cited a minimum of 1 mile from a residence. As a supervisor on Lincoln Town Board, John continues to entertain noise complaints from town residents. I spoke to John personally.
- ROB IDE, VERMONT, director of Energy Efficiency for the Department of Public Service, has said that the noise from the 11 550-KW Searsburg turbines is significant a mile away. Residents 1.5 and even 3 miles downwind in otherwise quiet rural areas suffer significant noise pollution.  
<http://www.aweo.org/ProblemWithWind.html>
- JANE DAVIS: Resides 930 meters from Deeping St Nicholas Wind farm just south of Spalding in South Lincolnshire. The wind farm was built last summer (2005) and became operational in early June (22006) – within 3 days we started having problems with the noise and hum emanating from the windfarm. Since last June we have had constant issues with loud noises and low frequency sounds that create a hum in the house all the time. We have kept a log throughout. Many times last summer as we are downwind of the prevailing wind we were woken by loud “WHOOSHING” noises, that stopped us sleeping for more than 4 hours a night. We informed our local environmental health department in June and they came out and were astonished at the loud noise recordings that they made. We now know that we suffer from a phenomenon known as aerodynamic or amplitude modulation. We also know that “in general, turbines are noisier now than in 1993”. (Hayes McKenzie Partnership – Acoustic Experts in a report for Angus Council, Forfar, Scotland. June 2004). This seems to support the fact that the government found it necessary to set a specific measurement for wind turbine noise, and that there is a Noise Working Group that operates between DTI & DEFRA. Aerodynamic modulation is not fully understood; Dr McKenzie from the Hayes McKenzie partnership in the closing statements in April 2007 for South Cambridgeshire District Council explained that: Aerodynamic modulation exists, but there is no clear understanding as to what causes it. It causes sleep disruption. It is not covered by ETSU. This site (Deeping St Nicholas) is a likely candidate. There is a need to assess and potentially apply a correction to ETSU. We do know and accept that not every wind farm creates noise issues but those that do make life impossible for those who live near them – and by near I mean less than 2km or 1.5 miles. As a result of our difficulties we have been forced to find an alternative place to sleep – our sleeping house – which is 5 miles away in Spalding itself. After spending many nights “sofa-surfing” we reached the conclusion in December that we had to do this in order to be able to work and live safely – with a normal amount of sleep.  
<http://www.wind-watch.org/documents/statement-from-jane-davis-of-deeping-st-nicholas/> April 2007
- DR. STEPHEN BRIGGS: an archaeologist who lives in the village of Llangwryfron in West Wales, initially welcomed the news that 20 turbines were to be built in the hills behind his home. He said: 'I'm as green as the next man and the developers assured us that the windmills would cause hardly any disturbance, but once they began operating I couldn't work in my garden any more - the noise was unbearable. It was as if someone was mixing cement in the sky'. Two neighbors became ill from a lack of sleep and after four years of frustrated appeal. The Briggs family left their home of 17 years. House prices near to wind farms have also plummeted. January 25 2004 54.inchyltwlt "Wind farms 'make people sick who live up to a mile away" By Catherine Milner. CATHARINE M. LAWTON: March 11 2004 letter to Mike Grainey , Oregon Department of Energy. And found at :  
[www.publications.parliament.uk/pa/cm200506/cmselect/cmwelaf/876/876we33.htm](http://www.publications.parliament.uk/pa/cm200506/cmselect/cmwelaf/876/876we33.htm)
- MR. GORDON YANCY: owner of Flatrock Inn, Loweville, NY. The Inn is surrounded by wind turbines. Gordon has a lot to say and will talk to anyone who is in jeopardy of having wind turbines in their future. Gordon stated “that sleeping with them is nearly impossible.” To quote him, “Take your vacuum cleaner, put it next to your bed, plug it in, turn it on, LEAVE IT ON, and try to go to sleep.” Gordon Yancey February 2006 letter to Catherine Bush.
- MARK TAPLIN, who has lived close to a wind farm near Truro in Cornwall for almost a decade, said: 'It has been a miserable, horrible experience. They are 440 meters away but if I step outside and they are not generating I know immediately because I can hear the silence. They grind you down - you can't

get away from them. They make you very, depressed - the chomp and swoosh of the blades creates a noise that beggars belief<sup>2</sup> (Emphasis added.) January 25 2004 54.inchyltwlt "Wind farms 'make people sick who live up to a mile away" By Catherine Milner. CATHARINE M. LAWTON: March 11 2004 letter to Mike Grainey, Oregon Department of Energy. And <http://heartland.org/Article.cfm?artId=14562>

WAYNE DANLEY, who lives close to a 400-foot wind turbine, & who describes his life had been turned upside down by a giant windmill located 900 feet from his house in rural Fenner, N.Y., where he has lived since 1976. "It sounds like a train going through, except the train never comes through:" he fears the days when the winds come from the northwest. "The whoop, whoop, whoop becomes a roar," he said. And in the spring before the trees sprout leaves, the turning turbine causes flashes of light in his living room that so annoyed his wife, the pastor of a local church, that she had to flee to the bedroom to get away from it. Danley said he has nothing against windmills on the neighboring wind farm. He only wishes someone would do something about relocating the one on his doorstep. "It's too close," he said. The Albuquerque Tribune: National Neighbors complain of wind farm nuisances: By Scripps Howard News Service April 28, 2006 URL:[www.abqtrib.com/albq/bu\\_national/article/0.2565.ALBQ\\_19839\\_4657761.0.html](http://www.abqtrib.com/albq/bu_national/article/0.2565.ALBQ_19839_4657761.0.html)

- WENDY TODD testified before Maine legislature April 30<sup>th</sup>, 2007. (Her testimony offered in person in Chilton, Wed. August 1<sup>st</sup>.) excerpts: Are there other issues with wind turbines? Yes. Most of which were discovered after the wind turbines were already in place. Noise is the largest problem, but shadow flicker and strobe effect are close behind for some of the residents. The rising and setting sun pierce through the blades of the turbines, creating a strobe-like effect in some of the resident's homes. For some it is blinding; even the best curtains and blinds can't remove the total effect. Some find that it makes them dizzy and disoriented. Others find that it can cause headaches and nausea. It is only for 20 to 40 minutes a day (when the sun is shining), depending on the season of the year, but it is still an intrusion into the homes and lives of the people who live near the site. The strobe effect can be similar to the sun cutting through the trees as you drive (sun-shadow- sun-shadow).
- SETH ROBSON: "Noisy turbine annoys neighbours": Windflow Technology shut down its Gebbies Pass wind turbine each night because of noise concerns. People 3km from the wind turbine could hear it whenever it was running they said,"It would be quieter than 30 decibels and we would only be able to hear it 3 per cent of the time. We are hearing it almost 100 per cent of the time when it is running," Ms Riley said. Two noises were emanating from the site, just more than 1km from her house. "Two hydraulic pumps run all the time. I can hear those at night," she said. "When they have the blades going it is terrible. It sounds like 'grind, grind, grind'. It obliterates the bird sounds and all the nature sounds that we have all come here for." Windflow director Geoff Henderson said the turbine was being shut down at night while the noise problem was sorted out. "We are not running at night because the neighbours have a concern about the noise levels, and we have acknowledged we need to do something about it." 11 August 2003 <http://stuff.co.nz/stuff/0,2106,2623336a11,00.html>
- DARRELL FOX: 6421 1550 E Street Tiskilwa, IL 61368: "Since the turbines have been up and running, it's horrifying." Darrell said the sound they hear ("it's always there," he said) is a jet-plane noise. It's worse at night. A low rumble. He said to imagine a day when there is low cloud cover and a jet is going through the clouds and you can't see it; you hear it. Again, always. When the wind is blowing from behind the blades, the jet noise is at its worst. They have several turbines to the west of their home, and with the wind out of the west it is terrible. Again, night the worst. When the wind is out of the east, so the wind hits their house before it strikes the turbines, it is the quietest. Darrell said, too, that the wind company, here, did the same thing that Noble & Zilkha have done: they took busloads of people to some windfarm, parked them right underneath, and the people said, "Well, these are totally silent!" The wind salesmen told folks the turbines "are about as loud as the gentle hum of a refrigerator." Darrell remarked on this: "This is an outrageous lie!" "You have to be about a quarter of a mile, or further, and then you actually hear them," said Darrell. Their highway supervisor, an honest man (said Darrell), went on his own to this same windfarm, tape-recorded and videotaped the turbines, and said "these things are a disaster." "They're noisy," etc. He was ignored. Like me, Darrell suspects that when the bus trips visit the showpiece windfarms, the company feathers the blades. He also described a pulsed sound, a "thumping" sound, but, again, mostly the loud roar. He also talked about the strobe effect. He described an incident recently where he went

down the road to feed some cattle by the creek, it was late in the day, the sun was setting behind the turbines, and he had his back to the turbines. The shadow flicker covers the entire farm. On this occasion he became seriously nauseous from the shadow flicker. He also described what he called a "siren" sound, from time to time. It's like an ambulance going by on the highway. This siren noise is also affected by the wind. Darrell added that the turbines interfere with TV reception. That they chop the reception and they can tell when the blades are actually cutting through the reception. The wind company has promised to install satellite dishes for all of these folks. Lastly, he talked about the strobe lights: red lights at night, white during the day. Very obnoxious. His parents can't sleep at night. They are forced to sleep with "white noise" in their room. They run a noisy fan in their room, trying to mask the turbine noise. He and his parents are all rather irritable these days. Darrell added, the wind companies were horrible. "They lie!" he repeated over and over in our conversation. Letter to Dr. Marther Luther September 25, 2005.

<http://www.allianceformedith.org/pdf/DairyFarmersReportNoiseProblemsNotesOnConversation.pdf>

- ROSE MARIE DERK, who lives a mile away from the turbines from the Waymart Wind Farm, Moosic Mountain in western Wayne County., Pennsylvania said the noise and aesthetic impact have been significant. She said the turbines sound like a large industrial fan and the disturbance is more noticeable at night when there is no traffic. "When you go to bed and your windows are open, you're hit with this buzz and roar," Derk said. "They're in the wrong place." Derk said numerous residents tried to stop the project at the township level to no avail. Now that the turbines are up, she said they look "outrageous and scary" and the benefits to the community have been minimal. "People thought they'd get their electric bill reduced, but ours went up and we're getting nothing," Derk said. "I can't understand what anybody thought they'd get out of this. This company came in, destroyed the top of the mountain and left us with it. 05/16/2005  
[http://www.zwire.com/site/news.cfm?newsid=14532565&BRD=2259&PAG=461&dept\\_id=455154&rft=6](http://www.zwire.com/site/news.cfm?newsid=14532565&BRD=2259&PAG=461&dept_id=455154&rft=6) and [www.allianceformedith.org/pdf/TomVeneskyWaymartFacilityTroublesResidents.pdf](http://www.allianceformedith.org/pdf/TomVeneskyWaymartFacilityTroublesResidents.pdf)
- MR. ARLON MONFILS, chairman of the Town of Lincoln in Kewaunee County, Wisconsin, publicly stated during the February 20, 2006, meeting of the Monroe County Sanitation/Planning & Zoning/Forestry Committee, that Lincoln residents have experienced "excessive noise from turbine blades" and "shadows [flicker] from blades." Mr. Monfils recommended that Monroe County residents "protect yourself the best you can."<sup>6</sup>
- PAULA STAHL, April 4, 2004 "THE NOISE WAS INCREDIBLE" It surprised me. It sounded like airplanes or helicopters. And it traveled. Sometimes you could not hear the sound standing right under one, but you heard it 3,000 yards down the hill, where the wind carried the sound. [This is cited from a letter written by Paula Stahl of St. George, West Virginia, about her experiences living in the neighborhood of the 66 MW Mountaineer Wind Energy Center. Formerly known as the Backbone Mountain Wind Farm, the 4,400-acre site has 44 turbines, 1.5 MW each, stretched along miles of ridgeline in Tucker and Preston counties. Ms. Stahl submitted the letter to the Berkshire Eagle and North Adams Transcript, neither of which has printed it.]
- LINDA COOPER: "I live in Tucker County [West Virginia], approximately 1.5 miles from the Backbone Mountain wind turbines, and have tried everything to get used to them. A brief visit to one of the viewing areas certainly gives no true impression of what it is like to be forced to live with them. We have now suffered for three long years under their hideous shadows. They have taken over the entire landscape and are in our sight no matter where we go, day or night, 24 hours a day, 365 days a year. The movement is impossible to ignore, no matter how hard we try, and the noise they make travels miles and miles, down the mountains and hollows, disturbing people who cannot even see them from their homes. I compare the noise to Chinese water torture, or fingernails on a chalkboard, or water dripping in a pan. Even on the calmest nights, the endless drumming goes on; windows closed, pillows over the head, it is still inescapable. While we were led to believe this would be a clean, quiet, pristine, and environmentally-friendly way to address energy problems and give a huge boost to our ailing economy, I feel we have been tricked. There appears to be no recourse or plan to compensate us for property value losses, erosion of our quality of life, or mental anguish. Besides these 44 wind turbines, thousands more are in the pipeline! God help!"-- from, "Activist Shares Wind Power Concerns -



Linda Cooper, Citizens for Responsible Wind Power," The Pendleton Times (Franklin, W. Va.), March 3, 2005, p. 4. <http://www.allianceformedith.org/pdf/LindaCooperWestVirginia.pdf>

- Pastor KATHLEEN DAN LEY, Naples Record, November 3, 2004: "AGAINST THE WIND" (Excerpts) My husband and I own a home in the township of Fenner, New York, and it is located in the middle of the Madison wind farm. I am not, and never have been, against wind power, but I want people to be well aware of the negative side of these giant windmills before allowing them to be built in your neighborhoods. Unfortunately, we were not given all of the facts, or we were given somewhat twisted information. We were told that the windmills had been redesigned so as not to be noisy, but the grinding noise goes on 24 hours a day (when they are operating) and at times is far worse than other times. From our bedroom window we can see no fewer than five towers and from the living room another two. On a stormy night the wind howls through our bedroom like a freight train -- yes, I know, the blades stop when the wind reaches a certain velocity, but nevertheless, they don't magically disappear. The wind continues to hit them, greatly increasing the sound that travels over them. In the middle of the summer we cannot enjoy our yard or have the windows open because these machines constantly grind and have a negative effect on one's nerves. When at the house I find that my nerves are constantly on edge.

We also have lost our television reception and were forced to purchase a satellite dish. Prior to the towers we always had very good reception of the local stations and generally had two to three more. Now it is impossible to get any of those stations. Incidentally, there is no cable in our area. The wind tower builders/management have more than once promised to look into this situation but have done nothing. They do not answer phone calls or follow up on appointments that they make with us.

Out of necessity to aviation there are lights on top of the towers, which now flash directly into our bedroom and living room windows all through the night necessitating the closing of the blinds and robbing us of the view of our own backyard and God's gift of nature -- one of the main reasons we moved to the country in the first place. Promises have been made and broken over and over again, and I find that also to be an extremely sad situation.

I pray that you can find a way to work through many of the issues without having such a huge impact on those living nearby. ( Letter Reprinted with permission)

[http://www.greenberkshires.org/wind\\_power\\_postings/aganst\\_the\\_wind.html](http://www.greenberkshires.org/wind_power_postings/aganst_the_wind.html)

- TOM SHEA, June 15 2006 Searsburg windmills aren't silent, intelligent. I have the unfortunate opportunity to see and hear these monstrous industrial generators defacing the previously pristine wilderness on a daily basis. These generators are not providing "clean" energy. They have destroyed a sizable part of the open terrain in Searsburg. They are a constant noisy reminder of the intrusion of big business on a small picturesque Vermont town. They are not "silent." They make constant noise with loud sporadic banging of the huge gears needed to turn the immense generators. In addition to being a sensitive black bear habitat, this area is also a migration route to ducks, geese and hundreds of other smaller migratory birds. All of this wildlife has been harmed by placing this electrical generating facility in the middle of the Green Mountain National Forest.

TOM SHEA Berkshire Eagle, June 15 2006 (reprinted with permission from the author) Searsburg, Vt., June 11, 2006. [http://www.greenberkshires.org/wind\\_power\\_postings/searsburg\\_windmills.html](http://www.greenberkshires.org/wind_power_postings/searsburg_windmills.html)

- DWAYNE & KEVIN BAILEY, PRINCE EDWARD ISLAND CANADA; (July 20, 2007) Dwayne developed headaches, popping and ringing ears, and could not sleep. He tried new glasses, prescription sleep aids and earplugs, to no avail. Dwayne's two year old was sleeping well prior to the wind farm, but began waking up, 5- 6 times a night. Kevin Bailey stated, "When you are outside working and absorbed in what you are doing, you are OK. If inside, resting or reading, it's a problem. Forget about sleeping at night. The repetitions would go away, you think that it is gone, and it comes back again." Kevin tried sound dampening by draping the front walls inside his house, and sleeping in the back, but this did not work. Kevin had problems with his electrical appliances. The fridge, water heater and power meter all vibrated. He purchased a new fridge, and it was just as bad. When the fridge was moved to the new house, the vibrations were gone. They complained to the province and the municipality, but no one would take them seriously. One official suggested it was too quiet there which is a funny kind of problem to have. There was not enough ambient background noise to block out the sound. Both families moved from the property.

- “JULIE and BART THIRY of Kewaunee County, who live in a ranch house 800 feet from the nearest of five turbines, believe that the windmills are somehow responsible for the persistent headaches of their 8- and 9-year old daughters.”<sup>7</sup>
- MARK HARRIS, a pastor from Bridgewater, Maine, spoke Friday August 3<sup>rd</sup>, 2007 at the Ground Search and Rescue in Pugwash about how a wind farm in Mars Hill, Maine has terrorized locals. He bought property in Mars Hill roughly 1200 feet away from the turbines, but hasn’t done anything with it because of how unbearable the sound and strobing from them is. “Many of the mills we have, on certain days when the wind comes from a certain direction and the humidity is such and such, it will be all but silent at 1200 feet away where my home site would be. But come back the next day and it’ll pound until you can’t tolerate being there and there’s no predicting when that will happen,” he said. He said the wind farm has wreaked havoc on the town, with many people now dealing with health complications allegedly caused by the turbines’ sounds and shadows. “Everyday (residents) deal with the sound. The intolerable levels aren’t every day, sometimes one or two days a week, sometimes it’ll skip a week but the next week it’ll be there for four or five days in a row, and there’s no knowing until it happens,” he said. “It’s pretty frustrating.” Harris thinks wind turbines being 500 metres away from property, which is currently the law in Cumberland County, isn’t enough. He said turbines would be safe if placed at least two kilometres away from residences. “I’m in favor of wind turbines, but they should be appropriately sited,” he said. “This needs to be done in the most responsible way so we keep it in good standing with the public. I think we need it. “The placing of them seems to be irresponsible far too often.” By Justin Dickie The Amherst Daily News 6 August 2007
- PAMELA FORINGER: “Our Fenner Wind Farm Story” Fenner, NY. Autumn 2004 As I sit in my kitchen and type this on my computer, I hear the constant hum of the blades. It’s early November, a brisk day and of course the windows are closed, so that muffles the sound a little. In the summer, with the windows open, there is nothing to block out the humming or the grinding sound that the turbine makes when it is being turned. Because the wind constantly changes direction the blades have to be turned to catch the wind. Imagine turning a 24-ton object perched on top of a 200 ft tower. That takes a bit of force and at times the sounds emitted are rather eerie. Depending on the weather, it can sound like a grinding noise or at times the shrieking sound of a wild animal. In the winter the noise always seems much louder, perhaps because of the starkness of the season and lack of foliage to muffle the noise. Anyway, when people tell you that the wind towers are virtually noiseless, they haven’t lived a couple of football fields away from one 24/7. Regardless of whether you see them or not, you still hear them—even when they are not operating. When the brakes stop the rotors (because it’s too windy), you hear a clunking and grinding that sounds like freight train cars colliding. And when it’s time to start them again, you can at times liken it to the roar of a jet engine. We have some absolutely gorgeous sunrises and sunsets in Fenner. As the sun slowly rises to the east of our house it usually bathes our bedroom wall with its rays. Unfortunately, we now get a strobe effect that can drive you absolutely crazy. It’s commonly called the “flicker factor.” As the sun shines through the rotors it creates a shadow pattern that you would liken to a strobe light. Because of the close proximity of 4 of the towers to our house, we get this light show at various times of the day, as the sun travels from east to west. Most of the time I have to close our shades to prevent this from giving me a migraine. And speaking of light shows, we get the nighttime show as well. Each tower has red blinking lights on top of the turbine, so unless the shades are closed in the bedroom at night there is a constant red light blinking in perfect view as we lie in bed. In the past we would see thousands of Canada geese as they made their way to the local swampland for a well-needed rest during their long journey each fall. The snow geese, whose migration pattern brought them directly over us, have since found a more convenient route—at least I haven’t seen them recently. Proponents of the wind farm would say it’s not so, but after 20+ years I think we can vouch for the fact. Our surrounding cornfields used to be full of geese this time of year. Not anymore. It didn’t happen overnight but, slowly, the numbers have dwindled. (reprinted with permission)  
<http://www.allianceformedith.org/pdf/PamelaForingerOurFennerWindFarmStory.pdf>
- RUSSELL BOUNDS: Railey Realty, 2 Vacation Way, McHenry, Maryland 21541 TESTIMONY Before the Maryland Public service commission on windplants affecting property values 2005. Have you heard from people in the vicinity of the wind turbines as to what problems they have as a result of the wind turbines? Yes. What is their primary complaint? The primary complaint is noise. Second is the visual

impact of the turbines. Going into the house and closing the door eliminates the view. It does not eliminate the sound. The constant drone cannot be escaped. The quiet of mountain living is gone. Their greatest concern is the substantial loss of value of their property. They do not believe they can sell without substantial loss and cannot afford to sustain the loss and move. When you say the primary complaint is noise, is this noise that has any substantial impact on their use of the property? Yes. It takes away the enjoyment of their property. It doesn't allow them to sleep at night. The attraction of a weekend or summer home in the mountains is the quiet. Buyers want some place to get away from the noise and sounds of industry and the city. What impact does that type of change in the characteristics of the property have on its value? It destroys it. It takes a property of substantial value and takes away all of the characteristics that are the strengths of that property. The visual impact takes away value. The noise takes away value. The property owners complain that the wind turbines take away value and there is no way for them to escape. [http://www.allianceformeredith.org/pdf/\(19\)RussellBoundsTestimony.pdf](http://www.allianceformeredith.org/pdf/(19)RussellBoundsTestimony.pdf)

■ Dear Scott,

Thanks for your email. The changes are made and yes, you may use our photos in any way which will help. If you need anything else please ask.

Daniel

November 28,2007

To The People of Union Township, the Union Township Board Members,

Life for the d'Entremont family since the Pubnico Point windfarm began operating has been filled with sorrow, illness, heartache and disbelief. How could a company be permitted to enter our community and turn our pristine area into a noise ravaged battleground. Why did it happen to us? Not that we would wish it on anyone else. First off, the community knew there was a windfarm being planned because two of the windfarm owners live in the community. They put up an anemometer tower and formed a company named Landco and proceeded to acquire the land necessary to construct their windfarm. Now they are leasing the land to their other company which owns the windfarm. Through word of mouth and some public meetings which nearly nobody attended people understood that the windfarm would be inaudible by the neighbors and would have no negative impact on the community. The residents of Pubnico could not visualize a 400ft wind turbine on Pubnico point or had any idea of the impact they would have nor did anyone research anything about it, including me. Since two of the owners were local residents and were related to most of the community everyone wished them well. The company kept everyone in the dark about the negative effects and the few who asked any questions were lied to. The first 2 turbines were operating in may 2004. One was 4000ft from our home, the second 4700ft. A 120 day trial period was required to monitor their productivity. We could hear them well and Carolyn, my wife was experiencing ringing in her ears. Visitors would comment that the one 4000ft away seemed really close. Some neighbors were complaining they were bothered by them at night. Three months later construction began again. People were complaining about the speeding gravel trucks and feared accidents. An older woman was rear ended by a truck. She wasn't hurt ;but the company quickly gave her a car to drive until they returned her car repaired. Nothing more said. The heavy trucks damaged the roads. It was easy to tolerate the noise and construction dust because we knew it was only temporary. February 2005 the windfarm was fully operational, 17 wind turbines. The windmill 4000ft away seemed far off compared to the one 1000ft from our home. They are loud. They've been compared to jet engines a plane that will not take off. There is no gentle swoosh, it is a whoosh noise. They grind, they bang, they creak. The noise is like surround sound, it's omnidirectional. It feels like there's this evil thing hovering above you and it follows you everywhere, it will not leave you alone. This noise will not allow you to have your own thoughts, the body cannot adapt, it's a violation of your body. It is a noise that the human body cannot adapt to even after more than a year of exposure. As time progresses the noise becomes even more unbearable. Our 5 year old son Elias was afraid and unable to sleep in his own bed for more than one year. He would get in our bed or in his brother's bed. We would put him to bed at 8:30 and many nights at 11:00 he would still be awake. Finally he would fall asleep wrapped up in the blankets in the fetal position with his head covered and with a fan at his head. We had to create more noise to mitigate the windfarm noise. The body can adapt to the fan noise. In the morning he would get up tired and cranky .In September 2005 he started school and he was not

getting enough rest. He began getting more and more aggressive with his friends. He was very defiant. We knew he was suffering terribly. He's had throat infections and often had a fever and not feeling well.

In January 2006 we had our house tested by a naturopathic doctor and she and her colleagues found the house so toxic that they advised us to move. These people were on our property for only 1.5 hours and they became so weak that they had to leave. The doctor said she couldn't think, she couldn't concentrate anymore. In February 2006 we brought Elias and Samuel(9) to another naturopathic doctor and she also recommended that we leave our home. Our family doctor says he cannot prove that a wind farm causes medical problems but he would not want to live or raise children where we are. We have contacted a scientist from Portugal who has studied the effects of infrasound on the human body and she also told us to leave for our sake. We abandoned our home February 21st, 2006. Since the move Elias has been doing much better. He sleeps in his own bed every night. He sleeps partially covered with his arms and legs spread everywhere. It was only ten days after the move while he was having his back rubbed in bed he said, "it's nice to be able to go to bed and sleep". He is much less defiant. He has become the kind gentle little boy he was before the windfarm nearly destroyed his life. Knowing what we know now we should have moved a year before. Our 9 year old son Samuel was sharing a room with Elias. He was also very sleep deprived. He would get up in the morning very tired. We would send him to school tired. He was tired and unable to concentrate and his school work suffered. He was also unable to concentrate on his homework. He began to withdraw within himself. He also began getting aggressive. Samuel seemed to be always angry. His teacher asked us what was the problem with Samuel because his change in behavior was something she would never have expected from him. Samuel's ear drum burst while we were there in 2005. He's had many throat infections and many headaches. He has developed allergies. He's the only one of 6 children that has allergies. Since the move Samuel has improved so much in his school work and his behavior and participation in class that the teacher says she cannot believe that he's the same child. He has not been aggressive with his friends. He's so kind and caring for everyone. His headaches are less frequent and less severe. Our 13 year old daughter Emanuelle had dramatic behavioral changes. She became withdrawn and was spending too much time alone in her room. She dropped her friends and lost interest in school work. She was also angry. She dropped all sports(basketball, volleyball, soccer, badminton). Emanuelle always had headaches. She became very defiant. Since the move Emanuelle is doing better in school. Her behavior is steadily improving. Her health is improving and she is socializing. She is feeling better about herself. Our 15 year old daughter Deminica was having a lot of difficulty sleeping. She was being awakened at all hours of the night. She was asking for sleeping aids. She had numerous headaches and some throat infections. She was very moody. She slept sound at friends homes. She had frequent severe abdominal pain. Since the move Deminica is sleeping well. She has not had any abdominal pain. Her headaches are rare. Her mood has improved. Our 19 year old son Nathaniel was sleeping in the basement. He was anxious and angry and was not sleeping well. His hands were peeling often. Nathaniel also developed vision problems. He loses sight completely in one eye or the other for a few minutes at a time. Many mornings Nathaniel had to grab his legs and put them off the bed and lift himself up with his arms. After some time he gets mobile. He has seen a number of eye specialists and undergone many tests and the doctors could find nothing wrong with him. There was a stair master machine at his high school which would measure how many stories a person could climb. Whatever the record was the teacher felt it would be difficult to break. Nathaniel more than doubled the record and he could carry his 540lbs friend on his back. One year near that windfarm he was nearly blind and crippled. Since the move Nathaniel is not as anxious or angry. He is relaxed and easy going. His hands are not peeling anymore. It took one year away from the windfarm to regain his vigor his eyes are almost entirely healed. Our 21 year old son Nehemiah was extremely angry and anxious. Nothing was ever satisfactory. He was yelling and screaming. He had headaches. Since the move Nehemiah is much calmer, not anxious and his anger almost gone. He is smiling and laughing a lot and is content. My wife Carolyn was anxious and she had numerous headaches. She was getting up frequently throughout the night to urinate and she was having pain with that. She could not get the sleep required to be rested. She was feeling her heart racing. She had shoulder joint pain which required cortisone injections. Her hearing was affected on the right side. Her glands on her neck were always swollen and painful. She was feeling a vibration in her lower legs on occasion when she was outside. Carolyn's vision is blurred and the doctors cannot find any problem with them(seems like there is a film on the eye balls). She also has high blood pressure. Carolyn spent more time in our house than any other member of the family. Since the move Carolyn is not anxious and her headaches are fewer. She hasn't felt the

vibration in her legs. Her eyes and shoulder have not fully recovered yet. She is sleeping much better. Carolyn is trying to find help to restore her vision. As for myself I always felt a sensation in my chest which was very discomforting. On extremely rare occasions when the windfarm was off I could sense they were off without seeing them. The noise was just a relentless attack on our bodies. Every time the blades passed the towers I could feel it within my body. I was unable to concentrate well enough to read in my bed. Since the move I don't have that sensation in my chest but it returns when I spend a few hours at our house. These physical and psychological effects develop gradually and sometimes it seems silly to associate them with a windfarm until you learn that others experience the same thing under similar conditions. If we would have had absolutely nowhere to go, if we would have been forced to stay in our home, I hate to think what kind of physical and mental state we would be in now. During the months that the sun is low in the sky we get a flickering in the morning and late afternoon as the sun passes behind the turbines. This induces headaches quickly to those who are more susceptible to them. When the full moon rises and passes behind the turbines the flickering is intense. We are devastated, we are broken because we have lost the home we built with our own hands and we have lost the land which has been in the family for generations. Our house is now unsellable. There is nobody in the community that wants to live there because of the windfarm. Nearly everybody supports us privately but they are afraid to speak out publicly. We are a community of 2000 people and I did a survey of 216 people and 96% said the windfarm was too close to our house. Also 89% said the windfarm was too loud at our house and 78% said that they felt they were not properly notified of the impact this windfarm would have on the community. Many people will randomly tell me that they sense that the community would not have allowed the construction of this windfarm if they had known or realized the impact it has had. Our local politicians were all in on the great deception. Our provincial legislator said they had made a mistake but we would have to pay for it and put up with it. He also told me to shut up about it. Other neighbors are experiencing more and more difficulty in coping with the windfarm. Instead of adapting to the windfarm it is getting more intrusive. The neighbors are having more difficulty sleeping and the problems associated with that. One neighbor had to sleep with ear plugs in the summer. Our neighbors are like us they love the area and the land they are on and they don't want to move. Our children were suffering so much the decision to abandon our home was made for us by the wind company. There has been some noise studies done at our home. They clearly prove excessive noise even with the outdated guidelines they are using but the windfarm is still permitted to operate full time. The turbines this company used are Vestas, V-80, 1.8 Megawatt. The Vestas workers who had experience in a number of areas erecting wind turbines told some community members if anyone complains give them one year and they'll shut up. In this case they were wrong. It's still difficult to believe or accept what has happened to us. It didn't have to be that way. With proper planning and setbacks these problems don't need to arise again for anyone.

Daniel d'Entremont

## Precedence For Larger Setbacks From Property Lines:

- ECOENERGY LLC, a division of The Morse Group, and its partner company Acciona will agree to follow the county's new setback guidelines for wind farms in Stephenson County, ILL. Zoning changes altering the classification of wind-farm projects were approved by the County Board on July 11. One of the provisions of the new zoning ordinance is that wind turbines have to be about 1,000 feet from the property of non-participating landowners, an increase from 500 feet. Shawn Gaffney, president of EcoEnergy, said his company's voluntary compliance is part of an effort to improve communication and relations with landowners and the public. In meeting the new setback requirements, EcoEnergy will likely have to relocate and in some cases eliminate wind turbine sites in the proposed farm. The company is continuing to work with adjacent landowners during this process, and hopes to start construction in 2008. "I think we feel it would be in keeping with the spirit of being a good neighbor," Gaffney said of the voluntary compliance. "We'd like to show the community this is a real project with

real benefits." September 29, 2007 by Travis Morse in The Journal-Standard Web link:  
<http://www.journalstandard.com/articles/2007/09/30...>

- TREMPEALEAU COUNTY WISCONSIN: Each Wind Turbine shall be set back from the nearest property line a distance no less than one-half (½) mile, unless mitigation has taken place and agreed by owner/operator and affected property owners involved, and recorded in the Trempealeau County Register of Deeds office which describes the benefited and burdened properties and which advises all subsequent owners of the burdened property. Passed 12-17-07
- TOWN OF STOCKBRIDGE CALUMET COUNTY WISCONSIN: WIND ENGERGY SYSTEMS LICENSING ORDINANCE: The Town Board of the Town of Stockbridge, Calumet County, Wisconsin, does ordain as follows: at least 1,000 feet from the property line of a non-participating property, unless the owner of the non-participating property grants an easement for a lesser setback. The easement must be recorded with the County Register of Deeds and may not provide for a setback that is less than 1.1 times the total height of the Wind Turbine; September 12<sup>th</sup>, 2007.
- TOWNSHIP OF CASCO: Ordinance 03-06 states: Each wind Turbine shall be setback a minimum of two times the total height from a non participating property line or 800 feet, (Note: a minimum of 1.1 times the total height or 500 feet is proposed in the ECOENERGY UNION PROJECT. The Town of Casco ordinance was provided to the committee by planning commission member Kim Gruebling. The committees submitted a records request to the Town of Casco for supporting documents for the setback and did not receive a response).
- CHERRY VALLEY, NEW YORK: Twelve hundred (1,200) feet from the nearest Site boundary property line. December 23, 2006 <http://www.wind-watch.org/documents/cherry-valley-wind-ordinance/>
- MANITOWOC COUNTY WISCONSIN: Wind turbines are required to be at least 1,000 feet from a non participating property owner. Chapter 24 of the County ordinance:
- TOWN OF WILTON, MONROE COUNTY WISCONSIN, passed resolution # which requires all Large Wind Energy Systems to be a minimum of 1/3 of a mile (1760 feet) from any property line. See attached resolution.
- MANITOWOC COUNTY WISCONSIN – County supervisors approved at their Tuesday meeting (September 18), two amendments to the county's large wind energy system ordinance. Supervisors also voted unanimously to adopt an amendment requiring all large wind energy systems to be setback one mile from any emergency communications tower. The county Planning and Park Commission recommended the amendments after it held a public hearing on both amendments on Aug. 27. Herald Times Reporter 9 September 2007 <http://www.wind-watch.org/news/2007/09/19/county-alters-wind-ordinance/>
- WHITE RIVER TOWNSHIP MUSKEGON COUNTY, MICHIGAN: No part of a WECS or WECS Testing Facility (including guy wire anchors) shall be located within or above any required front, side or rear yard setback. The setback for placement of a WECS or a WECS Testing Facility shall be at least 1600 feet from each property line of the property where the structure is located and at least 1600 from any public road right-of-way. Furthermore, no WECS or WECS Testing Facility shall be located within 1600 feet of the high water mark of Lake Michigan or White Lake. Posted 11-12-07 <http://www.wind-watch.org/documents/wp-content/uploads/whiteriver-ordinance.doc>
- TOWN OF BARTON, WASHINGTON COUNTY WISCONSIN: Residential Lot Setback - 20 rotor diameters or 1,320 feet from all property lines of lots in a residential zone, whichever is greater. State of Oregon - Model Wind Energy Conversion System Ordinance, Draft of 12/31/96, pp. 16 - 17. ( Catherine M. Lawton, Town of Barton, Washington County, Wisconsin: Commercial Wind Energy Facility, & Wind Access Model Ordinance)
- Manitoba Canada: The people in Manitoba fought back and instead of a 500 meter setback they now have a more realistic 2000 meter (2167 feet) from their property lines. Wind Turbine Setbacks-UPDATE Sept.11 2007- Posted on January 25th, 2007 <http://windfarms.wordpress.com/2007/01/25/wind-turbine-setbacks/>



- Centerville MI Township: Setback recommendation from property line: 1,000 feet. July 10, 2006 Windmill Ordinance Committee Minutes.
- Jefferson Township, Logan County, Ohio: Each proposed wind turbine generator shall be setback from any and all adjoining lot lines a minimum distance of 950 feet. The Zoning Board may reduce this setback to no less than 800 feet from any and all adjoining lot lines; provided, however, the amount of setback relief approved by the Zoning Board will be based on data provided by the applicant establishing that the lesser setback from an Adjoining Lot Line shall not adversely affect the health, safety or welfare of any person or animal. <http://www.wind-watch.org/documents/amendment-of-jefferson-township-ohio-zoning-resolution/>

## County & Township Examples For Larger Setbacks:

- TREMPEALEAU COUNTY WISCONSIN setbacks from Inhabited structures: Each Wind Turbine shall be set back from the nearest structure used as a residence, school, hospital, church, place of employment or public library, a distance no less than one (1) mile, unless mitigation has taken place and agreed by owner/operator and affected property owners involved and recorded in the Trempealeau County Register of Deeds office which describes the benefited and burdened properties and which advises all subsequent owners of the burdened property. Passed 12-17-07
- RIVERSIDE COUNTY, CALIFORNIA: "LU 15.9 Restrict the placement of wind turbines within 2 miles of residential development unless the applicant supplies documentation that the machine(s) will not produce low frequency impulsive noise." County of Riverside General Plan - Land Use Element, Page LU-34 Available at: <http://www.windcows.com/files/RiversideCalif.pdf>
- TOWNSHIPS OF CLAY BANKS, DOOR COUNTY WISCONSIN: November 2007, The Setback requirements from inhabited residences is proposed as follows: A wind turbine would have to be sited 2,640 feet away from the nearest inhabited structure within Clay Banks.  
<http://www.greenbaypressgazette.com/apps/pbcs.dll/article?AID=/20071124/ADV01/71123106/2011/adv>
- TOWN OF WILTON, MONROE COUNTY WISCONSIN, passed resolution # which requires all Large Wind Energy Systems to be a minimum of 1 mile from any residence and 1/3 of a mile from any property line. See attached resolution.
- TOWN OF BARTON, WASHINGTON COUNTY WISCONSIN, Catherine M. Lawton,: 4 times total WECS height or 500 feet, whichever is greater, (1600 feet for proposed turbines) from exterior boundaries if project site is adjacent to parcels of less than 40 acres; and 1.5 times total WECS height from all exterior boundaries if project is adjacent to parcels of 40 acres or more (with an allowance for setback reduction). Kern County, California. From NWCC's Permitting of Wind Energy Facilities: A Handbook, Appendix B. ( Catherine M. Lawton, Town of Barton, Washington County, Wisconsin: Commercial Wind Energy Facility, & Wind Access Model Ordinance)
- MANITOWOC COUNTY WISCONSIN — County supervisors approved at their September 18, 2007 meeting, two amendments to the county's large wind energy system ordinance. Supervisors voted 20-1 to approve an amendment requiring that information be posted on each large wind energy system so that the owner can be contacted in the event of a noise complaint. The placard must provide a telephone number for law enforcement or officials to call to investigate a noise complaint, sound level measurement, or administration of this ordinance, the amendment said. Supervisors also voted unanimously to adopt an amendment requiring all large wind energy systems to be setback one mile from any emergency communications tower. The county Planning and Park Commission recommended the amendments after it held a public hearing on both amendments on Aug. 27. Herald Times Reporter 9 September 2007  
<http://www.wind-watch.org/news/2007/09/19/county-alters-wind-ordinance/>

- MEREDITH COUNTY, NEW YORK: For the 400-foot turbines with 250-foot diameter blades rotating every three seconds, the setback should be 2,800 feet from all dwellings, roads, property boundaries, and public places. Meredith Comprehensive Plan, 2006, final draft, p. 7 Presented February 6, 2006, To the Town of Meredith Planning Board by Kenneth Jaffe, MD
- TOWN OF BETHANY, NEW YORK: Wind Turbine Study Committee Report, Ramon J. Cipriano, editor, January 8, 2007: Strongly recommend a minimum of 1 mile setback from all residences.
- CHERRY VALLEY, NEW YORK: Two thousand (2,000) feet from the nearest off-site residence, school or church, measured from the exterior of such residence, whether or not said residence is located in the Town of Cherry Valley. Ordinance Revised 11-09-06 Approved December 23, 2006  
<http://www.wind-watch.org/documents/cherry-valley-wind-ordinance/>
- Centerville MI Township Windmill Ordinance Committee, July 10, 2006: Setback recommendation from residence should be ten times the rotor diameter (2665 feet for eco-energy proposed project). This distance is stated in Wind Energy Handbook, Burton, Sharpe, Jenkins, Bossanyi, Wiley & Sons Ltd, New York, 2001 pg. 527;
- Otsego County, State of Michigan: 18.5.3.1 Article 18 of the Otsego County Zoning Ordinance is hereby amended to add a new Section 18.5, which shall read in its entirety as follows: Each wind turbine generator shall be set back from any adjoining lot line a distance equal to 2,600 feet. The Planning Commission may reduce this setback to no less than 2,100 feet. The amount of setback relief approved by the Planning Commission will be based on data provided by the applicant and prepared and certified by a registered Professional Engineer licensed in the State of Michigan, who is practicing in his or her area of competency. Such data shall be subject to review by the County's independent, recognized expert: Available at: <http://www.wind-watch.org/documents/wp-content/uploads/otsegocountywtgord.doc>
- Town of Malone, New York: Wind plant Ordinance: Section 1: Chapter 80. No large Wind turbines are permitted. Only Small wind turbines are permitted. <http://www.wind-watch.org/documents/wp-content/uploads/malonewindordinance.pdf>

## Peer-Reviewed G. P. van den berg "The Sound of High Winds", Summary

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### SUMMARY

This study was started after complaints of residents that the sound of a wind farm was louder and more annoying than predicted, especially when there was little wind in the evening or at night. The explanation appeared to be the occurrence of another wind profile than that used to predict the noise impact (the wind profile describes how the wind velocity increases with height). There are probably several reasons why this was not found earlier: 1) because wind turbines become taller, there is a growing discrepancy between prediction and practice; 2) measurements are usually done in daytime when the wind profile resembles more closely the commonly used standard profile; 3) based on the sound that occurs in daytime, it is hard to imagine the sound can be so different at night; 4) "there are always people complaining", so complaints are not always a reason for a thorough investigation; 5) at least some wind energy proponents prefer to downplay the disadvantages rather than solve them. According to Dutch legislation and international guidelines the sound production of a wind farm can only be checked by measurements when the wind farm operator cooperates. The consequence is an implicit partiality in favor of the operator detrimental to independent verification. Because of



the level of detail of instructions measurements and assessments are hampered and there is no margin for the very expertise of an investigator. For a lay person understanding the jargon was already utterly impossible and he cannot but hire an expensive expert to argue his case. From this study one can conclude that through the use of a restricted model of reality, viz. a forever neutral atmosphere, experts have lost sight (temporarily) of the true reality in which a neutral atmosphere is not very prevalent. It is precisely the occurrence of complaints that may indicate such errors.

The sound of modern wind turbines is generated mainly by the flow of the wind along the blades. In this process a turbulent boundary layer develops at the rear side of the blade where trailing edge sound of relatively high Ch. III Ch. II Ch. I

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frequencies originates and which is radiated into the environment. This turbulent boundary layer becomes thicker and produces more sound when the wind flows in at a greater angle.

The inflowing wind is turbulent itself. The blade cuts through these turbulent movements and as a result again sound is generated: in-flow turbulence sound. Here lower frequencies dominate. Finally a blade also radiates sound when the forces on the blade change because of a local variation in wind velocity. This happens every time the blade passes the tower because there the wind is slowed down by the tower. On the one hand this causes more trailing edge sound due to the change in inflow angle, on the other hand more infrasound is generated because of the sudden sideways movement at the rate of the blade passing frequency. For all these sounds loudness increases when the speed increases. Because the tip has the highest speed the sound of a wind turbine mainly comes from the blade tips. Moreover, for human hearing the trailing edge sound is most important because it is in an area of frequencies that we can hear well.

It is often assumed that there is a fixed relation between the wind velocity at hub height and at a reference height of 10 meter. This is the relation valid in a neutral or 'standard' atmosphere. No other relations are given in legislation or international guidelines for wind turbine sound that are valid in other conditions of the atmosphere, viz. the stable and unstable conditions.

The atmosphere is unstable when in daytime the air near the ground is relatively warm from contact with the surface heated by solar insolation. In that case vertical air movements originate and the wind profile is not equal to the profile in a neutral atmosphere, though it does not differ strongly. A stable atmosphere however has a markedly different wind profile. The atmosphere is stable when the air close to the ground is relatively cold due to contact with the ground surface when this cools down at night by radiating heat. A stable atmosphere occurs especially in nights with a partial or no cloud cover and the wind is not too strong (close to the ground). In a stable atmosphere the turbulence has decreased substantially

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and as a result layers of air are less strongly coupled. The lower layer of air is thus less taken along with the wind that at higher altitudes keeps on blowing, giving rise to greater differences between wind velocities at different heights.

The present study was performed mainly near the Rhede wind farm close to the Dutch - German border. The farm consists of 17 1.8 MW turbines of 98 m hub height and three 35 m blades. The level of the incoming sound has been measured at a number of locations. The sound could be measured up to a distance of 2 km. It proved that, contrary to predictions, already at a weak wind (at 10 m height) the turbines could rotate at almost top speed and consequentially produce much sound.

It appeared that a wind profile proper to stable conditions could explain the measured sound levels excellently. At the same wind velocity at a reference height of 10 meter, wind turbines in a stable atmosphere generate more sound than in a neutral atmosphere, while at the same time the wind velocity near the ground is so low that the natural ambient sound due to rustling vegetation is weaker. As a result the contrast between wind turbine sound and natural ambient sound is more pronounced in stable conditions than it is in neutral conditions.

When the wind profile after sunset changes while the atmosphere becomes more stable, the difference in wind velocity over the rotor increases. This causes a change in the level of the trailing edge sound. At the low tip this is reinforced because the inflow angle already was less favourable due to the wind being slowed down by the presence of the mast. The differences in wind speed lead to variations in the sound radiated by the blade tips that reach their highest values when a tip passes the mast. For a modern, tall wind turbine the calculated variation is approximately 5 dB at night, whereas it is approximately 2 dB in daytime. This is perceived as a more pronounced fluctuation of the sound.

A more stable atmospheric boundary layer moreover implies that there is less atmospheric turbulence, so wind turbines in a farm will experience a more equal and constant wind. As a result, in a stable atmosphere wind turbines can, more than in daytime, run almost at the same speed and then

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diverge again. With several turbines the fluctuations in sound can reinforce one another when they reach the ear of an observer simultaneously. With two turbines (at the same distance) this leads to an increase in level of 3 dB, with three turbines to an increase of 5 dB.

In measurements this reasoned upon effect indeed occurred. With a single 45 m high wind turbine at a distance of 280 m at night variations of 6 dB were found. Near the wind farm the variations were usually 5 dB, but they could rise to approximately 9 dB, as expected when the fluctuations of several turbines coincide.

From other research and from descriptions of residents one can establish that the sound of a wind turbine or wind farm becomes more annoying because of 'swishing', 'sloshing', 'clapping', 'beating' or 'thumping'. All descriptions mention a periodic variation on top of a constant noisy sound. This corresponds to the calculated and measured modulation of trailing edge sound. From psycho-acoustic research it has been shown earlier that human sensitivity to sound fluctuations is high at frequencies that occur in the night time sound of modern wind turbines. If this fluctuating sound is sufficiently loud in a bedroom it can cause sleep disturbance.

In the temperate climate zone a stable atmosphere is to be expected between sunset and sunrise over land if there is a -partly- clear sky (because clouds hinder the radiation of heat) and the wind is not too strong (because a strong wind promotes vertical heat exchange). From an analysis of measurements of the KNMI at Cabauw, in the central part of the Netherlands, up to an altitude of 200 m, it appears that there is a diurnal and seasonal pattern in the wind profile that correlates with the diurnal and seasonal variation in the heat exchange between the earth's surface and the atmosphere. The fact that at sunset the wind often lies down is a consequence of the increasing atmospheric stability, and this decrease in wind velocity close to the ground is accompanied by an increase at higher altitudes. This has significant consequences for the energy production of a wind turbines, where the rotor height plays an important part. If one starts from the measured wind velocities at Cabauw at 10 m height and a forever neutral atmosphere, the annually averaged electrical power generated by a 80 m high, 2 MW (reference) wind turbine would amount to almost

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500 kW. However, based on the real, measured wind speed at 80 m height the annual power in reality amounts to 600 kW. So, because of atmospheric stability there is, relative to a neutral atmosphere, a significantly higher yield at night time hours, that even amply compensates for the lower yield in daytime hours.

The higher wind velocity at night on the rotor also causes a higher level of generated sound. If again one starts from the measured wind velocities at Cabauw at 10 m height and an atmosphere assumed to be neutral, the average sound power level generated by the reference wind turbine is 102 dB(A). In reality, however, it is 2 dB higher. This is also an average over an entire year; in separate nights the difference can be substantially higher, e.g. when a turbine rotates at (almost) top speed at a time it was expected to not produce at all because of the low 10 m wind velocity.

The degree of atmospheric stability at Cabauw is hardly different from what was observed at the Rhede wind farm. At other locations in countries in the temperate zone stability occurs to a similar extent. The consequences of atmospheric stability as described here, will thus occur at many wind farms that exist or are to be built in the temperate zone. However, above large bodies of water stability is rather a seasonal than a diurnal phenomenon, and in mountainous terrain the consequences of stability on the wind profile can be strengthened as well as weakened due to changes induced by height variations in the area.

The sound of a wind turbine or wind farm can thus become more annoying after sunset for two reasons: it becomes louder and the sound exhibits stronger fluctuations. At a given rotor diameter a blade can only be made less noisy with a different design or by slowing down the speed. A decrease in speed however reduces the generated electrical power and must therefore be applied only when necessary. To achieve this a control can be applied that lowers the speed when a noise limit is exceeded, increasing the speed again when the limit allows. This control could work on the generator and/or the pitch angle of the blades.

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By changing the pitch angle while the blades rotate, the wind can flow in at an optimal angle at any position on the rotor, by which the energetic efficiency will increase on the one hand and the fluctuation strength of the sound will decrease on the other hand, even rendering the fluctuations inaudible. The total sound power will then decrease even relative to a neutral atmosphere, because the in-flow turbulence sound level will be lower due to the relative absence of atmospheric turbulence. Tilting the rotor to change the pitch angle during rotation does not appear to be a fruitful strategy: the tilt must be so great that the disadvantages will dominate.

The fluctuations near a wind farm can be stronger due to interference from the fluctuations of several turbines. This can be prevented by desynchronizing the turbines, as it happens in daytime by large scale atmospheric turbulence, by adding small and uncorrelated variations in the load of the rotors or the pitch angle of the blades of the individual turbines. Controlling the sound production thus requires a new strategy for managing wind turbines: in daytime there is often more margin available for sound production than at night and this margin can be used in daytime in exchange for more restrictions at night.

Finally another, very different problem was addressed: the influence of wind on a microphone in or without a wind screen. When there is sufficient wind the microphone signal contains a low frequency, rumbling sound disturbing the measurement of ambient sound. This rumble is not sound from the environment, but is generated by pressure fluctuations caused by turbulent wind velocity variations. With a pressure sensitive microphone

these pressure variations are not distinguishable from acoustical pressure variations. It appears that a wind screen is effective only by damping contributions of small turbulent eddies. A wind screen has no effect when eddies are bigger than the wind screen.

The strength of atmospheric turbulence does not only depend on the (average) wind velocity, but also on the local roughness of the earth surface and the stability of the atmosphere. These last two factors cause friction and thermal turbulence, respectively. The turbulence strength is

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well known for an unobstructed wind flow over flat land. Turbulence is weaker in a stable and stronger in an unstable atmosphere.

The 'sound' pressure level based on atmospheric turbulence appears to agree well with measured and published levels of wind induced pressure levels. Thus the influence of wind on a sound measurement in wind can be calculated. In reverse this calculation model yields a new method to measure the strength of atmospheric turbulence.

To conclude, it can be stated that with respect to wind turbine sound an important phenomenon has been overlooked: the change in wind after sunset. This phenomenon will be more important for modern, tall wind turbines and in view of the many wind farms that are planned. If this problem is not recognized and solved it will hamper the expansion of wind energy.

