IMPORTANT NOTE: This document was produced in 2009, early in AEI's engagement with the issue of wind farm noise. While most of the information herein remains useful, AEI's more recent wind farm noise reports and conference presentations are stronger and clearer representations of AEI's current understanding of this complex and subtle issue. See http://www.acousticecology.org/wind for current and more reliable information.

45 Cougar Canyon Santa Fe NM 87508 505.466.1879
acousticecology.org jim@acousticecology.org

Acoustic Ecology Institute Fact Sheet: Wind Energy Noise Impacts

Excerpted from a 25-page AEI Special Report: Wind Energy Noise Impacts, available at:
AcousticEcology.org/srwind.html *Visit this page for links to sources mentioned below*

Introduction

This AEI Fact Sheet is not intended to over-emphasize noise complaints, but rather to provide information that can foster informed conversation about any specific wind farm proposal. As you'll read below, it appears that noise can be a significant issue in at least some situations when turbines are within about a half mile of homes, with impacts occasionally occurring up to a mile away. Some acousticians and health professionals are encouraging setbacks of 1.5 miles (roughly 2km) or even a bit more. In the US, it is quite common to have setbacks defined as a multiple of turbine height; for example, 5 times the turbine height from a home (which would equate to 500m for a 100m turbine). It appears to AEI that a half-mile (800m) setback is marginally acceptable if the goal is to minimize impacts on residents, though we would prefer a one-mile (1.5km) setback, which would offer near assurance of avoiding noise issues.

Each proposed wind farm site is unique and must be evaluated based on local topographic, atmospheric, and land use patterns. Prevailing wind direction is a key factor, as is topography. **A recent UK government survey suggests that about 20% of wind farms tend to generate noise complaints; the question is, what are the factors in *those* wind farms that may be problematic, and how can we avoid replicating these situations elsewhere?**

Noise impacts are not necessarily deal-killers for wind energy, as long as developers are honest about what is likely to be heard and continue to work diligently to investigate the aspects of wind turbine noise that are still not fully understood. The Altamont Wind Farm in California, built on a major raptor flyway in the early years of industrial wind development, has continued to be a poster child for the bird-killing power of wind turbines, despite widespread understanding that it was an exceedingly bad siting decision, one not likely to be repeated. Similarly, many noise complaints today seem to be coming from people whose homes are on the near edge of fairly lax setback guidelines (within 1500 feet in many cases). Will a few ill-considered siting choices similarly poison attitudes about noise issues?

Resistance to wind farms is often belittled as NIMBY-ism (Not In My Backyard); but at the same time, proponents often slip into oversimplified WARYDU rhetoric (We Are Right; You Don't Understand). If we are to forge a reliable energy future that is respectful of both the environment and the rights of neighbors, we'll need to move past knee-jerk reactions on both sides, and develop best practices that can ensure that the landscape and local residents don't become long-term casualties of today's "Klondike Wind Rush."

How Noisy Are Wind Turbines?

The US National Wind Coordinating Collaborative, a multi-stakeholder group that aims to facilitate wind development, summarizes the situation in fairly straightforward terms:

> *By and large, those affected by the noise generated by wind turbines live within a few miles of a large wind power plant or within several hundred feet of a small plant or individual turbine. Although the noise at these distances is not great, it nevertheless is sufficient to be heard indoors and may be especially disturbing in the middle of the night when traffic and household sounds are diminished.*

In a similar vein, the American Wind Energy Association's fact sheet on noise notes that "Today, an operating wind farm at a distance of 750 to 1,000 feet is no noisier than a kitchen refrigerator." **This raises a question: how many of us sleep in the kitchen?**

The bottom line is that most modern industrial wind turbines are designed to keep noise levels at or below 45dB at 1000 feet (350 meters), which should drop to 35-40dB at a bit over a half mile (1000m); commercial turbines are quite often built this close to homes. Some are rated at lower sound levels. However, as is noted below, atmospheric conditions can wreak havoc with nice clean sound propagation models, especially at night. And, as turbines get bigger, their noise can be deceptively hard to predict; certainly, they can be quieter at their bases than some distance away, and temperature inversions, wind layers, and other atmospheric effects can lead to surprisingly distant sound impacts. *(See AEI's Wind Farm Noise 2012 report for in-depth discussion of sound propagation distances)*

It appears that turbine noise travels farther in calm night air; one widely-respected study (van den Berg, see below) found that sound levels were 5-15dB louder than predicted in some night-time atmospheric conditions, and noted that residents as far as 1.9km away were disturbed by noise. In nearly all cases, those downwind bear the brunt of the sound; if you live upwind of a wind farm, noise problems will likely be far less severe.