## Wind Rights

- Wind turbines produce wake effects 8-11 rotor diameters downwind. Requiring a setback of 5 rotor diameters from property lines provides a buffer that will protect the wind rights of all landowners in the vicinity of a wind project. We believe clear standards for property line setbacks are critical to preventing disputes over wind rights now and in the future. Without standards, conflicts among neighbors and among wind developers can arise. (Windustry, WIND ENERGY EASEMENTS AND LEASES: BEST PRACTICES AND POLICY RECOMMENDATIONS).
- Farmers' Guide to Wind Energy Legal Issues in Farming the Wind June 2007

### Impact on Neighbors:

Farmers should also consider whether the proposed wind project would be an appropriate addition to the project's surroundings. It is important to consider the proximity to neighbors, and how those neighbors use their land. Depending on the size and number of turbines, neighbors to a wind project may experience the sound of the turbines, the shadow cast by the turning blades, and interference with television reception. Neighbors may also be concerned about the look of the landscape, and effects on wildlife, property values, and safety. Moreover, a landowner who develops a wind project might also prevent neighbors from being able to develop wind projects on their own land.

### Property Rights in Land and Wind:

Generally, a landowner owns the right to both the land and the airspace, including the wind, immediately above it.

A landowner's right to use and build on the surface of the land is fairly clear. In most cases, these rights are subject only to state or local zoning and property laws, and the claims of any persons who share an ownership interest in the property.

The landowner's right to possess the wind flowing immediately above the surface of the land is also fairly clear, although this is a less-tested area of property law. Many states have recently passed statutes to clarify that landowners do have a distinct property right in the wind directly over their property.

The issue of who owns the wind is sometimes complicated, because the wind is a resource that literally "flows" over the surface of the land, and the construction of something like a tall building on one person's property could obstruct the flow of wind over neighbors' properties.<sup>4</sup> Similarly, a wind turbine creates a wake of still air in the area behind it, and if this wind shadow extends onto neighbors' properties, it could prevent those neighbors from later developing wind projects of their own.

The law continues to develop to reflect these characteristics of the wind as a resource. In many cases, the issue is dealt with by setback requirements in wind energy zoning laws, and developers frequently seek further agreements in which neighbors agree not to obstruct the flow of wind to nearby turbines in the future. These agreements, typically called wind easements, are discussed in more detail below.

State laws vary on whether wind rights can be permanently "severed" from the surface rights on the land. In California, a state court has held that wind rights can be severed from the land.<sup>6</sup> In South Dakota, there is a state statute that prohibits such severing.<sup>7</sup> In most other states, the law is unclear; however, as long as the wind rights are only temporarily transferred to a third party, this uncertainty should not be problematic. When the rights to wind above the land are permanently transferred to a different party, it can create difficulties of coordination in the future between the separate surface and wind owners.

#### Nuisance:

Nuisance is a tort that involves interference with another person's right to use and enjoy his or her property or public space. One typically thinks of nuisance as not involving direct physical damage to property, but rather intangible interference such as noise, odors, or loss of light or view. The remedy for a nuisance is generally that the offending activity must stop; in some cases, money damages might also be awarded.

A claim for private nuisance will arise if an activity, such as operating a wind turbine, substantially and unreasonably interferes with another person's use and enjoyment of his or her own land.

#### Specific Aspects of Wind Power Production that Could Lead to Tort

##### Liability:

Operation of a wind project carries the potential for personal injury, property damage, or interference with the property rights of neighbors. Although most of the negative effects of wind power production can be reduced through proper siting and permitting, the impacts of the project may be more significant than expected. Potential problems associated with wind turbines include noise; interference with communication, radio, or television signals; obstruction of view or altering the landscape; obstruction of light; and obstruction of wind and electromagnetic radiation.

##### Noise:

Noise may constitute a private nuisance if it interferes with the health and comfort of ordinary people in the area. Characteristics considered include the noise's nature, volume, duration, time, and locale.

Noise was the main issue in reported cases in which a wind turbine was accused of being a private nuisance.

##### Light:

A wind facility must be properly sited so as not to disturb the light to adjacent residences. While a turbine itself will not cast a substantial shadow, the shadow of the rotating blades has a "blinking" or "flicker" effect that could affect neighbors' use and enjoyment

of daytime living or working space.

#### Wind Shadow:

A wind shadow is an area of still air created behind a wind turbine. It is typically a cone whose length across the land is 10 times the diameter of the wind turbine rotor. No wind turbines may be erected in this area of still air, because they would not have enough wind to operate. This could present a problem for a neighbor who wishes to install his or her own turbines in an area that falls in the wind shadow of the farmer's current turbines. With proper siting, there should be no problem with wind shadow. It is not uncommon to site many turbines in close proximity and get adequate wind. Nonetheless, a farmer or developer may want to prevent disputes about wind shadows and neighbors' wind development interests by getting easements to the airspace on neighboring land that is in the wind shadow of the proposed turbines. The landowner who is in the wind shadow of the turbines is then compensated for the loss of his or her wind development potential.

## Significant Permitting Change in Minnesota:

- Minnesota's wind permitting law has recently been amended. Beginning January 15, 2008, county governments may assume responsibility for processing permit applications for wind projects under 25 MW. If a county pursues this option, the county may issue, deny, modify, impose conditions upon, or revoke permits based on standards established by the PUC or based on the county's own standards, if they are more stringent than the PUC's permit standards. For wind projects that remain under the PUC's jurisdiction in counties that choose to adopt more restrictive standards, the PUC must consider and apply those standards unless there is good cause not to.

Next Generation Energy Act, 2007 Minn. Laws (Chap. 136, art. 4, §§ 1314) (to be codified at Minn. Stat. §§ 216F.08, 216F.081).

SOURCE: Farmers Guide to Wind Energy, Legal issues in farming the wind. June 2007 . Published by the Framers Legal Action Group, St. Paul Minnesota ISBN - 13: 978-1-890508-09-8 ISBN - 10: 1-890508-09-8

## Property Values & Miscellaneous:

- Mick Sagrillo advice. Zoning ordinances are usually drafted to protect public health, safety, and general welfare. While public health and safety considerations are included in the Wisconsin statute, general welfare was specifically excluded. It should be fairly obvious what a public health or safety issue is, but this may not necessarily be so with general welfare. In practice, "general welfare" can include just about anything imaginable that a neighbor could claim, including that it would decrease property values, impede orderly development of the area, wouldn't fit in the neighborhood based on aesthetics. The neighbor could simply, claim, "I don't want to look at it." (AWEA Advise From an Expert, Mick Sagrillo). Reference to statute 66.0401.
- Mick Sagrillo advice to other stakeholders. Several of the perceived threats are: plummeting property value, blade throws, traffic accidents, and birds. Mick went to the Wildlife organization in WI, and it was agreed that there was no evidence to support that there is a problem. Therefore, no studies would be needed for those seeking wind turbines. Mr. Sagrillo advises to find people with seniority to write a letter in of wind turbines support, cultivate relationships as Steven Ugoretz, Environmental Analyst, for the State of Wisconsin, Department of Natural Resources did in his case. Benjamin Hunter mentioned that the New Jersey Audubon Society said that they would produce a similar letter. Mr. Sagrillo said it is important to also have a letter from a governmental- regulatory organization as well. A state letter would be better than a national governmental organization, although national governments agree that there is no problem with small wind turbines.

Big wind annoyances are occasional sound, seasonal blade shadows, and construction inconveniences. Also, misguided environmentalists who believe small wind turbines account for large fatalities of birds and bats. Mr. Sagrillo provided results of a study conducted by Wallace Erickson, which found that wind turbines account for only 0 placed in low populated areas like North Dakota, however, there are few transmission lines, making this infeasible. \*Meeting notes were produced by Rutgers University staff under the United States Department of Energy Wind Powering America Grant Award number DE-FC36-05R350005 and are provided as a general summary of stakeholder presentations and comments. These notes do not reflect the view or policy of the NJ Board of Public Utilities.<sup>7</sup>

■ Ellensburg (WA) Daily News, July 25, 2003; Glenn R. Schleede Reston, VA

Wind farms" produce winners and losers.

a. The BIG winners, of course, are the wind farm owners who gain the extraordinary federal and state tax breaks and subsidies that are now available to them, in addition to the revenue from the sale of electricity that is produced.

b. Small "winners" are the land owners who receive payments for "hosting" wind turbines.

c. The BIG "losers" include (1) neighboring property owners, (2) ordinary taxpayers who must pick up the income and property tax burden escaped by "wind farm" owners, (3) electric customers who pay the higher cost of electricity from wind energy. Recognize that "wind farm" owners are unlikely to have long term interest in the welfare of the areas where "wind farms" are built -- or of the people who live there. Technically, nearly all "wind farms" are owned by single asset Limited Liability Companies (LLCs), which are subsidiaries or affiliates of much larger organizations (usually large energy or financial corporations) that can make use of the extensive federal and state tax shelters that are available to "wind farm" owners.

Most of the companies that are proposing or building "wind farms" in WI. are headquartered elsewhere; i.e., in other states or in foreign countries. The tax breaks and subsidy money -- as well as the profits flow to those companies and are unlikely to benefit the people of Wisconsin.

Once projects are in operation, there is little incentive for these absentee owners to be responsive to citizens in the area where projects are built. In fact, once all the tax breaks and subsidies have been captured (i.e., 6 tax years for accelerated depreciation and 10 years for Production Tax Credits, owners have a reduced incentive to maintain production from the turbines.

■ Effects of Wind Turbines on Property Values

From Brad Jones  
Performance Plus B Business Consultants  
3996 Donley Rd

Meyersdale Pa and Garrettcounty MD.

In Meyersdale, two adjacent property owners sued the developer for a loss if property values at al. The judge ordered the developer to purchase their land a full Fair Market value, about \$100.00 each. The developer then put both properties back on the market: one sold for \$40.000 and the other for \$20.000. ( an employee of the developer)

Russell Bounds is a realtor in Garrett County MD. When I spoke to him 3 weeks ago he said the "properties with turbines proposed in their viewsheds cannot be sold." in other words these properties that were quite valued for "heritage views" are now worthless.

In this area our realtors have been advised by attorneys that they must disclose any wind proposals to prospective buyers. Mike Keenan, a local broker, has found that this is a sure-fire way to lose a sale. Properties with turbines proposed in their viewsheds are not moving and we are now seeing that valley properties are being impacted as well. A significant percentage of rural buyers want nothing to do with industrial developments. This is not a surprise.

- From FenLand Landscapes Against Turbines Study.  
What is the impact of wind "farms" on house prices?  
A report from the Royal Institute of Chartered Surveyors of a study done in February 2007 concerning the effect of wind turbines on house sales. The study was based on residential property near wind farms at two locations on Cornwall, and apparently seems to show there were no changes in property prices beyond one mile from the wind farms.
- In Furness, a couple have won a legal ruling providing that the value of their home has been "significantly diminished" by the construction of a wind farm nearby, because of damage to visual amenity, noise pollution and the "irritating flickering" caused by the sun going down behind the moving blades of the turbines 550 meters from the house. In so doing, the judge made what is believed to be the first ruling of its kind relating to wind farms.
- A letter from Beth Mosher  
My spouse and I have a home for sale in the village of Malone. One prospective buyer, pre approved for a loan, had a list of items that were "deal breakers" for the bank.  
Among the terms and conditions of the property site were: 1) It not be located on a landfill. 2) It not be constructed near an old spill or any identified DEC site and 3) It not be near "Windmills" as the term said. So much for no loss of property value. Here we have a local bank who will not approve a loan if the property is near "windmills"
- From David C Maturen, SR/WA  
Certified general Real Estate Appraiser  
Kalamazoo County Commissioner  
  
Whatever report the Wind Working Group Comes up with, it should be informational only, including the differing opinions that are out there, not be used to usurp local land use authority in regulating WRGs just like any other land use nor to deny property owners their rights. In our quest for "energy independence" for our society in general, let us know forget the potential for economic loss to individuals as an unintended consequence. We should be prepared to compensate adjacent owners for any property rights (value taken as a result of the introduction of wind farms)
- The ongoing study in Wisconsin though to be done in 2003. A conversation with Steve Brick of The Energy Center of Wisconsin indicated that as of this spring their study was not finished.
- The 2002 Strutt & Parker study in the Edinbane Windfarm on the Isle of Skye notes that the proposed 41 turbines would have a major impact on the locality. They estimated that nearby property values would decline by over \$ 1 million . They also note a 6.18 of their report that " In Germany, Estate Agents report diminution in values of between 20% and 30 % for properties in sight of the wind farms. We understand the FPD Savills have reported similar levels of depreciation for properties in Norfolk.



## Public Service Commission Records Request Part 1:



WISCONSIN DEPARTMENT OF  
ADMINISTRATION

JIM DOYLE  
GOVERNOR

MICHAEL L. MORGAN  
SECRETARY

Office of the Secretary  
Post Office Box 7864  
Madison, WI 53707-7864  
Voice (608) 266-1741  
Fax (608) 267-3842

October 17, 2007

Scott McElroy  
18047 W. Croft Road  
Evansville, WI 53536

RE: Your Public Records Requests

Dear Mr. McElroy:

I am writing in response to your September 26 and September 30, 2007, requests for records relating to development of various Draft Model Wind Ordinances and Reference Guides.

We have conducted a search of our files and the enclosed documents are being provided in response to your request. Paul Helgeson at the Public Service Commission also may have documents related to this subject. You should contact the Public Service Commission directly in order to obtain those documents. They can be reached at:

Public Service Commission  
610 N. Whitney Way  
Madison, WI 53705

Sincerely,

Patricia Reardon  
Paralegal

**PUBLIC SERVICE COMMISSION OF WISCONSIN  
WISCONSIN WIND POWER SITING COLLABORATIVE**

Minutes

1999 January 26, 9:00 a.m.

Pecatonica Room, PSC Building, lower level

**Attendees**

Frank Arevalo	Alliant Energy
Donna Danihel	Wisconsin Electric
Alex DePillis	Wisconsin Energy Bureau
John Dunlop	American Wind Energy Association
Bill Fannucchi	Public Service Commission of Wisconsin
Jeff Ford	Madison Gas & Electric
Karen Etter Hale	Madison Audubon Society
Paul Helgeson	Public Service Commission of Wisconsin
Bob Owen	SSE
Don Peterson	Madison Gas & Electric
Shawn Puzen	Wisconsin Public Service
Kathy Trudell	Kesowa Strategies/FPL Energy
Steve Ugoretz	Wisconsin Department of Natural Resources-ISS
Michael Vickerman	RENEW Wisconsin

**Report on AP-8 Order -- Paul Helgeson**

Paul reported that all the wind power order points, 5.3 to 5.5, were re-authorized in AP-8. These include:

- 5.3 Wind Power Siting
- 5.4 Utility Funding of G.I.S.
- 5.5 Wind Resource Assessment Program

**Report on Wind Resource Assessment Program -- Alex DePillis**

Alex explained some of the complexities in finalizing the contract with Global Energy Concepts (GEC) for the WRAP program. Though GEC has been conducting the WRAP program under an agreement with Wisconsin Public Service on behalf of the Wind Energy Task Force, NREL has granted the Energy Bureau funds to pay GEC for portions of their work. Rather than adding to the WPS contract, the Energy Bureau needs to contract directly with GEC.

As the analysis of the wind resource becomes more sophisticated, the data required to perform the analysis needs to be more detailed. For instance, identification of the locations of the monitoring towers is currently imprecise, and therefore the data is difficult to correlate with other overlay grids in the Geographic Information System analysis. Previously, wind mapping was accurate to a 1 x 3-km grid. Now, the system can predict wind speeds down to 100 x 100 m grids. Consequently, more accurate descriptions of the wind monitoring locations must be acquired. The coordinates for the sites may be available from the FAA, but no one has yet researched the issue.

Twelve of the thirteen towers have been installed. Eight are communications towers with data collected up to 60-m elevation. The other four are NRG Tall Towers with data monitoring up to 40 m. The final site must be near the two turbines near DePere, and lease agreements have been difficult to finalize.

Data has been collected for one year at seven of the sites. Installations occurred during three periods: 1997 November, 1998 June, and 1998 November. Six months of data is available for most sites, though they are not yet posted on the Energy Bureau Web site. Data will be made available through e-mail or a disk upon request.

#### **MG&E Report on Siting 11.2 MW Wind Project – Don Peterson**

Lincoln and Red River townships issued conditional use permits (CPU) in late November. The township and MG&E researched other CPU's for projects in other states and extracted portions of many of them, such as those pertaining to roads, fences, setbacks, etc. They relied heavily on CPU's issued in Kern County, California, and the site of the largest developed wind resource area in the United States. Don feels the CPU's issued in Kewaunee County have set the benchmark for CPU's in Wisconsin. He feels the CPU's retain more local control than those issued in Minnesota, where control is exerted by the state government. The major challenge was to site the turbines in locations that were not close to homes.

Seventeen turbines will be installed in Kewaunee county – 8 in Lincoln Township, and 9 in Red River. (Negotiating the CPU in Red River Township was easier than in Lincoln.) All will be Vestas V-47, 660 kW turbines with a 65-meter hub height. In addition, there will be two lattice steel 65-m met towers installed. None of the towers are allowed to be supported by guy wires.

MG&E is still working on a wheeling arrangement with WPS, which is the local service provider, and Alliant, which connects the site with Madison.

One of the constraints was that the foundations had to be dug without the use of blasting. Workers must remove the rock with pneumatic hammers. All of the foundations use the "inverted silo" Patrick & Henderson foundation system.

Work will continue at the site in March. Turbines and towers will be delivered to the site in April, and installed from April to June. MG&E expects to commission the turbines on June 9.

MG&E held numerous public meetings in the area. MG&E developed an information program which includes printed literature, a video representation, and a diorama (which is on display in the library of the Public Service Commission). They had also investigated the possibility of building the project in the Stockbridge area. Unfortunately, Stockbridge has no zoning ordinances, so "approval" became more subjective and arbitrary. Consequently, MG&E declined to pursue the project in the Stockbridge area. Both Mick Sigrillo (wind expert living in the county) and Ron Yesney from the Wisconsin Extension Service were helpful in providing non-biased information to local residents. Issues of concern included the impact on TV reception, noise, tourism, signage, promotion, and tax revenue. The townships were concerned that the capital investment will be depreciated every year for tax purposes, EMF, stray voltage (they had wrong

information), grounding issues and the tax revenue would decrease every year. MG&E agreed to make up the difference, so that the reduced property tax payments would be augmented by a direct payment from MG&E to the local units of government. The first year tax revenue is expected to be about \$42,000. MG&E will pay an "impact fee" in subsequent years to keep the revenue flow to the local township constant over the life of the project.

MG&E made a commitment in their application for Certificate of Authority (CA) to the PSC that they would not use the right of eminent domain to acquire wind rights. Technically, a Certificate of Public Convenience and Necessity (CPCN) from the PSC could override local planning authority. However, the Department of Administration (Energy Bureau) and the PSC are trying to assist development of wind energy in Wisconsin, and using excess authority would not build strong community support. MG&E only worked with willing landowners, and simply sited turbine around the property of unwilling landowners. MG&E also agreed to a two-year moratorium on additional wind development in the county.

MG&E is also contracting for pre-installation avian monitoring in the area, and will conduct searches in the project area after the project is operational.

MG&E is the developer, general contractor and owner of the project. They contracted with Northern Alternative Energy of Minneapolis to assist with the CA process, and with Ron Nierenberg from California to assist with turbine siting. They also have made a commitment to use as much local labor on the project as possible.

The impact of the wind project on land value is difficult to assess, and is not included in the CPU. Though there are two turbines installed near Glenmore, WI, recent property has sold in close proximity to the sites at an appreciated value.

It currently appears that the FAA will require that each tower is lighted with a strobe light for airplane safety, in spite of the fact that projects in other parts of the country need only have strobe lights placed strategically around the wind project area.

#### **Wisconsin Public Service report on siting 1.2 and 9.2 MW wind project – Shawn Puzen**

Many elements of the WPS project are very similar to the MG&E project – turbine type, foundation type, and installation in Kewaunee County. However, they started the process later than MG&E, so was able to pattern many of their agreements after MG&E.

All of the WPS turbines will be located in Lincoln Township. They were invited to make a presentation in Brussels, in Door County, but none of the turbines will be located there. One of the issues they had to deal with was the impact on neighboring landowners that did not receive any of the benefits. The fact that the utility was using a renewable energy resource helped to smooth acceptance, as well as the fact that WPS is the local utility. An adjacent landowner in Glenmore resisted the project there, and WPS had to settle them.

Land leases from MG&E and WPS are similar. The utilities pay easements on a per-turbine basis. They pay \$500/turbine plus \$500 for the "inconvenience" of having the

project on their property every year. The utility also pays 10% of the assessed value of the land taken out of service. The lease includes a 40 foot-wide access strip to the turbines, and a "laydown" area that is a square 200 feet on a side around the turbine site. None of the sites are within 400 feet of a residence. On average, landowners are receiving between \$1400 and \$1800 per turbine per year. The leases are for 30 years, renewable every 10 years. The utilities decided not to base the leases on production of the turbines, though that approach had been recommended to them. Since the utilities own the turbines, there is no actual "sale" of electricity from the wind project to the utility, and thus no "value" on which to base a royalty payment. WPS is contracting with Vestas to maintain the turbines for the first five years, which covers the warranty period.

One of the issues unique to this region is contamination of drinking water wells. Since the topsoil is so thin, it is possible that fracturing the rock below the soil may allow seepage into the aquifer. This was the reason the blasting the holes for the foundations was not allowed.

WPS owns 22 MW of feeder capacity to the area. This is one of the reasons that the area was selected by both utilities to build their projects in the county.

Construction at the WPS site will begin March 1.

#### **Additional Assistance**

Paul Helgeson asked in what ways the PSC could assist with future development of wind power in Wisconsin.

Don Peterson suggested that only 25% of the local people actually read the documents distributed by the utilities and other parties, which is not surprising, since they tend to be quite lengthy. He mentioned that George Braaksma, a landowner near Allendorf, Iowa, with two NEG-Micon turbines on his property, was brought to Lincoln Township to talk with landowners. Don felt it was very useful for landowners to talk with other experienced landowners.

Others suggested that the education about wind energy needs to be expanded – articles in publications frequently read by landowners, television spots, referrals to others in other parts of the country, testimony by experienced people. Steve Ugoretz said that they have copies of the National Wind Coordinating Committee Wind Farm Siting Guidelines.

Kathy Trudell believes that the landowner wants to feel protected, and they are reassured to receive information from the PSC.

#### **Report from Biological Issues Sub-group - Bill Fannucchi, Steve Ugoretz**

A "salting study" has been conducted at the two-turbine Glenmore site near DePere, in which researchers place dead carcasses in a pattern on the ground around the base of a turbine then observe the "removal rate" as they are carried off by predators. The first salting study was "discovered" by a group of government, utility and industry observers on tour after their Turbine Verification Program update meeting in Green Bay. Needless



to say they were shocked to see that so many birds had been hit by just one turbine! Within minutes they were provided with the scientific explanation.

The University of Wisconsin/Madison is conducting pre-construction baseline avian studies at the Rosiere site. They began the one year study on 1998 April 19, recording bird populations, bird movements, bird species, local flight heights, etc. At the present time, they are using only visual observations.

Avian impacts of wind development in the area may be influenced by the siting of the turbines. WPS has a more compact layout of their turbines, while MG&E turbines are more dispersed.

The University will continue the studies in the area, but will include the development areas from both companies in the avian studies. They will conduct a mortality investigation for two years after the turbines are commissioned.

The university is considering the use of audio tracking to observe nocturnal avian activity, which they consider to be more cost effective than radar observations. They expect the observations to cost between \$10,000 and \$12,000 per year. The University of Minnesota/Duluth conducted the baseline studies in southwestern Minnesota using a small, vehicle mounted radar, which cost about \$10,000.

The Biological Issues Group is also seeking more detailed land cover data, which is available from the Department of Natural Resources. The new data is in a grid format, which will greatly assist siting and resource assessment activities. The new data uses satellite images to determine land cover. They are currently using 1992-1993 data, with more current data to be available in May of this year.

The Group adopted a prototype area to refine the process to gather and present data. The prototype area extends south and east of Ripon, including Fond du Lac, Sheboygan, Dodge, Washington and Ozaukee counties. This allows them to develop procedures to define wetlands and other areas of concern, and determine the constraints imposed by their locations. Based on preliminary investigations, there may be more avian species in the area than originally projected, but the impacts may be negligible.

WEPCO is installing two Vestas V-47 turbines in the pilot area near Byron (south of Fond du Lac), which will give the biological sub-group additional experience with their siting process. An independent power producer (IPP) is considering a larger project in the pilot area, but details are not yet available. Approval of the PSCW is required only if a project will have an installed capacity of 100 MW or greater. However, a utility would still need to receive a Certificate of Authority (CA) even if the project is smaller than the 100 MW threshold. Bob Owen identified the Mayville area as one of the best wind resource areas of the state, with a capacity of "hundreds of megawatts."

Steve gave further background information on the NWCC Siting Guidelines. Much of the concern of avian impacts grew out of experience in the Altamont Pass area in California, the first major wind development in California and the home of many species of large raptors, including golden eagles, red tail hawks and other federally protected species. The NWCC is attempting to establish standard methods of gathering and

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evaluating avian data. Revisions have been proposed to the 1998 March publication comments are now being collected, and the second edition is expected to be released in the spring of 1999. The document will address the best methods to conduct avian-turbine interaction studies. These include mortality assessment, avoidance or reduction strategies, "repotting" turbines (turbine in the same location but with avian-friendly hardware), and the environmental perspective of repowering the Altamont wind generation area (replacing many smaller turbines with a few large, modern, avian-friendly turbines). A major difficulty is translating data from one area of the country to another. Standard methods for making the translation and for comparing wind resource areas are necessary. The NWCC is expected to be holding another avian workshop in the fall of 1999. The last one was held in June of 1998 – reports on that meeting are available on the NWCC web site or are available in hard copies (<[www.nationalwind.org](http://www.nationalwind.org)>).

Steve also mentioned the issue of bat interactions. He reported that ten bats appear to have been killed by wind turbines along the Buffalo Ridge wind development area in Minnesota, representing five species of bats. Bats are a concern in the prototype area, as thousands of bats emerge in waves from a bat hibernaculum in an old mine site near Iron Ridge to fly to their feeding areas.

#### **Where do we go from here? Paul Helgeson**

Paul sought to clarify how the wind siting collaborative can be helpful in the development of wind power in Wisconsin.

Alex DePillis called the MG&E conditional use permit a model for other proposed projects. The collaborative can provide referrals to other project areas. Michael Vickerman suggested the collaborative could provide a historical record of the development of other project sites. Donna Danihel suggested that the collaborative could help ensure local units of government are brought into the process. Paul Helgeson suggested that the county and/or township associations could be helpful in disseminating information on successful projects. In addition, the Regional Planning Commissions (such as East Central or Bay Lake) can provide that service. The collaborative can also provide model ordinances to local units of government considering wind projects, suggested Karen Etter Hale. A "toolbox" of examples for new development areas to consider would be helpful. The collaborative is also useful to share information on resource assessment development in the state, indicating where new projects might be considered. In addition, the collaborative is valuable as a networking tool.

#### **Next Meeting**

There was a consensus that many activities will be occurring over the next number of months, and that another meeting should be held. As two major projects will be under construction this spring near Rosiere, the group suggested holding the meeting in the Kewaunee County area. The suggestion is: May 13 at Lipinsky's Resort on Green Bay.

\*\*\*\*\*

Submitted by J. Dunlop, AWEA

**NOTE:** I have reserved a meeting room at Lipsky's on the Bay in Dykesville for 10:00 am on Thursday, May 13, 1999. My suggestion is that we meet in the morning, have lunch there and tour the windpower sites in the pm.

fn:visiting98jan

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## Draft Minutes of Guidelines and Model Ordinance Ad Hoc Subcommittee

**Attendees:** Meeting Nov. 4, 1999

Name	Affiliation	Phone	e-mail	Fax
Alex DePillis	Wisconsin Energy Bureau	608-266-1067	alex.depillis@doa.state.wi.us	608-267-6931
Steve Ugoretz	Wisconsin DNR, Integrated Science Services	608-266-6673	ugores@dnr.state.wi.us	608-267-7559
Paul Helgeson	Public Service Commission of Wisc.	608-26602072	helgep@psc.state.wi.us	608-266-3957
Diana Toledo	Wisconsin Coastal Management Program	608-261-8011	diana.toledo@doa.state.wi.us	608-267-6931
Michael Vickerman	RENEW Wisconsin	608-255-4044	mjvrenew@mailbag.com	608-255-4053
John Dunlop	American Wind Energy Association	612-377-3270	jrdunlop@igc.org	612-374-2181

### **Observations on the recent FPL Siting**

Tabled during to time constraint, taken up informally outside of meeting

### **Jurisdiction**

PSCW jurisdiction, any new generation:

	< 10 MW	< 100 MW	>= 100 MW
Regulated utility	Same as rules for < 100 MW, but environmental assessment not required	Certificate of Construction Authority (CA) required (environmental assessment must be included to receive CA) if any apply: A.) Small utility: operating revenue <= \$5 million, then if gross cost of project > \$100,000, OR B.) Medium utility: operating rev >5, < 250 million, then if estimated costs > 2% of operating revenue, OR C.) Large utility: operating revenue >= 250 million, then if project > \$5 million.	CPCN (certificate of public convenience and necessity, which includes env. assessment or EIS)
Indep. power producer	non-PSCW (DNR or other jurisdictions)	non-PSCW (DNR or other jurisdictions)	CPCN

- 1998 Act 204 eliminated PSCW jurisdiction on IPPs building projects < 100 MW.
- PSC chapter 112 clarified when construction authority would be required for regulated utilities building projects < 100 MW.
- Formerly a standard applied to projects < 12 MW. Projects < 10 MW now are exempt from the environmental assessment requirement of the < 100 MW rule.
- Kewaunee projects required no CPCN, but the PSC was involved in granting the CA because the projects were regulated utilities' projects.

G:\EnergyMarketsBureau\DePillis\WIND\Wind farm siting\Subcomm\Siting Collaborative subcommittee minutes 9911.doc

### Role of towns, counties and federal coastal zone

- Sometimes towns defer to county, e.g. to a county's model ordinance, if they have one.
- The town of Stockbridge, Calumet County, placed a two-year moratorium on towers. [Editor note: This may be in litigation at this time, Martin "Junior" Ecker.] Calumet County has zoning, but Stockbridge opted out.
- Coastal Zone Management can apply "federal consistency," i.e. that the Coastal Zone Management Program (housed in the state Department of Administration) ensures that the state's needs are addressed if there's federal involvement in a project. Question of whether the production tax credit constitutes sufficient federal involvement to trigger federal consistency? PSCW consultation with its counsel indicated that it wouldn't for the purposes of jurisdiction, above.
- There are 15 coastal counties, and Coastal involvement can be extended to upper, non-county portion of watersheds (e.g. if changes to an impoundment affect fish movement upstream past the county line).
- Three criteria for federal consistency.
  1. Federal money is involved
  2. A federal license or permission is granted
  3. Some sort of federal act by an agency is involved

### **Action of the Guidelines and Model Ordinance Ad Hoc Subcommittee**

(whose minutes you are reading at the moment)

#### Guideline vs. Model Ordinance; Audience for either output

- It was agreed to move directly to a model ordinance.
- Promulgation and the money for it could proceed via Coastal Management Program, whereby the regional planning commissions would ask for funding, beginning 10/2000, or through the Energy Center of Wisconsin, again beginning late 2000 (a pre-proposal has been submitted).
- Some discussion of audience of developers (give them guidelines instead, deal with towns and non-developer advocates of wind energy for the initial output of a model ordinance).
- Agreed that some with expertise should review model ordinance, e.g. Don Bain, Ron Yesney (UW Extension ec. dev. agent involved with Kewaunee siting) and \_\_\_\_\_ (guy from MN Planning).
- Door County Ordinance as edited was reviewed without comment by Dean Perlick of Dodge County Planning, who offered no comment, and had already drafted a far more complicated ordinance (see Appendix B and discussion below.)

#### Door County Ordinance

- The subcommittee began editing section 4.02 "Requirements" of the Door County Ordinance.

### **Unresolved Issues and Subsequent Contact (Dodge County Ordinance)**

- DePillis sent un-edited version of section 4.02 along with copy showing the edits and a clean, edited copy for review to the members of the subcommittee. Comments were received and incorporated. (Appendix A to these minutes).
- Deal with towns association to resolve whether Door County towns *must* to adopt the Door County ordinance.

#### Dodge County Ordinance (see Appendix B)

- During process of soliciting comments on edit of Door County ordinance, on about November 9, DePillis received phone call from Dean Perlick of Dodge County Planning Department, looking for a model ordinance.
- Dean e-mailed DePillis the Dodge County proposed ordinance. Same process with soliciting edits as for Door County ordinance.
  - (a) Phone call 12/7:

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Note item " (d)

- (b) County (corporation counsel) and Richard Lehman (attorney of Madison) reviewed it, suggested that much of the ordinance belongs in other zoning. Only about one third of the towns in the County have adopted zoning.
- (c) New approach (Dean mentioned a process called 59-95) would allow each down to give thumbs up or thumbs down on the ordinance, without having to adopt zoning, via a resolution.
- (d) Noise, on which the ordinance is silent, was assumed to be captured by the 1000-foot setback.
- (e) An exemption was added for private wind systems, defined to be less than 75 feet high and for generating power on site.
- (f) First possible opportunity for adoption would be the January County Board meeting (third Tuesday?).

***Appendix A1 Unedited version of section 4.02 of Door County Ordinance, as adopted.***

***Appendix A2 Door County Ordinance section 4.02, edited, showing edits.***

***Appendix A3 Door County Ordinance as edited.***

***Appendices B1, B2, B3***

B1: Dodge County Ordinance as received.

B2: Dodge County Ordinance showing recommended changes.

## Wind Energy Task Force/Wind Siting Collaborative MEETING MINUTES

By Alex DePillis, Wisconsin Energy Bureau, alex.depillis@doa.state.wi.us

### WETF - 10:00 am

1. Introductions - Agenda review
2. Wind Resource Assessment Program (Camille, GEC, and Alex, WEB)
3. Low Wind Speed Turbine Project Update (Rick, WPS, and Camille)
4. Future organization of WETF (Donna, WE)

### Lunch at Lipsky's - 11:30 am

### WSC - 12:30 PM

1. Activities of National Wind Coordinating Committee (Steve, DNR)
2. Update from Biological Issues committee (Bill, PSC)
3. Integration of wind speed, biological, topography, and other data using GIS (discussion)
4. Local zoning issues: Door County and other wind power ordinances.

### About 2:30 -Tour MGE and WPS Projects

#### Attendees:

Mark Eilers	NEG Micon
Don Peterson	MGE (Madison Gas and Electric)
Frank Arevalo	Alliant Energy
Paul Helgeson	PSCW (Public Service Commission of Wisconsin)
Shawn Puzen	WPSC (Wisconsin Public Service Corporation)
Bill Kusf (? sp)	WPSC
David Donovan	NSPW (Northern States Power, Wisconsin)
Jeff Carlson	(WEB) Wisconsin Energy Bureau
Alex DePillis	Wisconsin Energy Bureau
John Dunlop	AWEA (American Wind Energy Association)
Camille Drapeau	GEC (Global Energy Concepts)
Bill Fannucchi	PSCW
Steve Ugoretz	Wisconsin Department of Natural Resources
Mick Sagrillo	Sagrillo Power and Light
Jeff Ford	MGE
Rick Liebmnn (? sp)	WPSC
Joe Kramer	Resource Strategies/FPL
Robert Owen, Jr.	Superior Safety and Environmental

### **WETF 1, Introductions**

Introductions made, decision about lunch made, item 4 of WETF moved up a notch on agenda.

### **WETF 2, Wind Resource Assessment Program**

**(Camille Drapeau of GEC, Alex DePillis and Jeffrey Carlson of WEB)**

Two purposes: Characterize windiness statewide, and provide good data for utilities or prospective developers to look at windiest locations in the state.

Alex DePillis and Jeffrey Carlson of WEB: see handout. Usefulness of mapping is limited by usefulness of data used to generate maps. UCS maps of 1994 were based on coarse Batelle data of 1986.

Minnesota maps look nice, but have a caveat: data for NE Minnesota lacking, despite nice-looking map for that area.

Information dissemination: hard copies and electronic of semi-annual now available. Eventual purposed is to have a wind distribution, and show environmental exclusion zones, or zones of concern, and tell inquirers to get further detail from the state.

Camille Drapeau, GEC: see handout. Qualitative characteristics discussed. Lack of correlation between average wind speed and elevation of site. Diurnal variation similar for sites.

Escarpment sites good, site 403 (Rib Lake, Taylor County) very poor. Could relocate (see below), and use 402 for correlation.

Discussion of offshore monitoring. Suggest we convene a group to resolve issues between stakeholders.

Moving a site. Offshore permitting, etc. would be too lengthy of a process. Need to do it soon to get a full years' data. No objections to moving. Candidates: near 406 (somewhere on Military Ridge),

Arlington Lodi area (some good data from Anemometer Loan Program, Alex to suggest specifics to Camille), Gogebic Mountains, Janesville, Counties of Dane, Sauk, Ioway, Rock, Columbia, and Green. Camille to research and bring recommendation to the WETF.

Site 410 (the long-awaited shear tower study across from the Shirley/Glenmore/DePere Tacke turbines).

Camille has a lease in hand, not yet signed, but has a verbal go-ahead.

### **WETF 4, Future Organization of WETF**

Utilities had a recent (tele?) conference, decision is to bring the WETF into the RETF (Renewable Energy Task Force), and then break it out again as necessary.

Donna Danihel will be the chair.

### **WETF 3, Low Wind Speed Turbine Project Update**

Bill Kusf has taken over for the operational portion of the LWST from Jayme Van Campenhout.

Hydraulic run time causing emergency-brake shutdowns. Possibly faulty solenoid. Dirty Oil?

Lack of documentation that would be useful for maintenance. Maintenance contractor not interested. (see discussion of HPC, below)

Second Wind SCADA vs. Tacke SCADA; they were never intended to work together.

TVP is considering new sites.

HPC (Huron P \_\_\_\_ C \_\_\_\_ ) was part of the Tacke pre-bankruptcy. They have the contract with WPS, but no access to Tacke. Enron saying Tacke will only be sold (and perhaps by implication, supported) in Europe. Perhaps Enron will cover the WPS project, e.g. if Enron markets the 1.5 MW Tacke. Enron suing Enercon. Context of a proprietary debate, US vs. Germany.



***A fine lunch was had by all...brief after-lunch inspection of beach and Lipsky's "boat-el" by some among the attendees.***

***Wind Siting Collaborative 1, Activities of the National Wind Coordinating Committee (NWCC), Steve Ugoretz, WDNR)***

NWCC Avian Subcommittee has a 6<sup>th</sup> draft of the Standardized Methods and Metrics, anticipates it being endorsed at the AWEA Meeting.

Using a comparison of avian or bat interaction with other (non-turbine) structures, e.g. other types of towers, powerlines, windows.

Need to establish a protocol. Offshore? Add it to the protocol mix. Do applicable guidelines exist? If not, do we address it?

Add wind-bird interaction to the NWCC siting guideline revision?

Chiroptera (bats, an order within the class of mammal) were killed at Buffalo Ridge phase 1: 70.

(Annual?) Seems to be machine-independent.

Hibernaculum studies are ongoing. Coordinated by a Horicon Biologist. Come conservation components, (protect the site!). Big hibernaculums in Iron Ridge.

***Wind Siting Collaborative 2, Update from the Biological Issues Committee, Bill Fannucchi, PSCW***

Purpose is to find environmental constraints, and be able to avoid them. Checking windy areas first. Maps were shared and passed around. No constraints have been established, only examples were shown on the map.

Bay-Lakes Regional Planning Commission study was a resource inventory. See 4/8/99 memo from Dale Mohr of BLRPC to Michael Friis of Wisconsin Department of Administration.

Calumet population surveys underway. Glenmore surveys done. Kewaunee studies (MGE and WPS windfarms) getting underway (Shawn of WPSC).

Kewaunee, data for 3 years, two windfarms, 2 different layouts. Two years' nocturnal data.

Since the situation is very different, with a much more diverse and active and dynamic population, the important criteria is mortality as a percentage.

How would constraints zones be enacted? Would it be the developers' responsibility? What is the liability?

The information will be available. The guidance will be to be prudent. Operational solutions are an option. Use the best available information.

In the absence of prudent action, mortality constitutes the taking of a migratory species, a strict liability that leans away from the concept of "inadvertant."

Comparison to other structures? Need to compare to a control area. Other structures (cell towers, buildings) don't require studies. Therefore it's a problem of finding a meaningful baseline. Some indications exist that windturnics have less mortality per volume than guyed towers.

Glenmore had a pre-construction study of the communication towers.

***WSC, 3, Integration of wind speed, biological, topography, and other data using GIS (this item was either tabled, discussed elsewhere, or the minute-taker has no notes)***

***WSC 4, Local Zoning Issues: Door County and other wind power ordinances***

Door County Ordinance attached to this set of minutes.

Door County: Issue of a non-refundable \$500 fee. Requires a hearing on the application. Various setbacks named. Probably copied from a California or western-state ordinance.

Recommendation made that Counties, Cities, Towns Association and other stakeholders gather to develop a model ordinance.

***Meeting adjourned for tour of MGE and WPS Projects. Some pre-tour remarks:***

WPS-14 foundations in. Transformers are set. 9-person Vestas crew. 3 nacells on site. Four more due today.

MGE. Transformers set. Roads were somewhat widened. High voltage connections set. 12 nacells in place, no towers. Using a 200-ton crane for the bottom sections, followed by a 500-ton hydraulic crane for final lifting.

# DRAFT 1.0

## WETF and Siting Collaborative Agendas

Meeting of Monday 23 April, 2001

### WETF

#### Wisconsin Wind Resource Assessment Program (WRAP)

- Data collected so far
- Storing, checking, archiving, disseminating
- The future
  - Continuing some towers (ALP-DOE bridge money?)
  - Form of information given out
  - Final report for NREL

#### Turbine Performance, existing and under construction

- kW-hours
- capacity factors
- % of state energy and state RE

#### Turbine Verification Program

(TVP, also know as the Tacke turbines in Glenmore)  
\*\*\*\*\* ask Ray about this item \*\*\*\*\*

#### Renewable Portfolio Standard (RPS) and wind

\*\*\*\*\* Paul and me present this \*\*\*\*\*

### Siting Collaborative

Reminder of the Collaborative's charge

#### Report of the Biological Subcommittee

- Ugoretz and Fannucchi report, mostly on GIS
- Some update on NWCC work or other avian work of Ugoretz, e.g. communication towers.

#### Model Ordinance

- Report on the Ad Hoc Subcommittee's work thus far
- Decide on action paths (tentatively Collaborative or the Ad Hoc Subcommittee will disseminate the draft to regional planning commissions, other planning bodies, get comments and re-draft disseminate via planning committees and UW-Extension

#### Other Reports

- Status of Dodge County ordinance
- Status of Kewaunee moratorium
- State Energy Program special project: wind energy siting case studies



## DRAFT 1.0

To do... AFDeP

When did the model ordinance come up?

Chuck turb perf numbers with Paul

Ask Ray Janssen re TVP agenda point; Shawn Puzen do it?

Send out SEP summary with agenda... Other materials as well.

Contact feds re ALP money for bridge finance of monitoring towers

Get estimate of cost to keep towers running from Stacey



## Public Service Commission of Wisconsin

Daniel R. Ebert, Chairperson  
Mark Meyer, Commissioner  
Lauren Azar, Commissioner

610 North Whitney Way  
P.O. Box 7854  
Madison, WI 53707-7854

November 12, 2007

Mr. Scott A. McElroy  
18047 West Croft Road  
Evansville, WI 53536

Re: Open Records Request ORR 2007-014; draft wind ordinances

Dear Mr. McElroy:

This letter is the Commission's response to your October 22, 2007, open records request that you filed with the Commission by e-mail. I am writing as the Commission's Open Records Custodian.

You specifically requested these items:

1. "[C]opies of any records that were utilized by the authors and/or drafters of the 2003 & 2007 DRAFT wind ordinance, and 2003 & 2007 DRAFT wind ordinance reference guide specifically and narrowly related to health and safety issues (i.e. noise, setbacks, etc.). What I am most interested in acquiring, are any documents (preferably summarizing & peer reviewed if available) involving research records/tests and/or reports of any physician and/or audiologist; any clinical, medical, and/or scientific data, used by the authors/drafters of said ordinances and guides, in the initial creation of each document."
2. "[T]he language in the 2007 versions of said documents identified herein has been significantly changed in relation to sound/noise, as well as other noticeable changes. I am interested in acquiring any documentation utilized by the author(s) supporting the concept of said changes as necessary; and knowing who initiated the idea that this change was appropriate. I am most interested in acquiring, any documents (preferably summarizing & peer reviewed if available) involving research records/tests/ and/or reports of any physician ad/or audiologist; any clinical, medical, and/or scientific data, used by the authors/drafters to initiate said change(s) in the 2007 DRAFT Ordinance and reference guide."
3. "I would also like to know the exact date that the current 2007 DRAFT Ordinance and Guide replaced the 2003 DRAFT Ordinance and Guide, on the Department of Administration website, and the process behind this change."
4. "Lastly, the 2007 version of the DRAFT Model Wind Ordinance Guide specifically states: 'The model ordinance was developed by agency staff with input from stakeholders.' I would like a copy of the 'agency staff and stakeholders' referred to above, that had input in this process. If this 'input' took place at public meetings,

Telephone: (608) 266-5481

Fax: (608) 266-3957

Home Page: <http://psc.wi.gov>

TTY/TextNet: In Wisconsin (800) 251-8345, Elsewhere (608) 267-1479

E-mail: [pscsecs@psc.state.wi.us](mailto:pscsecs@psc.state.wi.us)

Mr. Scott McElroy  
Page 2

hearings, etc., agendas and minutes should have been created. Again, due to this most recent change (September/October 2007?), I would trust this information is readily available."

You ask that the Commission notify you of the cost of copying and provide a list of the Commission records that are within the scope of your request, so you can decide whether to request actual copies or to view the copies at the Commission's office. You also state that the Commission need not locate for you any records that the Department of Administration has already provided. The Commission received from the Department of Administration copies of the material it gave you, and the Commission has removed duplicates from the materials it has gathered for you.

In response to item one of your request, the only records in the Commission's files are three publications. These publications, each of which is separately available for sale, are:

1. "Wind Power: Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife," United States Government Accountability Office (September 2005). This publication, approximately 60 pages long, is separately available from the federal government.
2. "Permitting of Wind Energy Facilities," National Wind Coordinating Committee (Revised August 2002). This publication, 50 pages long, is available from the National Wind Coordinating Committee, c/o RESOLVE, 1255 23<sup>rd</sup> Street, Suite 275, Washington DC 20037. The website address is [www.nationalwind.org](http://www.nationalwind.org).
3. "Wind Energy Issue Papers," National Wind Coordinating Committee (1997). This publication, approximately 75 pages long, is also available from the same address shown above.

Under Wis. Stat. § 19.35(1)(g), published items that have been or will be available for sale or distribution from another source are exempt from the Open Records Law. As a result, the Commission directs you to the publisher if you choose to acquire your own copy of these documents. As with the other Commission records, however, if you choose to visit the Commission to view its records these three publications will be made available for your inspection.

Regarding item two of your request, the Commission has located four e-mails between two Commission staff employees, which discuss potential changes to the model ordinance. Draft changes to the ordinance are attached to three of these e-mails. Because the definition of "records" under Wis. Stat. § 19.32(2) does not include "drafts, notes, preliminary computations and like materials," the Commission is not releasing these draft changes. The Commission will, however, release the cover e-mails.

Mr. Scott McElroy  
Page 3

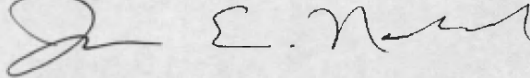
Regarding item three of your request, the Commission has no records indicating the date when the Department of Administration posted the current 2007 Draft Ordinance and Guide on its website.

Regarding item four of your request, the Commission has approximately 90 pages of records that identify "agency staff and stakeholders" and constitute the agendas and minutes you are seeking. Some of these pages consist of minutes marked "draft," but the Commission is providing you these documents because they were used and disseminated as the final version of meeting minutes. The minutes name the participants at meetings, showing the "agency staff and stakeholders" whom you requested be identified. Please note that these materials relate to the original version of the model ordinance, not the 2007 version. The Commission has no records that respond to your request regarding the 2007 version of the ordinance.

Please call me at (608)266-1264 when you decide whether you want copies of these records or want to inspect the records at the Commission's office. The Commission's fee for copying records is 15 cents per page, so copying the records the Commission has collected would total roughly \$15.00.

If you believe the Commission has improperly denied any part of your open records request, you may contact me to discuss the matter. Alternatively, any denial is subject to review by mandamus under Wis. Stat. § 19.37(1) or upon application to the attorney general or a district attorney.

Sincerely,

A handwritten signature in dark ink, appearing to read "J. Nashold", written over a horizontal line.

Jennifer E. Nashold  
General Counsel

JEN:DAL:O:\Open Records Request General Counsel\2007\McElroy 2007-014 Response 11-12-07.doc



# Public Service Commission of Wisconsin

Daniel R. Ebert, Chairpe  
Mark Meyer, Commissio  
Lauren Azar, Commissio

610 North Whitney Way  
P.O. Box 7854  
Madison, WI 53707-7854

December 13, 2007

Mr. Scott A. McElroy  
18047 West Croft Road  
Evansville, WI 53536

Re: Open Records Request ORR 2007-014; draft wind ordinances

Dear Mr. McElroy:

The Commission is providing copies of the documents outlined in my November 12, 2007 response to your public records request. Enclosed you will also find your check for \$15.00. Please note that my letter of November 12, 2007 contained an estimate of the copying charges the actual amount due for the records you requested is reflected in the enclosed invoice and to \$9.15. Please remit payment upon receipt of this letter.

Sincerely,

A handwritten signature in black ink, appearing to read "J. E. Nash".

Jennifer E. Nash  
General Counsel

JEN:DAL:O:\Open Records Request General Counsel\2007\McElroy 2007-014 Response 12-13-07

PUBLIC SERVICE COMMISSION OF WISCONSIN

FOR QUESTIONS CALL ACCOUNTS RECEIVABLE AT (608) 267-7709

FOR CORRESPONDENCE MAIL TO: PO BOX 7854, MADISON, WISCONSIN 53707-7

2076(11-01



SCOTT MCELROY  
18047 WEST CROFT RD  
EVANSVILLE, WI 53536

Invoice Number: MISC-1

Invoice Date: 12/13/2

Date Due: 01/14/2

Prepared By: 1124

<u>Quantity</u>	<u>Description</u>	<u>Unit/P</u>	<u>Amount</u>
61	Responsive materials regarding draft wind ordinances; Open Records Request ORR 2007-	(	9.15
		Sub Total	9.15
		Tax	0.00
		<b>Total Amount Due</b>	<b>\$9.15</b>

PLEASE DETACH AT DOTTED LINE BELOW AND RETURN WITH YOUR PAYMENT



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Invoice Date: 12/13/2

Date Due: 01/14/2

**Amount Due: \$9.15**

MAKE CHECK PAYABLE AND REMIT

146

PUBLIC SERVICE COMMISSION OF WISCONSIN  
BOX # 78283  
MILWAUKEE, WI 53278-0283

Amount Enclosed

## **HIGH LIGHTS OF WIND SITING GUIDELINES MEETING**

May 10, 1995

**DRAFT**

**Attendance:** See attached sheet

**Minutes:** Paul Helgeson, PSCW 608.266.2072

### **I. Experience Elsewhere**

Don Bain, Oregon DOE, and John Dunlop, Midwest representative for AWEA and from Minnesota, reported on their experience with wind siting guidelines in other areas of the country.

Bain reported on experiences in Oregon with bird-wind turbine interactions. Bird studies have been planned for a couple proposed projects but never went forward because the projects were never funded. The state regulates projects over 25 MW, the county regulates those under 25 MW. Oregon has a had a model county siting ordinance since 1984, Bonneville Power is currently under contract to update it.

Dunlop reported that large wind power developments were disadvantaged by Minnesota's Power Plant Siting Act. As a result, a wind siting task force that was established by the Environmental Quality Board (EQB). RESULTS?

A generic wind EIS was proposed but never carried out. Also, in the early 1980's a guide for local zoning ordinances was published by the state.

There was also general discussion of avian impacts in other parts of the nation and in Europe. The effect of different types of turbines discussed. Steve reported on activities of National Wind Coordinating Committee.

### **II. Guideline - Scope and Purpose**

The major areas in the guidelines were discussed. Need to define what was meant by wildlife area-- designated and undesignated.

Don Bain pointed out that the need for more data for some of the determinations, such as migratory corridors. Habitat restoration area could be sensitive issue.

Everyone seems interested in the room seemed interested and

supportive of the concept of developing guidelines, but some concern was expressed about the cost of necessary studies and how they would be funded.

**Costs:** WPS reported that study at DePere is costing under \$50,000. Similar study could be \$50,000 to \$200,000 in other areas. DOA, Energy Bureau, has \$17,000 from DOE for work on G.I.S. and is moving forward in this area.

### **III. COMMENTS / SUGGESTIONS**

1. Group should be enlarged to include conservation and hunting groups and rural development organizations.
2. **Comments on the draft guidelines should be sent to Steve Ugoritz ASAP.**

Steve Ugoretz  
Wisconsin DNR, EA6  
P.O.BOX 7921  
Madison, WI 53707-7921

### **IV. Next Meeting**

Monday, June 26, 10:30-12  
GEF 2, Room 317  
110 Webster

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# Wind Energy Siting Collaborative

## FINAL MINUTES

June 26, 1995

Attendance: Paul Helgeson PSC, Bill Fannucchi PSC, Steve Ugoretz DNR, Karen Etter Hale Audubon Council, Bob Owen, Joel Trick USFWS, Dan Moran DOA-Energy Bureau, Don Wichert DOA-Energy Bureau, Tim Seek Kenetech, Deb Berns WPS, Joe Gary MG&E, Walt Boeshaar WEPCO, Michael Vickerman RENEW

Minutes: Bill Fannucchi, PSCW

### I. National Wind Coordinating Committee

Meeting began with report from Steve Ugoretz on the Avian and Wind siting subcommittees meetings he recently attended. These committees are made up of regulators, wind energy developers, and environmental organizations.

The Avian subcommittee is addressing bird interactions and mortality at wind farms. They are working to coordinate national research that focuses on understanding the dynamics of bird interactions with turbines and on methods to resolve impacts.

The Siting Subcommittee is beginning work on developing a model statute and ordinance for siting wind farms.

Steve gave copies of the draft (June 12, 1995) siting guidelines developed in Wisconsin to members of these committees. The siting subcommittee has about a years worth of work to do and about 1 year of funding available from DOE.

### II. Avian Study Proposal

Don Wichert discussed Energy Bureau's GIS work on the Niagara Escarpment. They are combining current data on wind speeds with ground cover and land use. Estimated average wind speeds, extrapolated from 10 meters to 50 meters, of **15.8** mph at the Byron site and **15.0** mph in the Town of Herman (east of Lake Sinnissippi) were reported by Bob Owen. The Energy Bureau is also trying to get funding for an Avian study in the area of the Niagara Escarpment. Utilities were reported as not being interested in any specific site studies but might be interested in larger scale studies.

Steve Ugoretz handed out copies of a Scope of Work for an avian and wildlife characterization study for the southern Niagara escarpment area which is the technical aspect of the Energy Bureau's avian study project. He shared this document with the Avian Subcommittee and asked for feedback. Steve is looking for funding support for this effort. The next step is to develop a real study proposal. He suggested an RFP process to bring in interested parties and get a better indications of costs. DNR will also be applying for REAP funds from Department of Administration.

Tim Seek indicated that Kenetech may be able to make some support available in the form of Harvey Nelson. Tim also mentioned that the final environmental report out of the Buffalo Ridge Wind Project would be out in the near future and he would make copies available to our group.

### **Discussion of Windfarm Siting Guidance (6/12/95 version.)**

Paul Helgeson began discussion of the draft siting guidelines by reading comments from Dan Moran, Dan Juhl, and Paul Gipe. They were concerned with the implication that wind farms are aesthetically displeasing. Of concern was the comment in the guidelines that wind farms and recreation areas are incompatible. They feel that this is not always the case and that wind farms may actually be a tourist attraction.

The group was then asked to comment on the June 12 version of the siting guideline.

Bob Owen felt the draft guideline was too negative and implied that wind energy was "guilty" before the fact. He did not feel it fair to single out the wind industry to be burdened or disadvantaged because of unproven avian impacts. He felt that restrictive guidelines were unfair and would limit development.

Joel Trick commented that siting guidelines and restrictions are common for other kinds of facilities - landfills for example and that wind farms should be no different.

Dan Moran disagreed with the tone of the guideline that implied that wind farms were aesthetically unpleasant. He felt that the public would be more accepting of wind turbines than others on the committee suspect. He also agreed that bird impacts are an important issue but are linked closely to site specific conditions.

Tim Seek also felt that the guideline gave an unnecessarily negative slant to the aesthetic issue.

Deb Berns commented that site specific issues were predominantly important and that general guidelines should stay away from specifics.

Bill Fannucchi offered that the language of the guidelines could easily be neutralized to avoid negative connotation

Michael Vickerman also felt that the guidelines implied that wind energy was guilty before the fact. He also feels that the term wind farm should be clearly defined in terms of size and configuration. He recommended that the group read Paul Gipe's book "Wind Energy Comes of Age". He also stated that birds die mostly from electrocution and lead poisoning.

- some discussion followed on bird mortality, transmission lines and other causes of electrocution. -

Michael closed by asserting that rural aesthetic values are different from urban aesthetic values and that since turbines are going to be developed in rural areas, some attempt should be made to evaluate rural attitudes.

Karen Etter Hale commented that guidelines do not preclude development because they are guidance, not rules. Aesthetics tend to be site specific with some areas being more sensitive than others. She is generally pleased with the guidelines but felt that the guideline language could be neutralized so as not to prejudge aesthetic concerns.

Joe Gary felt that the guideline language was too strong and should be toned down.

Walt Boeshaar felt that the guidelines are a good start and are at the first stages of development. Mitigation methods need to be identified however.

The general consensus of the committee was to work on neutralizing the language of the guidelines. Specific comments **are due to Steve Ugoretz by July 7. A new draft will be out by July 14.**

In response to a question, Deb Berns commented on WPS's experience with landowners in the DePere area. Landowners were not concerned about bird impacts. The biggest concern was noise. People were not too concerned about aesthetics (but this is only a 2 turbine site). They were concerned to some extent about the number of turbine sites. WPS flew landowners to Buffalo Ridge to see and listen to the turbines there. Tim Seek said that the wind definitely was blowing and turbines were operating at the time. Landowner fears about noise were evidently put to rest.

#### IV. Power Plant Siting Criteria

The meeting closed with a short discussion of the PSC/DNR/Utility Power Plant Siting Criteria. D. Berns had suggested, in written comments, that these criteria be modified and used as a base for developing wind siting guidelines. Paul Helgeson briefly identified siting issues on that list that would not be of concern for wind farms (i.e. air and water issues) and highlighted areas that would likely be major concerns. Bob Owen commented that air quality would be a very important factor because it is one of wind energies environmental pluses. Bill Fannucchi responded that this is very true and is extremely important when wind farms are in competition with conventional power production. The group was in general agreement that Paul's comments provided a good base for discussion. He will prepare a modified list of siting issues from the PP siting Criteria for the group.

#### V. NEXT MEETING

August 1 at 10:30 at the PSC building, Third floor - 610 N.  
Whitney Way, Madison.

STEVE UGORETZ 101 S  
WEBSTER ST EA-6  
INTER-D  
PH# 608-266-6673 FAX#  
608-267-5231

MARCI YTTERBERG/TIM SECK  
KENETECH WINDPOWER INC 105  
SOUTH 5TH ST SUITE 735  
MINNEAPOLIS MN 55402 PH#  
612-321-0601 FAX# 612-321-0602

WALTER BOESHAAR WISCONSIN  
ELEC POWER CO 231 W MICHIGAN  
ST PO BOX 2046  
MILWAUKEE WI 53201-2046 PH# 414-  
221-4136 FAX? 414-221-3985

DAVE BLANKENHEIN  
MADISON GAS & ELECTRIC  
133 S BLAJR ST  
PO BOX 1231  
MADISON WI 53701-1231  
PH# 608-252-7942  
FAX# 608-252-1591

BOB OWEN  
1311 MIDDLETON ST  
PO BOX 620858  
MIDDLETON WI 53562-0858  
PH# 608-831-6150  
FAX# 608-831-1504

DONALD BAIN  
OREGON DOE 625  
MARION ST NE  
SALEM OR 97310 PH#  
503-246-1132 FAX# 503-  
768-4619

KAREN ETTER HALE MADISON  
AUDUBON SOCIETY 222 S  
HAMILTON ST SUITE 1  
MADISON WI 53703 PH#  
608-255-2473 FAX# 608-255-  
4053

DEBRA BERNIS  
WISCONSIN PUBLIC SERVICE CORP  
PO BOX 19001  
GREEN BAY WI 54307-9001  
PH# 414-433-1398  
FAX# 414-433-1176

PAUL HELGESON  
BILL FANNUCCHI  
PSCW  
PO BOX 7854 MADISON WI  
53707-7854 PH# 608-266-2072  
FAX# 608-266-3957

DEB BOOR  
WISCONSIN POWER & LIGHT 222 W  
WASHINGTON AVE PO BOX 192  
MADISON WI 53701-0192 PH#  
608-252-3223 FAX# 608-259-7289

DAN MORAN DOA-ENERGY  
BUREAU 101 S WEBSTER  
MADISON WI 53703 PH# 608-  
266-1067 FAX# 608-267-6931

JOHN DUNLOP  
AMERICAN WIND ENERGY ASSOC  
GREAT PLAINS REGIONAL OFFICE 448  
MORGAN AVE SOUTH SUITE 300  
MINNEAPOLIS MN 55405-1030 PH#  
612-377-3270 FAX# 612-374-2181

JOEL TRICK US FISH &  
WILDLIFE 1015 CHALLENGER  
CT GREEN BAY WI 54311 PH#  
414-433-3803 FAX? 414-433-3882

MICHAEL VICKERMAN  
RENEW WISCONSIN 222 S  
HAMILTON ST MADISON WI  
53703 PH# 608-255-4044 FAX#  
608-255-4053

DAN JUHL  
NEW WORLD POWER 191 W  
5TH ST COTTONWOOD MN  
56229 PH# 507-423-5547 FAX#  
507-423-5532

**Wind Energy Siting Collabora**  
**DRAFT Minutes**  
August 28, 1995

**Attendance:** Paul Helgeson PSC, Steve Ugoretz DNR, Bob Owen, Joel Trick USFWS, Dan Moran D Tim Seck Kenetech, Michael Vickerman Renew, Deb Berns WPS, Kirby Letheby WPL, Dave Blankenheim MG&E, Walt Boeshaar WEPCo

**Minutes:** Walt Boeshaar

**1. Minutes of 6/26/95**

B. Owen corrected the minutes to indicate that the 15-15.5 mph average annual windspeed estimate at the Town of Herman was for 50 M elevation not 30 M, and that measurements at Byron and Town of Herman were REAP site data, taken at 10 M (Byron) and at 30 M (Herman). The minutes were accepted with these corrections.

**2. Review of Guidelines**

As a first step toward consensus, each attendee briefly described their view of the Guideline's purpose. Purposes included use as a screening tool, an alerting mechanism for resource agencies, and as educational information for potential developers. M. Vickerman pointed out the guidelines are in part a response to conditions resulting from wind developments of a decade ago. Bob Owen expressed that responsible developers would voluntarily follow the steps in the Guideline, but the tone of the document was negative. D. Berns also indicated that the document was restrictive and set up potentially contentious issues.

**3. Co-ordination of Positions**

Further discussion of Guideline concerns centered upon issues of special characteristics of wind sites vs other generating facilities, applicability of current powerplant siting rules, affected minimum capacity and how to establish capacity, and the requirements of impacted regulatory and resource agencies.

A consensus was reached in that the Power Plant Siting Act and the current Power Plant Siting overview (small book) provide most of the necessary criteria for a wind site. However, some additional information is necessary to address wind-specific issues. To address the specific issues, the Guidelines would be reworked as an addendum to the overview. The addendum would include:

- An introduction, highlighting the unique characteristics and impacts of wind sites, such as wildlife impacts and typical geographic characteristics.
- A description of the siting process and how it applies to wind projects, with a definitions of terms.
- A reference list of affected agencies.

D. Berns, K. Letheby, and S. Ugoretz agreed to draft the rework of the Guidelines and provide the draft to the group by 9/30/95 for review and comment prior to the next group meeting.

**4. Avian Study (D. Moran)**

REAP funding of \$14,000 received, but still short of the \$120K for project, even with the \$60K matching from NREL. Scope of work will be redefined based on additional support from utilities and others. Approximately \$50K necessary to do the smallest valid study. The next NREL solicitation is expected in Sept./Oct. 1995.

**5. NWCC Siting Committee (S. Ugoretz)**

Next meetings 10/9-11/95 in the Twin Cities. Steve will attend and report at next meeting.

**6. GIS (P. Helgeson)**

Scope of work received from DNR, total costs need to be determined. Some of the required data is currently available, the rest will require original development.

**7. Next Meeting**

- 10/19/95 , 1:00 pm, @ MG&E (D. Blankenheim to arrange)
- Agenda: Review revised Guideline/Addendum

Post-It™ brand fax transmittal memo 7671		# of pages	3
To	Paul Helgeson		
Co.	PSC		
Dept.	Electric		
Fax #	6-3957		
From	Steve Ugoretz		
Co.	DNR		
Phone #	6-6673		
Fax #	My Comments		

#### MEMBERS PRESI

Ken Alderson	MG&E	608/252-70
Deb Berns	WPS	414/433-19
Walt Boeshaar	WEPCO	
Dave Blankenheim	MG&E	608/252-7
John Dunlop	AWEA/Great Plains	812/377-3
Karen Etter Hale	Madison Audubon Soc	
	Wisconsin Audubon Cn	608/255-2
Bill Fannucchi	PSCW	608/287-3
Paul Helgeson	PSCW	608/286-2
Dan Moran	WI Energy Bureau	608/266-1
Bob Qwan*	Consultant	608/831-6
Joel Trick	USFWS	414/433-3
Steve Ugoretz	DNR	608/286-8
Michael Vickern	RENEW	608/255-4

Arrived during the meet

#### CALL TO ORDER

Paul Helgeson convened the meeting. Attendees introduced themselves.

#### ACTIVITY REPORTS

National Wind Coordinating Committee, October 09 (Ugoretz, Helgeson, Fannucchi)

Avian Sub-Committee: Steve Ugoretz serves on the NWCC Avian Subcommittee. The sub-committee is developing standardized measurements for recording avian populations and activities. The strategies build on existing information, and strive to be consistent for different regions of the country. The committee is working more closely with the U.S. Fish and Wildlife Service. Numerous site studies are being conducted around the country.

*was held in Sept, 1995  
is being organized for 1996. Topic:*

The Second Wind Avian Interaction Work:  
both existing sites and prospective sites.

Topics will address

The subcommittee meets 3 or 4 times per year. Continuing operations are threatened by the budget cutbacks for the U.S. Department of Energy. The main value of the committee is to ensure compatibility and uniform applicability between studies, 2<sup>nd</sup> priority for conserving among the parties is wind resource development.

RECEIVED

Documentation of night migration is an important component of avian research. NREL is assembling a "radar wagon" that <sup>will</sup> be available from NREL on short term loan for nighttime assessments.

There was some criticism of the NWCC avian meeting in that the public was not a participant in the meetings. Local units of government were also not represented at the meeting. Many felt this is a significant omission.

Most states have no siting guidelines for projects of less than 12 MW of capacity. In California, the state has no jurisdiction in wind system siting.

*Is this a universal cut-off?  
(see Minnre  
report below)*

Washington County has initiated discussions on a conditional use permit filed on the "Eaton Project." The developer has installed six refurbished 17.5 kW turbines property. The machines are individually metered.

18  
qu

#### Minnesota Wind Siting Law (Dunlop)

Based on the recommendations of the Environmental Quality Board Wind Siting Task Force, the 1995 Legislature exempted wind energy projects from the state's Power Plant Siting Law as of August 1 of this year. The law also directs the EUB to adopt rules specifically governing large (> 5 MW) wind energy projects. The EUB has not yet adopted wind siting rules, which has led to some confusion regarding the application for Site Certification from Northern States Power for their Phase II project. The application was submitted under the previous rules, and the new rules are not in place.

#### AP-7 Decisions Regarding Wind Power Development (Helgeson)

Wind energy siting guidelines are to be a collaborative effort led by PSCW staff. Decisions

Wind energy siting guidelines are to be a collaborative effort led by PSCW staff. Decisions relate to both siting and resource assessment. The PSC has used cost data supplied by the utilities which equal approximately the data from the EPRI TAG. The Commission is expected to approve the AP-7 orders on 1995 December 7. The Commission will decide "Renewables Set-Aside" after their decision on restructuring, which is to occur on Dec 14.

Question from Michael Vickerman: What is the process for intervenors and staff to participate in the wind resource assessment decision? A: The Commission must approve the plan, but they will consider intervenor and staff comments.

#### Windpower-Avian Regulatory Policy Project (Ugon)

The primary objective is to document avian use in the designated wind energy area. A grant offer has been received with sufficient funds to begin the project. Site specific monitoring will be conducted.

*To fully investigate safe  
that a safe  
can be  
determined  
and use*



Two RFP's have been issued by NREL:

- 1) Reduce risk at existing wind power plants
- 2) Investigation of avian activity before and after a wind power project at a particular site

A second round of grants may be available contingent upon the budget available.

Additional funds will be sought from utilities to allow the use of more sophisticated equipment. The desired site will be in the southern Niagara Escarpment and selected in relation to distance from the marsh. To be eligible for the NREL funding, an experimental and a control site will need to be selected. Nocturnal migration is expected to be a very important component in the study. A suggestion was made to consider raising funds from communication industry with their strong vested interest in the issue. In addition, wind study may be valuable to ornithology research. Other possible funding sources: AT&T Foundation, cellular phone companies. The DNR may be able to sell GIS data collected as a part of study. DNR is particularly concerned about endangered species.

#### WINDFARM SITING GUIDELINES

migratory and

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The goals have changed with time. Originally the goal was to set detailed guidelines which would include a thorough assessment and details for compliance. The current approach gives the developer more flexibility in accomplishing the general environmental priorities for a wind energy project.

Bill Fannucchi: The two approaches should be combined.

Deb Berns: other interested parties, such as local officials, developers and land owners, should have a role to play in siting of projects.

Joel Trick: Noise should also be considered in siting.

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Michael Vickerman: It would be easy to establish uniform guidelines for expressing noise levels, and noise data is available from the manufacturers.

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Bob Owen: The original draft of the guidelines were unfair to the developer.

A sub-committee consisting of Deb Berns, Joel Trick, Karen Etter Hale and Paul Helgeson agreed to consider the points brought out in discussion and submit a revised draft for consideration for the full committee. Deb Berns volunteered to write the first draft. She expected to complete the draft by the first week in November.

Wisconsin Wind Siting Collaborative  
Meeting Notes  
Held at Madison Gas and Electric  
1995 October 19  
1:00 - 4:00 p.m.

**MEMBERS**

**PRESENT:**

Ken Alderson	MG&E	608/252-7020
Deb Berns	WPS	414/433-1398
Walt Boeshaar	WEPCO	414/221-4136
Dave	MG&E	608/252-7942
John Dunlop	AWEA/Great Plains	612/377-3270
Karen Etter	Madison Audubon Society Wisconsin Audubon Council	608/255-2473
Bill Fannucchi	PSCW	608/267-3594
Paul Helgeson	PSCW	608/266-2072
Dan Moran	WI Energy Bureau	608/266-1067
Bob Owen*	Consultant	608/831-6150
Joel Trick	USFWS	414/433-3803
Steve Ugoretz	DNR	608/266-6673
Michael	Renew Wisconsin	608/255-4055

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## **WISCONSIN WIND RESOURCE ASSESSMENT**

**Dan Moran:** Resource assessment guidelines should clearly indicate a preference for data taken at expected hub height -- at least 30 meters high. On the other hand, the guidelines should not be too specific and limit research options. **Dan Moran:** The oil overcharge plan could be modified to include resource assessment funds. **Michael Vickerman:** It is important that the information generated by resource assessment programs be made available to the public. Data is not currently available from Kenetech, which could be useful to the state climatologist. **Others:** The Commission could provide funds as well for resource assessment. **Fill Fannucchi:** Wind data should be provided in a GIS system. It is his hope that wind can exist on the landscape without problems.

## **NEXT MEETING**

**The next meeting will be at 1:00 p.m. on Thursday, December 7. Dave Blankenheim offered**

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## WISCONSIN WINDFARM SITING GUIDANCE

DRAFT 11/95

### **I. General Power Plant Siting Regulations**

There are a number of state and local regulations that require permits for power plant siting in Wisconsin. While the types of regulations and permits may vary, the information and data required to obtain these permits are generally consistent. Approval for wind generation plants of 12 megawatts (MW) or larger requires a Certification of Public Convenience and Necessity (CPCN) from the Public Service Commission of Wisconsin (PSCW). The CPCN requires that an analysis of the environment be conducted for compliance with the Wisconsin Environmental Policy Act (WEPA). Plants smaller than 12 MW do not require a CPCN; however, these smaller plants will require a number of state and local permits that may require information on environmental impacts. It is recommended that any windfarm development consider these guidelines when installing wind power generation.

### **II. Power Plant Siting Criteria**

Wisconsin has established statewide power plant siting criteria and a process for interested parties to participate in during the approval of these sites. These criteria and their use are presented in the document, "An Overview to Power Plant Siting", which is available from the Public Service Commission of Wisconsin. This document will assist planners and developers in understanding the types of data that should be gathered and how the information should be used to select a wind site.

Windfarm siting poses some different environmental issues from siting combustion-based electric generation facilities. Thus, technology-specific changes in the power plant siting criteria are needed for windfarms.

### **III. Windfarm Siting Criteria**

The following criteria, based on "An Overview to Power Plant Siting" should be evaluated when developing utility scale windfarms. Individuals installing turbines to serve individual homes or small businesses are also encouraged to use these guidelines. Applying the windfarm siting criteria should assist wind developers to identify areas with the least potential for adverse impacts. This outline lists the recommended siting criteria that should be evaluated in order to provide environmentally sound siting of wind facilities.

#### **I. Site Requirements**

- a. Air space restrictions
- b. Site expandability
- c. Site geography
- d. Site size
- e. Transmission access
- f. Site adaptability
- g. Access
- h. Site buffering
- 
- 
-

## **II. Community Impacts**

- a. Archeological & historic significance**
- b. Aesthetics**
- c. Costs to community services**
- d. Public attitude**

## **III. Public Health & Safety Concerns**

- a. Electric and magnetic fields (EMF)**
- b. Noise**

## **IV. Environmental Impacts**

- a. Wildlife areas**
- b. Natural areas**
- c. Wetlands/Floodplains**
- d. Migration corridors (bird and bat)**
- e. Protected species**
- f. Avian collisions**
- g. Stormwater runoff management**

## **V. Land Use Impacts**

- a. Forests**
- b. Land use compatibility (existing and future)**
- c. Previous land use**
- d. Agricultural land**
- e. Recreational/Scenic/Tourist areas**
- f. Active landfills**
- g. Land acquisition (ecological & restoration projects)**

## **VI. Economic Impacts**

- a. Future development limitations**
- b. Transmission & distribution changes**
- c. Jobs & purchases**
- d. Levelized delivered cost of energy**
- e. Local tax impact**
- f. Property values**

**There are several environmental and land use issues associated with the development of windfarms that have increased potential to create adverse impacts. Consequently, they require a thorough investigation and evaluation. These issues are identified below.**

**Wildlife and Natural Areas - Birds and other wildlife are known to concentrate in certain wildlife and natural areas. These areas may be officially designated State or Federal refuges, or other public or privately owned, non-government properties. Siting should avoid or minimize avian impacts in these areas along with other areas where birds congregate (i.e. resting and feeding stops during migration, active landfills). It will be important to know the activity patterns of both birds and wildlife associated with these areas, to allow for appropriate siting decisions. This type of information can be obtained from the responsible wildlife managers, wildlife experts, knowledgeable land owners or wildlife organizations in the vicinity. This information may allow for development in these areas to proceed, while decreasing the likelihood of conflicts. Developers should consider**

reasonable setbacks from areas with significant bird and wildlife populations. There are areas where the populations are significant due to the type of species present - not just because of the increased numbers of individuals. These setbacks should be based sound information about activity patterns in the proposed site area.

**Avian Collisions** [Migration](#) **Corridors** - Ongoing research is continually identifying new techniques for minimizing avian mortality at wind power installations. These technologies may consist of blade painting or tower designs that reduce or eliminate perching opportunities and should be considered when initially developing the wind energy facilities. Interested parties should contact the information sources listed below, to access the most up-to-date technology available. These strategies typically are geared towards minimizing mortality of birds at wind facilities during daylight hours. However, there is also a potential for mortality of birds and bats during nocturnal migration flights and this also should be part of the site investigation.

Developers should be aware of the migration corridors with the highest probability of bird concentrations and develop strategies to avoid adverse bird interactions. An example of a documented migration corridor is the hawks along the Lake Michigan shoreline. State and federal endangered, threatened and special concern species should receive special consideration. Sources for this information include the Department of Natural Resources (Bureau of Endangered Resources), U.S. Fish & Wildlife Services, birding clubs and knowledgeable local land owners.

**Wetlands** - Wetlands tend to attract a variety of birds and certain wetlands are important concentration areas for birds. To protect birds using wetlands and wetland hydrologic characteristics, windfarms should not be constructed within a wetland complex. Setback distances from the wetlands should be determined based on the size and functional values of the specific wetland, including values related to wildlife use and the hydrological relationship to the surrounding area. Protection of these values can be maintained while still allowing the construction of windfarms near some wetland areas.

**Land Use Compatibility** - Windfarms would be inconsistent with the philosophies of some park, recreational, and scenic areas with respect to noise and aesthetic values. The concern is with some active use and educational areas that focus on natural or wilderness amenities. Windfarms may be compatible with certain areas where a natural setting is not critical. Additionally, certain areas in the state are targeted for ecological restoration and windfarms would be incompatible within their boundaries (i.e. Baraboo Hills, Pine Barrens of northwestern Wisconsin and the Kettle Moraine State Forest). State designated natural areas also would be included in this category.

**Residences** - Local residents and adjacent land owners will likely have questions and concerns about the impacts of wind generation on their lifestyles and property. It is advisable to obtain the cooperation of neighboring property owners and the community early in the siting process. They can provide valuable input on layout, noise, aesthetics and other concerns that could eliminate conflicts later in the process. It will be beneficial for the developer to satisfy all the local concerns in order to obtain the required local permits.



#### **IV. Special Study Requirements**

During the initial stages of planning a wind site the developer should contact the Department of Natural Resources and the Public Service Commission to begin discussions on the appropriate environmental review that would be required for approval. There are several potential topics that may require site specific studies to be conducted. The magnitude of the various studies may change depending on the size of the wind farm, the site specific characteristics, or potential level of impact. Potential study topics are as follows:

1. To avoid or alleviate potential conflicts and impacts on bird, plant and animal species of the area during construction, operation, and maintenance, an inventory of existing wildlife management areas, natural areas, recreation areas, wetlands, native prairies and forests, and any other biologically sensitive areas should be conducted.
2. A site specific wildlife assessment should be conducted for each site under consideration. The study should include a characterization of the resident and migratory bird populations on a seasonal and day/night basis. Special emphasis should be placed on small mammals and other animals that may be prey base for raptors. This evaluation should follow accepted standard protocols for windfarms.
3. Bird use and interactions with wind turbines and supporting facilities should be monitored after installation, using accepted standard methods. The monitoring should evaluate any collisions and mortality that occur to determine whether the facility can be modified to prevent future collisions, or if mitigation is needed. An adaptive management approach to planning, design, construction and operations is highly recommended.

#### **V. Additional Information Contacts**

There are a number of areas to obtain information and agencies to consult with to complete the research and evaluation of a site for windfarm development.

Major .....

1. Public Service Commission of Wisconsin
2. Department of Natural Resources
  - a. Bureau of Environmental Analysis & Review
  - b. Endangered Resources
  - c. Water Regulation & Zoning
  - d. Wildlife
3. U. S. Fish & Wildlife Services
4. Local Governments
5. Federal, state and local Parks Departments
6. Audubon
7. Birding Clubs
8. Local Land Owners

Individual from the following list of conta

To be supplied....

#### **VI. References**

To be supplied.

Wisconsin Wind Siting Collaborat  
***FINAL* ~~BOARD~~ MEETING NOTES**  
Held at Madison Gas and Electri  
December 7, 1995  
1:00 - 3:30 p.m.

WINDFARM SITING GUIDANCE

1. Paul Helgeson reviewed background and purpose of guidelines.

- A. Intent is not to create new laws or regulation, but rather put existing rules in one place for benefit of wind farm developers.
- B. The current law, statute 196.49, requires construction authority for public utility projects of any size. Statute 196.491 requires a CPCN for any project over 12 MW, regardless of ownership.
- C. It is anticipated that many of the future wind development project in Wisconsin will be in projects under 12 MW and may not be owned by electric utilities.

Bill Fannucchi discussed his original concept for the guidelines. They were intended to be environmental guidelines as opposed to wind power plant guidelines. Their purpose was to help define environmental siting criteria for wind power projects. He distributed graphic of process (attached):

Paul facilitated a discussion to establish a clear focus and action plan for moving forward with development of guidelines. Discussion at past meetings provided the background required to take this step.

Most important issues:

- \*Exclusion Areas (1)
- \*Definition of "high impact areas" (4)
  - a) size of project
  - b) what is impacted? \*Bird/Wind
- turbine interactions (4)
- \* Wildlife impacts (1)

Interactions of major concern:

Rotating blades  
Turbine structure  
Bird collisions

The collaborative concluded that bird collisions with some part of the wind turbine was a major concern for everyone. The collaborative members agreed that the next step was to establish a subgroup to better define this issue and what is meant by high impact area.

BIOLOGICAL ISSUES SUBGROUP

Steve Ugoretz  
Joel Trick  
Karen Etter Hale  
Noel Cartright (invited)  
Bill Fannucchi  
Ken Alderson  
(at least one GIS person)

1. This subgroup is to provide an outline and plan as to how they will proceed to Paul H. following their first meeting. This will allow all collaborative members to comment on how this subgroup would proceed.
2. Subgroup will also submit a monthly progress update to Paul H.
3. CHARGE TO SUBGROUP:
  - Determine what we need to know.
  - Define high impact area. Define how to determine if an area is a high impact area. What data needs to be gathered and analyzed? Identify existing data resources.
  - Identify types of potential high impact areas which may be of concern (i.e. wetlands, nesting areas, parks, etc.)
  - Need to consider what are ideal siting area from developers' perspective. In others words, what are the most significant project development needs that will determine where sites are selected.

At the conclusion of the meeting slides of wind power projects in California, Minnesota, and Europe were shown by Ugoretz and Vickerman.

**NEXT MEETING:**

Wednesday, February 28, 1995  
10:00 A.M. @ MG&E

**MEMBERS PRESENT**

Ken Alderson	MG&E	608/2	7020
Deb Berns	WPS	414/4	1398
Walt Boeshaar	WEPCO	414/2	4136
Dave Blankenhei	MG&E	608/2	7942
Karen Etter Hale	Audubon Societ	608/2	2473
Bill Fannucchi	PSCW	608/2	3594
Paul Helgeson	PSCW	608/2	2072
Kirby Letheby	WP&L	608/2	3276
Dan Moran	WI Energy Bure	608/2	1067
Joel Trick	USFWS	414/4	3803
Steve Ugoretz	DNR	608/2	6673
Michael Vickerr	RENEW	608/2	4055

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# **PUBLIC SERVICE COMMISSION OF WISCONSIN**

## **WIND SITING GUIDELINES COLLABORATIVE**

### **DRAFT MEETING MINUTES**

1996 February 28

MG&E

### **ATTENDANCE**

Ken Alderson	MG&E	608/252-7
Dave Blankenheim	MG&E	608/252-7
Walt Boeshaar	WEPCO (via phone)	414/221-4
Noel Cutright	Wisconsin Electric	414/221-2
Earl Davis	EPRI	360/681-8
John Dunlop ✓	AWEA	612/377-3
Bill Fannucchi ✓	PSCW	608/267-3
Ron Gatti	DNR	608/221-6
Karen Etter Hale ✓	Audubon	608/255-2
Paul Helgeson ✓	PSCW	608/266-2
Ray Janssen ✓	W.P.S.	414/433-1
Kirby Letheby	WPL	608/252-3
Dan Moran	DOA Energy Bureau	608/266-1
Bob Owen ✓	SSE	608/831-6
Joel Trick ✓	USFWS	414/465-7
Jayne Van Campenhout	W.P.S.	414/433-1
Steve Ugoretz	DNR	608/266-6

### **REVIEW OF PREVIOUS MEETINGS**

- ? What is the desired size of wind power projects? Should the siting process apply to clusters of machines? The Power Plant Siting law applies to projects of greater than MW. PSCW guidelines will apply to all projects. Some issues will be unique to wind energy.
- \* The Collaborative decided on 1995 December 8 to set aside the guidelines and to concentrate on biological issues.

### **REPORT OF BIOLOGICAL ISSUES SUBCOMMITTEE**

The subcommittee adopted a ranking of issues for selecting sites:

1. Important designated sites; e.g. state or federal natural areas
2. Concentration

3. Breeding sites
4. Behavioral factors; e.g. resident risk
5. Flight patterns; e.g. avoidance behavior
6. Movement within area
7. Methods, information sources; communities, abundance, surveys

Good data sources include Ed Colson's work written for AWEA and the California Energy Commission bibliography.

Process for defining a "High Impact Area":

Noel reported that the Biological Issues Subcommittee recommended identifying a pilot area then inviting local bird experts to meet to evaluate the proscribed area and assess the avian risk. The group will use this avian resource information to establish the GIS grid. Steve supported the need for a template to help guide development.

Bill suggested that wind siting guidelines augment -- not replace -- the EIS portion of the power plant siting guidelines. The GIS will help focus on the environmental impacts and help to highlight sensitive resources areas.

Bob pointed out that regulations and permits determined by both the power plant siting guidelines and local county guidelines. In some towns, wind is a permitted use, and small IPP projects would not require a separate permit. In others, a conditional use permit may be required, or it may be necessary to have the property rezoned.

One of the challenges in establishing the GIS grids is the need for data. Many layers exist, but others need to be developed. For instance, there are over 10,000 miles of transmission lines in the state, and the grid with those needs to be improved.

The Department of Administration Energy Bureau is already providing GIS information PSCW under a \$71,000 contract. The Biological Subgroup anticipated that a number of months would be needed to develop the GIS templates, but with the assistance of DOA, the maps and grids will be provided to PSCW by March 1. Topological data is currently to a 75 m scale, but 10 m data is being developed. Most grids are to a 1:250,000 scale, but in some counties data exists down to a 1:24,000 scale for topological features.

DOA uses a modification of the GIS process used by the Union of Concerned Scientists in their 1993 study, "Powering the Midwest." Exposure data already exists for the model.

The proposed study area is based on the available wind and bird data. Since wind development off shore in Lake Michigan is a possibility, Bob recommended that the GIS maps include lake bottom depths.

Kirby questioned whether a statewide study might be more cost effective than studying only a small area. Though a statewide study would be more expensive, he reasoned that it might only be marginally more than the cost of doing a study of a limited area. He was also concerned that the study was proposing to be unreasonably detailed.

Members of the Subcommittee suggested that the process can be refined while evaluating a smaller area, which can then be applied to other areas or the entire state more cost effectively.

Earl inquired whether the GIS would be for development information only, or if it could be used in the regulatory process. Steve believes the GIS would be intended to assist in development, but that it could have a bearing on the regulatory process as well. Bill suggested that the GIS might assist in determining if a project would need to have a full EIS or simply an EAW. In that way, it could simplify the permitting process. Without the GIS, on the other hand, Commission staff would automatically require that a full EIS be conducted. However, no formal conclusions could be drawn only from the GIS.

The cost of developing the statewide study is mandated by the PSC to be paid by the utilities. The total cost, however, has been dramatically reduced by the \$71 k PSC contract with DOA for the initial model. The exact cost of completing the model has not been determined. Joel felt that the panel of experts would need to meet a full day to assess the level of risk for regions in a pilot study area. Jayme recommended that a prototype area study should first be conducted to help determine the costs involved.

Bill felt that an additional expenditure of \$10,000 to \$12,000 would cover the cost of the pilot study, including preparation of a GIS layer. Kirby expressed his concern that it wasn't clear where the group was going with the pilot project and that he wasn't sure of the need for the work, but that he would go along with the proposal in the hope that it would bring better definition of what is expected of the utilities. Kirby prepared the following questions to be answered, by the Biological Issues Subcommittee, for the utilities who will be expected to fund the study:

1. Cost of the prototype?
  - Scale/detail of the prototype
  - Any other implementation costs, such as the requirement for additional templates for the GIS
  - Time and financial resources expected from utilities

2. What is the estimated cost to perform study on relevant areas of entire state?  
Scale of the state level  
Any other implementation costs, such as additional layers for a statewide GIS Value, use and purpose of a statewide GIS; regulatory implications; would the GIS determine if an EIS is needed; what would the needed level of detail to make this determination
3. Relationship between the GIS and wind plant siting study criteria or wind plant siting study requirements.
4. What is the cost of maintaining and updating the GIS?  
Time and financial resources expected from utilities
5. Is this project relevant only to biological issues, or is it only part of the data needed?
6. Are there other anticipated GIS costs to the utilities? (Is this a question for another group?)

The Collaborative agreed to authorize the Biological Issues Subgroup to proceed with the pilot project in a rectangular area bounded on the west by STH 73, on the south by STH 60, on the north a line roughly following STH 23, and on the east Lake Michigan, with the understanding that the cost would be no greater than \$12,000.

## RELATED ACTIVITIES

Steve reported that the next National Wind Coordinating Committee will be meeting in April; he would like to have the guidelines available by that time.

Earl implored the Coalition to ensure that it uses the recommendations from the NWCC before branching out into other areas. The NWCC is a good forum to discuss wind development issues. Since Steve and Bill are on the NWCC Avian Subcommittee, he recommended that a utility representative, such as Jayme, should also join the subcommittee.

## ADJOURNMENT

The meeting was adjourned at 12:30 p.m.

Meeting notes provided by John Dunlop. Please contact Paul Helgeson (FAX: 608-266-3957), by March 26, if you have suggested changes in these notes.

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# Public Service Commission of Wisconsin

Cheryl L. Parrino, Chairman  
Daniel J. Eastman, Commissio  
Joseph P. Mettner, Commissic

610 North Whitney Way  
P.O. Box 7854  
Madison, WI 53707-7854

## Wind Power Siting Collaborat

<u>Name</u>	<u>Org</u>	<u>Phone</u>	<u>Fax</u>
*Ken Alderson	MG&E	608-252-7020	608-252-1:
Dave Blankenheim	MG&E	608-252-7942	608-252-1:
Donna Danihel	WEPCO	414-221-3421	414-221-2
*Noel Cutright	WEPCO	414-221-2179	414-221-2
John Dunlop	AWEA	612-377-3270	612-374-2
*Greg Egevedt	WPSC	414-433-5713	414-433-1:
*Bill Fannucchi	PSCW	608-267-3594	608-266-3:
*Karen Etter Hale	Audubon	608-255-2473	608-255-2:
Paul Helgeson	PSCW	608-266-2072	608-266-3:
Kirby Letheby	WPL	608-252-3276	608-259-7:
Dan Moran	DOA	608-266-1067	608-267-6:
Robert Owen		608-831-6150	608-831-1:
*Joel Trick	USFW	414-465-7440	414-465-7:
*Steve Ugoretz	DNR	608-266-6673	608-267-5:
Michael Vickerman	RENEW	608-255-4044	608-255-4:

: Paul Helgeson, PSCW, 608-266-2072

DA : 4/10/97

3-25-97  
MEETING

PAGES:

*Here are the minutes of the last meeting of the Wind Power Siting Collaborative, thanks John Dunlop. If you have questions or comments, please let me know as soon as possible hope that we will have some recommendations from the biologists for a meeting in June.*

PCH:dh:H\STAFF\TEAMS\RENEW\WINSITE\Fax-4-10-97.

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RECEIVED

Wind Power Siting Collaborative Meeting  
PSC-WI, Madison Hearing Room 1997  
March 25 Meeting Notes

Attendees: Ken Alderson, Donna Danihel (via phone), John Dunlop, Bill Fannucchi, Paul Helgeson, Robert Owen, Joel Trick, Steve Ugoretz

1) **CHECK-IN**

Paul Helgeson requested John Dunlop to take notes for the meeting. No changes were suggested to the agenda distributed by Paul

Recent business activities:

- Zond has signed a contract with MidAmerican Energy (Iowa) for 112 MW of nameplate wind capacity to be brought on line by the end of 1998
- Central & South West (TX) will be installing 40-50 MW by 1999
- Two Tacke turbines (600 kW, 46 m diameter, 60 m tower) will be installed by August of this year near DePere, WI

2) **REPORTS ON RELATED ACTIVITIES**

**A. National Wind Coordinating Committee (Steve Ugoretz)**

NWCC has developed position papers which will be distributed by the National Council of State Legislatures

Heather Rhoads (formerly of I-RENEW) has been hired by NWCC as their Outreach Coordinator.

NWCC will be developing a strategic plan to help determine future activities. They intend to "scale back mature activities." NWCC is expected to focus on distributed applications for wind energy. A key issue will be continued funding from the U.S. Department of Energy. NWCC is considering whether to terminate the NWCC Siting Committee or combine it with the Avian subcommittee.

The Avian Subcommittee is developing standardized methods for avian assessment and metrics for evaluation of avian activities. The committee is co-chaired by Dick Anderson and Bill Grant. A major challenge is to determine standard methods which will allow comparisons of avian concentrations between sites and the potential interactions with wind turbines. The Avian Subcommittee is expected to complete a draft standard this summer and submit it to the NWCC

board for review. The committee intends to conduct an informational workshop in February of 1998. The draft document will include "considerations" (rather than "issues"), methods of addressing the considerations, and recommended actions. The original authors should complete their review in May of 1997.

Q - Bob Owen: Will the document be available for review prior to its release? Steve: The

request should be made to the NWCC Siting Subcommittee. Q - Paul Helgeson: Will the

document include noise considerations?

Steve: The document will outline the *methods* to determine noise levels, but not set minimum standards for noise. The primary goal is to assist with permitting issues for projects.

Bill Fannucchi: There is considerable resistance to minimum standards. The issue is "how to deal with noise." Bill recommends a "tool box" approach to present optional methods to deal with the issue.

## **B. Wisconsin Wind Energy Task Force**

1. The four participating utilities have signed a contract with the German firm, Tacke, for two turbines to be installed on Scray's Hill just southwest of Green Bay, Wisconsin.
2. The WETF is considering issues to be included in the utilities' Advance Plan 8.
3. Global Energy Concepts (GEC, Karen Conover, President), has been contracted to conduct the wind resource assessment at fourteen sites in windy areas of the state. GEC needs to consider the "exclusion areas" that will be determined by the siting committee. Twelve sites will monitor winds up to 40 meter heights, and will use the two sites monitored by Bob Owen for the Energy Bureau. Funding for the project is provided by NREL (\$100k) and the utilities (\$350k). The project will rely upon input from the siting committee. The goal is to find the windiest areas of the state.

Recent wind resource assessment activity: There is a REAP wind monitoring site in the Chequamegon National Forest one mile southeast of Mellon in the Penoque Range. The site is about 20 miles south of Lake Superior on a wooded site. Two anemometers are mounted at 35 meters, some 25 meters above the treetops.

Steve inquired about the Green Mountain Power Zond project. Bob reported that a problem has been experienced with the hub attachment bolts and gearboxes, which may have to be replaced. There are 11 Z-40 550 kW turbines with full span pitch control.

## **3) REPORT FROM BIOLOGICAL ISSUES SUBCOMMITTEE**

Bill displayed GIS color maps that he has generated for the pilot area. The maps include suggested restrain areas for wind development. [For a copy of the maps, please contact Bill at 608/267-3594.] Additional data are required for GIS layers in order to determine the "constrained areas" for wind development. One layer being used is the State Hydrography layers which identify water bodies and land use by wooded, farmed, wetlands. They are also using the Wisconsin Wetland Inventory, which cost the department \$18k.

Joel: What is actually needed?

Bill: The hydrography layer would be very useful. Attention needs to be given to "edge mapping" - the interface between townships. The goal is to make it easier to develop wind

energy by defining "constraint zones." For instance, a constraint zone might include areas with high goose use.

Bob: What elevation data are available?

Bill: The finest elevation data available show 70 meter contour data. **Bat**

## **Issue**

The main concern is around the Needham Hybemaeculum just north of Iron Ridge and southeast of the Horicon Marsh. Remaining questions include 1) how widely distributed are the high concentrations of migrating bats, and 2) do the bats use the same migration paths each year. The committee is still developing the scope and funding for the evaluation, and should have a program plan completed by this summer, and field surveys begun by the fall. The committee is trying to be proactive in identifying any potential problems associated with the hybemaeculum. For instance, if a problem appears to exist, it would last only for a short period of time during a period of 4-6 weeks in September and April. The bat study will tie into the other avian studies. Preliminary data from the Kenetech project on the Buffalo Ridge indicates that about the same number of dead bats and birds have been observed, though both are relatively low numbers (about ten of each over the past two years). There is very little known about the viability of extrapolating data collected at the Needham to the rest of the state.

Bats collect under the Congress Steet Bridge in Austin, Texas. Perhaps attendees at the Windpower '97 conference in Austin who have an interest in this issue should be alerted that bat activity can be observed while in Austin.

## **4) NEXT STEPS**

### **A. GIS activities**

Bill: Data for the GIS can be expensive. There is \$25k in the WRAP budget to apply to the wind GIS. The Energy Bureau will conduct the development of the GIS data.

Joel: Karen Conover will be in Madison on April 7 to meet the utilities' Supervisory Committee. EPRI is conducting monitoring at Scray's hill, where the two Tacke turbines will be installed.

### **B. Guidelines for projects above or less than 12 MW**

Paul: The Public Service Commission only regulates projects greater than 12 MW; yet preferred dispersed wind projects will be no larger than 12 MW. What guidelines should be developed for smaller projects?

Bill: The purpose of the siting work is to develop an inventory of information and act as a clearinghouse for local units of government to receive information that will be relevant to small projects.

Steve: The NWCC is developing guidelines which may be adequate. This will be one of the tasks for Heather Rhoads to complete. They will be developing a "wind siting handbook."

## **5) NEXT MEETING**

Work will continue by the biological issues subcommittee. It was decided to establish another Siting Committee meeting after progress has been made by the subcommittee.

ca/John

Dunlop;

**Corrected 10/19/99**

## **WIND POWER SITING COLLABORATIVE**

Minutes October 12, 1999,  
10:00 am

### **Two RFP's have t**

Steve Buss	Alliant Energy
Alex DePillis	Wisconsin Energy Bureau
David Donovan	NSP-W
John Dunlop	American Wind Energy Association
Bill Fannucchi	PSCW
Jeff Ford	MG&E
Karen Etter Hale	Madison Audubon Society
Paul Helgeson	PSCW
Shawn Puzen	WPS
Mick Sagrillo	(by telephone)
Kathy Trudell	RSI/ FPL Energy
Steve Ugoretz	WDNR
Michael Vickerman	RENEW Wisconsin

### **1. SITING ISSUES AT KEWAUNEE COUNTY SITES**

(Jeff Ford reported on issues from MG&E perspective, Shawn Puzen from WPS, and Mick Sagrillo from local perspective.)

Noise. Jeff stated that MG&E has had several noise complaints mostly from opponents to the project. Sanchez Industrial, has been hired to do a study. Shawn and Mick reported that WPS has established a committee, on which Mick serves, to select a contractor to document and analyze the noise problem. Bill recommended that full octave spectrum analysis be done.

FAA Lighting. This seems to be a public concern only for WPS project and the lighting level on that project was the result of letters sent to FAA by opponents of the project. The light is intended to be horizontal; the lights are shielded on the top. Mick and Paul will try to work with FAA on a solution.

Well Problems. MG&E has had no problems, WPS has one reported problem and is investigating.

RFI/TV Reception. MG&E reports 5 TV reception complaints, mostly due to poor systems to begin with, but the company is paying for corrective work. Four of the five complaints have

Steve said the a revised version of Nation Wind Coordinating Committee Siting guideline should come out next year, in the meantime there is a new printing of the current version.

Discussion followed on the need for a shorter version of the guidelines specifically for Wisconsin. Alex mentioned the need for model wind ordinances so that other counties don't end up using something like the Door County model. There is a need for good information for both local government officials and developers.

The group decided to establish a committee to work on both guidelines and a model ordinance. **Guidelines committee: Paul Helgeson, Steve Ugoretz, Michael Vickerman, Alex DePillis, and John Dunlop.**

NWCC will be issuing a publication on Avian Standardized Methods and Metrics in November of this year.

## **5. FP&L PROJECT HEARING**

Paul reported on Town of Addison's attempt to hold a conditional use permit hearing Thursday night, 10/7/99. 500 people showed up from the town and surrounding communities. The meeting was called off at the order of the fire chief because of the overflow crowd. Many people were upset because they had only heard about the project a week before the hearing. Kathy thought FP&L didn't understand the political difference between Wisconsin and other midwestern states. Town was just not prepared to handle this kind of issue.

Kathy reported the following developments from FP&L:

- Rescheduled hearing won't be until early December
- Public info meetings will be held on October 27 and November 3 with 2 sessions each day. **[Set for 1:00pm and 6:30 pm for Wed., October 27, and Tues., November 2, at the Washington Fairgrounds Conference Center.]**

General discussion followed on public reaction and lessons to be learned from siting experiences in Wisconsin. One of the hardest issues to deal with is perception that such a project will reduce land values. Studies done on this issue as it relates to all kinds of electrical facilities are inconclusive. Really the only way to deal with this issue is indirectly by addressing related concerns such as noise, radio and TV interference, FAA lighting, and other issues raised in Kewaunee County. FP&L's approach included lessons learned in previous projects except for getting information out to the general public early. Concern was express that once people have an opinion on a project like this it is very difficult to change that. We should keep in mind that while there are similarities between this project and those in Kewaunee there are also many significant differences.

### **Next Meetings**

Whole group will meet sometime after the first of the year. The Guidelines/Model Ordinance committee will meet **Thursday, Nov. 4, 1:30** at Wisconsin Energy Bureau.

been taken care of. WPS reports similar situations in their project area. Mick reports that at least some of the TV reception problems are legitimate line-of-sight problems.

Mick attended Town of Lincoln board meeting on October 4, 1999, at which most recent resident concerns were aired. Another issue is "the strobe" effect of sun's rays passing through turbine blades when the sun is low in the sky. Planting trees to eliminate problem are addressing these problems. Mick believes that people perceive more noise from turbines when they are downwind and that the density of the WPS project makes the problem greater there. Vortex generators installed on the blades of the two turbines in the Glenmore project seem to reduce aerodynamic sounds.

## **2. MAPPING and WRAP DATA COLLECTION**

Alex reported that mapping at WEB is behind schedule because of recent software upgrades. Jeff Carlson has produced some preliminary maps, but nothing to share yet. Bill F. has not been able to work on his GIS layers because of other priorities.

Alex also reported that at least one year's worth of data has been collected at 12 Wind Resource Assessment Project (WRAP) sites. Site number 13, at which shear studies will be done, is to be installed on WIBU tall tower before winter. The existing site at Rib Lake will be moved to what is believed to be a better wind site in town of Arlington near Ag experimental station.

WRAP monthly reports from GEC are available from Alex.

## **3. ONGOING AVIAN STUDIES**

Shawn reported on studies jointly funded by WPS and MG&E. On June 1 population studies were resumed by Tom Erdman and mortality work continues to be done by Bob Howe, UW-Green Bay. Both are two-year projects. Bill Evans (a national expert formerly with the Cornell Laboratory of Ornithology) has been contracted to do nocturnal study of bird activity. He has setup 5 microphones, 2 reference sites (one near DePere and one south of wind projects in Kewaunee Co., 2 sites in the MG&E windfarm and one in the WPS wind farm. Additional microphones will be mounted on turbines in the two project areas. A preliminary report is expected from Bill Evans in early winter.

In September a total of about 50 Little Brown and Hoary bats were killed near the turbines. For a while no kills were found, but in the past week or so 20 have been killed.

Kathy reported that RSI conducted visual population studies in Town of Addison 5 days per week from April to June. Since June observation have been reduced to one day per week and in the past month the study was expanded to one hour before sunrise and one hour past sunset to look for bats. Very little bird or bat activity has been identified.

## **4. NATIONAL (NWCC) SITING GUIDELINES**

## Notes from Guidelines and Model Ordinance Ad Hoc Subcommittee

**Attendees:** Meeting January 12, 2000 at the PSCW. Beginning at 1:30 pm.

Next meeting PSCW 1/24/2000 9:30 – until the cows come home and all wind siting issues are complete

☺

Notes by DePi

Name	Affiliation	Phone	e-mail	Fax
Alex DePillis	Wisconsin Energy Bureau		<a href="mailto:alex.depillis@doa.state.wi.us">alex.depillis@doa.state.wi.us</a>	608-267-6
Frank Arevalo	Wisconsin Power and Light		<a href="mailto:frankarevalo@alliant-energy.com">frankarevalo@alliant-energy.com</a>	
Joe Kramer	Resource Strategies, Inc.	608-251-2	<a href="mailto:jkramer@rs-inc.com">jkramer@rs-inc.com</a>	608-251-5
James T. Tynior	Foley & Lardner, Attorneys at Law	414-297-5	<a href="mailto:jtynior@foleylaw.com">jtynior@foleylaw.com</a>	414-297-4
Chris Schoenher	Wisconsin Electric Power Company		<a href="mailto:cs9081@wepco.com">cs9081@wepco.com</a>	
Steve Ugoretz	Wisconsin DNR, Integr. Science Services	608-266-6	<a href="mailto:ugores@dnr.state.wi.us">ugores@dnr.state.wi.us</a>	608-267-7
Paul Helgeson	Public Service Commission of Wisc.	608-26602	<a href="mailto:helgep@psc.state.wi.us">helgep@psc.state.wi.us</a>	608-266-3
Michael Vickery	RENEW Wisconsin	608-255-4	<a href="mailto:mjvrenew@mailbag.com">mjvrenew@mailbag.com</a>	608-255-4
John Dunlop	American Wind Energy Association	612-377-3	<a href="mailto:jrdunlop@igc.org">jrdunlop@igc.org</a>	612-374-2

Six southern turbines to be re-located or lower in height (per FAA review)

Hearing for conditional use permit delay until 1<sup>st</sup> week April.