It is important to recognize that night-time ambient noise levels in rural areas are often 35dB or lower; so, it is not that hard for wind farms to become a new and dominant acoustic presence. All too often, wind developers tell local planning boards that the turbines will be inaudible, which is rarely the case. Similarly, some investigations of noise complaints come to the conclusion that anomalously high noise levels occur so infrequently that they are insignificant. But if temperature inversions or other atmospheric stability effects that cause excessive noise occur just 10% of the nights, that means that nearby residents may find their sleep disturbed 35 nights a year. Is this insignificant? Such questions need to be considered directly, not shunted aside.

While in many situations, the sound from turbines is drowned out by nearby wind noise, or is perceived as a gentle whooshing noise that is quite easy to accommodate, in some wind or atmospheric conditions, a pulsing noise can arise, which is much harder to ignore or acclimate to, making it a major source of complaints. Perceptually, the problem is that any pulsed or irregular sound (this rhythmic thumping tends to wax and wane over the course of a night) will tend to cause more disturbance. These pulses, sometimes termed Amplitude Modulation, are usually loudest in one or two specific directions, depending on the wind direction.

When considering noise predictions, **beware of overly simplistic comparisons of sound levels**. Acousticians, as well as advocacy organizations on both sides of the issue, will often say a turbine's noise is "equal to" or "the same as" a familiar sound (distant traffic, quiet conversation), or is "twice as loud" as something else (perhaps the background noise level). While these comparisons have a basis in physics and our anatomical responses, the fact is that humans do not perceive and compare sounds as neatly as they perceive, say, height or weight. Certainly, "twice as loud" is an indefinite value for most people; and, equivalent dB value sounds are experienced very differently depending on the nature of the sound itself and the situation in which we hear it.

These sections of this FactSheet—on Low Frequency Noise, and on Health Effects—are extremely limited. Please see more recent documents at http://www.acousticecology.org/wind for much more reliable information on these topics. In particular, see the Appendices of AEI's Wind Farm Noise 2012 report for in-depth discussion of recent research on both topics.

Low-Frequency Noise

In some cases, low-frequency noise can become an issue with wind turbines. These sounds may be inaudible to the human ear, yet still cause physiological responses in the body. Such low-frequency noise can be transmitted through the ground from towers, or be part of the broadband noise field generated by spinning turbine blades. Low-frequency noise travels greater distances with less loss of intensity than higher-frequency sound.

It is important to measure the noise from turbines using a dbC scale, sometimes written db(C), which is weighted to accentuate low-frequency components of a sound. Most noise standards are weighted to the dBA/dB(A) scale, which accentuates frequencies heard best by the human ear. It is becoming a standard procedure in dealing with industrial and machine noise to compare dBC and dBA readings; when dBC is 20dB more than dBA, or when dBC is 60dB or higher, it is considered an indicator that low-frequency noise is at problematic levels, and the need for special low-frequency mitigation is then generally called for.

Health Effects

The World Health Organization has found that to protect children's health **sound levels should be less than 30 dBA during sleeping periods**. They note that a child's autonomous nervous system is 10 to 15 dB more sensitive to noise than adults (WHO night time recommendations for the general public are 30dB inside bedrooms, and 45dB outside open bedroom windows). Even for adults, health effects are first noted in some studies when the 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.

In early 2009, New York physician Nina Pierpont will release a book that summarizes her preliminary research into the health effects of wind farms, centering on a "case series" study of people with similar physical responses in different locations. She proposes a new term, **Wind Turbine Syndrome**, to describe what she suspects is a vestibular system (inner ear/balance) disturbance. *(It should be clearly noted that only a small proportion of people living near turbines are strongly affected; Pierpont's work focuses on those few and is a first step at moving past a simplistic "it's all in their heads" response to these cases.)* While industry sources object to this focus on the few with special sensitivity, Pierpont is undertaking the first step in standard medical research: case series studies describe a new health issue, and provide a basis for design of more detailed field and clinical studies. Her work is generating a surprising amount of enthusiastic praise from fellow doctors, and marks an important new threshold in our consideration of the impacts of wind farms on people living within a mile or so.