New contracts for five machines (change of property holder), one machine slightly mo

End of April public hearing. First Tuesday of April are elections.

Need to begin construction 6/1/2000

### ***Kewaunee Report (Mick Sagrillo)***

#### **Complaints**

- Well—disproved by consultant. Attempt to get free well (free rider).
- Shadows. Awning installed. Some trees planted. New claim of livestock bolting. From son of opponent sitting on county board.
- TV reception...a real problem. Dona Look and Ken Loeber holding out for an antenna in the attic. Some free-rider new antennas or dishes installed. Promise of ongoing mitigation for life of project.
- Lights. Again Dona Look. Originally was two lights, now 8 lights on 14 turbines. This change originally due to agitation by opposition. Mick suggests that town and WPS write letter to FAA to return to the two-light configuration.
- Noise. Sanchez study for MGE underway. 50 dBA max in conditional use permit, some kind of 5 dBA penalty. Measured value at 47 dBA. WPS RFP for a four-season contractor study is now on the street. Impression is that lines of turbines are louder than single turbines, depending also on the microsite where the noise is being measured, sometimes due to reflective effects.

#### **Moratoria**

- Red River and Lincoln.
- Developed in conjunction with Bay-Lakes Regional Planning Commission (BLRPC). Copy handed out.
- Moratorium committee meeting for the first time six months after approval of moratorium. Eighteen-month moratorium. Moratorium includes the committee and a possible six-month extension.



- Members: Sagrillo, Opichka (firm opponent), Gillette (hosts turbines), Finnendale, and one other.
- One Committee per town.
- Development pressures loom, a four county study on property values says that Mick's county has the lowest (BLRPC study)
- A verbal BLRPC proposal suggests designating wind development zone, i.e. exclude it elsewhere. This struck at least DePillis as opposite to the approach the general Wind Siting Collaborative has taken, namely to include the entire state except for areas recommended as being inappropriate for development.

### ***Other items***

- Suggestion made of a meeting with BLRPC, SEWRPC, ECWRPC, Dick Lehman, Jim Tynion, and Paul Helgeson.
- Lincoln town and Rep. Lehman share concern about non-regulated utility subsidiary steamrolling a town. Note that project has 30-year life, contracts only 10-years.
- Reviewed provisions of Door vs. Dodge vs. Murray (MN) vs. Pipestone (MN) county ordinances. Addressed about five of about a dozen items.

Meeting ended about 4:05 pm.

# Model Ordinance Subcommittee of the Wisconsin Wind Power Siting Collaborative

Meeting Notes 2000  
August 16 Wisconsin  
Energy Bureau Madison,  
Wisconsin

***DRAFT 2000 August 22***

## Attendee

Alex DePillis Phyllis	Wisconsin Energy Bureau
Dube' John Dunlop	Wisconsin Electric
Gerald Heimerl Paul	American Wind Energy Association
Helgeson Jim	Farmer near Centerville, Manitowoc County Planning & Zoning
Johnson Larry Krom	Public Service Commission of Wisconsin
Shelly Laffin Cathrine	Town of Addison Preservation Group
Lawton Morten Lund	RENEW Wisconsin
Mike Mangan Dean	RENEW Wisconsin
Perlick Mick Sagrillo	Town of Addison Preservation Group
John Stolzenberg Jim	Folley and Lardner
Tynion Michael	Wisconsin Coalition for Community Wind Dodge
Vickerman	County
	Midwest Renewable Energy Association
	Legislative Council Staff Foley and Lardner
	RENEW Wisconsin

## **CALL TO ORDER**

Meeting called to order by Paul Helgeson, Chairperson.

Paul outlined the basis for the subcommittee. It is not a policy-making group, but a collaborative body to recommend procedures which may be adopted by local planning and zoning organizations. Ideally, all decisions of the subcommittee will be made by consensus. The short term goal is to have a proposed set of guidelines available for a meeting of the full collaborative in September.

In addition, the meeting is not a forum to discuss any one particular project. On the other hand, the recommendations which will be made will be based on experiences from other development.

## **AGENDA**

There were no additions or changes made to the proposed agenda.

## **DRAFT ORDINANCE FRAMEWORK**

Paul- asked for comments on the proposed framework.

Mike Mangan: The document does not address community wind projects (smaller projects using utility-scale turbines to supply power to the utility grid). As community wind projects are less controversial, as Mike suggests, they should be allowed without having to meet all the criteria being imposed on large scale projects. In addition, Mike recommends that the turbine rotor diameter should be used to classify wind turbines rather than the rated capacity.

Cathy Lawton: None of the substantive changes discussed at the last meeting (July 17) were incorporated into the current draft. She suggested that the draft document is not meeting the objectives of the subcommittee. The document cannot be used by municipal governments to make decisions regarding the siting of wind turbines.

Morten Lund: No agreement was reached on substantive issues at the July 17 meeting. The draft document is meant to be in the format of a reference guide. Therefore, we need to discuss and agree on the format. Then we should discuss other concerns and details. It is difficult to discuss substantive measures unless there is an agreement on the format. Morten didn't want to spend time drafting details unless there was agreement on the proposed outline.

Paul again asked for comments regarding the proposed outline headings.

Cathy: Section 3.2, Principal or Accessory Use, is the major problem. Cathy suggested that a land use must support or be a part of the principal use in order for it to be considered an accessory use. It is inconsistent to allow wind to be an accessory use when it is not associated with the principle use. For instance, if manufacturing plant were to exist on agricultural land, it would represent a secondary principle use, not an accessory use. Discussion followed. Others countered that accessory use need not be associated with the principal use. Paul suggested that the issue need not be resolved at the present time. Cathy summarized that there are three options:

1. Conditional use permit in specific zones.
2. A wind overlay district
3. Wind only zone

Morten said he was trying to say that in the proposed language. The issue was partially solved by changing the title of the section to "Conditional Use vs. Wind Overlay Zone."

**Action: Re-title Section 3.2 to "Conditional Use or Wind Overlay Zone"**

Dean Perlick suggested that section 4 in the draft, "Applicability," should be moved ahead of section 3, "Regulatory Framework." There was a consensus on the issue.

**Action: Switch sections 3 & 4**

Cathy suggested that all of the issues discussed in Chapter 4 ("Specific Permitting Considerations and Strategies") of the NWCC Handbook ("Permitting of Wind Energy Facilities"), be included in the model document. Morten commented that some of the items could be included in the appendix. However, the subcommittee needs to determine which items to include in the model document. Jim Johnson suggested that the items from NWCC be placed in 5.2 as "placeholders" for now. Paul recommended adding biological resources. Though air quality is regulated by federal law, it doesn't hurt to include reference to those laws in the handbook for local planning people.

Land use is another issue for wind siting. Morten: land use is a policy issue rather than a zoning issue. Cathy: The land use plan must agree with zoning issues. Zoning requirements may require a change in the land use plan. Paul: The NWCC Handbook should be referenced in the model ordinance. Cathy: the local planner needs more than a referral to the handbook - they need to be referred to the specific section of the handbook which addresses the issue being discussed.

A consensus was reached.

**Action: Add the following sections:**

**5.8 Biological Resources**

**5.9 Soil Erosion**

**5.10 Water Quality**

**5.11 Cultural and Archeological Resources**

**5.12 Waste**

**5.13 Air Quality**

Morten: Based on the discussion at the July 17 meeting, anemometer towers have been omitted from the draft document. Though met towers are also included as a part of the wind energy facility, they are principally installed prior to the development of a project. Therefore, they need to be addressed in another document which would be used prior to the wind siting ordinance.

Cathy: There may be other issues that are covered in other parts of a town's zoning ordinance. The model wind energy ordinance should suggest where to look in the existing ordinances for language which may already address the issues addressed in the model wind ordinance.

Mick: 1) Should include road damage. Morten: subsection 5 includes it.

Mick: 2) Should include insurance, assignability, and performance bond. Utilities have been known to reject projects based on these issues. Should include in 7.2.5.

?: The introduction needs to specify that if one section is determined to be unenforceable, the enforceability of the other sections will not be impacted. Definitions should be included either at the beginning or as part of an appendix.

Paul: The appendix should have the same numbering and headings as the model ordinance.

Morten: Munis will get cover letter, which will advise the manager to thoroughly read both the ordinance as well as the appendix.

Jim: The document should be in a brochure format, with an introduction section, a discussion of each issue, and the model ordinance. Paul: The subcommittee had moved away from a brochure format. Instead, the Commission could draft a brochure. The ordinance would have a one page cover memo providing the justification and expected use of the model ordinance. The background on the development of the model ordinance should be in the orientation section.

Morten: Perhaps all the documents could be assembled into a three-ring binder. The major sections would be: Introduction. Orientation. Model Ordinance. Detailed Discussion.

Jim: The big picture needs to be provided to the planner as well. It needs to answer the question, "Where does this ordinance fit into the existing system?" The section could include instructions on how to adopt an ordinance. A check list of the issues that need attention would be helpful, such as met towers, airport locations, etc. Morten: A separate section of the appendix needs to identify issues which are not included in the model ordinance.

Noise: Cathy: Need to check NWCC for language. Mick: Draft language came from Kewaunee permit. Cathy: 35 dB has been proposed in the U.K. Jim: The ordinance needs to address lot line vs. residence. Needs to address the background noise level. Mike: Need to include time-of-day provision in the noise limits. Mick: This is the major stumbling block in Kewaunee projects; it is very subjective. Cathy: In Boston, noise was a major issues in the rejection of a wind turbine on a 40 acre parcel. Mick: Kewaunee is considering a 45 dB limit at the lot line. Neighbors may

op out of the regulatory protection, if they have an interest in seeing the project go ahead, such as if they also have a project they wish to be located near the lot line.

Regarding Section 5.5, Ground Clearance. ??: The minimum height was included for safety requirements. Mick: The proposed reduction of ground clearance to a minimum clearance of 10 ft is "ridiculous." Cathy: The ordinance needs to address maximum height. Alex: height affects many aspects, such as setback requirements, visual impacts, etc.

Consensus: Height restrictions will be included in the discussion. It will be left to the town's discretion. Jim: This would be consistent with other "design standards" that are regulated by the town: paint color, height, fences, landscaping, etc. ??: The maximum height needs to be consistent with the land use plan. From a wind development standpoint, the developer will optimize the size of turbine for the wind resource and location. The munis need to understand that height greatly influences the options available to developers.

Consensus: Morten will add a paragraph on regulation of the total height in the visual section.

?: Need to consider design standards, such as glare, debris on the property.

?: TV signal interference can be a problem. Mick: This is the easiest problem to fix. It was a major issue in Kewaunee County, and the owners simply awarded satellite dishes to residences with problems. This issue needs to be addressed in the conditional use permit. A pre-construction survey needs to document the reception quality at all residences within a mile of the proposed facility.

Mick will provide a copy of the new one-mile survey requirement being considered in Kewaunee to Morten, who will incorporate it into the document.

Cathy: Need to include EMF and stray voltage.

Paul will draft the safety section and explain why EMF and stray voltage problems are not exacerbated by the introduction of wind turbines. Gerald: However, the issue needs to be addressed in the ordinance or the discussion, as many town administrators will have to respond to questions about the issue. Paul: Stray voltage is a distribution voltage issue, not transmission. EMF is due to a static charge buildup.

John: The guidelines need to include SI (metric) units so that the model ordinance will have long term applicability (as the metric system becomes more common in Wisconsin) and so that it can be understood by English-speaking people who already use the metric system (95.4% of the world do NOT use the inch-pound (our) system (most use SI); wind energy technology and manufacturing is conducted predominantly in metric units). With apprehension, a consensus was reached.

**Action: Include SI (metric) units in parentheses following all inch-pound units in the document.**

## **NEXT STEPS**

August 18 Michael to establish the discussion group on eGroups; will include all of the "extended" subcommittee (i.e., those whose attendance has been irregular)

September 01 Draft revisions from authors (assignees) to Morten

September 01 Authors post comments to discussion group

September 11 Subcommittee post comments to discussion group

September 18 Authors make revisions as necessary, based on comments

September 21 Morten to "merge" comments into master draft document

#### **NEXT MEETING:**

To be held in conjunction with the full Siting Collaborative on September 27

Items to be included in agenda:

Items in draft document

Appendix – *rename as "Reference Guide and Issue Discussion"*

#### **ASSIGNMENTS**

Alex DePillis:	Definitions; Mike Mangan to assist
Alex DePillis:	Different uses of wind turbines; this ordinance only addresses a narrow subsection of the available uses. Mick will provide assistance
Dean Perlick:	Regulatory Framework. Cathy will send comments to Dean for him to incorporate
Michael Vickern	Set up eGroups discussion group; John will serve as moderator required.
Paul Helgeson:	Other laws. Steve Ugoretz will provide assistance.
Paul Helgeson:	Air quality, with assistance from Steve Ugoretz
Paul Helgeson:	Safety
Morten Lund:	Lighting
Morten Lund:	Cultural resources, archeological issues, etc. (refer to NWCC manual)
Morten Lund:	Social issues, infrastructure.
Phyllis Dube'	Noise.
Steve Ugoretz:	Biological Issues
Steve Ugoretz:	Soil erosion and water quality
John Dunlop:	Measurement language protocol.
??	Setbacks
??	Waste

(submitted by John Dunlop)  
fn:visiting

WIND POWER SITING COLLABORATIVE  
April 23, 2001  
Pecatonica Room, Public Service Commission

Collaborative Members Present

Frank Arevalo	Alliant Energy/WP&L
Alex DePillis ✓	Dept. of Administration – Energy Mark
David Donovan	Xcel/NSPW
John Dunlop	AWEA
Bill Fannucchi	Public Service Commission
Jeff Ford	MG&E
Karen Etter Hale	Madison Audubon Society
Paul Helgeson ✓	Public Service Commission
Bob Owen	SSE
Carl Siegrist	WI Electric
Michael Vickerm	RENEW Wisconsin

Also Present

Jim Johnson	Town of Addison Preservation Gro
Cathy Lawt	Town of Addison Preservation Gro
Mike Mang	Self
Mick Sagril	MREA/Town of Lincoln
Jim Tynion	Foley & Lardner

Minutes from the last meeting (10/12/99) were distributed.

Model Ordinance subcommittee Report – P. Helgeson

The 9/21/00 draft document was circulated. C. Lawton noted that other drafts were prepared for the subcommittee's review.

Query – What should the Collaborative do with the draft ordinance? Three options were described.

- 1) Send the draft back to the subcommittee for further work;
- 2) Circulate the draft as is to the WI Towns Ass'n, WI Counties Ass'n, and the RPCs; or
- 3) Hand the drafting process off to PSC Staff.

R. Owen queried the need for sections 5.8 – 5.13, which the draft left blank. Suggested deleting these provisions.

Referencing C. Lawton draft (6 of 25), discussion followed on question of whether to use the document to develop stand-alone ordinances or to integrate wind-specific provisions into county zoning ordinance. Prevailing sentiment was to integrate model ordinance provisions into existing ordinance. Back to 5.8 - 5.13: D. Donovan and A. DePillis said that these issues could be dealt with by referencing the appropriate section in existing ordinances. R. Owen also questioned the requirement to bury wiring underground, noting that the MGE project is interconnected to distribution system by means of above-ground wiring.

Re definition of Wind Turbine: M. Sagrillo noted that the Lincoln Moratorium Committee wrestled with turbine categories and settled on three: home-sized installations (<20kW), farm-sized installations (20kW<100kW), and commercial installations (>100kW). Maximum height for home and farm sized turbines was set at 150 feet. M. Mangan noted that drawing the line at 150 feet would have the effect of treating a single 210-foot turbine no differently than a 10 turbine installation. M. Mangan stated that this would impede development of the Community Wind concept. D. Donovan noted that local governments would treat a project designed for personal use differently than one designed to sell power. There was general agreement that a local body would require performance bonding even for a single utility-scale turbine.

A. DePillis distributed two handouts that illustrated that many turbines between 20 kW and 100 kW exceed the 150 foot mark when a blade is directly overhead. He suggested raising the maximum height for <100 kW turbines to 170 feet, with the expectation that these systems would be subject to a less rigorous set of requirements. The committee agreed to change the height restriction specified in the definition of Wind Turbine from 150 feet to 170 feet in height.

#### Biological Subcommittee report - B. Fannucchi

PSC ordered the development of a GIS database. Work was interrupted by Arrowhead-Weston proceeding. Several data layers have been completed, which were distributed. These include a layer showing the transmission system, (69 kV lines and higher), substations, and power plants. Still need to collect more biological information. Data on bird and bat deaths at Kewaunee would continue to be collected until July 2001. Expressed uncertainty regarding the treatment of aesthetics in this GIS database. The database was evolving from a permitting tool to a certification tool.

M. Sagrillo reported on results of Kewaunee wind farm bird/bat mortality study through 2000.

(1/2 year of operation) mortality count — 6 birds/38 bats

(full year of (operation) mortality count - 8 birds/28 bats



A draft report on the study should be available by the end of this summer.

The National Wind Energy Coordinating Committee has begun revising the its siting handbook.

Town of Lincoln report - Mick Sagrillo

Per the Lincoln Moratorium Committee's request, the moratorium was extended another 6 months, to July 6, 2001. Red River took no action during its moratorium, and allowed it to expire last December. WPS has just finished its four-season noise study—results have not been published yet. Sanchez was the contractor for both MGE and WPS studies.

The collaborative decided to refer the draft ordinance back to the subcommittee for further work. A. DePillis agreed to work through the existing documents and produce another version for review. Deadline for comments on existing documents: 5/7/01. A. DePillis agreed to produce a new version by 5/15/01. The next meeting of the model ordinance subcommittee was set for 9:30 AM, 5/23/01 at DOA, to be chaired by M. Vickerman. C. Siegrist and M. Sagrillo will be added to the WisconsinWindOrdinance list-serv.

Respectfully submitted: Michael  
Vickerman April 24, 2001

GUIDELINES AND MODEL ORDINANCE AD HAC SUBCOMMITTEE  
OF THE  
WISCONSIN WIND POWER SITING COLLABORATIVE

Minutes For Meeting held on May 9, at 101 E. Wilson Avenue, Madison, Wisconsin

Present: Alex DePillis - Wisconsin Energy Bureau;  
John Dunlop - American Wind Energy Association; Dean Perlick - Dodge County;  
Christopher Schoenherr - Wisconsin Electric Power Company; Steve Buss - Alliant Energy;  
Steve Ugoretz - Wisconsin Department of Natural Resources;  
Catharine Lawton - Town of Addison Preservation Group;  
Lisa Bzdusek - Town of Addison Preservation Group;  
Jim Johnson - Town of Addison Preservation Group;  
Michael Vickerman - Renew Wisconsin;  
Paul Helgeson - The Public Service Commission of Wisconsin;  
Mick Sagrillo - MREA;  
James Tynion - Foley & Lardner; and  
Morten Lund - Foley & Lardner.

The meeting was convened at 1:00 pm and Mr. Helgeson was appointed the Chair of the meeting.

Following a question by Ms. Lawton, a short discussion ensued concerning the origins and purpose of the Subcommittee. The Chair informed the Subcommittee that the mission was to produce a draft model ordinance for the Collaborative to address wind energy project siting issues in the State of Wisconsin, as well as a memorandum to the Collaborative discussing the substance of the draft ordinance. This mission was not an Advance Plan 7 mandate, but rather the Collaborative precedes Advance Plan 7. The Chair further informed the Subcommittee that the Subcommittee was formed and its mission given with no regard to any particular existing wind project in Wisconsin, including the proposed wind project in the Town of Addison. The purpose of the Subcommittee is to draft language for all towns and counties in the State of Wisconsin.

The Chair, in response to a question from Ms. Lawton, further informed the Subcommittee that each member of the Subcommittee was invited to join based on his or her own merits, without any regard for any involvement they may or may not have in an existing wind project. In particular, the presence of representatives from Foley & Lardner was addressed, as Foley & Lardner also represents FPL Energy, Inc., the developer of the proposed wind project in the Town of Addison. The Chair concluded that Foley & Lardner, like all law firms, has a multitude of clients. Neither Foley & Lardner's membership on the Subcommittee, nor the existence of the Subcommittee itself, was in any way intended to influence, nor was any action of the Subcommittee caused by, any specific proposed wind project within the State of Wisconsin, including the Town of Addison project. The Chair also

noted that it was unlikely that any action taken or recommended by the Subcommittee would affect the Town of Addison project in any way. It was further noted that while the conclusions of the Subcommittee would be influential, they would not be binding on any municipality. The Chair noted Ms. Lawton's concern about the composition of the Subcommittee. It was pointed out that several constituencies are represented on the Subcommittee. The PSC, DNR, DOA are represented. The renewable energy lobby and private wind industry is represented through AWEA, Foley & Lardner and Renew Wisconsin. The general public, including towns and counties, are represented through Dean Perlick (Dodge County) and Mick Sargrillo. The utilities are represented by WEPCO and Alliant employees.

There was discussion regarding a possible size distinction for wind turbines or projects under the proposed ordinance. It was generally agreed that there should be separate rules and procedures for "small" projects, but some disagreement as to what would constitute a small project. Cutoffs were suggested both based on height of turbine and nameplate rating of turbines, as well as total output and a private versus commercial distinction. After some discussion, it was preliminarily agreed that a turbine height standard would be applied as well as a nameplate rating per turbine standard. The Chair asked for any additional questions regarding background and scope of the Subcommittee and the proposed ordinance. Ms. Lawton raised the issue of bird migratory routes. Mr. Ugoretz volunteered that the Wisconsin Department of Natural Resources is in the process of producing a map showing migratory bird flight paths in the State of Wisconsin. Ms. Lawton, reviewing a draft map of this kind, noted that the proposed site of the Addison Wind Farm appeared to be located in a migratory path. Mr. Ugoretz suggested that simply being a migratory path was not in itself problematic, as most bird migration takes place at altitudes substantially above the height of even the largest wind turbines.

The Chair moved on to request suggestions for presentation procedures for the draft ordinance. Mr. Dunlop suggested that the draft ordinance be presented to industry professionals, such as members of the American Wind Energy Association, prior to its presentation to the Collaborative. Mr. Tynion added that it could be beneficial to show the draft ordinance to selected county officials as well prior to its presentation to the Collaborative.

Ms. Lawton suggested that the ordinance be drafted to allow for different section options depending on the particular geography and circumstances of each given town or county. Mr. Dunlop and Mr. Tynion agreed, suggesting further that there might be a checklist added to the ordinance, providing that if the county falls within certain description, then certain sections should be implemented and others not. Mr. Tynion suggested that at least one additional meeting would be required prior to presenting the draft ordinance to the Collaborative.

After some discussion, it was agreed that the next meeting would be July 17, at 1:00 pm at the same location. Mr. Tynion proposed that Foley & Lardner distribute a redraft of the ordinance by late June, to permit Subcommittee members time to review the redraft prior to the next meeting.

The Chair requested that the Subcommittee turn its attention to the draft ordinance. The first topic for discussion was the cut-off for small, or "Private Use," projects. Mr. Sagrillo suggested that nameplate rating be used as a cut-off and Mr. Perlick suggested that height be used as a cut-off. Mr. Tynion suggested the two be combined to provide that the private use turbines less than or equal to 150 feet in height and less than or equal to [100] kilowatts per turbine. The Subcommittee agreed that this was the best approach.

The Subcommittee subsequently turned to the definitions contained in Section 2 of the proposed model ordinance. It was agreed that the definition of Wind Energy System would be improved by dividing into a definition for Wind Turbine and a definition for Wind Energy Facility. It was further decided that an additional section for optional use by the municipality would be added with regard to MET towers. After some discussion it was also quickly decided that the cover memorandum should include a section addressing the distinction between principal and accessory use of land as well as discussing the option of having an overlay zone specifically for wind energy. Also to be included in the memorandum would be a list of applicable laws at the federal, state and local levels including a discussion of why they were or not addressed in the draft ordinance.

Ms. Lawton suggested that simply requiring project developers to comply with all applicable laws might be insufficient because municipalities would not be able to determine whether or such compliance was in fact occurring, and, many such laws only have post facto enforcement. Mr. Ugoretz pointed out that this is already the case with many other local permits, such as septic tank placement, where relatively few municipalities have specific requirements, but where developers are simply required to comply with applicable laws. Mr. Tynion suggested that the ordinance could provide for the municipality to hire a third party expert at the expense of the developer to determine whether or not applicable laws are being complied with.

Ms. Lawton questioned whether any third party experts that were hired could ever truly be neutral in their evaluation, as almost by definition any expert sufficiently familiar with wind energy would be "in the wind energy industry" and therefore not impartial. It was decided that third party expert confirmation was the only workable option as laws change over time, and it would be inappropriate for municipalities to impose separate requirements which might now or later conflict with current or future laws.

The Subcommittee moved on to visual aspects of the wind project. Mr. Sagrillo suggested that simply stating that the turbines should be painted a "neutral" color might not be sufficient, as different municipalities around the country have considered neutral to mean different things. The Subcommittee decided that the ordinance should be left as it currently stands in this regard, but that the memorandum would elaborate on this discussion, and include some references to color decisions that have been made elsewhere.

The Chair turned the discussion to the type of tower (tubular vs. lattice), noting that the draft ordinance currently requires tubular towers. The Chair pointed out that there are advantages and disadvantages to each type of tower. The Subcommittee decided that the

ordinance should not address any specific tower requirement, but rather the memorandum should summarize the advantages and disadvantages of each type.

Ms. Lawton suggested that the ordinance should address fencing, both fencing around individual towers and around the project as a whole. Mr. Tynion suggested that fencing be addressed in the memorandum rather than the ordinance, which does not currently require fencing, and also suggested that a section be added to the ordinance requiring fencing around any substations.

Returning to the discussion of visuals, the Chair turned the discussion towards logos on the turbines themselves. Mr. Dunlop asked whether local signage rules would be sufficient to address any of these issues. It was decided that the cover memorandum would include a discussion of logo and other advertising practices as to wind turbines around the country.

A variety of other issues were raised and flagged for discussion in the memorandum rather than in the model ordinance. These included roads, fire safety plan, stray voltage and other transmission/voltage issues.

The meeting was adjourned at 4:45 p.m.

**AGENDA**  
**WIND POWER SITING COLLABORATIVE**

*10/12/01*  
*minutes*

Monday, April 23, 2001

**1) 1:30      Check-in**

**2) 1:40      REPORT FROM BIOLOGICAL ISSUES SUBCOMMITTEE**

(Fannucchi, Cutright, Etter Hale, Trick, Ugoretz, Puzan)

- GIS mapping layers, etc
- NWCC and other ongoing avian work

**3) 2:00      REPORT FROM GUIDELINES AND MODEL ORDINANCE  
SUBCOMMITTEE**

(Ugoretz, Vickerman, DePillis, Dunlop, Helgeson)

- Report on subcommittees work (draft documents above)
- Next steps? Perhaps circulate drafts to regional planning commissions, towns association, etc. for comments. Other ideas for finalizing document.
- How should documents be disseminated when complete?

**4) 3:30      S.E.P. WIND ENERGY SITING CASE STUDIES - DePillis, Blecker**

**5) 3:45      OTHER REPORTS**

- Dodge County ordinance
- Kewaunee County
- NWCC

**WIND POWER SITING COLLABORATIVE MEMBERS**

DNR	Steve Ugoretz
DOA -Energy Bureau	Alex DePillis
PSCW	Paul Helgeson/Bill Fannucchi
AWEA	John Dunlop
SSE	Bob Owen
Madison Audubon Society	Karen Etter Hale
US Fish and Wildlife	Joel Trick
RENEW	Michael Vickerman
Alliant Energy/WP&L	Frank Arevalo
Madison Gas and Electric	Jeff Ford/Don Peterson
WEPCO	Carl Siegrist
WPS	Shawn Puzen
Xcel/NSPW	David Donovan

**Ludwig, David P**

**From** Lepinski, Jim PSC  
**Sent** Thursday, August 18, 2005 10:20  
**To:** Helgeson, Paul PSC  
**Subj** RE: Draft Model Wind Ordinance

I will work on it early next w

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**From** Helgeson, Paul PSC  
**Sen** Thursday, August 18, 2005 10:1  
**To:** Lepinski, Jim PSC  
**Subj** Draft Model Wind Ordinance

Here it is with some of the changes your sugges

<< File: Model Ordinance August 18, 2005.doc

**Paul C. Helgeson, Senior Engineer**  
**Public Service Commission of Wisconsin**  
**P.O. Box 7854**  
**Madison, WI 53707-7854**  
**608-266-3905**  
paul.helgeson@psc.state.wi.us

 Ludwig, David PSC

---

**From:** Helgeson, Paul PSC  
**Sent:** Thursday, August 18, 2005 10:13 AM  
**To:** Lepinski, Jim PSC  
**Subject:** Draft Model Wind Ordinance

**Attachments:** Model Ordinance August 18, 2005.doc

Here it is with some of the changes your suggested.



Model Ordinance August 18, 200...

**Paul C. Helgeson, Senior Engineer**  
**Public Service Commission of**  
**Wisconsin**  
**P.O. Box 7854**  
**Madison, WI 53707-7854**  
**608-266-3905**  
[paul.helgeson@psc.state.wi.us](mailto:paul.helgeson@psc.state.wi.us)



**From:** Lepinski, Jim PSC  
**Sent:** Wednesday, February 07, 2007 9:08 AM  
**To:** Helgeson, Paul PSC  
**Subject:** FW: Draft Model Wind Ordinance

**Attachments** Wind Turbine Noise Ordinance.doc

Just use my original version, attached. The current version is so confused I don't know where to start to fix it.

**From:** Lepinski, Jim PSC  
**Sent:** Monday, August 29, 2005 10:17 AM  
**To:** Helgeson, Paul PSC  
**Subject:** RE: Draft Model Wind Ordinance

Here's the revised noise section. You should replace the entire noise section with this language. If you want, I think I can do a redline.



Wind Turbine  
Noise

**From:** Helgeson, Paul PSC  
**Sent:** Thursday, August 18, 2005 10:13 AM  
**To:** Lepinski, Jim PSC  
**Subject:** Draft Model Wind Ordinance

Here it is with some of the changes you suggested. «  
File: Model Ordinance August 18, 2005.doc »

**Paul C. Helgeson, Senior Engineer**  
**Public Service Commission of Wisconsin**  
**P.O. Box 7854**  
**Madison, WI 53707-7854**  
**608-266-3905**  
[paul.helgeson@psc.state.wi.us](mailto:paul.helgeson@psc.state.wi.us)

**From:** Lepinski, Jim PSC  
**Sent:** Monday, August 29, 2005 10:17 AM  
**To:** Helgeson, Paul PSC  
**Subject:** RE: Draft Model Wind Ordinance

Here it is with some of the changes your suggested. « File: Model Ordinance August 18, 2005.doc »  
**Attachments** Wind Turbine Noise Ordinance.doc

Here's the revised noise section. You should replace the entire noise section with this language. If you want, I think I can do a redline.



Ordinance.d

**From:** Helgeson, Paul PSC

**Sent:** Thursday, August 18, 2005 10:13 AM

**To:** Lepinski, Jim PSC

**Subject:** Draft Model Wind Ordinance

Here it is with some of the changes your suggested. « File: Model Ordinance August 18, 2005.doc »

**Paul C. Helgeson, Senior Engineer**  
**Public Service Commission of Wisconsin**  
**P.O. Box 7854**  
**Madison, WI 53707-7854**  
**608-266-3905**  
[paul.helgeson@psc.state.wi.us](mailto:paul.helgeson@psc.state.wi.us)

Here it is with some of the changes your suggested. « File: Model Ordinance August 18, 2005.doc »

**Paul C. Helgeson, Senior Engineer**  
**Public Service Commission of Wisconsin**  
**P.O. Box 7854**  
**Madison, WI 53707-7854**  
**608-266-3905**  
[paul.helgeson@psc.state.wi.us](mailto:paul.helgeson@psc.state.wi.us)

## Ecoenergy Questionnaire:



From the Desk of Curt Bjurlin  
EcoEnergy Wind 211 S. Paterson St., Suite  
380 Madison, WI 53703  
Phone : 815-266-018 Fax : 815-266-6019  
[cbjurlin@ecoenergyllc.com](mailto:cbjurlin@ecoenergyllc.com)

December 27, 2007

Mr. James Bembinster  
18002 W. County Road  
Evansville, WI 53536

RE: Health and Safety Research  
Questions Dear Mr. Bembinster

Please find enclosed our answers to your questions regarding the proposed Evansville three turbine wind energy project in the Town of Union. We look forward to working with you to develop renewable energy for the people of Evansville.

Sincerely,

A handwritten signature in black ink, appearing to read "C. Bjurlin", with a stylized flourish at the end.

Curt Bjurlin  
Wisconsin Project Developer

Cc: Mr. Kendall Schneider, Town of Union

[www.EcoEnergyLLC.com](http://www.EcoEnergyLLC.com)

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# **Response to the Town of Union Health & Safety Research Questionnaire**



**December 2007**

**Prepared by**

**Curt Bjurlin, M.S.  
Wes Slaymaker, P.E.  
Rick Gungel, P.E.**



**EcoEnergy Response to the Town of Union Questionnaire**

### **General Questions**

**1. Are you planning to install a met tower?**

EcoEnergy is currently reviewing the potential to install a met tower in the Town of Union to support the proposed wind energy facility.

Using data from this tower, along with data our tower in the Town of Magnolia, EcoEnergy will use the meteorologist AWS Truewind to calculate wind speeds. AWS Truewind is based in Albany New York and has over twenty years' experience in the wind energy consulting business, employing a large staff of qualified meteorologists, engineers, and technicians.

**A) If so, how long will wind data be accumulated?**

Should a tower be erected, data is typically accumulated for a year or longer. Once 6 months of data is accumulated the wind resource can be estimated. Public records of wind speeds, corroborated by existing met towers, provide a refined and well-tested method of estimating wind speeds at hub heights.

**B) How much wind will be necessary to make the project viable?**

Enough to make the project economically viable at the negotiated power purchase rate. That amount is not known exactly but is approximately 15 mph average annual wind speed at hub height (262 feet above ground)

**2. At a Town of Magnolia Wind Workshop, Gary from EcoEnergy stated, "There are winners and losers with every project." Can you explain who would be the "losers" and why? Please thoroughly explain this answer including any correlation to health and safety.**

Mr. Gary Haltaufderheide does not recollect the context of his remark, but he believes that this question may refer to a discussion about whether all property owners seeking turbines would receive them.

As you will read further in this questionnaire, EcoEnergy funds independent studies, as well as employs experts in siting, to determine locations that would be suitable for turbines in a manner as least intrusive as possible. However, any development—whether it be a subdivision, a store, a factory, a coal plant or a wind farm—may leave someone who is not completely satisfied by the outcome. Gary said that he has had dozens of meetings in both Union and Magnolia Townships, and when he has been able to speak one-on-one with citizens, he felt that the discussions were very positive and productive. He, and everyone at EcoEnergy, stresses that while we are employees of a wind farm developer, we are here because we hold a strong belief in wind energy—its energy security for our area, its sustainability, and its jobs creation effect on the local economy. Gary believes that any responsible wind development yields only winners, and regrets that some people may still feel unsatisfied, no matter how beneficial the outcome.

**3. How often is preventive maintenance done and by whom?**

Preventative maintenance is conducted every 6 months by operations and maintenance technicians. There are numerous qualified and experienced wind technicians currently working at existing projects in Wisconsin and nearby Illinois to support this installation.

**4. What is the timeline to decommission any wind turbine that is not in operation or is abandoned?**

The project lifetime is estimated to be 30 years, although wind turbines frequently continue useful production for many years beyond the initial estimate.

If the turbine is no longer functioning, then it will be decommissioned.

Additional decommissioning conditions can be specified by the local government.

**5. What does decommissioning and site restoration include?**

Removal of foundation to a specified depth (default is 42" below grade) and access road if it is not wanted by the landowner, plus site restoration returning the area to farmland of a similar condition prior to the project. Decommissioning conditions and site restoration are often specified by the local government, and backed by a bond or other financial assurance. The local government is typically the entity that offers the permit (e.g., the state, if the state offers the permit).

**6. What assurance does Union Township have that the wind turbines' owner will be financially responsible for decommissioning through the life of the project?**

A decommissioning plan and financial assurance will be tendered at the time of permitting of the wind project. This plan specifies the details of removing the turbine and restoring the site, and provides financial assurances to do so, even if the Owner is incapable of providing the funds.

**7. How does the wind turbines' owner handle breakdowns?**

They repair them. Wind turbines make clean renewable energy only when they are in operation, and it is in everyone's interest to keep the units in top condition and promptly address any maintenance or mechanical problems. There is no income or tax credits from a non-operating wind turbine.

**8. How will voltage flicker be controlled during startup in variable wind conditions?**

Voltage flicker can be mitigated in several ways, and manufacturers, such as Elspec, S&C Electric, and others, manufacture devices that mitigate or eliminate flicker. These devices typically employ capacitors or active electronics. Before a decision is made about whether any added equipment is necessary, or the exact device to be used, the interconnection will be studied by a qualified electrical engineer.

In addition, the AW 1500 variable speed wind turbine uses an IGBT power converter at the rotor side to control the generator torque. This torque control is

performed to reduce the periodic torque fluctuations caused by the so called "tower wakening effect."

To see a table of measurement results performed according to IEC 61400, please see Exhibit 1: Technical Specifications AW 82/1500 IEC IIIB (attached).

**9. Who will be responsible for power quality problems affecting customers connected to the distribution line?**

As is the case with any energy source connecting to the distribution line, the local utility will be responsible for identifying the source of power quality problems affecting a customer. The local utility will then inform the party responsible for the power quality issue and together a solution to the problem will be designed.

To tie and control energy produced by a wind farm into the interconnect system, an interconnection feasibility and a separate system impact study are conducted to identify the facilities and network upgrades needed to facilitate the requested interconnection. Impacts and upgrades necessary to mitigate problems will be identified. A good faith estimate of cost for the network upgrades and the interconnection facilities is identified.

The electrical engineering experience behind the transmission engineering will be EcoEnergy Wind's partner company under the Morse Group, EcoEnergy Engineering. EcoEnergy Engineering is an experienced firm in utility electrical interconnections and has completed interconnects from 4kV to 345kV.

The Morse Group is a privately held corporation that originated in Freeport, IL in 1944 with the founding of Morse Electric. Since its inception, Morse Electric has continued to grow through continuous investment in both technology and personnel in order to meet changing customer demands. Today, it is an industry leader ranked among the top 50 electrical contracting firms in the United States. Its services also include specialty electrical and controls engineering, project development and turnkey construction services with total annual sales exceeding \$100M. The Morse Group remains headquartered in Freeport, IL but has expanded operations nationally with permanent offices in Beloit WI, Madison WI, Rockford IL, Dubuque IA, Elgin IL & Las Vegas NV.

**10. What stray voltage or transient ground current problems are associated with distribution-connected wind turbines?**

Properly designed wind projects with distribution connections do not contribute to or create stray voltage issues. The electricity from the turbine generator is transferred to the local utility lines via underground buried and shielded electrical cable. The shielding of the cable prevents any induced current or voltage in adjacent powerlines or wires.

"Stray voltage" typically refers to a small voltage potential difference that exists between two surfaces that an animal can touch. This problem is most often discussed in association with dairy farms, where a cow is being milked or is

otherwise coming into contact with two surfaces of different electrical potential at once. "Stray voltage" is really somewhat of a misnomer, because the difference in potential is being caused by stray currents in the earth that are trying to find their way back to the utility ground or neutral. These currents exist everywhere, in cities, suburbs and rural areas. Stray voltage is NOT caused by modern wind turbine generators or associated wiring.

Stray voltage is most often caused when unbalanced loads are connected to the three-phase electrical utility system. In an ideal "balanced" 3-phase system, the currents from the three electrical phases sum exactly to zero and effectively cancel each other at any point in the system. In a real electrical power system, such as found in a milking barn, there are unbalanced loads and other phenomena that will allow some of the current to find its own path through the earth to return to the utility neutral. When these currents traverse a dairy farm facility with inadequate electrical grounding, small voltages can develop that will bother the livestock when they contact certain equipment, such as milking equipment. Stray voltage is best addressed by a well-designed and constructed grounding system in the dairy facility.

The electrical engineers at EcoEnergy design wind power systems so that there are no paths to attract these earth currents back to the utility.

There is a great deal of misinformation about "stray voltage" available from the internet. A good source of valid technical information about this subject is a book published by Midwest Plan Service at Iowa State University. The book is titled "Wiring Handbook for Rural Facilities", and is authored LaVerne Stetson and Bill Koenig. This book, published in 2006, contains a chapter on stray voltage, with easy-to-understand explanations of this commonly misunderstood phenomenon.

The proposed wind turbine array will be one more in a series of energy integration projects that EcoEnergy Engineering and Morse Electric have designed and built in the last ten years, ranging from a 5 MW cogeneration system at an ethanol plant, to several 300+ MW natural gas plants. This range of experience extends to EcoEnergy Wind's current portfolio of 19 wind energy facility projects under development totaling over 1300 MW.

11. Who will certify the turbine components, blades, and tower engineering and specifications?

These turbines are Germanischer Lloyd (GL) certified. GL is an internationally recognized and accredited certifier of large wind turbines.

Local independent Professional Engineers certify the foundation design.

Furthermore, Acciona, the largest wind farm developer in the world, and a world leader in the manufacture of wind turbines, stands behind the model likely to be chosen for this project, the AW 82/1500. Below is a listing of U.S. and worldwide sites in which the AW 82/1500 is already performing. This list does not include the multiple sites for which this turbine is scheduled to be installed.

#### **U.S.: North & South Dakota**

Tatanka Project - 120 turbines total, 180 MW



**Projects outside the US that use the AW-1500 turbine:**

**Australia:**

Waubra Wind Farm -Victoria, Australia - 128 turbines, 192 MW **Spain:**

Majales - Castilla-La Mancha, Spain - 33 turbines, 49.5MW

Cerro Blanco - Castilla-La Mancha, Spain - 32 turbines, 48 MW

Torre Miro I/II, Arriello & Folch I - Valencia, Spain - 33 turbines combined, 49.5MW

Vilob i- Catalonia, Spain - 27 turbines, 40.5 MW

Brena - Castilla- La Mancha, Spain - 24 turbines, 36 MW

Pla D'Embalague - Valencia, Spain - 24 turbines, 36MW

Las Cabrillas - Valencia, Spain - 24 turbines, 36MW

Torviscal - Castilla- La Mancha, Spain - 16 turbines, 24 MW

Folch II - Valencia, Spain - 10 turbines, 15MW

Les Comes - Catalonia, Spain - 2 turbines, 3 MW

**Canada:**

Chin Chute - Taber, Alberta, Canada - 20 turbines, 30MW. Magrath Wind - Lethbridge, Alberta, Canada - 20 turbines, 30 MW.

**France:**

Espinassiere - 8 turbines, 12MW - France

**12. Why is the setback measured from the center line of the wind turbine tower instead of from the rotor diameter? Please provide supporting documentation.**

It is the industry standard. Given that only three towers will be erected in the Town of Union project, we anticipate ample flexibility in siting, which will yield the least intrusive turbine locations possible.

There is a straightforward reason why we commonly use the turbine center when establishing setback measurements. To begin with, the turbine center is most easily depicted on maps. But more importantly, turbine rotor diameter is often included in setback calculations. For example, many setbacks are calculated based on total turbine height (from ground to tip of the blade at its highest arc), which explicitly includes the size of the rotor-swept area. To include rotor diameter in the calculation again would be double jeopardy and so is avoided by code officials.

**13. What are the construction specifications for the turbines? Please provide a copy of the turbine construction specifications?**

The construction specifications that Acciona applies to its AW 82/1500 turbine are proprietary. The specifications uniformly adhere to the most stringent legal and engineering requirements that Acciona faces in any location.

Acciona Energy has installed 4,696 MW of wind energy as of 2007. It has built 172 wind farms for itself and other companies with almost 5,000 turbines, making it the world leader in the development and construction of wind farms. It currently has 667 MW under construction and over 15,000 MW in development. Acciona brings an experienced team for each element of the development, construction, financing, and operations of the facility.

For more information about Acciona, please visit their web site:

<http://www.acciona-energia.com/>

(Note, choose "English" at the bottom to display the site in English.)

**Health and Safety**

**14. What potential health risks do wind turbines pose? Please provide scientific/medical and peer-reviewed documentation supporting your answer.**

We are not aware of any potential health risks that wind turbines pose. Wind turbines do emit sound, and shadow flicker may be present in homes near turbines that were poorly sited. The most intrusive aspects of these annoyances can be alleviated by careful siting, such as is done by our team of Geographic Information System specialists. Again, we know of no peer-reviewed scientific or medical papers that link wind turbines with health affects.

**15. What setback distances from residences and adjacent property lines does Ecoenergy plan to implement? Please provide scientific/medical and peer-reviewed documentation supporting your answer.**

Setback distances will depend on local ordinances, the topography, and our flexibility to site the turbines in the least intrusive manner.

EcoEnergy's general rule of thumb is to use 350 meters, or 1150 feet, from occupied residences. From non participating properties lines, we use a 440' setback, which is roughly 110% the turbine and rotor height. EcoEnergy's policy is informed by the work of Acciona, which develops and manages projects all over the world, based on differing local policies and ordinances that necessitate specific guidelines for each project.

While, we depend on local ordinances to establish setback requirements, the draft model ordinance for the state of Wisconsin provides a good example of a complete ordinance for wind energy siting.

**16. What assurances in setback planning do you have to protect public health and safety? Please provide scientific/medical and peer-reviewed documentation supporting your answer.**

Again, we know of no peer-reviewed documentation that indicates health or safety concerns with the siting of wind turbines. Wind turbines are sited in a variety of locations, sometimes in very close proximity to high density population centers. For example, turbines have been constructed on school grounds at several locations, as part of an effort to decrease impact to the environment and to help offset the cost of electricity. Specifically we can offer schools in Illinois, Iowa and Minnesota that all have large modern wind turbines adjacent the school yards. Additionally, Cleveland OH, Toronto, ONT, Moorhead, MN and other municipalities have turbines in urban environments that have been operating for a number of years.

**17. What are the sound issues from wind turbines? Please provide scientific/medical and peer-reviewed documentation supporting your answer.**

The wind turbines EcoEnergy proposes will be sited so the maximum sound level at a nearby residence is 45dBA. This is a maximum, however, and most of the time the sound level will be far lower. To give an example of this sound level, operating refrigerators or furnaces within a typical home create an environment that is 45 dBA. Detailed noise

studies will be supplied from third party consultants at the time the proposed turbines are sited. Sample studies can be provided (they were shown at the Town of Magnolia meeting in November 2007 for a project in Dane County, WI. These studies were performed by EAPC Engineers out of offices in Grand Forks, North Dakota.) Sound from wind turbines is generally broadband, and originates when the revolving rotor blades encounter turbulence in the passing air. Broadband sound is usually described as a "swishing" or "whooshing" sound.

Older style turbines, such as are no longer constructed, sometimes produced tonal sounds (a "hum" or "whine" at a steady pitch). This was caused by mechanical components or, less commonly, by unusual wind currents interacting with turbine parts (many of these turbines had a lattice style tower, instead of the tubular towers used with modern turbines.)

In addition, turbines have motors that change the orientation of the nacelle, and that adjust the pitch of the blades as needed to best capture the wind. Any sound produced by these motors is factored in to the total sound produced for modeling or permitting purposes. EcoEnergy will make sure that the final project will comply with local ordinances.

Wind plants are very, very quiet compared to other types of large facilities. Furthermore, wind turbines are always located where the wind speed is higher than average, and the "background" sound of the wind tends to "mask" any sounds that might be produced by operating wind turbines—especially because the turbines only run when the wind is blowing. The only occasional exception to this general rule occurs when a wind plant is sited in hilly terrain where nearby residences are in dips or hollows downwind and are sheltered from the wind—in such cases, turbine sound may carry further than on flat terrain. This terrain effect is factored into sound level studies prior to construction.

Virtually everything with moving parts will make some sound, and wind turbines are no exception. However, well-designed wind turbines are generally quiet in operation, and compared to the sound of road traffic, trains, aircraft, and even many farming practices, to name but a few, the sound from wind turbines is very low.

Today, an operating wind farm at a distance of 750 to 1,000 feet is no noisier than a kitchen refrigerator or a moderately quiet room.

Source/Activity Indicative sound level dB (A)

- Threshold of hearing 0
- Rural night-time background 20-40
- Quiet bedroom 35
- Wind farm at 350m 35-45
- Car at 40mph at 100m 55
- Busy general office 60
- Truck at 30mph at 100m 65
- Pneumatic drill at 7m 95
- Jet aircraft at 250m 105
- Threshold of pain 140

Source: The Scottish Office, Environment Department, Planning Advice Note, PAN 45, Annex A: Wind Power, A.27. Renewable Energy Technologies, August 1994. Cited in

"Noise from Wind Turbines," British Wind Energy Association,  
<http://www.britishwindenergy.co.uk/ref/sound.html>

The best test is to simply experience the sound from a turbine for one's self. In most situations, a person can stand directly beneath a turbine and have a normal conversation without raising his or her voice. EcoEnergy can arrange for a public visit to a wind farm near the Union Township.

**A) Does the sound vary with terrain?**

Yes. A wind plant sited in hilly terrain, where nearby residences are in dips or hollows downwind that are sheltered from the wind, may have turbine sound carry further than on flat terrain. This is factored into sound level calculations during the planning stages in order to avoid potential problems.

**B) Does it vary with weather?**

Humidity, heat, and air density do not have a significant measurable effect on sound from wind turbines.

**C) Does it vary in different wind speeds?**

Sound production increases with wind speed; however, the "background" sound of the wind tends to "mask" any sounds that might be produced by operating wind turbines—especially because the turbines only run when the wind is blowing.

**18. Please provide scientific/medical and peer-reviewed documentation supporting your answer.**

Source: The Scottish Office, Environment Department, Planning Advice Note, PAN 45, Annex A: Wind Power, A.27. Renewable Energy Technologies, August 1994. Cited in "Noise from Wind Turbines," British Wind Energy Association,  
<http://www.britishwindenergy.co.uk/ref/sound.html>

**19. What sound standards will EcoEnergy insure that the turbines will be within, based on the setbacks EcoEnergy plans to implement, and what scientific and peer-reviewed data do you have to insure and support there will be no health and safety issues to persons within your setbacks?**

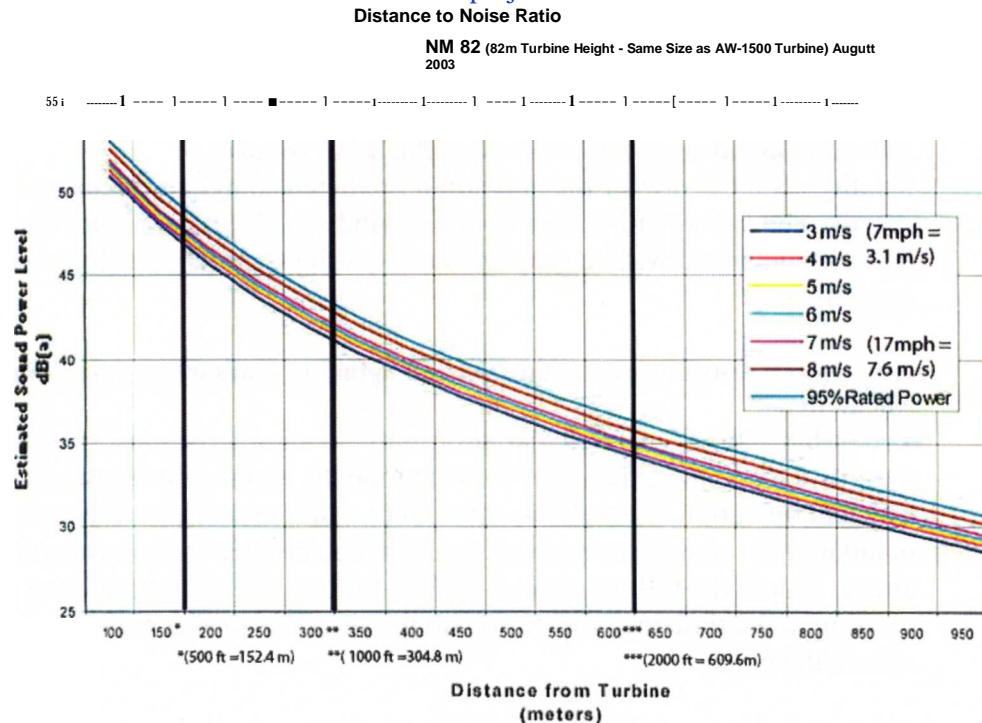
As mentioned, turbines are sited to have maximum sound level of 45dBA. These sound levels are well below levels causing physical harm. Medical books on sound indicate sound levels above 80-90dBA cause physical (health) effects. The possible effects to a person's health due to "annoyance" are impossible to study in a scientific way, as these are often mostly psychosomatic, and are not caused by wind turbines as much as the individuals obsession with a new item in their environment.