Noise Measurement

When the "experts" begin talking about noise, they throw around terms that can make most people's eyes glaze over. A key factor is that noise is generally measured over a period of time, stated in decibels (usually in dBA; weighted to match human hearing), and then characterized in various statistical shorthands, to clarify different aspects of sound fluctuations. These include: L_{eq}/LA_{eq} (sound level averaged over a given period of time; will be lower than the loudest sounds and higher than the quietest times); L_{90}/LA_{90} (sound is louder than this 90% of the time; represents the generally quietest times); L_{10}/LA_{10} (sound is louder than this only 10% of the time; represents generally loudest times, excluding extreme transient noises). A crucial decision when writing regulations meant to protect citizens from noise during quiet times of day or night is what period either turbine noise or existing "ambient" background noise is averaged over; day-long averages or 12-hour averages (both of which are preferred by industry noise consultants), can lead to noise standards that do not represent the quietest ambient or loudest turbine conditions, which is exactly when turbine noise can be an issue. A better approach is hourly (or three-hour) averages throughout the day or night, with regulated limits being tied to the quietest ambient period.

What Some Neighbors Are Hearing

Complaints from wind farm neighbors about noise are often discounted as the griping of a tiny but very vocal minority. **Are we simply hearing from the most sensitive or the most crotchety people? A recent research paper suggests not.** Christopher Bajdek's paper focused on creating realistic expectations about noise (and in so doing, countered both over-reactions of some websites and overly sanguine projections by industry reps). Presented at NOISECON 2007, a noise control industry conference, it included two key maps that charted dB measurements and the percentage of residents who were "highly annoyed" by the noise: **44-50% of people under a half mile away were "highly annoyed" (over a third within a half mile had been awakened by turbine noise)**; only as sound levels drop below 40dB do annoyance levels drop substantially; as sound drops below 35dB (a bit under a mile from nearest turbines), annoyance drops to 4% and less. Bajdek noted higher annoyance responses to wind farms than to other similarly loud industrial noises, such as roads and railroads, with the supposition that visual impacts elevate reported annoyance. However, that cannot account for the many people awakened by the noise; the irregularity of turbine noise may be a more important factor in making wind farms more annoying than other industrial sounds.

Here are a few of the most compelling "real world" reports from people affected by wind farm noise:

Juniata Township, Altoona, PA: 2000-3300 feet from wind farm with 40 turbines
Resident Jill Stull (turbines 2000ft/600m from her house) said, "You know when you're standing outside and you hear a plane coming about 30,000 feet overhead, then it goes off in the distance? It sounds like those planes are 5,000 feet above your house and circling and never land." The Stulls said they could move, but they aren't going to. "We're not going anywhere. I just want them to be quiet. I'm not going to jump on the 'I hate windmills' bandwagon because I don't," Jill Stull said. "I'm just tired of nobody listening. My point is what is your peace of mind worth? I can't play outside with my kids back at the pond in the woods because it gives me a headache."

"On a calm day, you come outside and try to enjoy a nice peaceful day, and all you hear is the noise all the time and you can't get away from it," said Bob Castel, who has two turbines behind his house. "The first time they started them up, I didn't know what it was. I was like man, that's a weird noise. It was that loud," said Castel.

Elmira, Prince Edward Island: 1km (3300 feet) from wind farm with ten 120m turbines
Problems began within weeks after the turbines started operating. Downwind from the turbines, when the air was moving just enough to turn them (12-15 knots from the northeast), the noise was loud. It was a repetitive modulated drone of sound. Dwayne Bailey and his father Kevin both claimed it sometimes was loud enough to rattle the windows of their homes on the family farmstead. The sound was even worse in the field behind their homes. Distances from 1 to 1.5 kilometers were the areas of the most annoying sounds. This spring the winds created constant misery.

"My idea of noise is a horn blowing or a tractor - it disappears," said Sheila Bailey. "This doesn't disappear. Your ears ring. That goes on continuously." 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.

Freedom, Maine: 1000 and 1400 feet from wind turbines
Local resident Phil Bloomstein used a sound meter to record decibel levels at his home. The results, which Bloomstein captures on a laptop, show a mean sound level of over 52 decibels, never dropping below 48 and peaking at 59 decibels. "When the turbines were being proposed to be put up," he says, "we were told that 45 decibels would be as loud as it would get except for ... no more than eight days a year." Neighbor Jeff Keating, a bit further from the closest turbine, said, to date, the noise has woken him up three times at night. He likened the experience to hearing the furnace kick on, then lying awake mad about having been woken. "It's not just a physical thing," he said, "there's an emotional side." Keating's neighbor Steve Bennett said he hears the turbines at all times of day. "It's like a jet plane flying overhead that just stays there," he said.

From a distance, the jet plane analogy fits the sound produced by the turbines - a white noise suggestive of a plane that never entirely passes. Closer to the turbines the sound quality changes. Each turbine rotates to face the wind and the sound varies in relation to one's orientation to the blades. At close range, facing the turbine head on, the sound is low and pulsing like a clothes dryer. From the side the blades cut the air with a sipping sound. Either way, when the wind is blowing, there is noise. "They simply do not belong this close to people's homes," Bennett said. "Our property values have been diminished, and our quality of life has been diminished." YouTube videos from Bloomstein: http://tinyurl.com/7gpvlc

Mars Hill, ME: 2600+ feet from turbine

Mars Hill resident Wendy Todd (house is 2600 feet from the nearest turbine): Unfortunately for us, the very mountain that has provided the wind facility with a class 3-wind resource often acts like a fence protecting us from the upper level winds that push the turbines. There are many times when winds are high on the ridgeline but are near calm at our homes. The noise and vibrations from the turbines penetrate our homes. At times there is no escape from it, no matter which room you go to. The noise ranges from the sound of a high range jet to a fleet of planes that are approaching but never arrive. When it's really bad it takes on a repetitive, pulsating, thumping noise that can go on for hours or even days. It has been described as a freight train that never arrives, sneakers in a dryer, a washing machine agitating, a giant heartbeat; a submariner describes it as a large ship passing overhead.

People think that we are crazy. They drive out around the mountain, stop and listen, and wonder why anyone would complain about noise emissions. But, believe me when we are having noise problems you can most assuredly hear the justification of our complaint. We have had people come into our yard get out of their vehicles and have watched their mouth drop. We have had company stop in mid conversation inside our home to ask, "What is that noise?" or say "I can't believe you can hear those like that inside your house."

Two views of the Mars Hill wind farm, showing proximity of rural landowners. It is not hard to imagine noise blanketing the fields, especially when the hill is sheltering the lowlands from wind.
Images from National Wind Watch

(Wendy Todd, continued): 18 families, each with homes less than 3000 feet from the nearest turbine, are experiencing disturbing noise levels; the next closest home is about 5200 feet away, and are only occasionally bothered when inside their homes.

Nick Archer, our Regional Director with the Maine Department of Environmental Protection, thought we were all crazy, too. But he finally made it to our homes and heard what we were talking about. I don't believe he has ever heard a 50+decibel day but he has heard close to that on more than one occasion and has made statements like these: "This is a problem," "We need to figure out what is going on with these things before we go putting anymore of them up," "I thought you were crazy at first but you are not crazy," "The quality of life behind the mountain is changed." Did he say these things just to appease us? I don't believe so.

Possible Factors in Noise Complaints

Why do neighbors sometimes experience noise levels beyond what industry noise models presume will be created by their wind farms?

One reason is that predicted noise levels can be based on unrealistically optimized lab conditions and perfectly new machines; thus the predicted noise output is likely to be the lowest that could occur. In addition, the idealized "spherical spreading" model generally used does not take into account terrain, vegetation, or atmospheric effects, each of which can either increase or decrease sound propagation. One useful approach to sound modeling is to assume a "worst case" ground cover (hard ground, which reflects, rather than absorbs, sound); such models often come closer to matching real, recorded sound levels than ones using "mixed cover" factors.

Topographical effects are very important to consider. Gently sloping terrain rising from a plain can sometimes cause sound levels to actually rise with increasing distance: Near the Vancouver Airport, hills rising from a flat plain caused sound levels to be 20dB higher at 5500m than at 4000m, because of the way the increasing ground angles caused sounds to combine, more than nullifying what, in a standard model, would be expected to be a 3dB decrease over that distance. A different topographical effect is the one reported at Mars Hill, Maine, where noise from turbines atop a ridgeline is made "worse" by the fact that the ridge blocks the wind at homes along its foot, eliminating the masking effect that is often assumed to drown out the sound of turbines in high wind conditions.