As part of the permitting and development process, EcoEnergy will develop a model/map of the expected sound that is based on number of and location of turbines, as well as surrounding topography. This project has not yet advanced to the point where we have enough data to develop a sound model/map for the project area. This model/map is a necessary part of the permitting process, because it allows EcoEnergy the final project will comply with local ordinances.

For reference purposes only, we have attached a Distance to Sound Ratio graph for a similar sized turbine [82m rotor, 80m tower]. This shows how sound levels are a function

of two factors: wind speed & distance from turbine. At 500' [152.4m] sound ranges between 45-50 dB, at 1,000' [304.8m] sound ranges between 40-45 dB. At 2,000' [609.6m], sound ranges between 33-37 dB.

All sound levels listed are approximate, for demonstration purposes only, and are not predictive of individual turbine locations in this project



**20. How will the wind turbines' owner correct any sound issues once the turbines are erected? Please provide documentation supporting your answer.**

To address concerns, EcoEnergy is willing to generate a sound measurement report. This report will be generated at the written request of a resident, not to exceed one request per year, or three requests total. If sound levels exceed 45dBA for periods greater than two minutes in any 24 hour period at the residence outside wall attributable to the wind turbine(s), then modifications will be made to the turbine to reduce the noise below the 45dBA amount.

Further, once the facility is up and running, there will be a project manager on site who oversees operations. This project manager will also be a point of contact for addressing issues. The project manager will work with EcoEnergy and the interested party to address the issue. Issues will be dealt with on a case-by-case basis.

**21. What sound studies will be done to project sound levels in dBA, dBC, and infrasound?**

Outside sound consultants prepare sound isoline maps showing sound levels predicted at various radii from the turbine. These are the maximum sound levels predicted. The turbine sound study report gives maximum sound levels at approximately 8m/s wind speeds primarily in dBA; these sound study reports are provided by an independent test group for

the turbine manufacturer. Please see Exhibit 2 (we can supply the test data, although they do not mean much to a lay person).

We do not conduct infrasound studies. The lower frequencies are measured and reported in the sound report we are provided, but we are not modeling those sounds.

**22. Are these sound studies based on variable wind speeds?**

No, these studies are for the maximum predicted sound levels, using 8m/s wind speeds. The sound will be less at lower wind speeds and at higher wind speeds the background sound will be greater than the turbine sound, which is why 8 m/s is chosen.

**23. How do you consider non-optimized and aging turbines when doing sound calculations?**

The turbines that EcoEnergy would install are among the most recent of advanced designs. Due to the expense of the components, and the profit associated with efficient operation, the turbines through regular maintenance are expected to maintain the same operation and sound characteristics as new systems. As offered above, should the turbine exceed 45dBA for the specified duration at a residence existing at the time the wind farm is built, then the turbine owner will have to reduce the noise.

The airline industry provides an example of similarly complex machinery operating for decades at optimum performance.

**24. What is the anticipated sound level and frequency range at hub height? Include calculations for cut-in and cut-out wind speeds?**

Please refer to the manufacturer's sound study report, Exhibit 2.

There is no additional sound when the turbine cuts in or out, just the regular sound that the turbine makes when the wind is turning the blades. Earlier generations of wind turbines had a clutch that would make a sound when it engaged. We still deal with this perception.

Further, at the cut-out wind speed of 20 m/s [46 mph], the background sound of the wind would be the greatest sound factor. Winds of 46 mph are very uncomfortable to be in, let alone listen to.

**25. What is the anticipated gain in dBA, dBC, and infrasound at ground level in a stable atmosphere or temperature inversion?**

We do not know the answer to this question. The maximum sound level maps attempt to predict the worst case, and are expected accurate to 1 dBA.

**26. What is the increase in sound dBA, dBC, and infrasound anticipated to be from having multiple turbines in one area?**

There may be an increase, but this cannot be estimated until final siting. Then it is modeled by the sound consultant, and the increase depends on the number of



turbines and the terrain, but does not increase by more than 1 -2 dBA for having multiple turbines in an area.

### **Ground Water**

**27. Please provide information on how wind turbine construction affects (groundwater level and quality, b) drainage. Please provide scientific/medical and peer-reviewed documentation supporting your answer.**

As part of the permitting process, EcoEnergy engages independent studies and analysis by experts to ensure that the natural environment is not significantly disrupted. These experts, for example, Natural Resources Consulting out of Cottage Grove, work both for private industry and government to address a variety of development types (retail development, road construction, industrial development).

It is not anticipated that wind turbine construction will cause an impact to groundwater quality or level.

A hydro-geologist with Clean Wisconsin ([www.cleanwisconsin.org](http://www.cleanwisconsin.org)), an environmental watchdog group, recently presented at an EcoEnergy open house to assure residents of Calumet County, Wisconsin, that turbine construction would not affect ground water.

**28. Will wind turbines and installation disrupt the water table and who will be responsible for drilling new wells?**

Wind turbine construction and operation is not expected to disrupt water tables. Therefore, if water table problems occur do to the impact of a different land use, it would be the responsibility of that company or individual to mitigate the problem. Of course, EcoEnergy will always mitigate issues for which we are directly responsible.

**29. How will ground water be protected during construction?**

As part of normal construction operations, EcoEnergy will be required to submit a stormwater and erosion control plan to the DNR. This plan will address any concerns about the loss of topsoil or impacts to water quality. In practice, turbine foundation work is not substantively different than house foundation work; when we manage a construction project, we will also manage contractors to assure a clean work site, avoid fuel or oil spills, and set up runoff barriers as required.

Electric wire trenching is often opened and closed in the same day, leaving very few chances for erosion control problems in those trenches.

**30. What will be done if ground water is contaminated? Please provide documentation supporting your answer.**

Again, we know of no impacts of turbine construction on ground water contamination. We would certainly be willing to examine any existing studies

that address this question, but to date we do not know of examples where ground water has been affected by turbine construction.

**31. What is the appropriate timeline to remediate groundwater problems and procedures to correct any problems?**

Again, we know of no impacts of turbine construction on ground water contamination. We would certainly be willing to examine any existing studies that address this question, but to date we do not know of examples where ground water has been affected by turbine construction. Of course, remediation of any problem associated with wind turbines would have to be on a case-by-case basis.

**Ice**

**32. What is the risk for ice throw from the wind turbines? Please provide documentation supporting your answer.**

Wind turbine blades do shed ice under certain conditions, but this is of little danger given the turbines are out in farm fields away from people. There are a number of wind turbines operating adjacent school yards in the Midwest, and no ice injuries have been reported from any of these installations. When humidity is high and temperatures are low, ice can build up on wind turbine parts, just like it builds up on other objects in the environment. When the wind turbine blades begin to turn, and the temperatures warm, this ice will fall off. Ice buildup on turbine blades rarely travels far because the turbine blades do not rotate quickly when encrusted in ice. Setbacks used to minimize sound are more than sufficient to protect the public from shedding ice. In addition, the ice buildup that slows a turbine's rotation is sensed by a turbine's control system, causing the turbine to shut down when the ice load is high.

Please see the safety letter supplied by Acciona (Exhibit 3), stating that of the more than 400 AW 1500 turbines in operation, to date there have no physical injuries to any member of the public in or around the turbines, nor death or serious injuries to any staff who have installed or repaired the turbines.

A healthy dose of common sense can prevent people from walking around or beneath turbines, trees, powerlines, and overhanging roofs when ice has built up on these objects.

**33. What is the projected ice throw? Please provide the manufacturer's documentation.**  
(Please see the response to question 32.)

**34. What kind of ice detection system is used?**

When the anemometer senses wind speeds and the actual power production is far below what it should be, ice is causing loss of aerodynamic lift on blades, which causes machine to shut down.

**35. Does the proposed wind turbine have blade heaters?**



The proposed wind turbines will not have blade heaters. However, the AW 1500 turbines have an excellent operating record under the frigid conditions that prevail in Alberta, Canada

**36. Will the turbine be shut down in severe icing conditions?**

If the sensors detect an imbalance in the blades, the turbine will shut down.

As stated in the safety letter: The Acciona AW 1500 turbines are designed with redundant safety systems, including hydraulic accumulator actuated blade pitch that automatically releases upon loss of grid power to stop the turbine, and a failsafe hydraulic actuated disk brake that prevents rotation of the generator and blades in an emergency condition.

**Fire**

**37. What type of fire detection and suppression systems are used in the nacelle?**

There is no active fire suppression in the generator.

**38. How are fires extinguished? Please provide documentation to support your answer.**

In the rare occurrence of a fire, a safe procedure is to let the fire burn itself out. Hydraulic fluids and lubricating oils are secured in a secondary containment system, but may still burn. Once the fire has extinguished itself, the turbine can be replaced or repaired.

**39. Will EcoEnergy provide special training and equipment for the fire department?**

As part of turbine commissioning, emergency response teams are given training on how to respond in the case that assistance is needed.

**40. Are there hazardous material issues with wind turbines? Please provide documentation to support your answer.**

Hydraulic fluids and lubricating oils are encased in the nacelle. There is, however, a secondary containment system that will capture fluids in the case of an equipment malfunction. This fail-safe system provides a much greater level of fluid retention protection than vehicles such as cars, trucks, and large farm equipment.

**Communication**

**41. How do wind turbines affect television reception, radio, emergency microwave communication, 911 communication, and cell phones? Please provide documentation to support your answer.**

EcoEnergy conducts a microwave beam study to prevent these interruptions. In the example attached study (Exhibit 4), conducted for Calumet County, Wisconsin, the conclusion was to ensure the clarity and continuity of signal by providing a setback of twice the rotor diameter, added to the beam radius and applied to the beam as an offset to avoid any interference.

A turbine operating between a transmitter and receiver of microwave beams, or 911 communications will intermittently interrupt the signal, so we do not site turbines where they interrupt a microwave beam path.

Regarding television and radio signals, interference is rare and easily avoided. Large wind turbines installed at wind farms can interfere with radio or television signals if a turbine is in the "line of sight." Improving a receiver's antenna or installing relays to transmit the signal around the wind farm solves this problem; both solutions are common practice in modern wind energy development. There are no known effects on cell phone reception.

#### **Other Landowner Rights**

42. Does EcoEnergy as a standard policy enter into good-neighbor agreements with non-participating landowners? Please provide a typical good-neighbor agreement to be used in Union township for non-participating landowners?

EcoEnergy has not committed to entering into good-neighbor agreements at this time.

43. **How does EcoEnergy preserve the wind rights of current non-participating landowners for the life of the project?**

Given the small footprint of the turbine array projected for the Town of Union, the wind rights of current non-participating landowners is not expected to be affected. EcoEnergy, however, would be happy to discuss the opportunity to host turbines with members of the public who have an interest in renewable energies. There are a number of options for participating in a wind energy project, ranging from utility scale turbines such as proposed by EcoEnergy to residential scale turbines that are affordable enough for a dedicated property owner to install and maintain. While residential turbines will not provide enough energy to power a neighborhood like the AW1500, they can certainly help to offset the energy use of a household.

#### **Lightning / Electrical**

44. **What are the dangers of a lightning strike? Please provide documentation to support your answer.**

Turbines can be damaged by lightning, but a lightning strike on a turbine poses no threat to any person or property nearby.

45. **How will lightning strikes be isolated to keep them off of the distribution lines?**

The wind turbines and towers have a lightning protection system that has been shown to be effective in routing most of the energy from lightning strikes into the surrounding earth, and not into the electrical system. In addition to the lightning protection system, surge arrestors in the wind turbine electrical system add robustness to the system and serve to prevent transient voltages from reaching the distribution system.

**46. Do you require a master label on the system?**

The authority having jurisdiction over the electrical installation will determine what listing is required for the equipment that is installed. The Acciona AW1500 wind turbine equipment is built to comply with IEC (International Electrotechnical Commission; [www.iec.ch](http://www.iec.ch)) standards.

**47. Are all turbine distribution lines tied together?**

Yes.

**48. Are multi-receptor systems used?**

Multi-receptors as a technique to reduce lightning strikes were introduced around the year 2000 to address strikes to non-conductive blades of the newer and larger sizes. Other techniques (tip-end receptors with drainage inside the end receptor) have subsequently been introduced. When the turbine is installed, advanced and cost-effective forms of lightning protection will accompany the turbine and blades. The form of lightning protection that will be used in the proposed project has yet to be decided upon.

**42. What is the (voltage and amperage) size of electrical connections to distribution lines?**

The Acciona Awl 500 turbine generates at 12 kV. This turbine can be directly connected to a 12.47kV electrical distribution system by using a transformer. The electrical interconnection voltage for the proposed project in Town of Union is 12.47kV, nominal. At that voltage, each turbine can contribute a maximum of approximately 83 amperes.

**Shadow Flicker - Visibility**

**43. At the Town of Magnolia Wind Workshop meeting, Wes Slaymaker stated when asked about mitigation for shadow flicker that EcoEnergy would plant vegetation and install window shades/blinds for a person's house, if sound and shadow flicker was an issue. Wes also stated that shadow flicker can be present at 1/2 mile from a resident in flat terrain. Is this how EcoEnergy plans to address sound and flicker issues? What preventive measures will EcoEnergy implement for sound and shadow flicker before installation?**

Shadow flicker is the term used to describe what happens when rotating turbine blades come between the viewer and the sun, causing a moving shadow. Shadow flicker is almost never a problem for residences near new wind farms. For some who have homes close to wind turbines, shadow flicker can occur under certain circumstances and can be a mild annoyance. However, the effect can be precisely calculated to determine whether a shadow will fall on a given location near a wind farm, and how many hours in a year it will do so. Potential problems can be easily identified using these methods, and solutions range from adjusting the turbine location to installing blinds and awnings to disrupt the effect. Normally, shadow flicker should not be a problem in the U.S. because at U.S. latitudes (except Alaska) the sun's angle is not very low in the sky. As a standard development practice, EcoEnergy holds a community meeting to discuss the results of the shadow study prior to constructing the project.

- 51. What is the affect on road visibility and snow patterns from wind turbines? Please provide documentation to support your answer.**

We know of no interaction between wind turbines and road visibility or snow patterns.

**Property Value**

- 52. Will turbines lower property values and assessments? Please provide documentation supporting your answer in addition to the Ben Hoen report.**

There is no evidence that the presence of a commercial wind farm within sight of a property decreases that property's value. In fact, a study conducted in 2003 surveyed property near multiple wind farms and found that not only do wind farms not harm property values, but that in some cases the values increased.

A nationwide study of many existing wind farms, conducted by the Lawrence Berkeley National Laboratory, is scheduled to be issued in January 2008. We will submit the results of that study as soon as it is made available. We feel that study's, such as are produced by the Lawrence Berkeley National Laboratory are the best method of evaluating the interaction between wind farms and property values.

- 53. Will the turbines' owner be willing to enter into a property value protection plan?**

EcoEnergy does not intend to enter into a property value protection plan. The real estate market is variable and unpredictable. For example, we are currently in a real estate slump throughout the nation, which unrelated to renewable energy. EcoEnergy is the clean, renewable energy business and will focus our efforts on careful siting, adherence to appropriate laws, and working to address problems before they exist. We look forward to providing clean, renewable energy to the people of Rock County by developing wind energy facilities that we all can be proud of.

***Exhibits Included:***

Exhibit 1: Technical Specifications AW 82/1500 IEC IIIB Exhibit 2: Manufacturer's Sound Study Report Exhibit 3: Acciona Safety Letter Regarding the AW 82-1500 Turbine Exhibit 4: Example Microwave Study, WPPI - New Holstein

## Exhibit 1: Technical Specifications AW 82/1500 IEC IIIB

Note:

See Acciona Specs brochure.

## Exhibit 2: Manufacturer's Sound Study Report



**Acciona AW 82/1500 IEC IIIb T80A LM40.3P**

<b>Customer:</b> Acciona Windpower, S.A. Pol. Ind. Barasoain, Parcela 2 31395 – Barasoain, Navarra Spain		<b>Site:</b>	Moncayuelo Wind Farm A-3.3
<b>Date of Order:</b> 2006-10-31		<b>Contractor:</b>	WINDTEST Kaiser-Wilhelm-Koog GmbH Sommerdeich 14 b 25709 Kaiser-Wilhelm-Koog Germany
		<b>Order No.:</b>	4250 06 03531 64

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**Wind Turbine Technical Data:**

Type: ..... Acciona AW 82/1500 IEC IIIb T80A LM40.3P  
 Manufacturer: ..... Acciona Windpower, S.A.  
 Turbine serial number: ..... 002  
 Rated power: ..... 1500 kW  
 Power control: ..... pitch  
 Tower type: ..... tubular/conical  
 Rotor manufacturer: ..... LM  
 Rotor blade type: ..... 40.3P  
 Rotor blade serial number: ..... 0100, 0101, 0102  
 Rotor diameter: ..... 82,026 m  
 Rotor blade pitch angle (degrees): ..... variable (0-90°)  
 Number of rotor blades: ..... 3  
 Rotor rated speed: ..... 18,25 min<sup>-1</sup>  
 Gearbox manufacturer: ..... Feller  
 Gearbox type: ..... TPH3-1600N  
 Gearbox serial number: ..... 480257700201  
 Generator manufacturer: ..... INDAR  
 Generator type: ..... TAR-500-X6/R  
 Generator serial number: ..... 5170  
 Generator speed range: ..... 700 - 1350 min<sup>-1</sup>  
 Generator rated power: ..... 1500 kW

These data do not replace the corresponding manufacturer's certificate.

**Measurement geometry:**

Hub height above ground: ..... 80 m  
 Measurement distance  $R_0$ : ..... 113 m  
 Height of microphone  $h_A$ : ..... -21 m  
 Distance rotor centre to tower axis  $d$ : ..... 3,6 m

**Measurement conditions:**

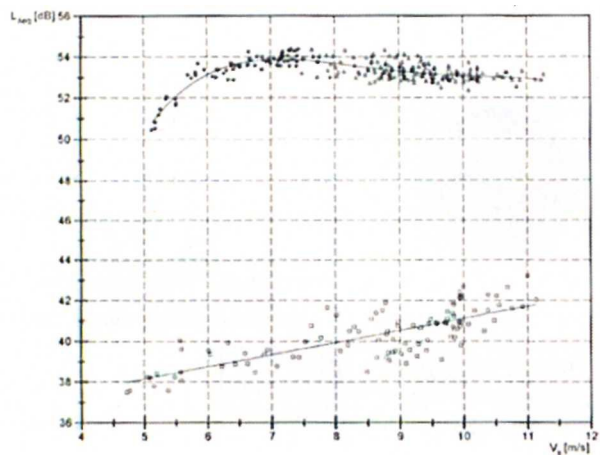
Measurement date: ..... 2006-12-06  
 Range of wind speed at 10m height, 1-min average  
 $WS_{10m}$ : ..... 4,7 - 11,1 m/s  
 Wind direction: ..... WNW  
 Range of power, 1-min-average  $P_{we}$ : ..... 556 - 1523 kW  
 Air pressure  $p_{Luf}$ : ..... 959 - 963 hPa  
 Air temperature  $T_{Luf}$ : ..... 7 - 10 °C  
 Turbulence intensity: ..... 10,4 %

**Power curve:**

From report: DEWI W-PV 06-012  
 Testing Auth.: DEWI  
 Measurement Period: 2006-08-04 - 2006-11-01

WS (m/s)	Power (kW)	WS (m/s)	Power (kW)	WS (m/s)	Power (kW)
1,61	-6,93	6,97	525,87	12,50	1513,74
2,03	-6,93	7,51	672,78	13,01	1513,51
2,53	-7,86	8,02	787,60	13,52	1515,39
3,00	-3,62	8,50	901,11	13,97	1516,41
3,51	9,55	9,00	1074,49	14,51	1516,39
4,02	68,27	9,50	1196,62	15,04	1516,98
4,52	107,41	10,01	1348,74	15,51	1518,00
5,02	176,77	10,49	1442,92	15,96	1517,43
5,52	241,98	10,99	1480,84	16,47	1515,96
5,99	321,57	11,50	1499,06	16,98	1516,38
6,51	423,68	12,03	1505,76	17,42	1516,85

Determination of the sound power level



$WS_{10m}$ [m/s]	6	7	8	9	10
$P_{wet}$ [kW]	867	1270	1486	1514	1516
$L_{WA}$ [dB]	101,7	102,5	102,2	101,8	101,5
$U_c$ [dB]	0,8	0,7	0,8	0,8	0,7

Summary of results of the noise emission measurement, in accordance with IEC 61400-11 and MEASNET, of a WTGS I Acciona AW 82/1500 IEC IIIb T80A LM40.3P

**WINDTEST**  
Kaiser-Wilhelm-Koog Gr

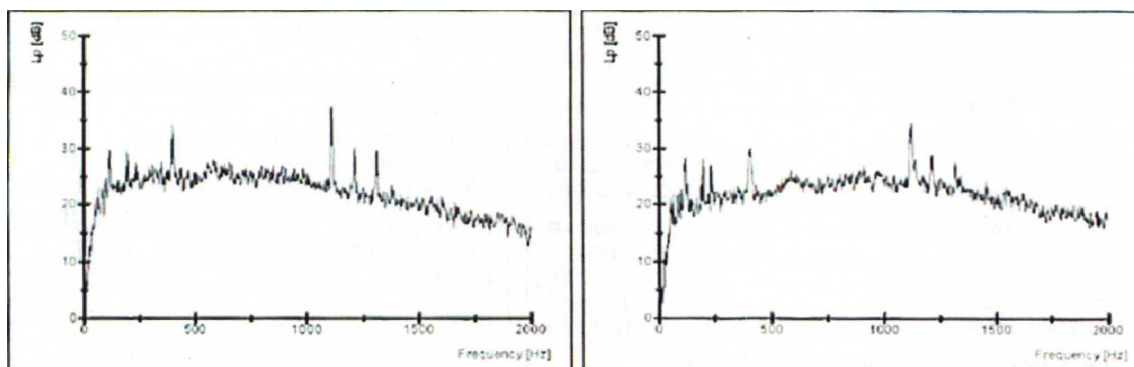


**Third octave sound power spectrum in dB(A) for the wind speed in 10 m height corresponding to the maximum sound power level given on page 1:**

1/3 octave freq. [Hz]	50	63	80	100	125	160	200	250	315	400	500	630
$L_{WA}$ (7 m/s)	72,1	72,8	76,0	80,8	84,7	85,0	88,2	90,4	91,9	92,8	92,9	93,5
1/3 octave freq. [Hz]	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
$L_{WA}$ (7 m/s)	92,6	93,2	92,3	88,9	86,7	86,1	82,0	79,5	76,0	71,3	65,8	63,4

### Tonality according to IEC 61400-11/Ed.2:

Representative FFT - Spectra (left 8 m/s and right 10 m/s at a height of 1



WS in 10 m height [m/s]	6,0	7,0	8,0	9,0	10,0
Freq. of most prevalent tone, f [Hz]	1086-1122	1114-1122	1088-1124	1112-1126	1084-1150
Tonality, $\Delta L_k$ [dB]	-0,87	-2,42	-0,51	-1,09	-1,71
Audibility, $\Delta L_{ak}$ [dB]	2,05	0,51	2,41	1,84	1,21

Engineer:

Dipl.-Ing. A. Jensen.



Checked:

Dipl.-Ing. J. Neubert  
Head of Acoustics Group

Laboratory accredited by DAP Deutsches Akkreditierungssystem  
Prüfwesen according to DIN EN ISO/IEC 17025. This  
accreditation is valid for the test and measurement procedures  
given in the certificate.



### Exhibit 3: Acciona Safety Letter Regarding the AW 82-1500 Turbine



Acciona Energy North America Corporation  
Suite 610  
101 North Wacker Drive  
Chicago, IL 60606  
Phone: (312)673 -3000  
Fax: (312)673 -3001

1 October 2007  
EcoEnergy  
Attn: Wes Slaymaker,  
P.E. VP of Wind  
Development Suite 380  
211 S. Paterson St.  
Madison, WI 53703

**RE: Safety & Acciona AW 1500 Wind Turbines**

Dear Mr. Slaymaker;

I write to you on behalf of Chicago based Acciona Energy North America Corporation to inform your company and the Town, County and State regulating bodies that are reviewing your applications to install these same AW 1500 model wind turbines, of the safety record of all the commercially installed and operating AW 1500 turbines worldwide.

There are over 400 AW 1500 wind turbines operating worldwide as of September 2007. To the best of my knowledge, to this date there have been no physical injuries to any member of the public in or around these turbines. Further, to the best of my knowledge, no deaths or serious injuries have occurred with any of the staff that have either installed or repaired these turbines.

The Acciona AW 1500 turbine has been independently certified by Germanischer Lloyd to meet or exceed the requirements of the applicable International Electrotechnical Commission standards. The Acciona AW 1500 turbines are designed with redundant safety systems, including hydraulic accumulator actuated blade pitch that automatically releases upon loss of grid power to stop the turbine, and a fail-safe hydraulic actuated disk brake that prevents rotation of the generator and blades in an emergency condition. The turbine has a secondary containment system for any spills of hydraulic fluids or lubricating oils. All electrical and mechanical components are shielded to prevent injury and protected within a locked steel tower that is not climbable or otherwise accessible to members of the public.

Additional concerns from host communities can be addressed if those concerns are submitted in writing. We are pleased to provide this information on our quality built and operated wind generating equipment.

Regards,

Phil Stiles, Senior Product Engineering Manager  
Acciona Energy North America Corporation

Exhibit 4: Example Microwave  
Study WPPI - New Holstein



# **Final Report Microwave Beam Study**

**New Holstein Project**

**July 13, 2007**

Submitted to:

Wes Slaymaker, P.E. EcoEnergy, LLC 2511  
Technology Dr., Suite 110 Elgin, IL 60124

Submitted by:

Jay Haley, P.E. EAPC Architects Engineers  
3100 DeMers Ave. Grand Forks, ND 58201

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## **1. Executive Summary**

EAPC was hired to determine if there are any potential microwave beam paths that may pass through the New Holstein project where EcoEnergy is considering erecting wind turbines.

The FCC database of registered transmitters was researched within a 30-mile radius of the proposed sites and a number of microwave beam paths were identified. Of those identified, 1 beam path was identified that would be in close enough proximity to Turbine 3 to present a potential interference problem.

Turbine 3 would have to be moved in order to avoid a conflict with the beam in question.

## **2. Introduction**

Microwave beams are point-to-point radio transmissions. If a wind turbine blade were to interrupt the beam path as the rotor turns, it could cause interference with the radio signal. In order to avoid interference, the wind turbine must be placed far enough away so that the turbines and blades are not within the actual beam path.

The beam path is defined by the locations of the transmitting and receiving towers, the height of the transmitters and receivers, and the beam width, which is widest at the midpoint of transmission. The beam width is a function of the transmission frequency and the length of the path.

There is no mandatory setback requirement to be maintained between the wind turbines and the microwave beam path, but typical industry practice is to maintain a minimum setback of 2 rotor diameters from the edge of the beam path at its widest point.

## **3. Study Methodology**

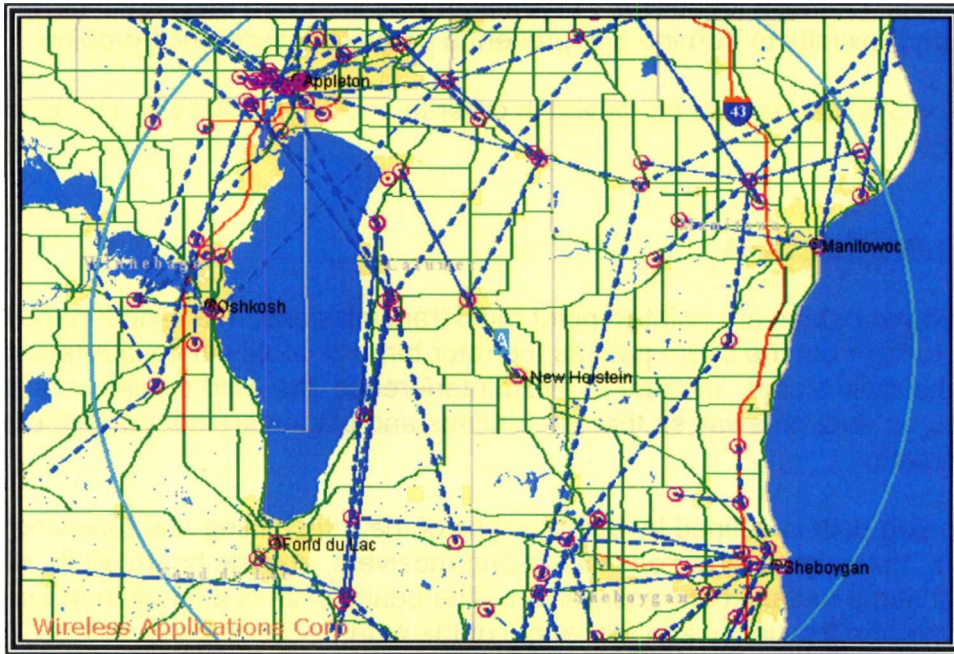
The study was performed as follows:

1. Search the FCC database for registered frequencies in the range of 2,000 to 25,000 MHz within a 30-mi radius of the project site.
2. Identify microwave beam paths crossing through the project area.
3. Calculate the maximum beam width of 1<sup>st</sup> Fresnel zone at midpoint of each microwave beam.
4. Plot microwave beams and wind turbines on a topographic map.

5. Measure distance from turbine blade tip to microwave beam at outer edge of 1<sup>st</sup> Fresnel zone when turbine blade is perpendicular to the beam path.

#### 4. FCC Database Search Results

The microwave beams identified within the 30-mile radius of the projects areas are shown in Figure 1 below.



**Figure 1 - Microwave beams within the**

## 5. Site Overview

The project areas where the turbines would potentially be located are shown in Figure 2 below. The wind turbines and radio towers are represented by orange X's, and the microwave beam path in question is displayed as a solid black line with a 2 rotor diameter offset on each side.

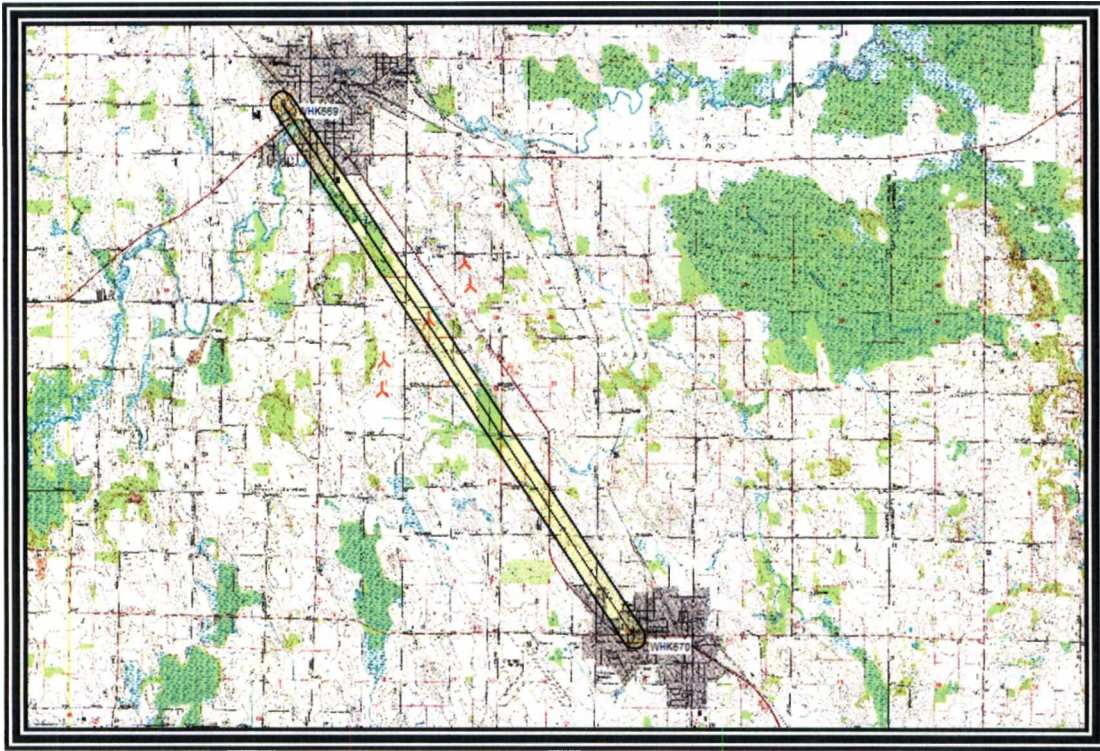


Figure 2 - Project Site Location

## 6. Siting Considerations

A total of four separate transmitting frequencies were identified. However, multiple signals are transmitted from a single tower so that, in this case, the 4 signals are contained within a single beam path. For the beam path identified, the maximum beam width of the 1<sup>st</sup> Fresnel zone between towers WHK669 and WHK670 is 62.5 feet at the midpoint of microwave beam KCM72, transmitting at 2186.4 MHz.

Using NAD 83, the coordinates of tower WHK669 are 44° 1' 48.9" N, 88° 10 7.3 W, and the coordinates of tower WHK670 are 43° 57' 4.9" N, 88° 5 41.3 W.

A complete listing of the signals is included below in Table 1.



Project: New Holstein												
Search Date 7/12/2007												
Call Sign	Segment #	Frequency (MHz)	Transmit Coordinates Receive Coordinates			Azimuth (Degrees)	Bearing (Degrees)	Distance (km)	Distance (miles)	Mode	Mode	Owner
			NAD 83 MAD 83									
			Lat. Lon. Lat. Lon.									
WHK6	1	21	44 1	88 10 7 3 N 43 57	88 5	1	8	10	6 58	6	1	Calumet County
69	1	36	48 9	4 9 N	41 3	4	5	59	6 58	3	9	Calumet County
WHK6	1	4	N	88 5 41 3 N 44 1	N	5		10	6 58			Calumet County
70	1	21	43	48 9 N	88		5	59	6 58	3	3	Calumet County
WHK6		86	57 4	88 10 7 3 N 43 57	10 7	9	8	10		6	1	
69		4	9 N	4 9 N	3 W	3	5	59		2	9	
WHK6		21	44 1	88 5 41 3 W 44 1	88 5	2	5	10				
70		36	48 9	48 9 H	41 3	6		59		5	1	
		4	N		W	1				6	1	
		21	43		88	4				3	9	
		86	57 4		10 7	5						
		4	9 N		3 W					3	3	
						9				6	1	
						3				2	9	
						2						
						6				5	1	
The microwave towers listed above were identified from the FCC database of registered												

licensed  microwave transmitters on the search date shown above Acceptance of this report is on the  basis that  EAPC Architects Engineers cannot in any way be held responsible for the application or use  made of the  findings or results from the search and that any such responsibility remains with the client										

**Table 1 - Microwave beam paths crossing the project area**

## 7. Conclusions and Recommendations

In its current location, it appears that Turbine 3 would have an impact on the beams that are transmitted between towers WHK669 and WHK670.

We recommend that a setback distance of not less than two rotor diameters plus the maximum beam radius be maintained from the tip of the turbine blade to the centerline of the beam path when the turbine blade is perpendicular to the beam path. If Turbine 3 were moved to the west, it appears that it would have to be moved 500 m in order to adhere to this recommendation.

# WPPI

1425 Corporate Center Drive  
Sun Prairie WI 53590-9109

WISCONSIN PUBLIC POWER INC

608-834-  
4500  
Fax 608-837-

## MEMORANDUM

TO: Jim Bembinster, LWTCC

CC: Town of Union Board of Supervisors  
Planning Commission

FROM: Eric Kostecki

DATE: December 28, 2007

SUBJECT: *Response to the Town of Union Wind Turbine Study Questionnaire*

This document is WPPI's response to the Town of Union Wind Turbine Study Committee's Health and Safety Research Questionnaire delivered to WPPI December 6, 2007. These responses have been sent to the Town of Union Board members and the Planning Commission members.

Regards,  
Eric Kostecki  
Renewable Energy Project Coordinator

To: Town of Union Wind Turbine Study Committee  
From: WPPI, Eric Kostecki - Renewable Energy Project Coordinator  
December 13, 2007  
Re: Health & Safety Research Questionnaire Responses

### WPPI Questions

1. A REC, Renewable Energy Credit is a "receipt" for buying a MW of Renewable Energy. Why are Renewable Energy Credits an important asset to a utility company?

Increasing the amount of renewable energy in WPPFs power supply portfolio is a key strategy to help stabilize future power costs. By diversifying power supply sources, renewable energy provides a hedge against fuel cost increases and supply interruptions from other energy sources. Wind and hydro power are also cleaner options than fossil fuel based sources. Existing Wisconsin coal fueled power plants emit approximately 1.7 pounds of carbon dioxide per kilowatt-hour (kWh). We estimate a single 1.5 megawatt (MW) wind turbine will generate approximately 4 million kWh per year, thus avoiding the release of 7 million pounds of carbon dioxide per year. In addition to the air quality benefit, this reduction in carbon emissions will save customers money by reducing the impact of potential state or federal carbon emission regulations.

Wisconsin Renewable Resource Credits provide a method for electric consumers to directly participate in supporting the installation and use of renewable resources. Participation in the RRC program also provides a methodology for WPPI to work toward compliance with mandates from the state of Wisconsin, which require that 10% of electric power sold to consumers must be supplied with renewable resources by the year 2015.

In short, a Renewable Energy Credit represents proof that one megawatt-hour (MWh) of electricity was generated from a renewable energy technology. The REC, renamed in Wisconsin to be Renewable Resource Credit (RRC), is what the state will use to determine compliance to the 10% renewable energy portfolio requirement.

2. You have had state mandates for the percentage of Renewable Energy being part of your power mix since your first day of operation, what other Renewable Energy sources are available to you to purchase besides wind?

Wisconsin first mandated use of renewable resources by state utilities in 2000. The first renewable energy sources utilized by WPPI were wind power, located out of state, and Wisconsin-based hydroelectric power.

Today, WPPI plans to meet the higher state renewable generation mandates with wind power from in-state and out-of-state wind projects, hydro power, solar photovoltaic and energy generated from landfill gas. It is important to note that out-of-state renewable energy resources are becoming more difficult and more expensive to acquire as states surrounding Wisconsin initiate or increase their own renewable resource requirements. WPPI presently purchases renewable energy generation from hydro, landfill gas to energy, wastewater methane gas to energy, wind and solar PV.

3. Are those sources still available to you?

Yes, see the answer to question 2. Theoretically, WPPI could issue a request for proposals specifying any type of renewable resource technology. In general, WPPI looks for available renewable energy resources that are economical and reasonably reliable.

4. Does the state mandate for purchasing Renewable Energy dictate how much wind power you must purchase or does it mean any Renewable Energy source?

No, the state mandate does not specify a particular technology; however, wind is the most economic and available technology.

5. What advantages does a Community Wind project bring to the customers of Evansville Water and Light?

WPPI is working with member electric utilities and local officials to install as much as 24 MW of wind power from turbines in several member service communities. By placing utility scale wind turbine generators in multiple communities, WPPI will create a large distributed generation renewable energy project. These distributed generation projects will bring renewable energy to member communities with no transmission costs and lower system losses than a single, large-scale site. A community-based project also brings all the environmental benefits of renewable energy to the customers of Evansville Water & Light. The energy generated by the wind turbines will be supplied to the distribution system of EW&L and used by its customers. It will also help customers understand how energy is generated and where some of their energy will come from.

6. Can wind energy be stored?

At the present time, it is not economically feasible to store large amounts of electric power from wind or other sources. Research into a number of technologies such as sodium-sulfur batteries and compressed-air storage



looks promising but is not yet developed for widespread commercial application.

7. If wind energy is being produced, and the demand isn't always there, and it can't be stored, where does it go?

The energy will flow into the distribution system, and then back to the transmission system via the substation, to be used by the next-closest loads.

8. How will the wind turbines be interconnected to the distribution line?

The wind turbines generate at 12,470 volts, the same as the three-phase distribution system in the Town of Union. After passing through the appropriate protection and metering equipment, the cables will be connected to the EW&L distribution system.

9. We contacted ATC and asked them about the proposed wind project for Evansville. They said they did not have any interconnection requests for this project.

- A) Has there been an interconnection study done?

No, the interconnection is to the distribution system, not the transmission system of ATC, hence no transmission interconnection study is needed.

- B) Who did it?

- C) Please submit a copy.

10. What are the power quality issues associated with wind turbines interconnected to distribution lines, i.e., voltage flicker, brown outs, islanding? How do you plan to handle these issues if they occur?

Modern wind turbines utilize sophisticated power management electronics to control the output voltage to minimize variations. "Islanding" is a situation that occurs when a distribution line is de-energized due to a fault or maintenance needs and a generating source does not shutdown. With modern wind turbines, when a fault or switching event occurs, the wind turbines sense the absence of system voltage and shut down to avoid generating voltage onto the system. This type of control is common for utility generating systems.

In the unlikely event of voltage flicker, there are several mitigation methods. There are several manufacturers, such as Elspec, S&C Electric, and others, who manufacture devices that can mitigate or eliminate flicker. These devices typically employ capacitors or active electronics to overcome the effects of flicker, but they are not always needed. Before a decision is made about whether any added equipment is necessary, or the

exact device to be used, the interconnection will be studied by a qualified engineer.

11. How many startups will the wind turbines be allowed to have during the day?

At this time, we know of no reason why the number of wind turbine startups will be restricted, either day or night. The wind turbines begin to turn when the wind has reached the cut-in speed of 3 meters per second (m/s) (6.7mph).

12. How many startups will the wind turbines be allowed to have at night?

See answer to #11.

13. Please list other Community wind projects similar to the proposed Town of Union project that would be connected to the distribution line.

WPPI is also working with the communities of Westby, New Holstein and Kaukauna to develop Community-based Wind Projects.

Additionally, WPPI owns two 900kW wind turbines in Worthington, MN that are connected to the local distribution system along with four other identical wind turbines. The turbines are within two miles of the edge of the city of Worthington and three miles of two golf courses. More pertinent, the turbines are within 600' of one home and within 1200' of others. There is also a radio tower within 1200' of the turbines. There have been no negative issues associated with this wind turbine project. These turbines have been in operation since July, 2002.

Nationally, there are numerous examples of wind turbines interconnected to the distribution system. A 7.2 MW project in Bowling Green/Amp-O-hio, and a 2.5 MW project in Hull, MA are just two examples.

14. Will the wind energy produced by the proposed Community Wind project be metered at the interconnection on the distribution line?

Yes

15. Will the energy consumed by the wind turbines off of the distribution line be metered? Is that reflected in the kW price of the wind energy or is that just another cost of business to Evansville Water and Light?

Yes, the meter will be bidirectional to measure consumption and generation. Any energy consumed by the wind turbines will be paid for by the wind turbine owners, the same as any other customer of EW&L.

16. How does pricing per kW compare with buying the wind energy from a wind farm owned by Alliant, or MG&E or WE to a kW purchased from a company in Spain?

Large wind projects can produce energy cheaper than smaller-scale developments whether they are utility-owned or owned by independent developers like Acciona. The price difference is due to simple economies of scale. It takes less work to develop 100 megawatts of wind generation at a single development site than it does to develop 100 megawatts at 33 or 66 sites. WPPI feels it is worth the slightly higher price to locate wind projects close to the loads, providing a distributed wind energy generation approach.

As mentioned previously, there is increasing competition for available renewable resources. In general, utility-owned wind power is not available for purchase or contract since these same utility companies have to meet the state mandate themselves.

17. Wouldn't pricing be more competitive buying it from a wind farm with Class 3 or Class 4 wind as opposed to this Class 2 area?

Not necessarily, even though in general, it is accurate to assume that a kilowatt-hour produced by a wind turbine in a higher wind class area will be less expensive than a kilowatt-hour produced by a turbine in a lower wind class area. However, cost at the turbine is not the entire story. Some of the highest class wind areas in the United States are remote from electric load centers, and the cost to transmit the power can make it more expensive than locally generated wind power. Furthermore, specific sites in the Town of Union are not necessarily Class 2. Most places have areas where winds will be higher speed than the majority of that area. In addition, modern wind turbine technology advancements make wind energy viable in areas of lower wind speeds than Class 3 or 4.

18. In the Janesville Gazette, October 13<sup>th</sup> you quoted." All of the electricity produced would be purchased by WPPI and used by customers in Evansville and Union. There is the possibility some of the energy might spill onto the power grid if, for example, the wind was blowing late at night when local customers weren't using all the power produced, said Eric Kostecki, renewable energy project coordinator with WPPI.

19. What is Evansville's load?

In 2006, the customers of Evansville Water & Light used 64 million kWh.

20. Who estimated the wind supplying 16% of the load?

The 1.5 MW Acciona wind turbine is predicted to produce 4 million kilowatt-hours per year in this area. The estimate was based on the annual estimated output of the wind turbines by divided by Evansville's annual usage. Since that 16% estimate was calculated, the 2006 EW&L data has become available and are little lower than 2005. Thus, the percentage is now above 18%, close to 19%. The annual estimated output is 12 million kWh, and Evansville's annual usage of 64 million kWh.

21. How will the wind turbines supply 16% of the load when the wind is not blowing, or is this an average figure for the year?

It's an average over the year.

22. If the wind turbine energy is going directly into the distribution line as we've been told by Ecoenergy how is it going to back feed to the grid?

There is a three-phase circuit that originates in the Evansville substation that has a total of five circuits leaving it. One of these three-phase circuits may be used to carry the energy from the wind turbines. If an existing circuit is used some of this energy will be used by loads on its way back to the substation. Any energy remaining that reaches the substation will be available for redistribution on one of the other circuits leaving the sub. Any energy that is not used by all the loads in Evansville will then feed back through the substation transformers and onto the transmission system. Again, this will only happen when the wind turbines produce more energy than is used by the loads in Evansville.

23. Wouldn't you have to have permission from ATC to "spill onto the grid"?

The amount of energy that could enter the transmission system will be determined in future interconnect studies. At that time, WPPI will work with ATC to determine whether such events would create significant impacts for the ATC system.

24. Would you be using the substation on Hwy M to put the power onto the grid? If not, which substation would you use?

It has not yet been determined where the interconnection will occur. This will be determined during the distribution interconnect study.

25. How will it get there, does the 3 phase distribution line run from the west side of Evansville to the substation?

Yes, a three-phase distribution line presently runs out to the Town of Union. Again, it has not yet been determined if this circuit will be used to carry the wind energy or if a dedicated circuit would be built.

26. Will that power be metered, is that another interconnection to the grid?

The energy generated by the wind turbines will be metered at the interconnection to the distribution line as stated in the answer to question 14.

27. How will the power be stepped down to run on distribution lines that are not equipped to handle the voltage?

The wind turbines will generate at the same voltage as the EW&L distribution system.

28. What are the advantages and disadvantages to the customers of Evansville Water and Light to have a Community Wind project?

Concerns about climate change are viewed by many as the biggest environmental challenge we face. Carbon dioxide (CO<sub>2</sub>) and other gases caused by human activity - including power generation - build up in the earth's atmosphere and trap the sun's rays like a greenhouse and are believed to contribute to global warming.

The buildup of greenhouse gases may be causing a gradual rise in average temperatures, and more frequent and severe droughts and floods. Recent studies also link harmful health effects to air pollution and particularly to high levels of sulfur dioxide, CO<sub>2</sub>, nitrogen oxide, particulate matter and toxic heavy metals found in the air. High levels of mercury in Wisconsin waters due to fossil fuel air emissions have prompted health advisories on the annual amounts of fish consumed.

Wind turbines are extremely effective at reducing emissions produced by fossil fuel electric generating sources. A single 1.5 megawatt wind turbine in the Community Based Wind program will produce approximately 4 million kilowatt hours annually. Existing Wisconsin power plants emit about 1.761 pounds of CO<sub>2</sub> per kilowatt hour. This

means that operation of each turbine can avoid the emission of 7,044,000 pounds of CO<sub>2</sub> per year.

The average forest absorbs approximately 3 tons of CO<sub>2</sub> per acre per year. Thus, the 16 turbine WPPI program prevents as much carbon dioxide from being emitted as could be absorbed annually by 18,784 acres of forest.

Wind power also provides important price protection for EW&L and other WPPI customers since once installed, there are no ongoing fuel or fuel transportation costs.

29. At the Ecoenergy presentation on Wind Energy this last summer at the Evansville High School, you said let me tell you about us, WPPI is building a new coal plant. Haven't other utility companies in Wisconsin built or are building coal plants recently? Isn't the idea behind the promotion of wind turbines to not build any more coal plants?

Yes, Wisconsin utilities, including WPPI are still building coal power plants. Demand for electrical energy in Wisconsin is growing at 2-3% per year. For the state of Wisconsin, this equates to approximately 250 to 300 megawatts of new demand annually. WPPI and other state utilities are working hard to encourage and promote conservation as much as possible, but the bottom line is that Wisconsin still must build some new generating sources. Coal, natural gas and nuclear are the three proven and conventionally available technologies. Large central station plants typically take six to ten years from concept to operation and utilities must look far out into the future and plan for expected loads. In 2006, WPPI's members used 5,000 giga-watt-hours (GWh), with a peak demand of 1000 MW.

The effort to develop more wind turbine energy is based on a desire to diversify supply options, stabilize future pricing and reduce the emissions that result from fossil fuel power plants by offsetting a percentage of that energy. WPPI does not believe that its intended purpose for promoting wind energy has ever been stated as to "not build any more coal plants." It is not possible to eliminate the future use of fossil fuels while still maintaining a sound economy. The technologies available for large scale use will change incrementally over decades. WPPI believes that Wisconsin must continue to utilize coal for some time.

30. Europe has been into the wind energy business big for over 20 years? How many coal plants have they closed? How many new coal plants are they building?

Again, although Europe has installed a significant amount of wind energy,

the important point is not whether any specific plants have been closed, but rather how much the need for additional new fossil fuel plants has been reduced.

31. Who will own the turbines when the project is completed?

Acciona Energy will own the turbines installed under the Community-based Wind power program and supply energy to WPPI under a long-term contract. This type of renewable resource acquisition provides lower-cost wind power than if WPPI purchased, installed and operated the wind turbines itself.

## Evansville Water & Light Questionnaire:

To: Town of Union Wind Turbine Study Committee

From: Evansville Water & Light January 2, 2008  
Re: Health & Safety Research  
Questionnaire Responses

### Evansville Questions

1. A REC, Renewable Energy Credit is a "receipt" for buying a MW of Renewable Energy. What does the Mayor of Evansville through your department promote the purchase of these credits to the Town of Union Residents?

**The Town of Union residents are customers of Evansville Water & Light, just the same as the residents of the City of Evansville. Evansville Water & Light, a municipal electric and water utility, is owned and operated by the city. The Mayor's challenge promotion went to all customers of EW&L. The purpose of the challenge was to get customers thinking about where their energy comes from and the impact of their energy use, as well as to give customers an opportunity to provide a small amount of money towards the advancement of renewable energy as a generating source. This small extra payment does not buy credits; rather, it buys a block of renewable energy. WPPI has submitted a plan to the Public Service Commission of Wisconsin to double the amount of energy that \$3 buys. Presently, the amount is 150 kilowatt-hours (kWh), and after PSC approval, the amount will increase to 300 kWh.**

2. There are state mandates for the percentage of Renewable Energy being part of the electric power mix. What other renewable energy sources are available to you to purchase besides wind?

**Evansville Water & Light receives its electric power from WPPI. The mix of their power supply portfolio provides the renewable energy percentages we need to meet the Wisconsin RPS. The renewable energy content in WPPI's power supply portfolio contains wind, hydro, landfill gas-to-energy and solar.**

3. Are those sources still available to you?

**Yes**



4. Does the state mandate for purchasing Renewable Energy dictate how much wind power you must purchase or does it mean any Renewable Energy source?

**No, the state mandate does not specify a particular technology, but wind is the most economic and available technology.**

5. What advantages does a Community Wind project bring to the customers of Evansville Water and Light?

**Historically, due to our role as a distribution-only utility with limited resources, Evansville Water & Light had little capability to demonstrate renewable electric power generation technologies or assist our customers in the use of renewable energy technologies. One of the advantages of joining Wisconsin Public Power Inc. is the ability to provide our customers with access to participation in renewable energy programs.**

**With WPPI membership, EW&L customers can support the development of renewable energy resources through the purchase of blocks of renewable energy, an opportunity which previously did not exist. In addition, WPPI membership makes available to our customers a number of renewable energy customer assistance and grant programs.**

**The Community Based Wind program is a unique utility-scale wind development project. By utilizing the economic base of WPPI to contract for 24 MW of wind power, EW&L gets access to renewable energy at an economy of scale unavailable without our WPPI membership. In addition, the connection of these utility scale generators directly to community-owned utility distribution systems eliminates the transmission costs and losses generally associated with installation of this much capacity.**

**Finally, we believe that connection of these wind energy facilities to the EW&L distribution system will provide our customers with a unique opportunity to understand how wind energy generation works and where some of their energy comes from.**

6. What other Renewable Energy sources have been promoted in Evansville and the Town of Union?

**Because Evansville only recently joined WPPI, there have been few past opportunities to promote renewable energy sources. WPPI participated in last year's Evansville Energy Fair and displayed information on all of their renewable energy projects. Evansville Water and Light and WPPI recently awarded a grant that will allow the high school trades class to add solar photovoltaic to the house they are building next year. In**

**addition, WPPI offers grants and funding to promote most all renewable energy technologies.**

7. Can wind energy be stored?

**At the present time, it is not economically feasible to store large amounts of electric power from wind or other sources. Research into a number of technologies such as sodium-sulfur batteries and compressed-air storage looks promising but is not yet developed for widespread commercial application.**

8. Can other Renewable Energy sources be stored?

**See the answer to question 7. The one addition here is that hydro could conceivably be pumped back up to a higher elevation during off-peak times and then allowed to flow back down to generate energy during on-peak times. This is referred to as "pumped-storage".**

9. If wind energy is being produced, and the demand isn't always there, and it can't be stored, where does it go?

**The energy will flow back to the transmission system and used by the next-closest loads.**

10. What stray voltage or transient ground current issues will wind turbines be creating?

**By design, the wind turbines should not create these issues.**

11. Who will be responsible for mitigating problems associated with stray voltage and transient ground current?

**Responsibility for such issues would depend on the source of the problem.**

12. Will you test for stray voltage and transient ground current before the proposed project would be installed?

**At this time there is no plan to perform any tests.**

13. Do all of the power poles have ground wires?

**All of the distribution power poles should have a pole ground bonded to a ground rod at the base of each pole and bonded to the system neutral conductor.**

14. What are the ground wires for?

**The three-phase, four-wire distribution system is a solidly grounded wye connected system. Per Code, a total of 8 grounds per mile are required on distribution lines, but most utilities install grounds on every pole. The phase-to-ground voltages will have a solid reference to ground due to the ground wires providing neutral stability. If not installed, the phase to ground voltages will "float" and the phase-to-ground voltages will exceed their ratings, causing failures in equipment due to overvoltage.**

15. How will the wind turbines be interconnected to the distribution line?

**The wind turbines generate voltage at 12,470 volts (V), the same as the three-phase distribution system in the Town of Union. After passing through the appropriate protection and metering equipment, the cables will be connected to the EW&L distribution system.**

16. What is the advantage and disadvantage to the Evansville Water and Light customers for the turbines being interconnected to a distribution line rather than a transmission line?

**The advantage of connecting utility-scale wind energy generating facilities to the EW&L distribution system is the cost savings associated with avoidance of new transmission facility construction and the ongoing savings produced by minimizing line losses associated with long distance energy transport. Connection of the proposed wind generators to the EW&L system also directly provides our customers with all the environmental and economic benefits of wind power. The Public Service Commission of Wisconsin Rules for Interconnecting Distributed Generation Facilities (Ch 119), along with state of the art power electronics in the proposed turbines, will ensure safe and reliable operation of the EW&L system.**

17. What is the voltage and amperage size of electrical connections between the turbines and the distribution lines?

**The wind turbines generate at 12,470 V, the same as the three-phase distribution system in the Town of Union. The amperage (A) is determined by the output of the wind turbines and can range from 0 to 200 A.**

18. What causes limitations to penetration on distribution lines?

**Limitations can result from the system equipment which ranges from the strength of the transmission source to the size of the conductors on the particular circuit that would carry the energy and the amount of load on it. Many of these components can be upgraded to handle the maximum turbine output. Another limiting factor on the amount of generation depends upon where the turbines interconnect to the utility.**

19. We contacted ATC and asked them about the proposed wind project for Evansville. They said they did not have any interconnection requests for this project.

A) Has there been an interconnection study done?

**No, the interconnection is to the distribution system, not the transmission system of ATC, hence no transmission interconnection study is needed.**

B) Was this the same study done in conjunction with the study for the new substation on Hwy M?

C) Who provided it?

D) Please submit a copy (ies).

20. What are the power quality issues associated with wind turbines interconnected to distribution lines, i.e., voltage flicker, brown outs, islanding?

**Modern wind turbines utilize sophisticated power management electronics to control the output voltage to minimize variations. "Islanding" is a situation that occurs when a distribution line is de-energized due to a fault or maintenance needs and a generating source does not shutdown. With modern wind turbines, when a fault or switching event occurs, the wind turbines sense the absence of system voltage and shut down to avoid generating voltage on to the system. This type of control is common for utility generating systems.**

**In the unlikely event of voltage flicker, there are several mitigation methods. There are several manufacturers, such as Elspec, S&C Electric, and others, who manufacture devices that can mitigate or eliminate flicker. These devices typically employ capacitors or active electronics to overcome the effects of flicker, but they are not always needed. Before a decision is made about whether any added equipment is necessary, or the exact device to be used, the interconnection will be studied by a qualified engineer.**

21 .Who will be responsible for power quality issues that are incurred?

**The Public Service Commission of Wisconsin has specific rules as to the responsibility of correcting power quality issues in electric distribution systems. Evansville Water & Light would be responsible for identifying the source of the issue and notifying that entity of the findings and the entity's responsibility for correcting the issue.**

22. How will voltage flicker be controlled during startup in variable wind conditions?

**The proposed wind turbines use sophisticated power electronics to control the generator output. This control dampens out the fluctuations, hence, no significant power or voltage variations are produced.**

23. How many turbine startups will be allowed during the day?

**At this time, we know of no reason why the number of wind turbine startups will be restricted, either day or night. The wind turbines begin to turn when the wind has reached the cut-in speed of 3 meters per second (m/s) (6.7mph).**

24. How many turbine startups will be allowed during the night?

**See answer to #23.**

25. Wind Turbines are susceptible to lightning strikes, what special precautions will be taken to ensure power surges are isolated from the distribution line?

**Due to their height, wind turbines can occasionally experience a lightning strike. The blades and tower utilize grounding conductors to direct the lightning energy to earth should they be struck. This is the same protection employed on TV, radio and cell towers. These grounding conductors are isolated from the conductors that carry the wind turbine energy to the distribution system. In addition, the basic design of distribution system places lightning arrestors throughout the system to protect it from lightning strikes it may experience.**

26. Please list other Community wind projects similar to the proposed Town of Union project that would be connected to the distribution line.

**Other community-wind projects that WPPI is involved with include Westby, New Holstein and Kaukauna.**

**Additionally, WPPI owns two 900kW wind turbines in Worthington, MN that are connected to the local distribution system along with four other identical wind turbines. The turbines are within two miles of the edge of the city of Worthington and three miles of two golf courses. More pertinent, the turbines are within 600' of one home and within 1200' of others. There is also a radio tower within 1200' of the turbines. There have been no negative issues associated with this wind turbine project. These turbines have been in operation in July, 2002. There are other projects nationwide that are interconnected to the distribution system. A 7.2MW project in Bowling Green/Amp-Ohio, and a 2.5MW project in Hull, MA are two examples.**

27. Will the wind energy produced by the proposed Community Wind project be metered at the interconnection on the distribution line?

**Yes.**

28. Will the energy consumed by the wind turbines off of the distribution line be metered? Is that reflected in the kW price of the wind energy or is that just another cost of business to Evansville Water and Light?

**Yes, the meter will be bidirectional to measure consumption and generation. Any energy consumed by the wind turbines will be paid by the wind turbine owners, the same as any other customer of EW&L.**

29. Who will own the wind turbines in this proposed project?

**Acciona Energy will own the turbines installed under the Community - Based Wind power program and supply energy to WPPI under a long-term contract. This type of renewable resource acquisition provides lower-cost wind power than if WPPI were to purchase, install and operate the wind turbines itself.**

30. What are the wind turbines owner(s) responsibilities?

**Owner responsibilities are far-ranging, but of highest importance is that once installed, the wind turbines are maintained to operate at peak reliability and efficiency. Another important responsibility is to maintain open access to the wind turbines in order for WPPI and Evansville Water & Light to provide educational opportunities for the schools and general public alike.**

31. How does pricing per kW compare with buying the wind energy from a wind farm owned by Alliant, or MG&E or WE to a kW purchased from a company in Spain?

**Large wind projects can produce energy cheaper than smaller scale developments, whether they are utility-owned or owned by independent developers like Acciona. The price difference due to simple economies of scale. It takes less work to develop 100 megawatts of wind generation at a single development site than it does to develop 100 megawatts at 33 or 66 sites. WPPI feels it is worth the slightly higher price to locate wind projects close to the loads, providing a distributed wind energy generation approach.**

**There is increasing competition for available renewable resources. In general, utility-owned wind power is not available for purchase or contract since these same utility companies have to meet the state mandate themselves.**

32. **Wouldn't pricing be more competitive buying it from a wind farm with Class 3 or Class 4 wind as opposed to this Class 2 area?**

**Not necessarily, even though in general, it is accurate to assume that a kilowatt-hour produced by a wind turbine in a higher wind class area will be less expensive than a kilowatt hour produced at a turbine in a lower wind class area. However, cost at the turbine is not the entire story. Some of the highest class wind areas in the United States are remote from electric load centers, and the cost to transmit the power can make it more expensive than locally generated wind power. Specific sites in the Town of Union are not necessarily Class 2. Most places have areas where winds will be higher speed than the majority of that area. In addition, modern wind turbine technology advancements make wind energy viable in areas of lower wind speeds than Class 3 or 4.**

33. **In the Janesville Gazette, October 13<sup>th</sup> you quoted." All of the electricity produced would be purchased by WPPI and used by customers in Evansville and Union. There is the possibility some of the energy might spill onto the power grid if, for example, the wind was blowing late at night when local customers weren't using all the power produced, said Eric Kostecki, renewable energy project coordinator with WPPI.**

34. **What is Evansville's load?**

**In 2006, the customers of Evansville Water & Light used 64-million kWh.**

35. **Who estimated the wind supplying 16% of the load?**

**The 1.5 MW Acciona wind turbine is predicted to produce 4 million kilowatt-hours per year in this area. The estimate was based on the annual estimated output of the wind turbines by divided by Evansville's annual usage. Since that 16% estimate was calculated, the 2006 EW&L data has become available usage numbers have come in. Thus, the**

**percentage is now above 18%, close to 19%. The annual estimated output is 12 million kWh, and Evansville's annual usage of 64 million kWh.**

36. How will the wind turbines supply 16% of the load when the wind is not blowing, or is this an average figure for the year?

**It's an average over the year.**

37. If the wind turbine energy is going directly into the distribution line as we've been told by Ecoenergy how is it going to back feed to the grid?

**There is a three-phase circuit that originates in the Evansville substation that has a total of five circuits leaving it. One of these three-phase circuits will be used to carry the energy from the wind turbines. Some of this energy will be used by loads on its way back to the substation. Any energy remaining that reaches the substation will be available for redistribution on one of the other circuits leaving the sub. Any energy that is not used by all the loads in Evansville will then feed back through the substation transformers and on to the transmission. Again this will only happen when the wind turbines produce more energy than what is used by the loads in Evansville.**

38. Wouldn't you have to have permission from ATC to "spill onto the grid"?

**The amount of energy that could enter the transmission system will be determined in future interconnect studies. At that time, WPPI will work with ATC to determine whether such events would create significant impacts for the ATC system.**

39. Would you be using the substation on Hwy M to put the power onto the grid? If not, which substation would you use?

**It has not yet been determined where the interconnection will occur. This will be determined during the distribution interconnect study.**

40. How will it get there, does the 3 phase distribution line run from the west side of Evansville to the substation?

**Yes, a three-phase distribution line presently runs out to the Town of Union. Again, it has not yet been determined if this circuit will be used to carry the wind energy or if a dedicated circuit will be built.**

41. How many miles away is the substation?



**Approximately five to six miles.**

42. How much would the wind power dissipate before reaching that substation?

**That is dependent on a number of specific circuit design parameters that have not yet been detailed out, as well as how much energy is generated. It is quite possible that much of the energy could be consumed by customers before it even reaches the substation. Again, it is all dependent on the final interconnection design.**

43. Will that power be metered, is that another interconnection to the grid?

**The energy generated by the wind turbines will be metered at the interconnection to the distribution line, as stated in the answer to questions 15 and 27.**

44. How will the power be stepped down to run on distribution lines that are not equipped to handle the voltage?

**The wind turbines will generate at the same voltage as the EW&L distribution system.**

45. What are the advantages and disadvantages to the customers of Evansville Water and Light to have a Community Wind project when other sources of Renewable Energy including wind are readily available today?

**Concerns about climate change are viewed by many as the biggest environmental challenge we face. Carbon dioxide (CO<sub>2</sub>) and other gases caused by human activity - including power generation - build up in the earth's atmosphere and trap the sun's rays like a greenhouse and are believed to contribute to global warming.**

**Wind turbines are extremely effective at reducing emissions of CO<sub>2</sub> produced by fossil fuel electric generating sources. A single 1.5 megawatt wind turbine in the Community Based Wind program will produce approximately 4 million kilowatt hours annually. Existing Wisconsin power plants emit about 1.761 pounds of CO<sub>2</sub> per kilowatt hour. This means that operation of each turbine can avoid the emission of 7,044,000 pounds of CO<sub>2</sub> per year.**

**Wind power also provides important price protection for EW&L and other WPPI customers since once installed, there are no ongoing fuel or fuel transportation costs.**

**Community Based Wind also ensures that renewable resources will continue to be available in the future. States neighboring Wisconsin have recently enacted or increased utility renewable energy purchase requirements. Higher demand for renewable resources in neighboring states will increase competition for all renewable sources for Wisconsin utilities.**

**Finally, it is important to recognize that even with significant conservation efforts electric power consumption continues to increase and we must plan to meet some of that increase with renewable sources.**

46. Will the power produced by wind turbines cost more than the current power costs and will that cost be passed on to Evansville customers?

**The customers of Evansville Water & Light will not experience a rate change due to a community-based wind project. The cost of the energy from these projects is combined into the total cost of energy from all forms of generation and for all of WPPI's members. Providing wind energy will provide a hedge against fossil fuel cost increases in the future, as there are no fuel costs associated with wind energy. For these projects, WPPI has negotiated a long-term Power Purchase Agreement for the energy generated. The terms of that agreement are proprietary; however they are fixed for 20-years, unlike coal or natural gas plants.**

## Public Service Commission Questionnaire:

To: Paul Helgeson, WI Public Service Commission  
From: Town of Union Wind Turbine Study Committee  
November 6, 2007  
Re: Health & Safety Research Questionnaire

### Questions

- 1) The Townships get mixed messages from wind developers and Renew Wisconsin on the weight of the Draft Model Wind Ordinance for Wisconsin. Is the Draft Model Wind Ordinance for Wisconsin a law?

**Paul C. Helgeson, Senior Engineer Public Service Commission of Wisconsin answer received 1-2-07 at 12:41pm:**

1. The draft Model Ordinance is a model that can be used by towns and counties as they see fit.  
It is not law.

- 2) In the Draft Model Wind Ordinance it states:

**PURPOSE** The purpose of the Ordinance is to provide a regulatory scheme for the construction and operation of Wind Energy Facilities in the [Town/County], subject to reasonable restrictions, which will preserve the public health and safety.

Who defines what a reasonable restriction is? Is it a law?

**Paul C. Helgeson, Senior Engineer Public Service Commission of Wisconsin answer received 1-2-07 at 12:41pm:**

2. What is reasonable would be defined by local governments and the courts.

- 3) In regard to Wisconsin Statute 66.0401 item (a):

Wisconsin Stat. § 66.0401(1) provides:

(1) **AUTHORITY TO RESTRICT SYSTEMS LIMITED.** No county, city, town or village may place any restriction, either directly or in effect, on the installation or use of a solar energy system, as defined in s. 13.48(2)(h)1.g., or a wind energy system, as defined in ...[66.0403(1)(m)], unless the restriction satisfies one of the following conditions:

- (a) Serves to preserve or protect the public health or safety.
- (b) Does not significantly increase the cost of the system or significantly decrease its efficiency.
- (c) Allows for an alternative system of comparable cost and efficiency.

We have been given the impression that public health or safety must be supported by “peer-reviewed” and “credible” documentation. Is that a state law? NO ANSWER

- 4) Were “peer-reviewed” and “credible” documentation used in the Draft Model Wind Ordinance concerning safety and noise?

NO ANSWER

- 5) What other State Statutes concerning public health and safety require “peer-reviewed” and “credible” documentation? NO ANSWER

- 6) In keeping with abiding with the legal requirements in the Wisconsin Statute 66.0401 we asked a Legislative Attorney what the State of Wisconsin's definition of Public Health and Safety was, and the answer was, “I think it is safe to say that "public health and safety" is an intentionally ambiguous term”.

He went on to say,

”The reason these terms are intentionally ambiguous is that they involve judgments. They apply to situations either too various or too detailed as to be anticipated and dealt with specifically in laws. Where they apply to governmental bodies, such as the development of a wind ordinance by the Board of the Town of Union, they provide general guidance but intentionally leave the hands of the board members free to design an ordinance that meets the needs of that community, so long as the ordinance is reasonable.(“Reasonable” is another ambiguous term, but it is the primary consideration in reviewing many kinds of governmental actions.).”

Wouldn't this clearly say that the Town of Union Board and any other local government has the right to write an ordinance that protects their resident's health and safety without intimidation? NO ANSWER

- 7) In reading the Mission/Vision Statement for the Public Service Commission the last sentence states,

“In all of the above, we consider and balance diverse perspectives and we endeavor to protect the environment, and the public interest and the public health and welfare.”

How do you feel you balance big business interests in Wind Development with the public health and welfare? NO ANSWER

## **Questions Specific to the Draft Model Wind Ordinance**

- 8) Can you advise the process in creating the 2003 Draft Model Wind Ordinance?

Paul C. Helgeson, Senior Engineer Public Service Commission of Wisconsin answer received 1-2-07 at 12:41pm:

8) Process for creating the Draft Model Wind Ordinance is described in the Model Wind Ordinance Reference Guide and in documents that your group has obtained from the Commission.

- 9) Can you advise the process in creating the 2007 Draft Model Wind Ordinance?

Paul C. Helgeson, Senior Engineer Public Service Commission of Wisconsin answer received 1-2-07 at 12:41pm:

9) The Only significant changes are in section 5.3 and were made to be clearer and consistent with the PSCW sound measurement protocol for electric power plants. Some parts of the ordinance language were moved to the Reference Guide.

- 10) In the 2007 DRAFT Model Wind Ordinance it states: "the model ordinance was developed by agency staff and stakeholders." Please identify who these persons are.

NO ANSWER

- 11) Why was the 2007 DRAFT Model Wind Ordinance put on the Department -of Administration website ; then taken off; then put back on? This all occurred in the past 6 months. NO ANSWER

- 12) When was the 2007 DRAFT Model Wind Ordinance put the DOA website the first time; when was it taken off; when was it put back on the second time? NO ANSWER

- 13) What medical, scientific, and/or clinic data was utilized in the creation of each DRAFT ordinance? Please be specific. NO ANSWER

- 14) We understand that you and a female colleague at the Department of Administration were the co-authors of the 2007 DRAFT ordinance. Please identify other the co-author.

NO ANSWER

- 15) Why were significant changes made to the noise portions of the 2007 Draft Ordinance?

Paul C. Helgeson, Senior Engineer Public Service Commission of Wisconsin answer received 1-2-07 at 12:41pm:

15) (See the answer to #9, above)

- 16) The World Health Organization recommends noise levels much different than your two DRAFT ordinances. Can you explain why you would not utilize their expertise and make

your recommendation consistent to those recommended by the World Health Organization for community noise?

NO ANSWER

- 17) When a wind project is proposed, often times the developers suggest to local government, that they may receive revenue based on a variety of factors (PILOT Program; Shared revenue). Can you explain how the payments are determined for counties/townships based on incentives/megawatts produced or whatever criteria is used? Who actually pays this money out? How much has been paid out since 2000?

Paul C. Helgeson, Senior Engineer Public Service Commission of Wisconsin answer received 1-2-07 at 12:41pm:

17) Shared Revenue formulas are specified in Wis. Stat. § 79.04(6)(c) 1 and §79.04(7)(c)1. The formula is based on the nameplate capacity of the generators and the fact that a renewable resource is used. If the generators are in an unincorporated town, the town receives \$1667 per MW per year and the county receives \$2333 per MW per year. These are annual payments in place of property taxes. If you have further questions on the Shared Revenue program you should contact the Wisconsin Dept. of Revenue.

- 18) We have documented facts of the following: pending lawsuits worldwide, settled lawsuits right here in Wisconsin, neighbor easement agreements, bulldozed properties, property de-valuations, abandoned properties, nuisance payments, sound easements & payments, significant medical problems, quality of life issues, people relocating away from turbines, etc. With all these documented problems worldwide, it is clear to see that setbacks are the key to a successful wind project. The National Research Council recommends setbacks be at least ½ mile or so from residences. Many physicians are now recommending setbacks be at least 1 mile. **The Public Service Commission of Wisconsin** ("PSCW") has determined that it is important to site wind energy facilities carefully. The PSCW has also concluded that there is the potential for adverse environmental impacts when wind energy facilities are sited improperly (Public Service Commission of Wisconsin Advance Plan 7 Findings of Fact, pp. 22 – 23). As seen in Invenergy's Beech Ridge Wind Farm located in West Virginia, turbines are setback between one and four miles from residences. The project manager was quoted as follows: "At a distance of 1,000 feet, most potential negative impacts of wind turbines are significantly reduced. At a distance of one mile, these impacts are no longer a legitimate concern." Yet in Wisconsin we continue to see a recommendation from the DOA/Public Service Commission of 1,000 feet setback from residential housing. If your role is to protect the people and the environment of Wisconsin, why would you not recommend larger setbacks when you created your new 2007 DRAFT ordinance, knowing the problems that are documented worldwide related to insufficient setbacks? Please explain thoroughly. NO ANSWER

Here are the answers to the PSC questions.

From: Helgeson, Paul PSC [mailto:Paul.Helgeson@psc.state.wi.us]

Sent: Wednesday, January 02, 2008 12:41 PM

To: cathyjimb@eishome.com  
-Subject: H & S Research Questionnaire

Jim and Wind Turbine Study Group,

I have answered the questions that I can . I hope my answers are helpful.

1. The draft Model Ordinance is a model that can be used by towns and counties as they see fit. It is not law.
2. What is reasonable would be defined by local governments and the courts.
8. Process for creating the Draft Model Wind Ordinance is described in the Model Wind Ordinance Reference Guide and in documents that your group has obtained from the Commission.
9. The Only significant changes are in section 5.3 and were made to be clearer and consistent with the PSCW sound measurement protocol for electric power plants. Some parts of the ordinance language were moved to the Reference Guide.
15. (See the answer to #9, above)
17. Shared Revenue formulas are specified in Wis. Stat. § 79.04(6)(c) 1 and § 79.04(7)(c)1. The formula is based on the nameplate capacity of the generators and the fact that a renewable resource is used. If the generators are in an unincorporated town, the town receives \$1667 per MW per year and the county receives \$2333 per MW per year. These are annual payments in place of property taxes. If you have further questions on the Shared Revenue program you should contact the Wisconsin Dept. of Revenue.

Paul C. Helgeson, Senior Engineer Public Service Commission of Wisconsin  
P.O. Box 7854  
Madison, WI 53707-7854 608-266-3905 [paul.helgeson@psc.state.wi.us](mailto:paul.helgeson@psc.state.wi.us)

## IMPACTS ON HUMAN HEALTH AND WELL-BEING

Wind-energy projects can have positive as well as negative impacts on human health and well-being. The positive impacts accrue mainly through improvements in air quality, as discussed previously in this report. These positive impacts (i.e., benefits) to health and well-being are diffuse; they are experienced by people living in areas where conventional methods of electricity generation are used less because wind energy can be substituted in the regional market.

In contrast, to the extent that wind-energy projects create negative impacts on human health and well-being, the impacts are experienced mainly

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by people living near wind turbines who are affected by noise and shadow flicker.

#### Noise

As with any machine involving moving parts, wind turbines generate noise during operation. Noise from wind turbines arises mainly from two sources: (1) mechanical noise caused by the gearbox and generator; and (2) aerodynamic noise caused by interaction of the turbine blades with the wind. As described below (see “Noise Levels”), noise of greatest concern can be generally classified as being of one of these three types: broadband, tonal, and low-frequency.

The perception of noise depends in part on the individual—on a person’s hearing acuity and upon his or her subjective tolerance for or dislike of a particular type of noise. For example, a persistent “whoosh” might be a soothing sound to some people even as it annoys others. Nevertheless, it appears that subjective impressions of the noise from wind turbines are not totally idiosyncratic. A 1999 study (Kragh et al. 1999) included a laboratory technique for assessing the subjective unpleasantness of wind-turbine noise. Preliminary findings indicated that *noise tonality* and *noise-fluctuation strength* were the parameters best correlated with unpleasantness (Kragh et al. 1999).

Broadband, tonal, and low-frequency noise have all been addressed to some degree in modern upwind horizontal wind turbines, and turbine technologies continue to improve in this regard. With regard to the design of a wind-energy project, one is generally interested in assessing whether the additional noise generated by the wind turbines (relative to the ambient noise) might cause annoyance or a hazard to human health and well-being.

Noise impacts also can result from project construction and maintenance.

These are generally of relatively short duration and occurrence but can include equipment operation, blasting, and noise associated with traffic into and out of the facility. These are not addressed in detail in this section.

In the following, a brief review of wind-turbine noise and its impacts is presented along with suggested methods for assessing such impacts and mitigation measures.

#### Noise Levels



Noise from wind turbines, at the location of a receptor, is described in terms of sound pressure levels (relative to a reference value, typically  $2 \times 10^{-5}$  Pa) and is typically expressed in dB(A), decibels corrected or A-weighted for sensitivity of the human ear. Note that there is a difference between sound *power* used to describe the source of sound and sound *pressure*

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used to describe the effect on a receptor. The sound power level from a single turbine is usually around 90-105 dB(A); such a turbine creates a sound pressure of 50-60 dB(A) at a distance of 40 meters (this is about the same level as conversational speech). Noise (sound-pressure) levels from an onshore wind project are typically in the 35-45 dB(A) range at a distance of about 300 meters (BWEA 2000; Burton et al. 2001). These are relatively low noise or sound-pressure levels compared with other common sources such as a busy office (~60 dB(A)), and with nighttime ambient noise levels in the countryside (~20-40 dB(A)). While turbine noise increases with wind speed, ambient noises—for example, due to the rustling of tree leaves—

increase at a higher rate and can mask the turbine noise (BLM 2005a).

In addition to the amplitude of the noise emitted from turbines, its frequency content is also important, as human perception of sounds is different at different frequencies. Broadband noise from a wind turbine typically is a “swishing” or “whooshing” sound resulting from a continuous distribution of sound pressures with frequencies above 100 Hz. Tonal noise typically is a “hum” or “pitch” occurring at distinct frequencies. Low-frequency noise (with frequencies below 100 Hz) includes “infrasound,” which is inaudible or barely audible sound at frequencies below 20 Hz.

Mechanical sounds from a turbine are emitted at “tonal” frequencies associated with the rotating machinery, while aerodynamic sounds are typically broadband in character. Mechanical noise is generated from rotating components in the nacelle, including the generator and gearbox, and to a lesser extent, cooling fans, pumps, compressors, and the yaw system. Aerodynamic noise, produced by the flow of air over blades, is created by blades interacting with eddies created by atmospheric inflow turbulence. This broadband aerodynamic noise is generally the dominant type of wind turbine noise, and it generally increases with tip speed. Both mechanical and aerodynamic noise often are loud enough to be heard by people. With older downwind turbines, some infrasound also is emitted each time a rotor blade interacts with the disturbed wind behind the tower, but it is believed that the energy at these low frequencies is insufficient to pose a health hazard (BWEA 2005). Nevertheless, a recent study by van den Berg (2004, 2006) suggests that, especially at night during stable atmospheric conditions, low-frequency modulation (at around 4 Hz) of higher frequency swishing sounds is possible. Note that this is not infrasound, but van den Berg (2006) states that it is not known to what degree this modulated fluctuating sound causes annoyance and deterioration in sleep quality to people living nearby.

Low-frequency vibration and its effects on humans are not well understood. Sensitivity to such vibration resulting from wind-turbine noise is highly variable among humans. Although there are opposing views on the subject, it has recently been stated (Pierpont 2006) that “some people feel

disturbing amounts of vibration or pulsation from wind turbines, and can

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count in their bodies, especially their chests, the beats of the blades passing the towers, even when they can't hear or see them." More needs to be understood regarding the effects of low-frequency noise on humans.

##### **Assessment**

Guidelines for measuring noise produced by wind turbines are provided in the standard, IEC 61400-11: Acoustic Noise Measurement Techniques for Wind Turbines (IEC 2002), which specifies the instrumentation, methods, and locations for noise measurements. Wind-energy developers are required to meet local standards for acceptable sound levels; for example, in Germany, this level is 35 dB(A) for rural nighttime environments. Noise levels in the vicinity of wind-energy projects can be estimated during the design phase using available computational models (DWEA 2003a). Generally, noise levels are only computed at low wind speeds (7-8 m/s), because at higher speeds, noise produced by turbines can be (but is not always) masked by ambient noise.

Noise-emission measurements potentially are subject to problems, however. A 1999 study involving noise-measurement laboratories from seven European countries found, in measuring noise emission from the same 500 kW wind turbine on a flat terrain, that while apparent sound power levels and wind speed dependence could be measured reasonably reliably, tonality measurements were much more variable (Kragh et al. 1999). In addition, methods for assessing noise levels produced by wind turbines located in various terrains, such as mountainous regions, need further development.

##### **Mitigation Measures and Standards**

Noise produced by wind turbines generally is not a major concern for humans beyond a half-mile or so because various measures to reduce noise have been implemented in the design of modern turbines. The mechanical sound emanating from rotating machinery can be controlled by sound-isolating techniques. Furthermore, different types of wind turbines have different noise characteristics. As mentioned earlier, modern upwind turbines are less noisy than downwind turbines. Variable-speed turbines (where rotor speeds are lower at low wind speeds) create less noise at lower wind speeds when ambient noise is also low, compared with constant-speed turbines. Direct-drive machines, which have no gearbox or high-speed mechanical components, are much quieter.

Acceptability standards for noise vary by nation, state, and locality. They can also vary depending on time of day—nighttime standards are generally stricter. In the United States, the U.S. Environmental Protection Agency only provides noise guidelines. Many state governments issue their own regulations (e.g., Oregon Department of Environmental Quality

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2006), and local governments often enact noise ordinances. Standards of acceptability need to be understood in the context of ambient (background) noise resulting from all other nearby and distant sources.

##### **Shadow Flicker**

As the blades of a wind turbine rotate in sunny conditions, they cast moving shadows on the ground resulting in alternating changes in light intensity. This phenomenon is termed shadow flicker. Shadow flicker is different from a related strobe-like phenomenon that is caused by intermittent chopping of the sunlight behind the rotating blades. Shadow flicker intensity is defined as the difference or variation in brightness at a given location in the presence and absence of a shadow. Shadow flicker can be a nuisance to nearby humans, and its effects need to be considered during the design of a wind-energy project.

In the United States, shadow flicker has not been identified as causing even a mild annoyance. In Northern Europe, on the other hand, because of the higher latitude and the lower angle of the sun, especially in winter, shadow flicker can be a problem of concern.

#### **Assessment**

Shadow flicker is a function of several factors, including the location of people relative to the turbine, the wind speed and direction, the diurnal variation of sunlight, the geographic latitude of the location, the local topography, and the presence of any obstructions (Nielsen 2003). Shadow flicker is not important at distant sites (for example, greater than 1,000 feet from a turbine) except during the morning and evening when shadows are long. However, sunlight intensity is also lower during the morning and evening; this tends to reduce the effects of shadows and shadow flicker. The speed of shadow flicker increases with wind-turbine rotor speed.

Shadow flicker may be analytically modeled, and several software packages are commercially available for this purpose (e.g., WindPro and GH WindFarmer). An online tool for simple shadow calculations for flat topography is also available (DWEA 2003b). These software packages generally provide conservative results as they typically ignore the numerous influencing factors listed above and only consider a worst-case scenario (i.e., no shadow or full shadow). Inputs to a shadow-flicker model in WindPro, for example, include a description of the turbine and site, the topography, the joint wind speed and wind direction distribution, and an average or distribution of sunshine hours. Typical output results include the number of shadow-hours per year; these are often represented by iso-lines or contours of equal annual shadow-hours on a topographical map. Daily and

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annual shadow variations may also be a part of the result (DWEA 2003b). A typical result might indicate, for example, that a house 300 meters from a 600 kW wind turbine with a rotor diameter of 40 meters will be exposed to moving shadows for approximately 17-18 hours annually, out of a total of 8,760 hours in a year (Andersen 1999).

#### **Impacts**

Shadow flicker can be a nuisance to people living near a wind-energy project. It is sometimes difficult to work in a dwelling if there is shadow flicker on a window. In addition to its intensity, the frequency of the shadow flicker is of importance. Flicker frequency due to a turbine is on the order of the rotor frequency (i.e., 0.6-1.0 Hz), which is harmless to humans. According to the Epilepsy Foundation, only frequencies above 10 Hz are likely to cause epileptic seizures. (For reference, frequencies of strobe lights used in discotheques are higher than 3 Hz but lower than 10 Hz.) If a turbine is close to a highway, the movement of the large rotor blades and possible resulting flicker can distract drivers. Irish guidelines, for example, recommend

that turbines be set back from the road at least 300 meters (MSU 2004).

### **Mitigation Measures**

Shadow flicker is not explicitly regulated. When a maximum number of hours of allowed shadow flicker per year is imposed for a neighbor's property (such as 30 hours/year for one wind-energy project in Germany), this number refers to those hours when the property is actually used by the people there and when they are awake. Denmark has no legislation regarding shadow flicker, but it is generally recommended that there be no more than 10 hours per year when flicker is experienced.

Even in the worst situations, shadow flicker only lasts for a short time each day—rarely more than half an hour. Moreover, flicker is observed only for a few weeks in the winter season. To avoid even limited periods of shadow flicker, a possible solution is to not run the turbines during this time. Obviously, another solution is to site the turbines such that their shadow paths avoid nearby residences.

Since tools for estimation of shadow flicker are readily available, such calculations are routinely done while planning a wind-energy project. One such study was performed for the Wild Horse project in the state of Washington (Nielsen 2003). Using results presented in the form of shadow flicker maps and distributions, one can determine suitable locations for wind turbines. Recently, tools have become available (GH WindFarmer) that not only compute shadow flicker in real time during turbine operation, but also convey information to the turbine control system to enable shutdown if the

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shadow flicker at a particular location becomes particularly problematic. However, the committee is unaware if such real-time systems have been implemented at any specific wind-energy project.

### **LOCAL ECONOMIC AND FISCAL IMPACTS**

Wind-energy projects can have a range of economic and fiscal impacts, both positive and negative. Some of those impacts are experienced at the national or regional level, as discussed in Chapter 2. These involve, for example, tax credits and other monetary incentives to encourage wind-energy production, as well as effects of wind energy on regional energy pricing. In this section, the focus is on the local level: on private economic impacts, positive and negative, as well as on public revenues and costs.

#### **Lease and Easement Arrangements**

As discussed in Chapter 5, most of the onshore wind-energy projects in the United States have been sited on private land. Typically, the developer of a wind-energy project acquires rights to the use of land through negotiations with landowners. Rarely is land purchased in fee simple; instead, the developer purchases leases or easements for a specified duration. While a uniform offer may be made to landowners, contract prices may be negotiated individually and privately. The power of eminent domain is not available to non-government wind-energy developers.

#### **Assessment**

According to the American Wind Energy Association (AWEA 2006f), leasing arrangements can vary greatly, but a reasonable estimate for a lease payment to a landowner from a single utility-scale turbine is currently about \$3,000 per year. Lease and easement arrangements can be a financial boon to landowners, providing a steady albeit modest income, but only if the financial and other contractual terms are fair.

A number of guides are now available for landowners who are considering

either lease arrangements or granting easements for wind-energy projects. Some of these, such as the guides of the Wind Easement Work Group of Windustry, located in Minnesota, have been prepared by collaborations of wind-energy industry, government, and other partners (Nardi and Daniels 2005a). This work group has provided extensive guidance addressing such questions as:

- How much of my land will be tied up and for how long?
- What land rights am I giving up? What activities can I continue?

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- How much will I be paid and how will I receive payments?
- Are the proposed payments adequate now and will they be adequate in the future?
- Does the proposed method of payment or the agreement itself present adverse tax consequences to me?
- Are there firm plans to develop my land, or is the developer just trying to tie it up?
- If payments are to be based on revenues generated by the wind turbines, how much information is the developer willing to disclose concerning how the owners' revenue will be determined?
- What rights is the developer able to later sell or transfer without my consent?
- Does the developer have adequate liability insurance?
- What are the developer's termination rights?
- What are my termination rights?
- If the agreement is terminated either voluntarily or involuntarily, what happens to the wind-energy structures and related facilities on my land?

#### **Policies to Protect the Parties Involved**

In a companion document, Windustry's Wind Easement Work Group issued a short set of best practices and policy recommendations regarding easements and leases (Nardi and Daniels 2005b). These included:

- *Public disclosure of energy production from wind turbines:* In order to facilitate transparency for production-based payments, increase public knowledge about the wind resource, and provide information to the state on the economic contribution of wind power.
- *Public filing of lease documents and public disclosure of terms (or include a "no gag" clause):* In order to reduce competition among neighbors, encourage developers to give fair deals, and lower the possibility of a single holdout among landowners.
- *Limiting easement periods to 30 years and option periods to 5 years:* To avoid tying up either the landowners or the developer for unduly long periods.

#### **Property Values**

It has been claimed that wind-energy projects do not adversely affect property values (Associated Press 2006). In contrast, it has been asserted that "adverse impacts on environmental, scenic and property values are often overlooked" (Schleede 2003, p. 1).

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It is difficult to generalize about the effects of wind-energy projects on property values. A 2003 Renewable Energy Policy Project (REPP) study of the effect of wind development on property values found no statistical effects of changes in property values over time from wind-energy projects (Sterzinger et al. 2003). This study examined changes in property values within 5 miles of 10 wind-energy projects that came online between 1998 and 2001, looking at the three-year period before and after each project came online and using a simple linear-regression analysis. The study found no major pre-post differences, and it also found no major differences when property-value changes in the 5-mile areas around the wind-energy projects were compared with selected “comparable communities.”

The REPP study, however, examined only *average* price changes. The authors noted that “it would be desirable in future studies to expand the variables incorporated into the analysis and to refine the view shed in order to look at the relationship between property values and the precise distance from development” (Sterzinger et al. 2003, p. 3). A 2006 study (Hoen 2006) more closely examined the effects on property values between 1996 and 2005 within 5 miles of a 20-turbine, 30-MW project in Madison County, New York. This study used a hedonic regression analysis method and found no measurable effects on property values, positive or negative, even on residences within a mile of the facility. In contrast, a 2005 analysis by the Power Plant Research Program of the Maryland Department of Natural Resources concerning a proposed wind energy facility—the Roth Rock facility in Garrett County, Maryland—concluded that the facility would have an uncertain impact on the property values of neighboring properties. It reached this conclusion after reviewing the 2003 REEP study as well as a 2004 study in the United Kingdom by the Royal Institution of Chartered Surveyors (RICS), which found negative impacts, especially on non-farm properties (RICS 2004), and after analyzing the property-value impacts of the Allegheny Heights (Clipper) wind-energy project located north of the Roth Rock project and permitted in 2003 (MDDNR 2006).

Property values are affected by many variables. Thus, empirically isolating the impacts of one variable (a wind-energy project) is extremely difficult unless one or more turbines are located close to a specific property, and even then, there may be confounding factors. Forecasts of property values in prospective host areas that are based on comparisons with existing host areas are of questionable validity, especially if there are significant differences between the areas.

#### **Assessment**

Despite the difficulty of reaching widely generalizable conclusions about the effects of wind-energy projects on property values, it is possible to theorize

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about important variables. The discussion of aesthetic impacts earlier in this chapter is relevant. On the one hand, to the extent that a property is valuable for a purpose incompatible with wind-energy projects, such as to experience life in a remote and relatively untouched area, a view that includes a wind-energy project—especially one with many turbines—may detract from property values. On the other hand, to the extent that the wind-energy project contributes to the prosperity of an area, it may help to bring in amenities and so may enhance property values.

Because wind installations in the United States are a relatively recent



phenomenon and are only now beginning to burgeon, the long-term effects of wind-energy projects on property values also are difficult to assess. While property values may be initially affected by a wind-energy project, the effect may diminish as the project becomes an accepted part of the landscape. On the other hand, the effects on local and regional property values of a few projects with 20 to 50 turbines may be quite different from the effects of numerous projects with 100 to 200 turbines.

#### **Mitigation Measures**

When siting facilities that provide a public benefit but may be undesirable as neighbors, one mitigation measure that has been explored, for example, with waste facilities, is to provide property-value guarantees to property owners within a specified distance from the facility when they want to sell their properties (Zeiss and Atwater 1989; Smith and Kunreuther 2001). An issue in this arrangement is the fair level of the guaranteed selling price, as adjusted over time by an inflation factor.

#### **Employment and Secondary Economic Effects**

A wind-energy project is a source of jobs throughout its life cycle: for parts manufacturers and for researchers seeking to improve wind-turbine performance; for workers who transport and construct wind turbines and related infrastructure; for workers employed in the operation and maintenance of turbines, transmission lines, etc.; and for workers involved in project decommissioning. The number, skill and pay level, and location of the jobs will vary depending upon the scale, location, and stage of the project. Some of the jobs may be in the area that will host the wind turbines; some may be in a manufacturing plant several states away. At all locations, in addition to direct employment impacts, employment may be indirectly fostered through secondary economic effects, including indirect impacts (e.g., changes in inter-industry purchasing patterns) and induced impacts (e.g., changes in household spending patterns).

In addition, however, it is conceivable that a wind-energy project will

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have some adverse impacts on the economy of its host area. While it has been argued that wind-energy facilities can be a tourist attraction (AusWEA 2004), it also has been argued that wind projects are seen by people as undesirable in national forest areas (Grady 2004) and can damage tourism in areas of high scenic beauty (Schleede 2003). It is also possible that, while one or a few wind-energy facilities may be a tourist attraction, a proliferation may have the reverse effect.

#### **Assessment**

According to the AWEA's "Wind Energy and Economic Development: Building Sustainable Jobs and Communities," the European Wind Energy Association has estimated that in total, every MW of installed wind capacity directly and indirectly creates about 60 person-years of employment and 15 to 19 jobs. The fact sheet notes that the rate of job creation will decline as the industry grows and is able to take advantage of economies of scale (AWEA 2006f).

Of greatest interest at the local level, however, are not these totals but rather the jobs that become available to local or regional workers because of a wind-energy project in their vicinity. These jobs are likely to involve site preparation and facility construction during the project start-up period; skeleton crews for facility, grounds, and transmission line maintenance during facility operation typically about 20 years; and crews to perform

decommissioning and site restoration work when the facility is closed. The size of crews will vary depending upon the project scale, site characteristics, etc., but estimates of the number of employees, pay scales, skill requirements, and duration of employment can be made with reasonable accuracy. The secondary effects of wind-energy projects on the economy (both positive and negative) are much harder to estimate. On the one hand, a wind-energy project may increase the need for service sector businesses and jobs (gas stations, motels, restaurants, etc.). On the other hand, it may deter economic growth that would otherwise occur in the area (e.g., second homes, recreational facilities, and related amenities). To estimate the secondary effects of a wind-energy project on a region's economy, the region first must be geographically defined. Changes in its economic activity generally are then measured in terms of changes in either (1) employment, including part-time and seasonal employment; (2) regional income, i.e., the sum of worker wages and salaries plus business income and profits; or (3) changes in sales or spending. A regional economic multiplier may be used to estimate the secondary economic effects of new money flowing into the region. In conducting the impact analysis, the aim is to estimate the changes that would occur if the project is built versus if it is not built (not just the before/after changes).

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While regional economic models have been available for some time, they generally are not well suited to assessing the secondary economic impacts of a single project on a small region or area. Recently, however, an economic model was developed specifically to estimate the economic benefits from a new wind-energy facility. This model, which was developed for the National Renewable Energy Laboratory (NREL), is called JEDI (Jobs and Economic Development Impacts). JEDI is an input-output model that calculates the direct, indirect, and induced economic benefits from new wind-energy facilities. (A new JEDI model, JEDI II, estimates the local economic benefits from new coal and natural gas facilities as well.) JEDI II uses input data such as the size of the project, its plant-construction cost, the length of the construction period, and fixed and variable operation and maintenance costs to estimate impacts (direct, indirect, and induced) in terms of jobs, wage and salary income, and output (economic activity) both during the construction period and during the operating years (Goldberg et al. 2004).

Models such as JEDI can improve understanding of the economic impacts of new energy facilities, especially when those impacts are considered at the macro level. Similarly, assessments of the actual economic impacts of wind-energy facilities, in addition to forecasts of economic impacts, can improve our collective understanding of the economic benefits of wind-energy facilities and how those benefits are distributed. Surveying 13 studies of economic impacts (actual and forecast) of wind facilities on rural economies, one NREL report concluded that these facilities have a large direct impact on the economies of rural communities, especially those with few other supporting industries; however, such communities also see greater "leakage" of secondary economic effects to outside areas. In addition, the report concluded that the number of local construction and operations jobs created by the facility depends on the skills locally available (Pedden 2006).

More studies are needed of the economic impacts of wind facilities,



both actual and estimated. The NWCC (2001) provides these guidelines for assessing the economic development impacts of wind energy:

- The audience for the study and the objectives to be pursued should receive primary consideration.
- The assumptions and scenarios used to analyze economic development impacts should be clearly stated.
- The model used to calculate impacts should use regional economic input data. The data should be representative of the study region (country, state, county, reservation, or multiple states and counties).
- Both the potential positive and negative (i.e., displacement) economic impacts of wind-energy development should be considered.

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- The evaluation should consider the ownership, equity and sources of capital, and markets for the project for their relative impacts on the local community, reservation, state, region, or county.
- The evaluation should consider the timing and scale of the project in relation to other wind-energy development in the state, region, or country. Pioneering projects in new areas face economic considerations different from those of incremental projects in mature wind-resource areas.
- The evaluation should distinguish between short-term and longterm impacts.
- The evaluation should consider relative impacts on the economy at a level appropriate to the scope of the study.
- For both wind development and the displaced alternative, the evaluation should consider how new labor, material, and services would be supplied.

These guidelines are apt but demanding. From the perspective of the local affected area, it may be best to focus on the jobs that will be directly created by the project—what skills they require, what their pay levels are, what their duration will be, and what the company’s hiring practices are—as well as on reasonably anticipated effects—positive and negative—on the local economy.

#### **Employment Commitments**

A developer seeking to be favorably received by a host area may explore with local officials the possibility of a commitment to give hiring preferences to local workers. As Pedden (2006) noted in a report on the economic impacts of wind facilities in rural communities, “some local governments offer incentives to developers in return for the developer agreeing to hire local labor.”

#### **Public Revenues and Costs**

Like other industries, a wind-energy project generates tax dollars for the local government. According to the AWEA, “Wind Energy and Economic Development: Building Sustainable Jobs and Communities” (AWEA 2006f):

- Alameda County, in California, collected \$725,000 in property taxes in 1998 from wind-turbine installations valued at \$66 million.
- 240 MW of wind capacity installed in Iowa in 1998 and 1999 produced \$2 million annually in tax payments to counties and school districts.

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- The director of economic development in Lake Benton, Minnesota, said that each 100 MW of wind development generates about \$1 million annually in property-tax revenue.

In addition, as with the private economy, the wind-energy project may indirectly generate taxes for the local government. However, as discussed above with regard to the private economy, an assessment of fiscal benefits in the form of tax revenue should be based on changes that would occur if the project was built versus if it was not built. The project may encourage some forms of economic development that generate taxes, but it may deter others.

A wind-energy facility also may entail public costs. Some of these, such as improvements of local public roads accessing the facility, will be obvious. Others, such as improved community services that may be expected in the wake of the development, will be indirect and less obvious. Taken together, the costs to a small, rural government have the potential to be significant.

**Fiscal Commitments**

The developer and the local government should have a clear mutual understanding of both the basis for tax revenues and what public expenditures are expected to make the project possible.

**ELECTROMAGNETIC INTERFERENCE**

Through electromagnetic interference (EMI), wind-energy projects conceivably can have negative impacts on various types of signals important to human activities: television, radio, microwave/radio fixed links, cellular phones, and radar.

EMI is electromagnetic (EM) disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics or electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses and intermodulation products. In relation to wind turbines, two issues are relevant: (1) possible passive interference of the wind turbines with existing radio or TV stations, and (2) possible electromagnetic emissions produced by the turbines.

There are several ways in which electromagnetic waves can deviate from their intended straight-line communication paths. These include:

- Blocking the path with an obstacle, thus creating a “shadow” or area where the intended EM wave will not occur. To a large extent, the

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“blocking” depends on the size of the obstacle as a function of the wavelength of the electromagnetic wave.

- Refraction of the EM wave. Refraction is the turning or bending of any wave, such as a light or sound wave, when it passes from one medium into another with different refractive properties.

In the context of wind-energy projects, EMI often is discussed in relation to the following telecommunications facilities:

- Television broadcast transmissions (approx 50 MHz-1 GHz)
- Radio broadcast transmissions (approx 1.5 MHz [AM] and 100 MHz [FM])
- Microwave/radio “fixed links” (approx 3-60 GHz)
- Mobile phones (approx 1 or 2 GHz)

- Radar

### **Television**

The main form of interference to TV transmission caused by windenergy projects is the scattering and reflection of signals by the turbines, mainly the blades. In relation to the components that make up a wind turbine, the tower and nacelle have very little effect on reception (i.e., only a small amount of blocking, reflection, and diffraction occurs). This is backed up by laboratory measurements that show that the tower introduces only a small, localized (up to approximately 100 m) attenuation of the signal (Buckley and Knight Merz 2005).

The British Broadcasting Corporation has issued recommendations based on a simple concept for calculating the geometry associated with reflected signals from wind turbines and how directional receiving aerials can provide rejection of the unwanted signals (BBC 2006).

Typical mitigation requirements include:

- Re-orientation of existing aerials to an alternative transmitter
- Supply of directional aerials to mildly affected properties
- Switch to supply of cable or satellite television (subject to parallel broadcast of terrestrial channels)
- Installation of a new repeater station in a location where interference can be avoided (this is more complex for digital but also less likely to be required for digital television)

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### **Radio**

Available literature indicates that effects of wind projects on both Amplitude Modulated (AM) and Frequency Modulated (FM) radio transmission systems are considered to be negligible and only apply at very small distances from the wind turbine (i.e., within tens of meters). For AM transmissions, this is due to low broadcast frequencies and long (100+ meter) signal wavelengths, which makes distortion difficult even for very large wind turbines. For FM transmissions, this is due to the fact that ordinary FM receivers are susceptible to noise interference only while operating in the threshold regions relative to signal-to-noise ratios. Thus, a distorted audio signal may be superimposed on the desired sound close to a wind turbine, potentially causing interference, only if the primary FM signal is weak.

### **Fixed Radio Links**

Fixed radio links, also known as point-to-point links, are by definition a focused radio transmission directed at a specific receiver. Fixed links are not intended to be picked up by any receivers other than those at which they are directed. They typically rely on the use of a parabolic reflector antenna (like satellite dishes) to transmit a direct narrow beam of radio waves to a receiving antenna. A direct line of sight is required between the transmitter and receiver, and any obstructions within the line of sight may degrade the performance or result in the loss of the link.

A wind turbine may degrade the performance of a fixed link, not only if it is within the line of sight of the link but also if it is within a certain lateral distance of the link, known as the “Fresnel Zone.”

### **Cellular Phones**

Mobile-phone reception depends greatly on the position of the mobile receiver. Therefore, the movement of the receiver and the topography—including both natural and unnatural obstacles—have a major impact on the

quality of the signal. The mere movement of the receiver can ensure that wind turbines will have a very minimal effect, if any, on communication quality.

### **Radar**

The potential for interference of wind turbines with radar is only partially understood. If there is such interference, it would primarily affect

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military and civilian air-traffic control. In addition, National Weather Service weather radars might be affected.

Two recent reports treated the problems in some detail. The first is a report by the U.S. Department of Defense to the U.S. Congressional Defense Committees (DOD 2006). The second is a British report on the impacts of wind-energy projects on aviation radar (Poupart 2003).

The DOD report concludes that “[w]ind farms located within radar line of sight of air defense radar have the potential to degrade the ability of the radar to perform its intended function. The magnitude of the impact will depend upon the number and locations of the turbines. Should the impact prove sufficient to degrade the ability of the radar to unambiguously detect objects of interest by primary radar alone this will negatively influence the ability of U.S. military forces to defend the nation.” It concludes further that “[t]he Department has initiated research and development efforts to develop additional mitigation approaches that in the future could enable wind turbines to be within radar line of sight of air defense radars without impacting their performance.”