Increasingly, though, **researchers are discovering that atmospheric effects can cause the most troubling noise issues over larger areas than expected**. In the daytime, warming air rises, both carrying sound aloft and creating turbulence that scatters turbine noise; in addition, more ground-based ambient noise during the day masks turbine sounds. At night, however, when the air stabilizes it appears that noise from wind turbines can carry much farther than expected. This effect can occur with light winds at turbine height and the ground, or with light winds at turbine height and very little or no wind at ground level. With light and steady breezes capable of spinning the turbines, but not stirring up much ambient noise, sound levels measured at homes 400m to nearly two km away are often 5-15dB higher than models would suggest.

The effect of inversion layers on sound levels has not been systematically studied, though many opportunistic reports suggest the obvious: when an inversion layer forms above the height of turbines, it can facilitate longer-range sound transmission by reflecting some of the sound back toward the ground, and forming a channel for sound propagation. In many locations, this will be a relatively rare occurrence, but in areas with frequent inversion layer formation, it should be considered.

Possible solutions: **It is hard to escape the implication that setback distances may need to be increased in places where the prevalence of such topographic or night time effects suggest sound will often remain at annoying levels for larger distances.** Certainly, noise modeling studies should include calculations based on night time stable atmospheres; G.P. van den Berg, whose 2006 Ph.D. thesis is a comprehensive study of these effects, concludes that "With current knowledge, the effects of stability on the wind profile over flat ground can be modeled satisfactorily." (his measurements indicate that more sophisticated sound models were accurate to within 1.5dB, while simpler models missed the mark by up to 15dB) He goes on to note: "In mountainous areas terrain induced changes on the wind profile influence the stability-related changes and the outcome is less easily predicted: such terrain can weaken as well as amplify the effect of atmospheric stability."

There are certainly many suitable sites for wind farms that are remote enough to avoid even the possibility of noise issues in people's homes. At this crucial stage in the development of the wind power industry, it would be sadly short-sighted to insist on placement of turbines in the "grey area" between what noise models suggest is enough (perhaps 1500 feet) and the zone in which complaints have cropped up (up to a mile or so). Taking a big-picture view, the power generating potential in areas that are marginally close to people's homes is a very small proportion of the nation's wind power capacity. **Let's start where we know turbines will not disturb neighbors, rather than risk a generation of vocal complaints that may impede future development as turbines become quieter.**

Current Approaches to Regulating Wind Farm Noise

While the United States does not have national noise standards, many European countries do. These countries, and many state or county regulations in the US, typically set an absolute sound level that any industrial facility must meet. Commonly, 45dB is used as the night-time limit, and 55dB as the daytime limit; higher thresholds are sometimes allowed, but rarely does the night-time limit drop below 40dB. The problem comes in rural areas, where night-time ambient noise (wind, distant traffic, etc.) is often 35dB, and sometimes as low as 25dB. Given that 10dB is perceived as twice as loud, the problem is obvious.

It should be noted that the majority of wind farms do not trigger noise complaints. These are likely sited far enough away to work well for nearby residents. A 2007 report from the UK found that roughly 20% of wind farms (27 of 133) had received complaints about noise. While noise modeling (predicting the noise levels around wind turbines) tends to indicate that noise impacts should be insignificant beyond several hundred meters, the French National Academy of Medicine has called for a halt of all large-scale wind development within 1.5 kilometers (roughly 1 mile) of any residence, and the U.K. Noise Association recommends a 1km separation distance. In the US, there is no overall recommendation; setback decisions are made locally, and often are based on a 45dB night-time noise limit, so that turbines are sited no closer than 350m (roughly 1100 feet); 350-700m is often considered a reasonable setback in the US, based on simple sound propagation modeling. Though it is not uncommon for larger setbacks to be used, 1000m (1km) or 1500m (1 mile) setbacks are rarely required.

The International Standards Organization (which sets recommendations for all manner of human impacts) and the World Health Organization both recommend noise levels markedly lower than those used in most places, especially at night. WHO recommends a night-time average noise level of no more than 30dB inside bedrooms, and the ISO sets its limit even lower in rural areas, down to 25dB from 11pm-7am.

Local Regulatory Challenges

Small town governing bodies are generally ill equipped to address the questions before them when wind energy companies apply for local permits. In many cases, the proposed wind farm is the first outside industrial facility to be proposed in the town; it is almost always the first 24/7 noise source to appear in the local rural landscape and soundscape.