The U.K. report focused on the development and validation of a computer model that can be used to predict the radar reflection characteristics, which are a function of the complex interaction between radar energy and turbines. These effects are described by the Radar Cross Section (RCS). The report concludes that the model enables a much more detailed quantification of the complex interaction between wind turbines and radar systems than was previously available. Among the findings are:

- Wind-turbine towers and nacelles can be designed to have a small RCS.
- Blade RCS returns can be effectively controlled only through the use of absorbing materials (stealth technology).
- The key factors influencing the effect of wind-energy facilities on radar are spacing of wind turbines within a facility, which needs to be considered in the context of the radar cross-range and down-range resolutions.
- No optimal layout or format can be prescribed, because each windenergy facility will have its own specific requirements that depend on many factors.

The report concludes that the model has a large potential for further use, such as the following:

- It can generate the detailed data required for sophisticated initial screening of potential facility sites.
- It can support the development of mitigation and solutions, in

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cluding siting optimization, control of wind-turbine RCS, and the development of enhanced radar filters that are able to remove returns from wind turbines.

- It is clear that as of late 2006, the interference of wind turbines with radars is a problem as yet unsolved. Research and larger-scale investigations are currently under way in several countries; they may eventually lead to standardization and certification procedures.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **Aesthetic Impacts**

Wind-energy facilities often are highly visible. Responses to proposed wind projects based on aesthetics are among the most common reasons for strong reactions to them. Reactions to the alteration of places that contribute to the beauty of our surroundings are natural and should be acknowledged. Excellent methods exist for identifying the scenic resource values of a site and its surroundings, and they should be the basis for visual impact assessments of proposed projects. Tools are available for understanding project visibility and appearance as well as the landscape characteristics that contribute to scenic quality. Lists of potential mitigation measures are also readily available. Nevertheless, the difficult step of determining under what circumstances and why a project may be found to have undue visual impacts is still poorly handled by many reviewing boards. The reasons include a lack of understanding of visual methods for landscape analysis and a lack of clear guidelines for decision making.

### **Current Best Practices**

Information concerning best practices in the United States is found through the NWCC and its sponsored proceedings and links. Europe and Canada generally have done a more thorough job in providing definitive best-practice guidelines. The integration of local, regional, and national planning and review efforts in those countries contributes to the success of their review processes. Funding in those nations for planning and more extensive surveys of public perceptions of wind energy is also far ahead of that in the United States. Here, standards for best practices are evolving as communities and states recognize the need for a more systematic approach to evaluating visual impacts. There is considerable variability in the review of proposed projects.

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### **Information Needs**

Processes for evaluating the aesthetic impacts of wind-energy projects should be developed with a better understanding of the aesthetic principles that influence people's experience of scenery. Comparative studies are needed of wind-energy projects that have relatively widespread acceptance of their aesthetic impacts and those that do not. These studies could provide useful information about a range of factors that contribute to acceptability within different landscape types. These studies should take into account that sites and projects vary dramatically in the types of scenic resources involved; the proximity and sensitivity of views; and the particular project characteristics, including scale.

The tradeoffs between placing wind-energy projects close to population centers where they are closer to electricity users but visible to more people, and placing them in remote areas where they are less visible but where the wilderness, remote, and undeveloped qualities of the landscape may hold

value need discussion as well as a clear understanding of the tradeoffs involved. These issues need to be addressed broadly, not only singling out aesthetic concerns.

#### **Impacts on Recreational, Historic, Sacred, and Archeological Sites**

Wind-energy projects can be compatible with many recreational activities, but concerns may arise when they are close to recreational activities for which the enjoyment of natural scenery is an important part of the experience. Historic, sacred, and archeological resources can be harmed by direct impacts that affect the integrity of the resource or future opportunities for research and appreciation. The experience of certain historic or sacred sites or landscapes can also be indirectly affected by wind-energy projects, especially if particular qualities of the surrounding landscape have been documented as important to the experience, interpretation, and significance of the proximate historic or sacred site. Greater clarity is needed about how such situations should be evaluated. For example, the importance and special qualities of the experience must be assessed within the context of the relative visibility and prominence of the proposed wind-energy project.

#### **Current Best Practices**

Useful methods exist for evaluating both the relative sensitivity of recreational areas and recreational users, and for determining valuable scenic resources. Siting to avoid impacts on highly sensitive recreational uses, and project design to mitigate both direct and indirect impacts can be important. Mitigation techniques can include relocation of project design

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elements, relocation of recreational activities (such as a trail), and enhancement of existing recreational activities.

State Historic Preservation Offices (SHPOs) generally identify all known historic sites of state and national significance. Local historical societies or comprehensive plans may identify additional sites of local significance. The SHPO typically requires a Class II survey to determine the existence of unknown resources in areas where such surveys are lacking. Guidelines for evaluating direct impacts on historic sites and structures often are available, and many states require archeological surveys for certain sites. Few guidelines currently exist, however, for evaluating indirect impacts of windenergy projects on historic or sacred sites and landscapes.

#### **Information Needs**

- Research examining the perceptions of recreational users toward wind-energy projects that are located near dispersed and concentrated recreational activities would provide useful data for decision makers. However, aesthetic impacts are very site-specific, so the results of such research likely will be able to guide site-specific assessments but not substitute for them.
- Guidelines are needed concerning distances at which recreational activities can occur safely around wind turbines.
- Policy makers and decision makers need better guidance from historic-preservation experts and others concerning the methods for evaluating the effects of wind-energy projects on historic, sacred, and archeological resources.

#### **Noise and Shadow Flicker**

Noise can be monitored by various measurement techniques. However, an important issue to consider, especially when studying noise, is that its perception and the degree to which it is considered objectionable depend



on individuals exposed to it.

Shadow flicker caused by wind turbines can be an annoyance, and its effects need to be considered during the design of a wind-energy project. In the United States, shadow flicker has not been identified as even a mild annoyance. In Northern Europe, because of the higher latitude and the lower angle of the sun, especially in winter, shadow flicker has, in some cases, been noted as a cause for concern.

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##### **Best (or Good) Practices**

Good practices for dealing with the potential impacts of noise from a wind-energy project could include the following:

- Analysis of the noise should be made based on the operating characteristics of the specific wind turbines, the terrain in which the project will be located, and the distance to nearby residences.
- Pre-construction noise surveys should be conducted to determine pre-project background noise levels and to determine later on what, if any, changes the wind project brought about.
- If regulatory threshold levels of noise are in place, a minimum distance between any of the wind turbines in the project and the nearest residence should be maintained so as to reduce the sound to the prescribed threshold.
- To have a process for resolving potential noise complaints, a telephone number should be provided through which a permitting agency can be notified of any noise concern by any member of the public. Then, agency staff can work with the project owner and concerned citizens to resolve the issue. This process can also include a technical assessment of the noise complaint to ensure its legitimacy.

Shadow flicker is reasonably well understood. With a little careful planning and the use of available software, the potential for shadow flicker can be assessed at any site, and appropriate strategies can be adopted to minimize the time when it might be an annoyance to residents nearby.

##### **Information Needs**

Recent research studies regarding noise from wind-energy projects suggest that the industry standards (such as the IEC 61400-11 guidelines) for assessing and documenting noise levels emitted may not be adequate for nighttime conditions and projects in mountainous terrain. This work on understanding the effect of atmospheric stability conditions and on sitespecific terrain conditions and their effects on noise needs to be accounted for in noise standards. In addition, studies on human sensitivity to very low frequencies are recommended.

Computational tools have become available that not only compute shadow flicker in real time during turbine operation, but also convey information to the turbine-control system to allow shutdown if the shadow flicker at a particular location becomes particularly problematic. Hence, the development and implementation of a real-time system at a wind-energy

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ergy project to take such actions when shadow flicker is indicated might be useful.

## Planning for and Regulating Wind-Energy Development

The purpose of this chapter is to describe the current status of planning and regulation for wind energy in the United States, with an emphasis on the Mid-Atlantic Highlands, and then critique current efforts with an eye to where they might be improved. To accomplish this purpose, we reviewed guidelines intended to direct planning and regulation of windenergy development as well as regulatory frameworks in use at varying geographic scales. To enhance our interpretation of wind-energy planning and regulation in the United States, we drew on the experiences of other countries with longer histories of wind-energy development and different traditions of land-use planning and development regulation. We focused on onshore wind energy, although many elements of planning and regulation that influence onshore wind-energy developments apply to offshore installations as well.

As with other human endeavors that engage both private and public resources, wind-energy development is influenced by an interconnected, but not necessarily well-integrated, suite of policy, planning, and regulatory tools. “Policy” can be broadly defined to encompass a variety of goals, tools, and practices—some codified through laws; some less formally specified. (For a discussion of traditional and new policy tools, see, e.g., NRC 2002.) Policies encompass, but are not limited to, planning and regulation. Policy tools related to wind energy, including national and regional goals, tax incentives, and subsidies, have been discussed in Chapter 2, so we concentrate on planning and regulation here. “Planning”—whether legally mandated or not—is a process that typically involves establishing goals; assessing resources and constraints, as well as likely future conditions; and

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then developing and refining options. “Regulation,” as understood within a legal framework, typically consists of methods and standards to implement laws. Regulation is created and carried out by public agencies charged with this responsibility by law. The scope of agency discretion in establishing and administering regulations depends largely upon whether the law is highly detailed or more general.

The chapter begins with a review of guidelines that have been developed to direct wind-energy planning and/or regulation. Some of these have been promulgated by governmental or non-governmental organizations concerned with limited aspects of wind energy, such as the guidelines for reducing wildlife impacts developed by the U.S. Fish and Wildlife Service (USFWS 2003). Some are more comprehensive in scope, such as those developed by the National Wind Coordinating Committee (NWCC 2002). We also consider guidelines developed by states to direct wind-energy development toward areas judged most suitable and to assist local governments in carrying out their regulatory responsibilities with respect to wind



energy. Then we review regulation of wind-energy development via federal laws, including development on federal lands, in situations where there is a federal nexus by reason of federal funding or permitting, and where there is no such nexus. Next we review regulation of wind-energy development at the state and local levels by concentrating on recurring themes: the locus of regulatory authority (state, local, or a combination thereof); the locus of review for environmental effects; information required for review; public participation in the review; and balancing positive and negative effects of wind-energy development. In these sections we also report on the interaction between planning and regulation, although that interaction is generally less well developed in the United States than in some of the other countries we examined. Then we critique what we have learned about regulation of wind energy by examining some of the tensions in regulation, for example between local and broader-level interests and between flexibility and predictability of regulatory processes. Finally, we present a set of recommendations for improving wind-energy planning and regulation in the United States.

#### **GUIDELINES FOR WIND-ENERGY PLANNING AND REGULATION**

In the United States and, notably, in other nations with considerable wind-energy experience, governmental and non-governmental organizations working at various geographic scales have adopted guidelines to help those developing wind-energy projects and those regulating wind-energy development to meet a mix of public and private interests in a complex, and often controversial, technical environment. Here we review U.S. guidelines for different jurisdictional levels (e.g., state, local), for different environmental

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components (e.g., wildlife), and for the different purposes of guiding planning versus guiding regulatory review. We also draw on the experience of other countries where guidelines for wind-energy development have a longer history.

Some guidelines are for proactive planning of wind-energy development. “Planning” is an ambiguous term, however. Within the context of wind-energy development, it can refer to highly structured processes that carry considerable legal weight and result in identifying certain areas as suitable for wind turbines (as in the Denmark example below). Alternatively, it can refer to loosely structured processes that are largely advisory and result in criteria for evaluating the favorable and unfavorable attributes of prospective sites (as in the Berkshire example below). In addition, planning for wind-energy development may take a broad view of the incremental impacts of multiple wind-energy projects in a region, or it may take a narrow view and focus primarily on a single project. And, geographic scales for planning range from the national to the local level.

Other guidelines focus on regulation. They prescribe for regulatory authorities reviewing wind-energy developments what procedures should be followed, what kinds of information should be examined, and what criteria should be used to make permitting decisions. Many guidelines mingle the two functions of planning and project-specific regulatory review. In practice, planning guidelines that suggest where and how wind-energy development should be done may become criteria for regulatory permitting decisions if projects inconsistent with planning guidelines are rejected. The United States is in the early stages of learning how to plan for and regulate wind energy. The experiences of other countries, where debates

over wind energy have been going on for much longer, can be instructive for bringing U.S. frameworks to maturity. For example, Britain and Australia have dealt with controversies about wind-energy development by working with stakeholder groups, including opponents of wind energy, to develop “Best Practice Guidelines” (BWEA 1994; AusWEA 2002). BWEA (British Wind Energy Association) and AusWEA (Australian Wind Energy Association) were convinced that “they needed to become more transparent and more engaged with the public than any other industry” (Gipe 2003). In Ireland, the Minister of the Environment, Heritage and Local Government released an extensive “Planning Guidelines” document on wind energy in June 2006 (DEHLG 2006). This document advises local authorities on planning for wind energy in order to ensure consistency throughout the country in identifying suitable locations and in reviewing applications for wind-energy projects. Not only are these guidelines prescriptive—that is, they express procedures and approaches that *should* be taken—but they also are linked to other government policies.

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A prescriptive national approach is less likely in the United States, where each state is governed by different laws and policies regarding the regulation of wind-energy projects, but the comprehensive approaches used in other countries could be adopted at the state level. The highly structured approach of Denmark, for example (see Box 5-1), could be informative for states wishing to develop integrated frameworks to plan for and regulate wind-energy development. We note, however, that Denmark is smaller and more homogeneous than many U.S. states, has a much stronger tradition of central planning of land use, and has many wind projects owned by local cooperatives, rather than private developers.

#### **National Wind Coordinating Committee Guidelines**

The NWCC was established in 1994 as a collaboration among representatives of wind equipment suppliers and developers, green power marketers, electric utilities, state utility commissions, federal agencies, and environmental organizations. Its permitting handbooks propose guidelines for how wind-energy developments should be reviewed. In 2002, the Siting Subcommittee of the NWCC revised its *Permitting of Wind Energy Facilities: A Handbook*, originally issued in 1998 (NWCC 2002). Intended for those involved in evaluating wind-energy projects, the handbook describes the five typical phases of permitting processes for energy facilities, including wind turbines and transmission facilities:

- (1) *Pre-Application*: This phase occurs before the permit application is filed, during which the developer meets with the permitting agency(ies) and others immediately affected, such as nearby landowners, and local agencies. This phase may be mandatory or voluntary, and it may involve public notice and/or public meetings.
- (2) *Application review*: This phase begins when the permit application is filed. Its activities, required documents, and public involvement requirements depend upon the application review process, as does its duration. In some cases, agencies may be required to reach a decision within a specified period.
- (3) *Decision making*: In this phase, the lead agency determines not only whether to allow the project but also whether to impose measures constraining the project’s construction, operation, monitoring, and decommissioning.

During this phase, public hearings are likely to be required.

(4) *Administrative appeals and judicial review*: Appeals of permit decisions may be made to the decision maker, to the administrative review board, or to the courts.

(5) *Permit compliance*: This phase extends through the project's life.

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### BOX 5-1

#### Planning for Wind-Energy Development in Denmark

Until the beginning of the 1990s, the approach in Denmark (like the U.S. approach today) was: "Find yourself a site, and then apply for permission to erect your wind turbine(s)" (DWEA 2004). This laissez-faire approach changed in the early 1990s, when Denmark's third energy plan—Energy 2000—was put forward. It included the goal of 1,500 MW of installed wind energy by 2005. In 1994, an executive order, the "Wind Turbine Circular," made cities responsible for planning for wind turbines, including looking for appropriate sites. In 1999, with a new Wind Turbine Circular, the planning responsibility was redirected to county (amt) authorities. These county-level efforts, and corresponding local efforts, target areas considered suitable for wind farms. The original goal of 1,500 MW nationally was met several years before the 2005 deadline. In 2002, the Danish government indicated that further onshore wind-energy development would not be encouraged but that offshore wind-energy development would be allowed. Denmark's success in installing so much wind-energy capacity has been attributed to numerous factors including (1) the relatively small size of wind projects (1-30 turbines), (2) cooperative ownership of many wind projects with direct benefits to local citizens, and (3) comprehensive planning and review in which localities directly participate (J. Lemming, RISØ, personal communication 2006; Nielsen 2002).

#### Regulatory Review Within a Planning Context

In Denmark, planning for land-based wind development is linked to the regulatory review process. The centerpiece of the review process is a mandatory environmental impact assessment (EIA) (if a project involves more than three wind turbines or wind turbines over 80 meters in height). The regional planning authority—typically, the county—is responsible for initiating the EIA and ensuring its quality. The EIA is a joint effort of the developer, the developer's consultants, and the county. The EIA must describe the project and establish that the site is appropriate from a wind resource standpoint. The site is further described, including working areas and roads to be used during construction. Alternative sites must be investigated, as well as the no-build alternative, and the developer must substantiate why the proposed site is preferred. It may include monitoring, inspection, addressing local complaints during the project's operation, as well as following up on requirements for closure and decommissioning.

These five phases are included in the handbook as descriptions of what typically happens (given a great deal of variation among states), not as recommendations of what should happen. However, the authors of the handbook suggest eight principles that should be followed when structuring a permit review process:

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The EIA must describe the landscape surrounding the site, with emphasis on anything that may be affected during the construction or operation phases of the project. Protected species of flora and fauna require special consideration, as do birds protected under international agreements. Any adverse effects on water reserves must be noted. If the project is to be located outside areas previously designated for wind farms, conflicts over the use of land (e.g., because of protected species, arable land, scenic resources) must be given special attention. The EIA also should assess the project's positive environmental impacts (e.g., reduced CO<sub>2</sub>, NO<sub>x</sub>, and SO<sub>2</sub>). Standards have been set for evaluating impacts on the human environment. No turbine may be sited closer to the nearest residence than a distance of four times the

height of the turbine. The EIA must address adverse noise and visual impacts, including cumulative impacts from multiple turbines within a radius of 1 to 2 km. The noise level from the wind turbine(s) must be estimated, using a protocol described in the Noise Declaration (a national-level regulation). The EIA must describe how far shadows from the turbines will reach at all times of year, and the layout of the turbines in relation to major landscape features must be described. Possible adverse effects on property values, tourism, and other commercial activities in the vicinity should be described. Prior to preparation of the EIA and the planning documents, the project must be publicized for at least four weeks, with opportunities for private citizens and organizations to submit suggestions and comments. These submissions must be included when preparing the EIA. Following completion of the EIA and the planning documents (or their amendments), this material must be publicized for at least eight weeks, after which a public hearing is held where suggestions or objections are again gathered. Following the final decision on the project, anyone who has submitted objections to the project must receive a written answer to the objections.

When the EIA is completed, authorities at the county and local levels formulate amendments to their wind-energy plans, using the EIA as a common point of reference. During the subsequent public comment period, the state can veto the project (this is a national-level decision) but must substantiate why it is exercising its veto power. After public hearings, the plans are presented to county and local political bodies (the county council and the city council). The county council or city council may approve or reject the project. Construction begins only if the project has been approved (Ringkøbing Amt, Møller og Grønborg, and Carl Bro 2002).

- *Significant public involvement*: Including early and meaningful information and opportunities for involvement.
- *An issue-oriented process*: One which focuses the decision on issues that can be dealt with “in a factual and logical manner” (NWCC 2002, p. 16).
- *Clear decision criteria*: As well as clear specification of factors that must be considered and minimum requirements that must be met.
- *Coordinated permitting process*: Including both horizontal coordination among various agencies and vertical coordination between state and local decision makers.

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- *Reasonable time frames*: In part to provide the developer with known points for providing information, making changes, and receiving a decision.
- *Advance planning*: In particular, early communication on the part of the developers and the permitting agencies.
- *Timely administrative and judicial review*: Including addressing issues such as who has standing to initiate a review and time limits within which reviews must be initiated.
- *Active compliance monitoring*: Including specifying reports that must be submitted and establishing site inspection timetables, non-compliance penalties, a complaint resolution process, etc.

#### **Federal Government Guidelines**

Concerns about the effects of wind-energy projects on bird and bat mortality, in combination with federal laws protecting some wildlife species, led the U.S. Fish and Wildlife Service (USFWS) to provide interim guidelines for evaluating wildlife impacts (technical aspects of which are reviewed in Chapter 3). We know of no other federal-level guidelines addressing the review of wind-energy projects on private land. However, the Federal Aviation Administration (FAA) reviews all structures 200 feet or taller for compliance with aviation-safety guidelines. There have not been uniform standards until fairly recently (see Box 5-2). Both the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) provide guidance

for the review of wind-energy projects on lands under their jurisdictions. These are described below under federal regulatory approaches to wind energy.

#### **U.S. Fish and Wildlife Service Interim Guidelines**

On May 13, 2003, the USFWS released “Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines” (USFWS 2003).

Adherence to the guidelines is voluntary, as the guidelines note:

... the wind industry is rapidly expanding into habitats and regions that have not been well studied. The Service therefore *suggests* a precautionary approach to site selection and development and will employ this approach in making recommendations and assessing impacts of windenergy developments. We *encourage* the wind-energy industry to follow these guidelines and, in cooperation with the Service, to conduct scientific research to provide additional information on the impacts of wind-energy development on wildlife. We further *encourage* the industry to look for opportunities to promote bird and other wildlife conservation when planning wind-energy facilities (e.g., voluntary habitat acquisition or conservation easements) (USFWS 2003, emphasis added).

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##### **BOX 5-2**

#### **Federal Aviation Agency (FAA) Obstruction Lighting Guidelines**

To determine lighting requirements, each site and obstruction is reviewed by the FAA for particular safety concerns, such as distance from nearby airports. Negative effects of required lighting on night-flying birds and bats, and sometimes also on people near wind-energy projects, have prompted revisions of initial lighting standards for wind turbines. A recent study conducted by the FAA Office of Aviation Research resulted in recommendations for obstruction lighting that considerably reduced earlier lighting guidelines (Patterson 2005). The following chart summarizes the former and current guidelines, though individual site requirements may vary. Source of current guidelines: FAA (2007).

Former FAA Guidelines    Current FAA Guidelines

- Lights mounted on the nacelle of every turbine
- Two flashing or pulsed light fixtures for night lighting
- Two flashing white light fixtures during daytime
- Flashing can be synchronous or random
- Lights needed only to mark periphery (ends or edges) of project or cluster; with maximum lighting distance of a half-mile; highest turbines must also be lit.
- Single red flashing or pulsing light fixture at night.
- White strobe lights may be used but not in conjunction with red lights (one or the other)
- Flashing must be synchronous (all at the same time)
- No daytime lighting required as long as turbines are a white color (not gray).
- Preferred light is a red flashing (L-864) with minimum light intensity of 2000 candelas.
- Lights should be mounted above the nacelle height for visibility (hub may obscure)
- Turbine locations should be noted on aviation maps.

The guidelines include recommendations regarding:

- A two-step site evaluation protocol (first, identify and evaluate reference sites—i.e., high-quality wildlife areas; second, evaluate potential development sites to determine risk to wildlife and rank sites against each other using the highest-ranking reference site as a standard).
- Site development (e.g., placement and configuration of turbines, development of infrastructure, planning for habitat restoration); and turbine design and operation (USFWS 2003).

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The guidelines direct wind-energy development away from concentrations of birds and bats and toward fragmented or degraded habitat (rather than areas of intact and healthy wildlife habitat). The guidelines also address

some desirable features of regulatory review processes, such as recommending multiyear, multiseason pre-construction studies of wildlife use at proposed project sites; multiyear, multiseason post-construction studies to monitor wind-project impacts; and involvement of independent wildlife agency specialists in development and implementation of pre- and post-construction studies. The guidelines were circulated to the public with a request for review and the Service recently announced the development of a Federal Advisory Committee Act-compliant collaborative effort to revise the guidelines based on public comment.

#### **State and Regional Guidelines**

Several states with wind resources have developed guidelines for siting and/or permitting wind-energy projects. This has been particularly true for states where review occurs at the local level, since the projects may be complex and very different from the kinds of projects most local governing bodies are used to addressing. The NWCC Guidelines (NWCC 2002) appear to have provided a useful template for states, with basic information that can be adapted to the particular needs and conditions of states that have wind potential. Below we describe a few of these to illustrate the types of provisions that state guidelines may include.

Kansas's wind-energy guidelines were adapted from the NWCC Guidelines and are intended to assist local communities in regulating land use for wind-energy projects. The guidelines recognize landscape features that are important in Kansas. Under "Land Use Guidelines," (KSREWG 2003, p. 3) native tallgrass prairie landscapes are singled out as having particular value, especially where they remain unfragmented. Cumulative impacts are noted because there is intense interest in wind-energy development in certain areas of the state. Kansas includes guidelines on "Socioeconomic, Public Service and Infrastructure," as well as on public interaction (KSREWG 2003, p. 6).

South Dakota also adapted NWCC permitting guidelines (SDGFP 2005). In sections concerning "natural and biological resources," South Dakota's guidelines call attention to areas of the state that have been identified as potential sites for wind-energy development, but are considered "unique/rare in South Dakota" (SDGFP 2005, p. 1). Developers are urged to use environmental experts to make an early evaluation of the biological setting and to communicate with agency, university, and environmental organizations. They are warned that "if a proposed turbine site has a large

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potential for biological conflicts and an alternative site is eventually deemed appropriate, the time and expense of detailed wind resource evaluation work may be lost” (SDGFP 2005, p. 3). In sections on “visual resources,” developers are told to inform stakeholders about what to expect from a wind-energy project, target areas already modified by human activities, and be prepared to make tradeoffs and coordinate planning across jurisdictions and with all stakeholders. Under “socioeconomic, public services, and infrastructure,” developers are admonished not to take advantage of municipalities that lack zoning or permitting processes for wind-energy development.

Wisconsin’s guidelines (WIDNR 2004) focus on natural resource issues with minimal guidance in other areas. The guidelines direct wind-energy development away from wildlife areas, migration corridors, current or proposed major state ecosystem acquisition and restoration projects, state and local parks and recreation areas, active landfills (because they attract birds), wetlands, wooded corridors, major tourist/scenic areas, and airports and landing strips clear zones. USFWS guidelines are cited as models for pre-construction studies, with two years of post-construction monitoring recommended for the first wind-energy projects in a particular area.

In contrast with guidelines focused exclusively on wildlife issues, some guidelines reflect a much more comprehensive approach. As illustrated in the accompanying box (Box 5-3), the wind-energy siting guidelines developed by the Berkshire Regional Planning Commission in Massachusetts are multifaceted and proactive, as is an assessment methodology prepared by the Appalachian Mountain Club for wind energy in the Berkshires (BRPC 2004; Publicover 2004).

Regulatory review processes could possibly use such a method to evaluate proposed wind-energy projects to see if they met a threshold for suitability. Similar procedures have been proposed for other states, such as Virginia, where Boone et al. (2005) proposed a land-classification database for use in screening out sites that are likely to be deemed unsuitable for wind-energy development, such as designated wilderness areas or concentrations of birds or bats.

#### **Guidelines Directed Toward Local Regulation**

In some cases, the guidelines that states have developed are intended to serve as models for local ordinances and local-level review processes. The “Michigan Siting Guidelines for Wind Energy Systems” (MIDLEG 2005) is a model zoning ordinance for local governments, although it notes that “the Energy Office, DLEG (Department of Labor and Economic Growth) has no authority to issue regulations related to siting wind energy systems”

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#### **BOX 5-3**

##### **Guidelines for Planning and Regulatory Review of Wind Energy in the Berkshires, Massachusetts**

Perhaps as a result of interest in wind-energy project development in the Massachusetts

Berkshire region, the Berkshire Regional Planning Commission developed “Wind Power Siting Guidelines” (BRPC 2004). Most of these guidelines refer to desired features of application and regulatory review procedures. For example, the guidelines direct that viewshed analyses should be done “with the most accurate elevation data available from the state using a GIS such as ArcGIS Spatial Analyst or 3D Analyst” (BRPC 2004, p. 1) and that “important cultural locations, Shakespeare & Company, and Hancock Shaker Village should be located

on the map to determine if they will be impacted by the visibility of the turbine development" (pp. 1-2). There are also safety guidelines, such as "Existing homes are not within potential safety impact areas from ice or blade throw or tower failure" (p. 2).

The commission also asked the state of Massachusetts to become involved in wind-energy development to provide "state-wide siting guidelines for the development of wind power facilities" (p. 3) and "financial assistance to municipalities with areas conducive to wind-energy development to develop adequate local land use regulations for wind energy facilities" (p. 4). The commission suggested that communities hosting wind-energy projects should require that applicants pay for consultants to assist the municipality in evaluating the possible and negative impacts of a proposed project and in establishing beneficial agreements for municipal revenue generation.

Also working in the Berkshires, the Appalachian Mountain Club (AMC) developed "A Methodology for Assessing Conflicts Between Windpower Development and Other Land Uses" (Publicover 2004). This document considers various ecological and sociocultural characteristics that make sites appropriate or inappropriate for wind-energy projects, beyond engineering or economic considerations. Beginning with Geographic Information System (GIS) layers identifying wind sites of Class 4 and above, the AMC methodology overlaid known ecological, recreational, and scenic resources onto the wind map. Resource data were assigned "conflict ratings" that included importance of a resource (local, state, federal significance), proximity to the site, and size of the area. These data can be examined with different subjective weightings on ecological and social factors to see how they might affect an overall site suitability rating. A trial application of this method of analysis suggested that certain sites had far fewer conflicts than others, but the authors cautioned that many variables that could be important to siting decisions were not included in the study.

(MIDLEG 2005, p. 1). Pennsylvania also has produced a model zoning ordinance for local communities (Lycoming County 2005), discussed below in the analysis of state and local regulatory review. Both the Michigan and Pennsylvania models are very basic in their requirements, with little detail about information required or how it will be judged.

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### **REGULATION OF WIND-ENERGY DEVELOPMENT**

In this section we move from guidelines for planning and regulating wind-energy development to a review of regulatory frameworks that have been put in place at different jurisdictional levels and for different land ownerships. First, we review federal regulation of wind energy: most narrowly, federal regulation of wind-energy development on federal lands; then federal regulation of wind-energy development that has a federal "nexus" via federal funding or permitting; then, most broadly, federal regulation of wind-energy development regardless of land ownership.

To better understand regulation of wind-energy development, we review regulatory frameworks for a number of states. Because the focus of this document is the Mid-Atlantic Highlands, we include all four states in this region (Pennsylvania, Maryland, Virginia, and West Virginia). These four states vary in the intensity of their review processes, thus giving a picture of the range of regulatory oversight in the United States today. We also review wind-energy regulation for states outside the Mid-Atlantic Highlands, choosing some from northeastern states that share many landscape, social, and wind-energy characteristics with the Mid-Atlantic Highlands, and some from contrasting landscapes.

In reviewing regulatory frameworks at all levels, we emphasize regulations that are likely to be particularly salient for wind-energy projects, and especially regulations that are likely to affect wind development in the Mid-Atlantic Highlands region. We give rather little attention to regulations



that apply equally to any type of construction or industrial operation, wind energy or other.

### **Federal Regulation of Wind Energy**

#### **Federal Regulation of Wind-Energy Development on Federal Lands**

As of mid-2005, all of the wind-energy facilities erected on federal lands were in the western United States on land managed by the BLM; they included about 500 MW of installed wind-energy capacity under right-of-way authorizations (GAO 2005). At that time, the BLM developed its Final Programmatic

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Development (BLM 2005a) in order to expedite wind-energy development in response to National Energy Policy recommendations. The Wind Energy

Development Program, which is to be implemented on BLM land in 11 western states, establishes policies and best-management practices addressing impacts to natural and cultural resources (BLM 2005b).

As of mid-2006, other federal land management agencies such as the USFS had not developed general policies regarding wind-energy development

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and were reviewing proposals on a case-by-case basis. No wind-energy projects currently exist on USFS lands but two were under review as of mid-2006, one in southern Vermont in the Green Mountain National Forest and another in Michigan in the Huron Manistee National Forest. National Forests operate under the guidance of Land and Resource Management Plans, which form the basis for review of all proposed actions. Recent updates of Forest Land and Resource Management Plans address wind-energy projects. In most cases a project would require a “special use authorization” (Patton-Mallory 2006). If an application is accepted, the project undergoes National Environmental Policy Act (1969) (NEPA) review (see next section), but the process will vary depending on the agencies and states involved.

Section 388 of the Energy Policy Act of 2005 gave the U.S. Department of the Interior’s Minerals Management Service (MMS) responsibility for reviewing offshore wind-energy development proposals that occur on the outer continental shelf. As of the fall of 2006, the MMS was drafting a programmatic environmental impact statement (EIS) for renewable energies on the outer continental shelf. No offshore wind-energy project was operational or even under construction in the United States at the end of 2006.

#### **Federal Regulation of Wind-Energy Projects with a Federal “Nexus”**

Wind-energy developments are subject to the NEPA if they are considered “federal actions” because a federal agency is conducting an activity, permitting it, or providing funds for it. (Another potential federal “nexus” for wind energy—the federal production-tax credit for renewable energy facilities [see Chapter 2]—does not trigger review under the NEPA.) The Council on Environmental Quality has promulgated regulations that include provisions for establishing categorical exclusions from NEPA requirements (NEPA Task Force 2003). Otherwise, the NEPA requires that federal agencies prepare an environmental assessment or, if significant impacts are anticipated, the much more extensive EIS. An EIS must describe the proposed action and provide an analysis of its impacts as well as alternatives to that action, and it must include public involvement in the EIS process. If an EIS is undertaken, socioeconomic impacts must be analyzed as part of

the EIS. Otherwise, socioeconomic/cultural impacts of wind-energy projects are given little explicit attention at the federal level. Wind-energy projects on BLM land are under a programmatic EIS, as described above (BLM 2005a).

Based on interview with Robert Bair of the Green Mountain National Forest Service, 2006.

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##### **Federal Regulation of Wind-Energy Development in General**

Federal regulation of wind-energy facilities is minimal if the facility does not receive federal funding or require a federal permit; this is the situation for most energy development in the United States. The Federal Energy Regulatory Commission (FERC) regulates the interstate transmission of electricity, oil, and natural gas, but it does not regulate the construction of individual electricity-generation (except for non-federal hydropower), transmission, or distribution facilities (FERC 2005).

Apart from the FAA guidelines, the threat of enforcement of environmental laws protecting birds and bats is the main federal constraint on wind-energy facilities not on federal lands, because—as discussed in Chapter 3—bird and bat fatalities have been observed at a number of existing facilities. The Migratory Bird Treaty Act applies to all migratory birds native to the United States, Canada, and Mexico; this includes many species that use the Mid-Atlantic Highlands, including for migration. The Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668a-d, last amended in 1978) protects two raptor species. Bald eagles nest in isolated parts of the Mid-Atlantic Highlands whereas golden eagles are mainly migrants or winter residents, although a few may nest in the region (Hall 1983). Permits to “take” species protected under the Migratory Bird Treaty Act (16 U.S.C. §§ 703-712) and to take golden eagles under the Bald and Golden Eagle Act can be issued by the USFWS in very limited circumstances. The Endangered Species Act (ESA) (7 U.S.C. 136; 16 U.S.C. 460 et seq. [1973]), protects species that have been listed as being in imminent danger of extinction throughout all or a significant portion of their range (endangered) or those that are likely to become endangered without appropriate human intervention (threatened). There are federally listed species from many taxa in the Mid-Atlantic Highlands, some of which may be affected by windenergy projects (Chapter 3). The ESA also protects habitat designated as “critical” to the survival of listed species. Non-critical habitat is protected indirectly in that if habitat destruction would lead to the direct take of an individual of the protected species, destruction of the habitat would be a violation of the ESA. In this situation the species is receiving the protection, not the habitat. Thus, the ESA provisions could affect wind-energy development not only via mortality of birds and bats due to collisions with wind turbines, but also via mortality or habitat loss for endangered or threatened species due to construction and operation of wind-energy facilities. The ESA does allow incidental taking of a protected species (i.e., taking that is incidental to an otherwise legal activity) if a permit has been granted by the USFWS. This provision has been applied to a wind-energy development via incidental take permits that have been approved as part of the Habitat Conservation Plan submitted during the permitting process for the Kaheawa

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Pastures Wind Energy Generation Facility on Maui (HIDLNR 2006). The USFWS is responsible for implementation and enforcement of these three laws. Violations are identified in several ways, including receiving citizen complaints and self-reporting by individuals or industry. Although the USFWS investigates the “take” of protected species, the government, as of mid-2005, had not prosecuted industry, including wind-energy companies, for most violations of wildlife laws (GAO 2005).

Like other construction and operation activities, wind-energy projects are subject to federal regulations protecting surface waters and wetlands, such as the Clean Water Act. If a project disturbs one acre or more, or is part of a larger project disturbing one acre or more, the project developer must comply with National Pollutant Discharge Elimination System (NPDES) requirements. Compliance involves preparing a Storm Water Pollution Prevention Plan in order to obtain an NPDES permit, which is issued by the state’s environmental regulatory agency. Section 404 of the Clean Water Act may also apply if the waters of the United States are potentially affected. Before construction begins, the developer also must ensure that the requirements of various federal laws and regulations protecting historic and archeological resources are met. Provisions such as these apply to all types of construction, not just wind energy, and we will not consider them in any detail here.

**State and Local Regulation of Wind-Energy Development**

Most regulatory review of wind-energy development takes place at the state or local level, or some combination of them, and most energy development has been on private land, although a few states have anticipated that wind-energy projects could be proposed for state-owned land. In reviewing state and local regulatory frameworks, the committee found it difficult to be sure that we understood these frameworks and their implementation accurately. There are several reasons for our uncertainty:

- The written regulations themselves are often complex and sometimes apparently contradictory.
- Aspects of their implementation are often discretionary, making it hard to summarize the true effects of the written regulations.
- Regulation of wind-energy development is new for most jurisdictions, so both the regulations themselves and the procedures for implementing them are evolving and precedents are being set gradually through experience.

Because of the rapidly changing nature of regulation of wind-energy development, the committee examined records from several recent wind

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energy proposals to see how the regulatory process is working in practice, as well as reviewing the regulations themselves.

**State-Owned Lands**

Some states have developed policies with regard to the use of stateowned lands for wind-energy development. The Pennsylvania Department of Conservation and Natural Resources has completed draft criteria for siting wind-energy projects and a GIS screening tool to guide consideration of the appropriateness of commercial-scale wind-energy development on a

small portion of state forestlands (PADCNR 2006).

The state of Vermont has decided that commercial wind-energy development is not an appropriate use for state-owned lands, but that smallscale individual turbines would be appropriate for powering state facilities (VTANR 2004).

### **Privately Owned Lands**

All of the federal regulations described in the previous section as applying to wind-energy developments or other construction activities, regardless of ownership or funding, apply in addition to the state and local regulations discussed here. In some cases, there are state and local regulations that parallel federal requirements. Many states have their own regulations for endangered species, water quality, and so forth. In the Mid-Atlantic Highlands, Pennsylvania, Maryland, and Virginia have state laws protecting various animals and plants (Musgrave and Stein 1993); West Virginia does not (WVDNR 2003). States assemble their own lists of species protected under these laws and may include species not listed at the federal level. Also, most wind-energy projects undergo some type of local review through local zoning and related ordinances. These local ordinances will not be discussed in detail, unless they are the only level of review or when the local provisions are particularly salient for wind-energy projects (e.g., noise or height ordinances). State and local regulations that govern construction and development projects typically apply to wind-energy projects as well.

Rather than summarize the regulatory process for particular state or local jurisdictions, we concentrate on several recurring themes, some of which came to our attention during public presentations to our committee and some of which we identified as we examined the regulations for numerous states and municipalities. These themes are: (1) the locus of regulatory review (state, local, or mixed); (2) separation or integration of utility and environmental issues in the review process; (3) the information required for review; (4) the procedures for public participation in the review process;

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and (5) balancing the positive and negative effects of wind-energy development. In the following sections, we describe these themes using examples from the Mid-Atlantic Highlands states and elsewhere. Then we critique and interpret some of the same themes, along with some others, in order to identify potential improvements to regulatory processes.

#### **Locus of Regulatory Authority: State, Local, Mixed**

Regulatory review of wind-energy development varies considerably. It tends to follow one of three patterns: (1) all projects are handled entirely at the state level, (2) larger projects are handled at the state level and smaller projects at the local level (with the size cutoff varying among states), or (3) all projects are handled primarily at the local level. Many states have some state-level permitting of electrical generation facilities, especially transmission lines. Three of the four states in the Mid-Atlantic Highlands have state utility commissions that oversee proposals for electricity generation and transmission. In Virginia, siting (or expanding) a wind-energy facility falls under State Corporation Commission regulation of electric generation facilities (VASCC 2006a). In Maryland, the Public Service Commission must approve construction of electricity-generating facilities and all overhead electric transmission lines of more than 69 kV (MDPSC 1997). In May 2005, West Virginia finalized specific provisions pertaining to wind-energy

facilities in its Public Service Commission procedures (WVPSC 2005). Other states are in the process of incorporating specific language concerning wind-energy projects into regulatory rules and guidelines.

In addition to systems for permitting construction and operation of electricity-generating facilities and transmission lines, approvals are often required to connect wind-generated electricity to regional transmission grids, such as the PJM Interconnect in the Mid-Atlantic Highlands. (The PJM Interconnect covers central and eastern Pennsylvania, virtually all of New Jersey, Delaware, western Maryland, and Washington, D.C. A new control area called PJM West is now covered by PJM Interconnect and covers the northern two-thirds of West Virginia, portions of western and central Pennsylvania, western Maryland, and small areas of southeastern Ohio [Bartholomew et al. 2006]).

In some cases, the developer must obtain a variety of state permits before final review by a local planning or governing body. Sometimes the state regulatory authority coordinates or consolidates these permits. The Oregon Office of Energy encourages developers of smaller wind-energy facilities to obtain permits through the Energy Facility Siting Council rather than dealing separately with the variety of state and local permits otherwise required. They argue that at the state-level siting process there is “a defined set of objective standards,” while “local-level siting is subject to local procedures

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and ordinances that vary from county to county and city to city” (White 2002, p. 4). In addition, the Oregon Energy Office states, “Most local land use ordinances address energy facility siting in a superficial way, if they address it at all. It may not be clear what standards the local jurisdiction will apply in deciding whether or to issue a conditional use permit” (p. 4). It notes that “most planning departments around the state have no experience siting large electric generating facilities” (White 2002, p. 5).

Local governments (counties and towns or cities) regulate wind-energy development via local ordinances that apply to any construction proposal. Local regulations, such as zoning of land uses, rights-of-way, building permits, and height restrictions, may constrain wind-energy development. In Virginia, for example, the following local permits were required for the proposed Highlands New Wind Development: (a) a conditional-use permit from the County Board of Supervisors (conditions on height, setback, lighting, color, fencing, screening, signs, operations, erosion control, decommissioning, bonding); (b) a building permit from Highland County; and (c) a site plan approved by the Highland County Technical Review Committee (VASCC 2005).

In Pennsylvania, local regulations constitute the only review, and county governments that issue zoning recommendations and permits for land development and subdivision plans are the regulatory authorities. The Pennsylvania Wind Working Group (which included representatives of the Pennsylvania Department of Environmental Protection, the Clean Air Council, municipal governments, environmental advocacy organizations, and wind-energy companies) has developed a model ordinance to help local governments carry out this responsibility. The Pennsylvania model ordinance contains no environmental provisions except during decommissioning, when re-seeding after grading is required. It does provide guidance on visual appearance of wind turbines and related infrastructure, sound levels, shadow flicker, minimum property setbacks, interference with communications

devices, protection of public roads, liability insurance, decommissioning, and dispute resolution. The model ordinance contains language about waivers of the provisions of the ordinance (PAWWG 2006).

As another example, Manitowoc County, Wisconsin, has developed an ordinance regulating large wind-energy projects, defined as projects with more than 100 kW capacity or a total height of more than 170 feet (Kirby Mountain 2006). This ordinance puts limits on noise (less than or equal to 5 dB(A) above the ambient level at any point on neighboring property). It restricts wind-energy development to areas zoned “agricultural” and puts a one-quarter-mile buffer around any area that is zoned C1-Conservancy or NA-Natural Area or within one-quarter mile of any state or county forest, hunting area, lake access, natural area, or park. It requires setbacks of towers from neighboring properties and from public roads and power

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lines. Other requirements include minimum lighting needed to satisfy FAA guidelines, uniform design for towers within one mile, and steps to reduce shadow flicker at occupied structures on neighboring property.

#### **Locus of Review of Environmental Impacts**

Another source of variation in wind-energy regulation among different states is how the review of environmental impacts takes place (here, we are treating “environmental” broadly, to include sociocultural effects, as well as effects on the non-human environment). In some states, environmental permitting of wind-energy projects—including their biological, aesthetic, historic, air quality, and water quality considerations—is under the aegis of the public-utility regulatory authority. In other states, this function is performed by another state agency or by a regional or local body. Most wind-energy projects do not have a federal nexus that triggers NEPA review (see above), but some states have their own environmental-review processes that may come into play when wind-energy developments are proposed. New York and California both have State Environmental Quality Review processes (e.g., NYSEDA 2005a) that trigger required EISs in certain circumstances.

In New York, for example, the Department of Environmental Conservation classifies actions as Type I (likely to have significant impact, EIS required), or Type II (only local permits required), or Unlisted (may fall into either category). Projects that are 100 feet or taller in an area without zoning regulations that alter an area 10 acres or larger trigger an EIS process; most commercial wind-energy projects would fall in this category.

In many states, the state utilities commission is charged with the authority to weigh environmental impacts, along with other factors, in deciding whether to permit a wind-energy facility to be built and operated, but with provisions for input from other state and federal agencies more knowledgeable about the environment. In Virginia, the Department of Environmental Quality coordinates the environmental review of electricity-generation facilities and may be responsible for issuing certain permits, such as an Erosion and Sedimentation Control Plan or a section 401 permit from the State Water Control Board. It coordinates input from the Departments of Game and Inland Fisheries, Conservation and Recreation, Historic Resources, Transportation and Mines, Minerals and Energy, and the Virginia Marine Resources Commission. However, the Virginia State Corporation Commission (SCC) has the ultimate responsibility for reviewing and issuing construction permits for wind-energy facilities and other electricity-generating units (VASCC 2006a). In West Virginia, the Division



of Natural Resources may become involved if permits related to impacts on endangered and threatened species are required (WVPSC 2005). In Maryland, the Department of Natural Resources (DNR) Power Plant Research

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Program is responsible for coordinating the review of proposed energy facilities and transmission lines with other units within the DNR as well as with other state agencies (MDDNR 2006).

The manner in which environmental information is presented to state regulatory authorities varies as well. In West Virginia, input from the Division of Natural Resources and from the USFWS is presented during the public comment period, which would seem to give it less “weight” than if it were presented in a separate stage of the review process. However, the West Virginia process also requires the applicant to file an affidavit listing any permits required by federal or state wildlife authorities due to anticipated impacts on wildlife (WVPSC 2005). In Vermont, where regulatory review of energy facilities is a quasi-judicial process, the Vermont Agency Natural Resources is automatically a party in the case and makes recommendations during hearings on wildlife studies and other natural resource issues (VTANR 2006).

It is not always clear what roles the environmental agencies will play in permitting decisions. In Virginia, the Department of Game and Inland Fisheries (DGIF) coordinates evaluation of effects of proposed projects on wildlife. Although generally supportive of alternative energy sources, including wind, the DGIF voiced substantive concerns about possible effects on birds and bats from the proposed Highland New Wind Development in Highland County to the Virginia SCC. The DGIF asked that the developer provide additional wildlife information and visual analysis, referring to the USFWS guidelines as a standard for wildlife studies that should be provided. The DGIF later wrote to the SCC that the proposed project presents unacceptable risks to wildlife, given that it lacks pre- and post-construction studies of birds, bats, and some other species groups requested by the DGIF, and that it lacks binding requirements for mitigation of adverse effects on wildlife populations. This is strong language from the DGIF, but authority to decide what requirements or conditions to impose on the developer remains with the Virginia SCC (Virginia State Corporation Commission, Case No. PUE-2005-00101, Hearing Examiner’s Ruling, July 11, 2006).

#### **Information Required for Review**

Regulatory authorities are charged with weighing a complex mix of environmental, socioeconomic, and cultural factors in deciding whether to permit wind-energy development. Even states that have only local review of wind-energy projects, such as Pennsylvania, prescribe a long list of factors for which the applicant should provide information to the review process (e.g., Lycoming County 2005). Generally, little direction is provided about what and how much information to provide, which leads to a wide variance in the amount and quality of information provided by industry for different

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projects. Some states are developing clearer standards through accumulated

practice. West Virginia's recent additions to its utilities review process to address wind-energy development are unusual in prescribing the duration and time of year for studies on birds and bats near proposed wind-energy projects (GAO 2005, p. 31). In some states, pre-hearing conferences are used to identify the types and extent of information that should be provided by the applicant. As illustrated by the Highland New Wind Development case in Virginia (VASCC 2006b), regulatory authorities, other agencies, and parties can request additional information if there appear to be gaps or insufficient information on which to make a decision.

The burden of proof for compliance with regulatory criteria rests almost entirely with the applicant, who usually delegates responsibility for demonstrating compliance to contractors with specialized knowledge. In some cases, regulatory authorities have staff that can provide additional information and review the application for accuracy. In some instances, regulatory authorities may hire independent experts, sometimes at the expense of the developer. In general, it is up to the applicant to provide sufficient information that a decision can be reached, but up to the opposing parties to demonstrate why the standards for acceptance have not been reached.

#### **Public Participation in the Review**

It is a well-accepted democratic principle that those whose well-being may be affected by decisions should have a chance to provide input to regulatory processes (see discussion above regarding eight principles for wind-energy regulation, also NWCC 2002). Participation (other than by the applicant and the decision-making authority) is important for securing additional technical expertise, giving a voice to those who might be affected, and conveying information about public values that the decision makers need to carry out the balancing act that the decision procedures require. However, the manner in which input is received varies greatly at all phases of participation. In cases where a proposal for wind-energy development triggers an environmental impact process, whether a NEPA or a state process, as in New York, requirements for public participation may be spelled out as part of the environmental review procedure, although this participation is often late in the process. Elsewhere, requirements for public participation are part of the utilities-review procedure.

The first prerequisite for public participation is that the relevant "publics" should be informed of proposed wind-energy developments. Some state regulations spell out in great detail who should receive notice (and who should give notice) via what media and at what point in the application process. Sometimes the requirements differ according to the size of the proposed project. Some regulatory processes require notification to selected

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state, federal, and local government agencies, in addition to adjoining property owners and the general public.

There may be different categories of participation, depending partly on the type of decision process followed in a particular jurisdiction. The most common include an information meeting, in which the developer provides information to the public and answers questions about the project; a site visit, to which both regulators and the public are invited and which may include visits to points from which the project would be visible; a public hearing, during which members of the public can provide comments (usually written comments also are accepted over a designated period of time); and participation in the hearing process. On the less formal end of the spectrum,



developers and local and regional governments often organize forums for discussing either specific projects or issues of wind-energy development generally. More formally, in contested cases affected parties can apply for “intervener” status. In Vermont, participants become interveners by demonstrating that they will be materially affected by the project. Interveners often include abutting property owners, town or county governments (e.g., planning commissions), as well as public interest groups, environmental organizations, and business groups that can demonstrate that they have a substantive interest in the outcome, are not adequately represented by another party in the case, and would not unduly delay the proceedings. In states like Vermont where quasi-judicial rules apply to the hearing process, interveners receive all mailings concerning written testimony, design changes, etc. They are entitled to present their own witnesses and to cross-examine witnesses (VTPSB 2006).

In all the processes the committee reviewed, input from participants is advisory to the decision authorities. When agencies or other governing bodies that hold permitting responsibilities could refuse to issue a permit required for construction or operation to begin (e.g., local construction permit), they also function as decision authorities. In other instances, their input to the overall decision authority is advisory and is weighed along with other inputs.

Some jurisdictions, both state and local, have formal processes to receive protests from those who disagree with decisions to permit wind-energy development. Decisions may be appealed to a higher board or the state supreme court. Those who can demonstrate that they have been harmed by wind-energy development may be able to seek damages. Those who are concerned about effects on public resources, such as wildlife or cultural resources, may be able to request modifications of the wind-energy installation or of operating procedures to mitigate harm to these resources, especially if they are in violation of specific provisions of a permit. There may also be processes by which the public can provide notice to public officials if a permit violation has been observed.

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Although all the required participation processes we reviewed fall into the more passive, one-way communication end of the participatory spectrum (e.g., officials informing the public or officials receiving input from the public), it appears that both applicants and decision authorities are sometimes taking the initiative to convene more active participatory processes with multiway communication among applicant, decision authorities, other government entities, and affected individuals and organizations. Indeed, the permitting guidelines developed by the NWCC urge proponents of wind energy to begin working with affected communities well before submitting formal applications in order to reduce the likelihood of crippling public opposition later in the process (NWCC 2002). In other countries, such as Britain, Australia, and Denmark, early negotiation with affected communities and likely opponents of wind-energy developments has been identified as essential to eventual success in siting wind-generation facilities (BWEA 1994; AusWEA 2002; Ringkøbing Amt, Møller og Grønborg, and Carl Bro 2002). In Germany a government program designed to provide incentives for public acceptance of wind projects gave residents the right to become investors in local wind-energy projects with direct benefits to their own electric bills (Hoppe-Kilpper and Steinhäuser 2002).

In addition to participation as an element of regulatory review, participation in proactive planning for wind-energy development is another part of the public-participation spectrum. At least in theory, comprehensive plans form the basis for zoning ordinances and may inform regulatory processes at the state or local level, especially when there is clear language concerning particular resources and land uses. Some states, such as Oregon, require towns to develop comprehensive plans (White 2002). Wind-energy plans have been critical for siting wind-energy projects in Denmark, as described earlier (Ringkøbing Amt, Møller og Grønborg, and Carl Bro 2002). Public participation at the planning stage helps ensure that the values important to stakeholders and general citizens are reflected in the comprehensive plans that seek to guide wind-energy development.

#### **Balancing Pluses and Minuses**

Once regulatory authorities receive information on environmental effects, costs, and technical specifications for proposed wind-energy developments, they are charged to decide whether to allow the development to go forward, and with what, if any, conditions to ameliorate negative effects. Directions for this complex weighing of pluses and minuses of using wind energy are scant and generally limited to general statements about “balancing” interests and acting “in the public good,” resulting in a holistic balancing of positive and negative impacts of the proposed development, rather than a decision based on clearly stated decision criteria. Often, the direction

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to regulators appears to presume approval unless serious difficulties with the proposed development become evident. In Virginia, an applicant must show the effects of the facility on the reliability of electric service and the effects on the environment and on economic development, and why the construction and operation of the facility would not be contrary to the public interest (VASCC 2006a). In Vermont, the Public Services Board weighs overall public benefits (need, reliability, economic benefit) against impacts to the natural and cultural environment (VTPSB 2003). In West Virginia, the utilities commission is directed to balance the public interest, the general interest of the state and local economy, and the interests of the applicant (WVPSC 2006a). In some cases the general public good inherent in providing electricity may be judged to outweigh some level of other impacts. This weighing of public good against impacts can be informed by review criteria; by evidence presented; by state energy plans or policy, if they exist; or by precedent. The state may apply conditions to minimize adverse impacts on the environment, including scenic and cultural resources. The applicant can be required to mitigate adverse impacts involving views, noise, traffic, etc. Some states have articulated standards for making wind-energy regulatory decisions (e.g., State of Oregon 2006). However, specific criteria for different elements of the regulatory review, such as assessment of environmental effects, often are lacking. In Maryland, applicants are required to comply with environmental regulations, and conditions may be imposed to mitigate adverse impacts on environmental and cultural resources, but what constitutes compliance and what may be required for mitigation are open to interpretation in particular cases. Maryland’s Wind Power Technical Advisory Group, a non-regulatory body from the Power Plant Research Program, has recommended standards for siting, operating, and monitoring wind-energy projects to minimize negative effects on birds and bats (MD Windpower TAG 2006). Sometimes more specific criteria are found in case

law rather than in statutes. Vermont, for example, developed a much more detailed process known as the “Quechee Analysis” for analyzing visual impacts as part of case history, which has become an integral part of the regulatory criteria (Vissering 2001). Maine has developed guidance for review of development within the Unincorporated Territories (Maine Land Use Regulatory Commission 1997), but it has not been updated to address some of the specific attributes of wind-energy projects. The best processes provide a detailed framework that asks critical questions, along with a framework for determining how the outcome should be judged. The same lack of definite criteria applies to post-construction operation, although some jurisdictions are working on specific monitoring criteria. In Virginia, the DGIF supports setting a threshold for implementation of mitigation measures if more than 1.8 bats or 3.5 birds are killed per turbine per year. Research is currently being conducted on new technologies

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for deterrents or mechanisms that reduce mortality of bats and birds. As these mitigation measures become available, the DGIF recommends their pre- and post-construction implementation in consultation with natural resources agencies (VADEQ 2006).

#### **A Critique of Planning and Regulatory Review**

Wind energy is a recent addition to the energy mix in most areas, and regulation of wind-energy development is evolving rapidly. Our review of current regulatory practices captures only a snapshot of a changing landscape. Regulatory authorities, wind-energy developers, affected citizens, and non-governmental organizations promoting and opposing wind-energy projects are learning as they go. In this section we move beyond simply describing the current status of planning and regulation of wind-energy development to evaluating the merits and deficiencies of current processes and suggesting where and how they might be improved. We call attention to some cross-cutting themes affecting regulatory review of wind-energy development: (1) the interactions among choosing the locus of review, balancing competing goals, and facilitating public participation; (2) the merits of flexible versus more rigidly specified review processes; (3) cumulative effects of wind-energy development; (4) long-term accountability for both positive and negative effects of wind-energy development; and (5) assistance to improve the quality of decisions about wind-energy development.

#### **Interaction of Locus of Review, Balancing of Interests, and Public Participation**

In analyzing different types of regulatory processes, the committee found variation ranging from reviews conducted almost entirely at the state level to those conducted almost entirely at the local level. Choosing a level for reviewing wind-energy development is likely to imply some corresponding consequences for the balance of competing interests and for the structure and content of public participation in decisions. These corresponding consequences may not be intentional and the connection to level of review not explicit. Several states seem to be moving toward state-level review, perhaps because of concerns about potentially inequitable decisions in different locations and the inexperience inherent in local review. Oregon, for example, encourages developers to select state rather than local review by offering a more streamlined process at the state level (White 2002). Review at a scale larger than local allows implementation of a rational power-generation network with oversight of potential cumulative impacts.

Putting utility regulation at the state rather than local level implies that there is a public interest that is broader in scale, and greater in importance,

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than strictly local interests. If the preceding is true, then environmental and societal costs of wind-energy development, evaluated at site-specific, local, and regional scales, must be weighed against public benefits that might be realized at the state level or beyond. Some states have examined this tension between local and broader interests quite explicitly. For example, Vermont created a Commission on Wind Energy Regulatory Policy in 2004 to recommend changes to the current regulatory process (Vermont Commission on Wind Energy Regulatory Policy 2004). One issue of concern was whether wind-energy projects should be reviewed under the State's Public Service Board, which reviews all public-utility projects, or whether review should be made under the more localized District Environmental Commissions, which focus on land use. That report represents a thoughtful and deliberate consideration of the implications of level of review for how local versus broader-scale interests are to be weighed in decisions about wind-energy development. The Vermont analysis confirmed the choice of a state-level review process, where public interest on a broad scale is weighed against possibly adverse effects at the local level, but it also recommended increased protection for local interests during the process through aggressive public notification and public participation.

One of those increased protections concerns the manner of public participation in the review process, another arena where choosing the level of review may implicitly determine who has standing as a participant in the review process and how they can participate. Where review is strictly local, broader interests may have less opportunity to be heard. These broader interests may include people beyond the wind-energy development site who would like to receive the benefits of wind energy, and regional or national organizations advocating the protection of wildlife and humans from possibly harmful effects of wind-energy development. Some more-formally constituted participatory processes, such as quasi-judicial hearings, specify how individuals or organizations may petition for an enhanced status. For example, they can be designated "interveners," which entitles them to privileges such as cross-examining experts and receiving copies of all filings in a contested case. The Vermont Commission on Wind Energy Regulatory Policy made numerous recommendations concerning public participation in the regulatory process, addressing issues such as advance notice to communities and affected individuals prior to filing, the number and timing of public hearings, the definition of "affected communities," and information and assistance to increase public understanding of and participation in the regulatory process.

Another matter that may be affected by level of review is equity with respect to socioeconomic class, race, or ethnicity of citizens living near wind-energy facilities who are most susceptible to local adverse effects. Environmental-justice issues most often are raised where locally controversial

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facilities are sited disproportionately in low-income or otherwise politically weak neighborhoods, where citizens may lack educational and political resources to represent their own interests effectively. Here, level of review may cut both ways: developers might take advantage of strictly local review to site facilities where oversight is weak, or state-level review might consistently place the interests of the larger public ahead of the interests of a politically weak local population. These concerns may be less likely to arise for wind-energy facilities than for other types of locally controversial facilities, because the technical requirements for successful wind-energy development constrain the location of facilities so tightly (at least on land).

Both developers and regulatory authorities can take the initiative to foster public participation in wind-energy development, rather than stopping at the minimum needed to satisfy regulatory requirements. Local and state governments can invite public participation in proactive planning for wind-energy development to learn how stakeholder groups and the general citizenry view opportunities and obstacles. Developers could meet with adjoining landowners, community groups, and environmental organizations during the pre-application phase to hear concerns about a proposed project, giving them the opportunity to make changes that decrease the likelihood of public opposition. To prepare for this involvement, developers may benefit from providing descriptions of the proposed project and rationale for selecting the proposed site rather than an alternative for the public to review. Regulatory authorities can solicit public participation beyond required public notices and public hearings to bring local knowledge about environmental and cultural resources into the decision-making process and to satisfy procedural justice concerns for representation of those affected by regulatory decisions.

#### **Optimizing Flexibility, Rigor, and Predictability of Regulatory Review**

Processes for reviewing wind-energy proposals vary in the formality of the process and in the degree to which timelines and decision criteria are specified in advance. There are tradeoffs between the predictability and rigor that may be achieved with processes that are more formal and more clearly specified, and the flexibility and adaptability that may be achieved with processes that are less formal and less clearly specified. For example, many review processes specify a timeline for various stages of the review (e.g., submission of technical information, notification to affected publics) or specify a deadline for the regulatory authority to respond to the request for permission to construct a facility. Having specific timelines and deadlines protects developers, regulators, and the public from the extended uncertainty that might accompany a drawn-out review process. However, one notable characteristic of wind-energy proposals is that they vary enormously

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in the complexity of potential effects. This complexity suggests that a more-flexible timeline would allow both complex and simple projects to meet common standards for quality of information submitted and quality of evaluation of that material by regulators and the public. In Vermont, rather than specifying the same deadline for all utility proposals, state statutes require the utilities board to set timelines for each proposal based on its complexity; once set, all the parties to the review are held to the timelines (Vermont Commission on Wind Energy Regulatory Policy 2004).

In evaluating current regulatory-review processes, the committee was struck by the minimal guidance offered about the kind and amount of information that should be provided for review; the degree of adverse or beneficial effects of proposed developments that should be considered critical for approving or disapproving a proposed project; and how competing costs and benefits of a proposed project should be weighed, either with regard to that single proposal or in comparison with likely alternatives if that project is not built. This lack of guidance leaves a lot to the discretion of regulatory authorities and the other agencies that review elements of the proposed project, making both developers and the public vulnerable to inconsistent requirements among proposed projects and among potential locations. It also has limited our knowledge of the impacts of wind-energy development on human and natural resources. As regulatory authorities accumulate experience with wind-energy proposals, conventions are developing for how much pre-project study of bird and bat activity should be done or what level of bird or bat mortality at operating wind-energy projects will be considered cause for remedial action, as Virginia DGIF has done in recommending limits for bird and bat mortality in comments on the proposed New Highland Wind Development (VADEQ 2006). Nevertheless, there is still something to be said for letting the context of a particular wind-energy proposal set the requirements for information and the thresholds for regulatory decisions, as the Vermont process does for setting the timeline for review. Such flexibility could optimize the expenditure of both private and public resources on information collection and review by focusing on the particular elements most likely to be troublesome for a particular project. However, this degree of flexibility requires a great deal of trust in the judgment of the regulatory authority by developers and the public. Proactive planning for wind-energy development at state and local levels could give valuable direction to regulatory review by articulating public values that might be affected by projects (e.g., local aesthetic values or socioeconomic concerns, such as effects on tourism). These values, as translated into planning guidelines and local zoning ordinances, help set standards for regulatory review. There are advantages and disadvantages to giving regulators more direction on how to weigh competing costs and benefits of proposed wind

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 energy projects to make decisions that advance “the public good,” as is required of many regulatory authorities. Having thresholds of positive or negative effects may make regulatory decisions easier to defend from criticism, but specification of such thresholds can inhibit regulators from weighing a complex suite of factors to make a combined index of how much a particular project advances the public good. Tools from multicriteria decision making (e.g., Hammond et al. 2002) can help structure this process by representing preferences for possible outcomes and weighting various decision criteria in numerical form. However, the assessment of those weights and preferences are expressions of value, raising the critical question of whose values should inform decisions about the public good. Some argue that citizens have authorized regulatory bodies, such as utilities commissions, to represent public values taken as a whole. Others argue that only through participatory processes, including negotiation of regulatory rules, or through overtly political processes, such as public forums, can the



diverse values of different constituencies be expressed. Public involvement in areas affected by wind-energy proposals is one mechanism for eliciting that diversity of values, but the complex task of combining them into a single decision remains with the regulatory authority.

There are, similarly, pros and cons to more versus less formal review processes. On the formal end of the spectrum, quasi-judicial processes have such merits as producing written records of deliberations, prescribing who can speak in what capacities during hearings, providing opportunities to cross-examine expert witnesses and challenge evidence, and requiring authorities to respond to public comments to indicate how an issue has been addressed. These merits are, to some extent, offset by constraints on who may qualify to participate in hearings and what roles they can play. In addition, more formal processes, although providing a basis for appeal when parties question a decision, may solidify conflicting views and inhibit the more creative give-and-take that can sometimes help resolve contentious issues.

#### **Assuring Long-Term Project-Permit Compliance**

Post-construction monitoring for compliance with permit conditions is a critical part of the regulatory process. It is needed to ensure that projects are built according to approved plans and that required post-construction studies and mitigation measures are being carried out properly. Full access to project sites is needed for those charged with conducting studies or monitoring activities. Access has been problematic in the past. For example, access to the Mountaineer Project in West Virginia to conduct studies of bird and bat fatalities was discontinued by the project owner (E. Arnett, Bat Conservation International, personal communication 2005).

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The application for the proposed Jack Mountain/Liberty Gap project was dismissed without prejudice (i.e., the application could be resubmitted) by the West Virginia Public Service Commission because the applicant refused to allow access to the property for hydrological studies (WVPSC 2006b). Well-defined processes for addressing post-construction monitoring and potential permit violations are needed at both local and state levels. Public confidence in facility compliance would be enhanced if site operators designated an accessible contact person who could respond to inquiries or complaints. In addition to monitoring for adverse environmental effects, including adverse socioeconomic effects, documenting the energy benefits of wind-energy facilities over the lifespan of the installation also is important. For this purpose, data on electricity generated, which must be reported monthly to the Department of Energy's Energy Information Agency for electricity-generating plants of 1 MW or greater, should be more easily accessible by the public than they currently are on the agency's web site. To ensure long-term compliance with monitoring, mitigation, and reporting requirements, commitments made by the initial site developer should be passed to subsequent operators of the site, including those responsible for maintaining, refurbishing, or re-powering during the project's lifetime, and decommissioning after its lifetime. To ensure transparency, state public-service commissions, with the corresponding state environmental or natural resources offices, could evaluate pre- and post-construction monitoring as part of the permitting process.

#### **Proactive Planning and Evaluation of Cumulative Effects**

The positive and negative cumulative effects of wind-energy development

across space and over time generally receive little attention in current regulatory-review processes, although developers have sometimes been asked to provide information about cumulative effects (e.g., Highland New Wind Development in Virginia [VADEQ 2006]). As the Vermont Commission on Wind Energy Regulatory Policy (2004) noted, broader review may facilitate better consideration of cumulative effects than strictly local review. In addition, wind turbines can be large in relation to natural landscape features, extending their effects (e.g., visual impact) beyond the boundaries of the municipality where the turbine itself is located. Broader review would capture effects that extend beyond local jurisdictions. Consideration of cumulative effects would be facilitated by more proactive planning for wind-energy development at scales ranging from national to regional between or within states. Resistance to centralized planning and devotion to private-property rights and individual autonomy in the United States may rule out the type of integrated planning and regulation that northern European countries and Australia have pursued. Nevertheless, Copyright © National Academy of Sciences. All rights reserved. Environmental Impacts of Wind-Energy Projects <http://www.nap.edu/catalog/11935.html>

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there is room in the United States for better integration of these functions to the benefit of wind-energy developers and for protection of the public good. It is a waste of private and public resources when developers invest in projects that cannot be sited successfully. Planning at state and local levels works with regulatory review to direct wind-energy development to locations and site designs that minimize adverse effects. Clear planning documents set the stage for predictable and defensible review actions. There often are thresholds for project or turbine size, below which regulatory scrutiny either is not required or is much reduced. If several small projects are installed in a small area, their effects could accumulate without the benefit of regulatory review. For example, several individual businesses or farms may install small turbines, on the order of 40 kW. Although a single turbine meeting relevant construction and zoning requirements might have little effect on local wildlife, aesthetics, and cultural resources, several of them might have significant effects, but they would not be regulated. This is a gap in current regulatory policy.

#### **Improving the Quality of Review**

Evaluating the merits and drawbacks of wind-energy proposals strains the resources of regulatory authorities in state utilities commissions and even more in local governments. Although experience is accumulating, wind energy still is new and unfamiliar. Local decision authorities are unlikely to learn by experience very rapidly because they see relatively few windenergy proposals. Regulatory guidelines, both from nationwide efforts (e.g., NWCC 2002) and state-level efforts (e.g., KSREWG 2003; KSEC 2004), are one form of assistance to state and local decision makers. Many states, including California, Colorado, Maryland, Pennsylvania, New York, and states in the Great Lakes Region, have sponsored or established wind-energy working groups, bringing together stakeholders such as environmental groups, industry, academia, and state agencies to set goals and guidelines for wind-energy development. In some states, efforts such as Maryland's Wind Power Technical Advisory Group help fill technical gaps at the local level (MD Windpower TAG 2006). In Vermont, the state utilities board can hire independent experts at the expense of the developer to assist the state in its review (Vermont Commission on Wind Energy Regulatory Policy 2004). Similar assistance would be even more beneficial to local decision makers.



## FRAMEWORK FOR REVIEWING WIND-ENERGY PROPOSALS

Part of the committee's charge was to develop an analytical framework for reviewing environmental and socioeconomic effects of wind-energy

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proposals. Ideally, this framework would (1) detail not only the types of effects to be considered, but also how those effects are to be evaluated as desirable or undesirable and how positive and negative effects are to be weighed in an overall assessment of a particular proposal; (2) address wind-energy development across a range of spatial and temporal scales; (3) integrate technical information on wind-energy effects with expressions of relevant public values; and (4) enable comparisons of wind-energy projects with other forms of electricity production. We have stopped short of this ideal for several reasons.

Although in theory it seems sensible to weigh the comparative environmental performance of different electricity sources, in practice the generally piecemeal nature of U.S. policy making and regulation offers few opportunities for such comparisons. Energy policies (expressed through such means as tax credits and other financial incentives) usually are the result of considering particular energy sources by themselves rather than the result of weighing the advantages and disadvantages of different energy sources. Regulatory review of energy facilities almost always is a yes/no judgment on a single proposal (perhaps with modifications or conditions imposed), not a comparative judgment of the merits of different energy sources, sites, or facility designs. There is little planning that addresses particular mixes of energy sources, particular sites for wind-energy development, or particular designs for wind-energy facilities. Even if such planning were done, it would have limited impact on proposed wind-energy facilities and their approval, because proposals usually arise one at a time. The review of individual proposals usually is quite limited in scope, both temporally and spatially, with little opportunity for a full life-cycle analysis or for consideration of effects that accumulate across space and time.

In addition, the U.S. system, with its private ownership of most energy facilities and with its prevailing emphasis on markets as the best arbiters of balancing the costs and benefits of energy projects, offers few opportunities for thorough public deliberation on the full spectrum of positive and negative effects of a particular energy facility. At present, if a proposed project meets regulatory requirements (which generally do not include a comprehensive balancing of positive and negative effects), it usually must be approved. Setting regulatory thresholds (e.g., for noise, number of birds killed, visibility) implies that some tradeoffs among costs and benefits are addressed, but even if the tradeoffs are addressed, it usually is not in a transparent and comprehensive way. Instead, these implicit tradeoffs evolve more or less invisibly as projects are proposed, reviewed, modified, and implemented. Eventually, this evolution may result in changes to regulatory processes and standards, but even then, the weighing of tradeoffs does not necessarily become transparent.

There is, moreover, currently no social consensus on how the advantages

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and disadvantages of wind-energy projects should be traded off or whose value systems should prevail in making such judgments. Instead, these decisions usually take place through a combination of citizen participation, political advocacy, and regulatory decision making. As discussed earlier in this chapter, both predictable but also more rigid regulatory review procedures, and less predictable but also more flexible procedures, have their advantages. In addition, maintaining the flexibility to tailor the intensity of regulatory review to the complexity and controversy associated with particular wind-energy proposals makes more efficient use of society's resources than a "one size fits all" process that does not provide opportunities for exceptions.

For all of these reasons, we focus our efforts on incrementally improving the way wind-energy decisions are made today. We offer an evaluation guide that aids vertical coordination of regulatory review by various levels of government and helps to ensure that regulatory reviews are well grounded procedurally and evaluate the many facets of the human and nonhuman environment that may be affected by wind-energy development.

### **Coordinating Levels of Governmental Responsibility**

To assist those responsible for planning and regulating wind-energy development and to facilitate the coordination of their work, we suggest using a two-dimensional matrix of jurisdictional levels and areas of responsibility. Jurisdictional levels range in scale from international (occasionally) and national to regional, state, and local. Areas of responsibility include formulation and execution of policy, planning, and public relations; legal and regulatory activities; and impact evaluation. In Figure 5-1, these two dimensions are displayed as a matrix.

The details of how this matrix is filled out will vary from state to state, and to a lesser extent, from project to project. Nonetheless, using the matrix and considering each of its cells will help to ensure that important elements of governmental responsibilities have not been overlooked and that review efforts are well coordinated across geographic areas and jurisdictional levels. Once the respective responsibilities of the various jurisdictions are clearly identified and articulated, a checklist of questions like those in Box 5-4 below can serve as a template for evaluation.

### **Evaluation Guide**

The evaluation guide presented here represents a step toward a realistic, workable framework for reviewing proposed and evaluating existing wind-energy projects. If this guide is followed and adequately documented, the results will provide a basis not only for evaluating an individual wind

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energy project, but also for comparing two or more proposed projects and for undertaking an assessment of cumulative effects of existing and proposed facilities. In addition, following this guide may facilitate rational documentation of the most important areas for research.

The guide first addresses procedural considerations—policy, planning, and public relations—and relevant laws and regulations. It then addresses the main potential effects of wind-energy facilities, organizing them into six categories drawn from Chapters 3 and 4: (1) impacts on the environment, (2) impacts on human health and well-being, (3) aesthetic impacts, (4) cultural impacts, (5) economic and fiscal impacts, and (6) electromagnetic

interference. A seventh cross-cutting category concerning cumulative impacts is added. All these potential effects should be considered also in light of the benefits of any proposed project, including environmental benefits. The guide (Box 5-4) is presented as sets of questions to aid evaluation at various jurisdictional levels.

## CONCLUSIONS AND RECOMMENDATIONS

The committee concludes that a country as large and as geographically diverse as the United States, and as wedded to political plurality and private enterprise, is unlikely to plan for wind energy at a national scale in the same way as some other countries are doing. Nevertheless, national-level energy policies (implemented through mechanisms such as incentives, subsidies, research agendas, and federal regulations and guidelines) to enhance the benefits of wind energy while minimizing negative impacts would help in planning and regulating wind-energy development at smaller scales. Uncertainty about what policy tools will be in force hampers proactive planning for wind development. More specific conclusions and recommendations follow.

Federal Regional/State Local  
Policy, Planning, and Public Relations  
Legal and Regulatory  
Evaluation of Impacts  
Environmental  
Human Health and Well-Being  
Aesthetic  
Cultural  
Economic and Fiscal  
Electromagnetic Interference

**FIGURE 5-1** Matrix for organizing review of wind-energy projects

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## 214 ENVIRONMENTAL IMPACTS OF WIND-ENERGY PROJECTS

### BOX 5-4

#### Guide for Evaluating Wind-Energy Projects

##### Policy, Planning, and Public Relations

1. Are the relevant energy policies and planning processes clearly defined at all jurisdictional levels, and are they coordinated and aligned among federal, state, and local levels? Are national-level energy policies available and being used? Are well-reasoned planning documents available to make regulatory-review actions predictable and defensible?
2. Have mechanisms been established to provide necessary information to interested and affected parties, and to seek meaningful input from them as wind-energy projects are planned and implemented? Are developers required to provide early notification of their intent to develop wind energy?
3. Are procedures—including policies and regulations—in place for evaluating the impacts of wind-energy projects that cross jurisdictional boundaries, especially for those that involve more than one state?
4. Is guidance available to developers, regulators, and the public about what kinds of information are needed for review, what degrees of adverse and beneficial effects of proposed wind-energy developments should be considered critical in evaluating a proposed project, and how competing costs and benefits of a proposed project should be weighed with regard to that proposal only, or by comparison with likely alternatives? Are there mechanisms in place through which interested parties can obtain the pertinent available information?
5. Are regional planning documents available that provide guidance on the quality of wind resources, capacity of transmission options, potential markets, major areas of concern, and tradeoffs that should be considered?

##### Legal and Regulatory Considerations

1. Are wind-energy guidelines and regulations issued by different federal agencies compatible, are those guidelines and regulations aligned with other federal regulating rules and regulations, and do the guidelines and regulations follow acceptable scientific principles when establishing data requirements?
2. Does the review process include steps that explicitly address the cumulative impacts of wind-energy projects over space and time; that is, by reviewing each new project in

the context of other existing and planned projects in the region?

#### **Evaluation of Impacts**

##### **General**

1. Are the biological, aesthetic, cultural, and socioeconomic attributes of the region sufficiently well known to allow an accurate assessment of the environmental impacts of the wind-energy project, and to distinguish among the potential sites considered during the site-selection process? Are there species, habitats, recreational areas, or cultural sites of special interest or concern that will be affected by the project? How will this descriptive information be collected, who will judge its quality and reliability, and how will the information be shared with stakeholders? Are there key gaps in the needed information that should be addressed with further research before a project is approved or to guide the operation of an approved project?

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#### *PLANNING FOR AND REGULATING WIND-ENERGY DEVELOPMENT 215*

##### **Environmental Impacts**

1. What environmental mitigation measures will be taken and how will their effectiveness be measured? Are there any legal requirements for such measures (e.g., habitat conservation plans)? Are any listed species at risk from the proposed facility?
2. How and by whom will the environmental impacts be evaluated once the project is in operation? If these evaluations indicate needed changes in the operation of the facility, how will such a decision be made and how will their implementation be assured?
3. What pre-siting studies for site selection and pre-construction studies for impact assessment and mitigation planning are required?
4. What post-construction studies, with appropriate controls, are required to evaluate impacts, modify mitigation if needed, and improve future planning?

##### **Impacts on Human Health and Well-Being**

1. Have pre-construction noise surveys been conducted to determine the background noise levels? Will technical assessments of the operational noise levels be conducted? Is there an established process to resolve complaints from the operation of the turbines?
2. Is there a process in place to address complaints of shadow flicker and does the operator use the best software programs to minimize any flicker?

##### **Aesthetic Impacts**

1. Has the project planning involved professional assessment of potential visual impacts, using established techniques such as those recommended by the U.S. Forest Service or U.S. Bureau of Land Management?
2. How have the public and the locally affected inhabitants been involved in evaluating the potential aesthetic and visual impacts?

##### **Cultural Impacts**

1. Has there been expert consideration of the possible impacts of the project on recreational opportunities and on historical, sacred, and archeological sites?

##### **Economic and Fiscal Impacts**

1. Have the direct economic impacts of the project been accurately evaluated, including the types and pay scales of the jobs produced during the construction and operational phases, the taxes that will be produced, and costs to the public?
2. Has there been a careful explication of the indirect economic costs and benefits, including opportunity costs and the distribution of monetary and non-monetary benefits and costs?
3. Are the guarantees and mitigation measures designed to fit the project and address the interests of the community members and the local jurisdictions?

##### **Electromagnetic Interference**

1. Has the developer assessed the possibility of radio, television, and radar interference?

##### **Cumulative Effects**

1. How will cumulative effects be assessed, and what will be included in that assessment (i.e., the effects only of other wind-energy installations, or of all other electricity generators, or of all other anthropogenic impacts on the area)? Have the spatial and temporal scales of the cumulative-effects assessment been specified?

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#### *216 ENVIRONMENTAL IMPACTS OF WIND-ENERGY PROJECTS*

##### **Conclusion**

Because wind energy is new to many state and local governments, the

quality of decisions to permit wind-energy developments is uneven in many respects.

#### **Recommendation**

Guidance on planning for wind energy and on data requirements and on procedures for reviewing wind-energy proposals should be developed. In addition, technical assistance with gathering and interpreting information needed for decision making should be provided. This guidance and technical assistance, conducted at appropriate jurisdictional levels, could be developed by working groups composed of wind-energy developers, non-governmental organizations with diverse views of wind-energy development, and local, state, and federal government agencies.

#### **Conclusion**

There is little anticipatory planning for wind-energy projects, and it is not clear whether mechanisms currently exist that could incorporate such planning in regulatory decisions even if such planning occurred.

#### **Recommendation**

Regulatory reviews of individual wind-energy projects should be preceded by coordinated, anticipatory planning whenever possible. Such planning for wind-energy development coordinated with regulatory review of wind-energy proposals would benefit developers, regulators, and the public because it would prompt developers to focus proposals on locations and site designs most likely to be successful. This planning could be implemented at scales ranging from state and regional levels to local levels. Anticipatory planning for wind-energy development also would help researchers target their efforts where they will be most informative for future wind development decisions.

#### **Conclusion**

Choosing the level of regulatory authority for reviewing wind-energy proposals carries corresponding implications for how the following issues are addressed:

- Cumulative effects of wind-energy development.

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#### *PLANNING FOR AND REGULATING WIND-ENERGY DEVELOPMENT 217*

- Balancing negative and positive environmental and socioeconomic impacts of wind energy.
- Incorporating public opinions into the review process.

#### **Recommendation**

In choosing the levels of regulatory review of wind-energy projects, agencies should review the implication of those choices to all three issues listed above. Decisions about the level of regulatory review should include procedures for ameliorating the disadvantages of a particular choice (e.g., enhancing opportunities for local participation in state-level reviews).

#### **Conclusion**

Well-specified, formal procedures for regulatory review enhance predictability, consistency, and accountability for all parties to wind-energy development. However, flexibility and informality also have advantages, such as matching the time and effort expended on review to the complexity and controversy associated with a particular proposal; tailoring decision criteria to the ecological and social contexts of a particular proposal; and fostering creative interactions among developers, regulators, and the public to find solutions to wind-energy dilemmas.

#### **Recommendation**

When consideration is given to formalizing review procedures and

specifying thresholds for decision criteria, this consideration should include attention to ways of retaining the advantages of more flexible procedures.

#### **Conclusion**

Using an evaluation guide to organize regulatory review processes—such as the guide we have provided here—can help achieve comprehensive and consistent regulation, coordinated across jurisdictional levels and across types of effects.

#### **Recommendation**

Regulatory agencies should adopt and routinely use an evaluation guide in their reviews of wind-energy projects. The guide should be available to developers and the public.

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### *218 ENVIRONMENTAL IMPACTS OF WIND-ENERGY PROJECTS*

#### **Conclusion**

The environmental benefits of wind energy, mainly reductions in atmospheric pollutants, are enjoyed at wide spatial scales, while the environmental costs, mainly aesthetic impacts and ecological impacts such as increased mortality of birds and bats, occur at much smaller spatial scales. There are similar, if less dramatic, disparities in the scales of occurrence of economic and other societal benefits and costs. The disparities in scale, while not unique to wind energy, complicate the evaluation of tradeoffs.

#### **Recommendation**

Representatives of federal, state, and local governments should work with wind-energy developers, non-governmental organizations, and other interest groups and experts to develop guidelines for addressing tradeoffs between benefits and costs of wind-energy generation of electricity that occur at widely different scales, including life-cycle effects.

## Final Recommendation:

- We recommend protecting Union Township residents by requiring the setbacks from any residence at minimum one half mile (2640 feet) from residence to blade tip, which will generally eliminate any health and safety risks and make any wind farm constructed in Union Township as safe as possible for all township residents. We also believe a setback from a non-participating landowner be no less than 1000 feet from a property line. We believe this is the responsible thing to do to protect the health and safety of all Union township residents.

The standards laid out in the WI model wind ordinance published by the Wisconsin Department of Administration ("DOA"), is outdated, non-binding, and has no legal basis under Wisconsin law. The WI model wind ordinance is not, itself, based on any scientific data or any analysis of public health and safety impacts. Instead, it is based on a draft ordinance that was originally advocated by wind energy developers and later published by staff of the State of Wisconsin without any legal authority behind it. As such, the setbacks and noise restrictions in the model ordinance are simply arbitrary standards that have no rational basis whatsoever. Furthermore, since the model ordinance was published, much more scientific information to support longer setbacks and strict noise limits on wind turbines has been reported. In fact, there is now a substantial amount of scientific and testimonial evidence to support longer setbacks to protect public health. Wis. Stat. § 66.0401 clearly allows restrictions on wind energy facilities if they are reasonably necessary to protect public health and safety, regardless of the impact of such restrictions on the cost and efficiency of the system. Pursuant to Wis. Stats. §§ 66.0401 and 66.0403, municipalities are expressly authorized to impose local restrictions on wind energy systems through licensing or other non-zoning ordinances. Under Wis. Stat. § 66.0401(1), local restrictions on solar and wind energy systems are permitted if they serve the public health or safety, do not significantly increase the cost of the system, or allow for an alternative system of comparable cost and efficiency. Therefore, restrictions on setbacks, noise, lighting, environmental protection, and other matters are authorized, provided they meet these statutory requirements. In other words, if such restrictions are based on protecting public health and safety OR do not significantly increase the cost of the system OR allow for an alternative system of comparable cost and efficiency, the restrictions will satisfy the law.

The ½ minimum mile setback is consistent with the:

- (1) NATIONAL RESEARCH COUNCIL recommendation in: Environmental Impacts of Wind energy projects May 2007, 2007 NRC Report.
- (2) Wind Energy Handbook, Burton, Sharpe, Jenkins, Bossanyi, Wiley & Sons Ltd, New York, 2001 pg. 527

## Credentials of Professionals Who Advised Our Committee:

Dr. Nina Pierpont

### HOME ADDRESS

Same as office.

### PERSONAL

Place of birth: Stamford, CT

Date of birth: May 18, 1955

Married with two adult stepchildren

### EDUCATION AND TRAINING

#### Education

1991 M.D. The Johns Hopkins University School of Medicine

1985 Ph.D. Princeton University (Ecology, Evolution, and Behavior)

1981 M.A. Princeton University (Ecology, Evolution, and Behavior)

1977 B.A. Yale University (cum laude)

1973 Milton Academy, Milton, Mass.

1970 New Canaan Country School, Conn.

#### Post-Doctoral Training

1992 to 94 Pediatrics Dartmouth-Hitchcock Medical Center, Lebanon, NH

1991 to 92 Pediatrics Children's National Medical Center, Washington, DC

1985 to 86 Ornithology American Museum of Natural History, New York, NY

#### Licensure and Certification

1997 Licensed Physician, New York

1997 Licensed Physician, New Hampshire (expired)

1995 Pediatric Advanced Life Support (recertified 2002)

1994 Diplomate, American Board of Pediatrics (recertified 2000, expires 2008)

1994 Licensed Physician, Alaska (expired)

1994 DEA Registration

1994 Advanced Trauma Life Support Provider (expired)

1994 Advanced Cardiac Life Support Provider (expired)

1992 Neonatal Advanced Life Support Provider (recertified 2003)

### Continuing Education

2006 Workshop in Basic Pediatric Hypnosis (20 hours)

2006 Introductory Theraplay Training (27 hours)

2005 Psychiatry: Comprehensive Update and Board Preparation (Harvard, 51 hours) 2005

ADHD Across the Life Span (Harvard, 22 hours)

2004 Gesell Developmental Evaluation, Dr. Anthony Malone, Latham, NY (6 days)

2002 Promoting Student Success (Mel Levine, Univ. of N. Carolina, 20.5 hours)

2002 Psychiatric Neuroscience Home Study Course (Harvard, 16.5 hours)

2000 Child and Adolescent Psychopharmacology (Harvard, 20 hours)

1998 Clinical Diagnosis and Treatment of Fetal Alcohol Syndrome (7.5 hours)

1997 Pediatric and Adolescent Gynecology (Harvard, 14 hours)

### PROFESSIONAL APPOINTMENTS

#### Hospital or Affiliated Institution Appointments

2004 to Consulting Pediatrician Alice Hyde Medical Center, Malone, NY

2000 to 03 Senior Attending in Pediatrics Bassett Healthcare, Cooperstown, NY

1997 to 00 Attending Pediatrician Alice Hyde Medical Center, Malone, NY

1995 to 96 Chief of Pediatrics Yukon-Kuskokwim Delta Regional Hospital, Bethel, AK (Yup'ik Eskimo)



1994 to 95 Staff Pediatrician Yukon-Kuskokwim Delta Regional Hospital, Bethel, AK  
Other Professional Positions

1998 to 00 Private Practice (Solo) Pediatrics Malone, NY

1997 to 00 Staff Pediatrician St. Regis Mohawk Health Services, Hogansburg, NY

1997 to 98 Staff Pediatrician North Country Children's Clinic, Malone, NY

Academic Appointments

2000 to 03 Assistant Clinical Professor of Pediatrics Columbia University College of Physicians and Surgeons

1980 to 85 Teaching Assistant Princeton University

1978 Teacher Children's School of Science, Woods Hole, MA

1977 to 78 Research Assistant Yale University

LANGUAGES SPOKEN Spanish, French

#### AWARDS AND HONORS

1984 National Science Foundation Dissertation Grant (Princeton)

1979 to 82 National Science Foundation Predoctoral Fellowship (Princeton)

1979, 80 Dunlop Prize, Biology Department, Princeton University

1981 to 83 Research grants from the National Academy of Sciences, American Museum of Natural History, American Ornithologists' Union, and others

1973 National Merit Scholar to Yale University

#### MAJOR ADMINISTRATIVE RESPONSIBILITIES

1995 to 96 Chief of Pediatrics Yukon-Kuskokwim Delta Regional Hospital, Bethel, AK

#### PROFESSIONAL SOCIETY INVOLVEMENT

1997 to American Academy of Pediatrics Fellow

2000 to Medical Society of the State of New York

2006 to Franklin County Medical Society

2000 to 03 Otsego County Medical Society

#### COMMUNITY SERVICE

1998 to 00 Physician member, Child Abuse Response Team, Franklin County, NY

1994 to 96 Physician member, Child Abuse Response Team, Yukon-Kuskokwim Delta, AK

#### GRAND ROUNDS

May 94 "Infectious Diseases in Yup'ik Eskimos" at Dartmouth-Hitchcock Medical Center (Lebanon, NH)

May 01 "Vaccinations: The Debate" at Bassett Healthcare (Cooperstown, NY)

March 02 "Evaluation of Children and Adolescents with Behavior and Learning Problems" at Bassett Healthcare (Cooperstown, NY)

April 02 "Vaccinations: An Overview for Family Practitioners" at Bassett Hospital of Schoharie County (Cobleskill, NY)

Feb 03 "A Neurodevelopmental Approach to ADHD" at Bassett Healthcare (Cooperstown, NY)

#### BIBLIOGRAPHY

##### Original reports

Pierpont N, Fitzpatrick JW. Specific status and behavior of *Cymbilaimus sanctaemariae*, the Bamboo Antshrike, from southwestern Amazonia. *Auk* (Journal of the American Ornithologists' Union) 1983; 100: 645-52.

Terborgh JT, Robinson SK, Parker TA, Munn CA, and Pierpont N. Structure and organization of an Amazonian forest bird community. *Ecological Monographs* 1990; 60: 213-38.

#### Proceedings of Meetings

Pierpont, N. Competencia y coexistencia de trepadores [Competition and coexistence of woodcreepers]. In: Rios MA, ed. Reporte Manu. Lima, Peru: Centro de Datos para Conservacion, 1985, 13 pp.

#### Abstracts

Pierpont N. Interspecific dominance and the structure of woodcreeper guilds [Abstract]. American Zoologist 1983; 23: 1001.

Pierpont N. Interspecific aggression and the ecology of woodcreepers (Aves: Dendrocolaptidae). Ph.D. Dissertation, Princeton University, Princeton, NJ. Ann Arbor, Michigan: University Microfilms, 1986; Abstract No. 8602443.

Pierpont N. Habitat selection induced by interspecific aggression in Amazonian birds [Abstract]. Proceedings of the IV International Congress of Ecology, Syracuse, N.Y., 1986, p. 271.

Karron RA, Singleton RJ, Petersen KM, Bonilla D, Hughes B, Davidson N, Bulkow L, Pierpont N, Wainwright R, Santosham M, Harrison LH. RSV is a frequent cause of hospitalization in Alaska Native infants. Poster, ICAAC meeting, 1995.

#### Newspaper, testifying

Pierpont N. Health, hazard, and quality of life near wind power installations: How close is too close? Malone (New York, USA) Telegram, March 2, 2005, p. 5.

Pierpont N. Health effects of wind turbine noise. Report presented to NY State legislators, February 3, 2006.

Pierpont N. Wind turbine syndrome. Testimony before the New York State Legislature Energy Committee, March 7, 2006.

Nina Pierpont, MD, PhD

<http://www.ninapierpont.com/?s=wind&p=2>

Nina Pierpont, MD PhD

Fellow of the American Academy of Pediatrics

February 8, 2006

#### Education

1991 M.D. The Johns Hopkins University School of Medicine

1985 Ph.D. Princeton University (Behavioral Ecology)

1981 M.A. Princeton University (Behavioral Ecology)

1977 B.A. Yale University, National Merit Scholar (cum laude)

#### Post-Doctoral Training

1992 to 94 Pediatrics Dartmouth-Hitchcock Medical Center, Lebanon, NH

1991 to 92 Pediatrics Children's National Medical Center, Washington, DC

1985 to 86 Ornithology American Museum of Natural History, New York, NY

#### Licensure and Certification

1997 Licensed Physician, New York

1997 Licensed Physician, New Hampshire (expired)

1995 Pediatric Advanced Life Support Instructor and Affiliate Faculty

1994 Diplomate, American Board of Pediatrics (recertified 2000, expires 2008)

1994 Licensed Physician, Alaska (expired)

#### Hospital or Affiliated Institution Appointments

10/00 to 12/03 Senior Attending in Pediatrics Bassett Healthcare, Cooperstown, NY

1997 to 00 Attending Pediatrician Alice Hyde Hospital, Malone, NY

1995 to 96 Chief of Pediatrics Yukon-Kuskokwim (Yup'ik Eskimo) Delta Regional Hospital, Bethel, AK

1994 to 95 Staff Pediatrician Yukon-Kuskokwim (Yup'ik Eskimo) Delta Regional Hospital, Bethel, AK

#### Other Professional Positions

2004 to ... Private Practice (Solo) Pediatrics (emphasizing Behavioral Peds) Malone, NY

1998 to 00 Private Practice (Solo) Pediatrics Malone, NY (poorest county in state)  
1997 to 00 Staff Pediatrician St. Regis Mohawk (Iroquois) Health Services, Hogansburg, NY  
1997 to 98 Staff Pediatrician North Country Children's Clinic (clinic for needy children),  
Malone, NY  
Academic Appointments 2000 to 03 Assistant Clinical Professor of Pediatrics Columbia  
University, College of Physicians and Surgeons

Gordon Lee Whitehead

Date of Birth: 29 September 1943  
Citizenship: Canadian  
Address: 210 Windsor Drive, Stillwater Lake, Nova Scotia B3Z 1G5  
Telephone: (902) 826-7370  
Facsimile: (902) 826-7061  
E-Mail Address: gordon.whitehead@ns.sympatico.ca

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#### PROFESSIONAL EDUCATION/CERTIFICATION:

Bachelor of Science degree (B.S.) in Audiology and Speech Language Pathology, minor in  
Psychology, Western Illinois University, Macomb, Illinois, U.S.A., granted in 1966.

Master of Arts degree (M.A.) in Audiology, Northern Illinois University, DeKalb, Illinois,  
U.S.A., completed in 1968, granted in 1969.

Professional certification in Audiology [Aud(C)] from the Canadian Association of Speech  
Language Pathologists and Audiologists, the national Canadian professional certification  
organization.

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#### RECENTLY CONCLUDED EMPLOYMENT AND CONSULTANTSHIPS:

Mr. Whitehead partially retired in May 2005, and became fully retired in June 2006.

Adjunct Professor/Lecturer, Dalhousie University, Graduate School, School of Human  
Communication Disorders, Halifax, Nova Scotia, 1980 through 2006; teaching many courses,  
including coursework in Noise in Industry and the Community.

Member, Faculty of Graduate Studies, Dalhousie University, Halifax, Nova Scotia.

Private Practice Industrial and Community Audiology Services (HCCA Ltd./Hearing  
Conservation and Civic Audiology Ltd.), Halifax, Nova Scotia, Sept. 2000-April 2005.

Workers' Compensation Board of Nova Scotia, audiological consultant, and ongoing  
activities including sound level measurement and analysis in relationship to hearing loss,  
and back-to-work assessments, concluded June 2005.

Veterans Review and Appeal Board Canada, Charlottetown, Prince Edward Island.  
Ongoing audiological consultantship, concluded April 2005.

Royal Canadian Mounted Police, Community Noise Bylaw Enforcement Training, various  
locations. Sound level training certification workshops for RCMP personnel; ongoing  
audiological consultant, concluded April 2005.

Railroad Association of Canada/Canadian National Railway. Concluded hearing standards consultancy 2005.

Attorney General's Office/National Police Force, the Department of Health, and the Department of the Environment, Road Town, Tortola, British Virgin Islands. Concluded consultancy June 2005.

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#### MAJOR RECENT PROFESSIONAL ACTIVITIES:

Sound Level Measurement and Analysis and Formal Reporting, services have been provided in myriad environments, including industrial, mining, naval/military, educational institutions, music industry, compensation activities, etc. Measurement includes sound intensity, spectrum analysis, reverberation analysis, etc.

Acoustical Assessment/Modification Recommendations, bandrooms/rehearsal rooms, classrooms, gymnasiums, etc.

Provision of Hearing Conservation Services, including sound level measurement and analysis, noise reduction/ hearing protection, hearing testing/retesting, and hearing conservation employee educational activities.

Educational/Training Workshops, hearing conservation training and refresher courses, occupational health nursing workshops, tinnitus management for audiologist workshops, employee education, special-purpose workshops relating to noise and hearing issues, police training relating to noise issues, etc. Custom designed/taught workshops with an audiological content, as requested.

University Teaching/Professorship, audiology graduate program full coursework relating to Noise in Industry and the Community, and requested lectures in other courses. Twenty-plus university graduate level courses have been taught over the past 25+ years.

Calibration Services, calibration of audiological instrumentation for hospital-based audiology clinics, private practice audiology clinics, school and industrial hearing screening programs.

Client Audiological Diagnostic Services, limited predominantly to tinnitus patients.

Canadian International Hearing Services, served as a volunteer providing services to 3 Caribbean countries during 7 trips.

Note: professional audiology services have been provided for more than 38 years.

#### PROFESSIONAL ASSOCIATION AFFILIATIONS:

Canadian Association of Speech Language Pathologist and Audiologists (CASLPA) - full member prior to retirement.

- Holds professional certification [Aud(C)] in Audiology from CASLPA.
- CASP (Canadian Accreditation of Service Programs) site visitor, for the professional accreditation of audiology clinic facilities in Canada.

Speech and Hearing Association of Nova Scotia (SHANS) - full member prior to retirement.

Former member (and 2-time presenter) of the National Hearing Conservation Association.

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#### NEW AUDIOLOGICAL CLINIC ESTABLISHMENT ACTIVITIES (15 Clinics):

Established audiology clinic at Surrey Place Centre (formerly Mental Retardation Centre), Toronto, Ontario.

Established Barrie Audiology Clinic, a private practice clinic, Barrie, Ontario.

While serving as Audiology Division Supervisor/Assistant Supervisor for the Nova Scotia Hearing and Speech Clinic, was instrumental in establishing thirteen initial, permanent audiology clinics in the following Nova Scotia communities: Sydney Mines, Glace Bay, Cleveland, Antigonish, New Glasgow, Truro, Amherst, Kentville, Yarmouth, Bridgewater, Lower Sackville, Camp Hill Hospital (Halifax), Halifax Infirmary (Halifax). Also established two civilian ENG (electronystagmographic) clinics in Nova Scotia (Halifax and Sydney).

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#### PREVIOUS PERTINENT EMPLOYMENT:

Director, Industrial and Community Audiology - Nova Scotia Hearing and Speech Clinic (NSHSC), Halifax, Nova Scotia, September 1997 to 31 October 2000.

Audiologist, Nova Scotia Hearing and Speech Clinic, Halifax, Nova Scotia, November 1990 to September 1997.

Supervisor of the Audiology Division, Nova Scotia Hearing and Speech Clinic, Halifax, Nova Scotia, September 1981 to November 1990. Directly involved in setting up 13 new audiology clinics around Nova Scotia.

Assistant Supervisor of the Audiology Division, Nova Scotia Hearing and Speech Clinic, Halifax, Nova Scotia, June 1980 to September 1981.

Audiologist, Nova Scotia Hearing and Speech Clinic, Halifax, Nova Scotia, November 1979 to June 1980.

Lecturer, Teacher Education of the Deaf (TED Graduate Program), Université de Moncton, Moncton, New Brunswick, 1987, 1989, 1990.

Audiology Clinical Practicum Coordinator, Dalhousie University, Graduate School, School of Human Communication Disorders, 1980-1981 academic year.

Clinical Audiologist/founder, Barrie Audiology Clinic, Barrie, Ontario, March 1975 to August 1979. This is a private practice clinic that is still operating.

Industrial Audiologist/Founder, Hearing Conservation Services, Barrie, Ontario, March 1975 to August 1979.

Audiological Consultant, Huronia Regional Centre for the Mentally Retarded, Orillia, Ontario, 1974, 1977 and 1979.

Audiological Consultant, Prince Edward Heights, Hospital School for the Mentally Retarded, Picton, Ontario, 1972 to 1974.

Clinical Supervisor, Department of Rehabilitative Medicine, Program in Speech Language Pathology, University of Toronto, Toronto, Ontario, July 1970 to December 1974.

Audiological Consultant, Ottawa Civic Hospital, Department of Otolaryngology, Ottawa, Ontario, 1970 to 1973.

Audiological Consultant in Cortical Audiometry, Children's Psychiatric Research Institute, London, Ontario, 1970.

Research Audiologist/Research Grant Writer, Department of Otolaryngology, University of Toronto, Toronto, Ontario, July 1969 to July 1975.

Clinical Audiologist, Toronto General Hospital, Toronto, Ontario, July 1969 to January 1975.

Clinical/Research Audiologist (and founder of Audiology Clinic), Mental Retardation Centre, (now Surrey Place Centre), Toronto, Ontario, July 1969 to January 1973.

Audiologist, Dixon State School for the Mentally Retarded, Dixon, Illinois, July 1968 to June 1969.

Teacher of aural rehabilitation, speech reading, auditory discrimination, remedial English and current events, in adult deaf vocational rehabilitation program, State of Illinois Department of Vocational Rehabilitation, Northern Illinois University, DeKalb, Illinois, 1967-1968 academic year.

Speech Language Therapist, Dixon State School for the Mentally Retarded, Dixon, Illinois, June to September 1967.

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#### MISCELLANEOUS:

Adjunct professor/lecturer in graduate schools of Dalhousie University/Université de Moncton/University of Toronto, teaching numerous courses, including: Noise in Industry and the Community, Hearing Aids, Pediatric Audiology, Electrophysiological Audiometry seminar, Electronystagmography seminar, Calibration seminar, etc.

Presenter of hundreds of lectures and workshops from one hour to three day's duration, including most areas of diagnostic audiology, industrial hearing conservation, cortical audiometry, sound level measurement and analysis, physics of sound, instrument calibration, infant hearing screening, tinnitus management, electronystagmography, and electrocochleography.

Active participant in the CASP (Canadian Accreditation of Service Programs) process that evaluates and accredits hospital-based and private audiology clinics across Canada.

Expert witness in numerous court sessions and compensation hearings.

Recipient of audiological sound level measurement/analysis contract services for the Canadian Department of Defence-funded study granted to Dr. Sharon Abel and Brian Crabtree, entitled A Study of Risk Factors for the Development of Noise-Induced Hearing Loss in Canadian Forces Personnel, July to September 2003.

Recipient of Veterans Review and Appeal Board Canada (Public Works and Government Services Canada contract #51019-02-7022), 2003, for policy development: Tinnitus

Disability Guidelines: Development of a Formal, Model Tinnitus Policy, and Hearing Loss Disability Guidelines: Recommended Revisions to Existing Policy.

Writer and co-researcher of four Defence Research Grants entitled “Hearing Under Stress”, Department of Otolaryngology, University of Toronto, Toronto, Ontario, 1973 to 1977.

Councillor, Executive Board, Ontario Speech and Hearing Association, Toronto, Ontario, 1972 and 1973.

Acting Chairperson/Co-founder, Audiology Section, Ontario Speech and Hearing Association, 1973.

Study visit (impedance), Dr. K. Terkildsen, Copenhagen, Denmark, 1969.

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- 1 Beech Ridge Energy Project Details, [http://www.beechridgewind.com/Docs/1-25-06\\_Beech\\_Ridge\\_Wind\\_Fa\\_Sheet.pdf](http://www.beechridgewind.com/Docs/1-25-06_Beech_Ridge_Wind_Fa_Sheet.pdf)
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