Energy company experts attend town council or selectmen meetings, often submitting comprehensive documentation that is rarely fully comprehensible to the lay members of the town's governing body. While these documents don't generally promise anything quieter than 45dB, the outside experts too often assure local officials that the wind farms will be inaudible—relying on flawed assumptions that high winds will always create enough increase in ambient noise to drown out the turbines. The use of comparisons, such as "a kitchen refrigerator" or "traffic 100 yards away" is likewise a common way of reassuring locals—one such expert went so far as to assure a council that the 45dB drone of turbine noise was "comparable to" bird song on a summer afternoon!

"There are no rules and regulations on windmills," Paul Cheverie, chairman of the Eastern Kings Community Council (Prince Edward Island, Canada) says. "The more we get into it, the more we realize we jumped the gun." **Wisconsin towns and counties have been especially proactive in implementing wind farm ordinances.** Calumet County limits turbine noise to be no more than 5dB louder than the background ambient levels at the quietest time of night, and Trempealeau County adopted a one-mile setback requirement. See some Wisconsin wind ordinances at http://betterplan.squarespace.com/wind-ordinances-wisconsin-stat

The statistical measures used by acousticians can read like Greek to most laymen (dBA_{90} anyone?). See the brief note on page 3, and be sure to seek out a good primer on these terms before agreeing to any ordinance language.

Most of these documents have been supplanted by other more recent or more comprehensive studies. Please see AEI's Wind Farm Noise 2012 and Wind Farm Noise 2011 reports for references; see also source documents linked at http://www.acousticecology.org/wind/

Detailed Documents Of Note

This AEI Fact Sheet draws on several detailed reports by others. Those wishing to learn more, or to inform themselves so as to discuss these issues in depth with regulatory authorities, company representatives, acousticians, or neighbors, will benefit from reading the source material below.

The full AEI Special Report on Wind Turbine Noise Impacts includes comprehensive resource lists, including links to download the following papers and many others, along with links to websites of wind industry organizations, government regulators, wind advocates, landowner support groups, and organizations concerned with wind turbine noise. See AcousticEcology.org/srwind.html

- G.P. van der Berg's 200-page Ph.D. thesis, published as **The sounds of high winds: the effect of atmospheric stability on wind turbine sound and microphone noise**, is a treasure-trove of detailed acoustic analysis and clear lay summaries, regarding both atmospheric stability issues and the challenges of recording effectively in high-wind conditions (i.e., avoiding wind noise on mics so as to more accurately capture ambient noise levels). http://tinyurl.com/78baby
- Soysal and Soysal, **Wind Farm Noise and Regulations in the Eastern United States**. Paper presented at the Second International Meeting on Wind Turbine Noise, Lyon, France, September 2007. A well-done and concise (12p) summary of wind farm noise sources, sound levels measured at one typical wind farm in Pennsylvania, and noise regulation challenges.
- Kamperman and James, **How To Guide to Wind Turbine Siting**, August 2008. Two acousticians who have become roaming expert witnesses for rural towns addressing wind development submitted these proposed limits at the July 2008 national Noise Control conference. In brief, they suggest limiting turbine noise to 5dB above night-time ambient noise levels at any neighboring property boundary, or a maximum of 35dB within 30 meters of any occupied building.

This book gathers case reports, a useful first step, but is not a "summation of research" on health effects

- Nina Pierpont, M.D. **Wind Turbine Syndrome**. Book to be released in 2009. Pierpont's short book-length summation of research into the health effects of low-frequency noise, and more specifically of audible as well as low-frequency noise emitted by wind turbines, is garnering impressive praise from fellow physicians. windturbinesyndrome.com
- Champaign County, Ohio, **Wind Turbine Study Group Report** - Pages 21-33 cover noise issues, including lots of back and forth (point/rebuttal) comments from study group members

---

The Acoustic Ecology Institute works to increase personal and social awareness of our sound environment, through education programs in schools, regional events, and our internationally recognized website, AcousticEcology.org, a comprehensive clearinghouse for information on sound-related environmental issues and scientific research. Our over-arching goal is to help find pragmatic ways to bridge the gaps between extreme positions voiced by advocacy-oriented organizations, and so to contribute toward the development of ethical public policies regarding sound.

AcousticEcology.org is an unparalleled resource for issue updates and reliable background information. The site features a News Digest, science summaries, Special Reports, and extensive lists of research labs and advocacy organizations on all sides of sound-related environmental issues, including ocean noise, motorized recreation in wildlands, oil and gas development, wind turbines, and more.

Contact Jim Cummings at 505-466-1879 or AcousticEcology.org