Wind Turbines are Hazardous to Human Health

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Overview of The Problem:

Wind turbines such as those currently being constructed in rural areas **generate high levels of infrasound noise**. This is very low frequency noise (sound waves of less than 20 cycles per second) that **you cannot hear. Even though you cannot hear the sound, it is easily detected by the ear at the levels that are produced and can have effects on the body that profoundly disturb some individuals**.

The situation is somewhat similar to **ultraviolet (UV) light and the eye**. We cannot see ultraviolet light but we all understand that it can affect us profoundly, causing sunburn, photokeratitis (also known as snow blindness or welder's flash) and cataracts. For UV light, there are simple ways that the damaging effects can be avoided using sunscreens and eye protection.

For infrasound exposure in your home, there is currently **NO WAY TO PROTECT YOURSELF**. Although double glazing and door seals will reduce the levels of the sounds you can hear, they have little influence on the infrasound level in the home. Infrasound is a slowly-changing pressure wave, that can only be blocked by completely sealing the house, making it airtight. In practice this cannot be performed due to building codes and the risk of suffocation.

The effects of wind turbine infrasound build up slowly on people. For most, there are no effects while in the vicinity of wind turbines for short periods (such as the workday) and when higher levels of other sounds (i.e. sound you can hear) are present. **The problem arises when people try and sleep in their homes in the presence of wind turbine noise**. The audible sounds are reduced by the house structure, so the room may be fairly quiet, but the sound becomes dominated by the infrasound that the person cannot hear. The infrasound is detected by the ear and has subtle influences on the body that we are only just beginning to understand. It can cause dysequilibrium (like sea-sickness, but not induced by movement), tinnitus, a sensation of fullness in the ear and worst of all, disturb sleep, probably by stimulation of subconscious neural pathways to the brain. People undergo repeated arousals from sleep (brief partial awakenings that are not remembered) and repeated awakenings when sleeping in such an environment that leave the individual stressed and unrefreshed. Sleep disturbance over a prolonged period is known to be extremely hazardous to health, causing mental changes, high blood pressure, diabetes and increased mortality.

In many cases, these health effects have been significant enough to force people to abandon their homes. In a few cases the homes have been "bought out" by the wind turbine companies (and the owners typically "silenced" by non-disclosure agreements, otherwise known as "gag" orders), but in others the home is abandoned and is difficult to sell to another family. Properties located in the vicinity of wind turbines are becoming increasingly difficult to sell. Recent epidemiological studies suggest that significant disturbances of sleep and mental health occur for people living in homes up to 5 kilometers away from the wind turbines. This is because infrasound is capable of traveling greater distances than the sound you normally hear (which is why elephants and whales use it to communicate).

The wind turbine companies and most politicians are **turning a deaf ear to this problem**, and continue to promulgate false and debunked arguments that no problem exists. In this collection of pages we consider in detail some of these issues in which we have scientific expertise.

Specific Issues Considered:

- **Industrial Wind Turbines Generate Infrasound.**

- **The Ear Detects Infrasound at Levels that are not Heard**

- **Infrasounds you Cannot Hear Can Affect you.**

- **Why Wind Turbine Sound Measurements using the dB(A) Scale (A-weighted) are Misleading.**

- **Why it is Difficult to Demonstrate the Infrasound Generated by Wind Turbines**

- **550 Meter (or lower) Setbacks are Insane !**

Links to presentations, publications and other articles

- **Radio Interview about Wind Turbines and Infrasound with Dale Goldhawk, Zoomer Radio AM 740 Toronto, Nov 3, 2010**

- **Presentation at the First International Symposium, THE GLOBAL WIND INDUSTRY AND ADVERSE HEALTH EFFECTS, Picton Ontario, October 29-31, 2010**

- **Publication: Responses of the Ear to Low Frequency Sounds,Infrasound and Wind Turbines**

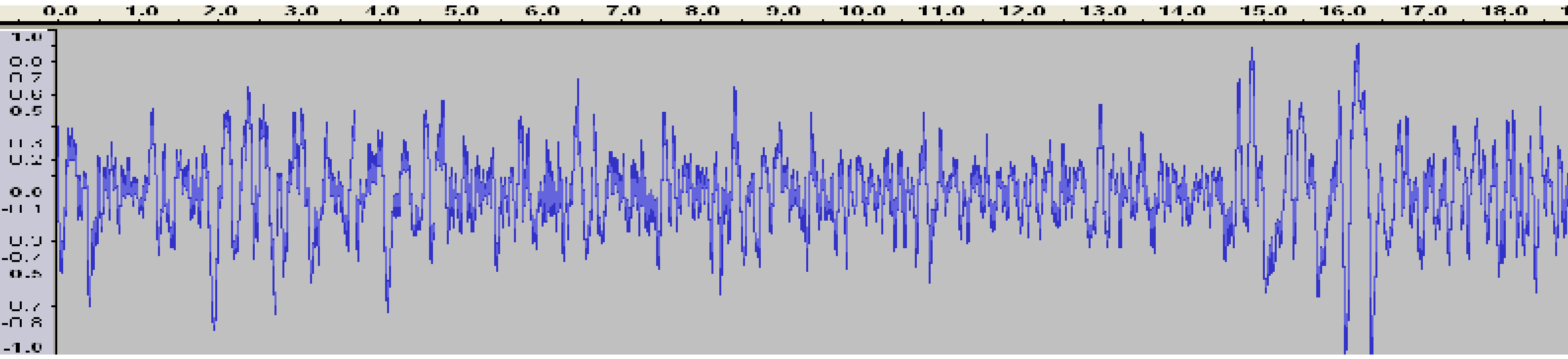
- **NIDCD Website: Scientist Challenges the Conventional Wisdom That What You Can't Hear Won't Hurt You**

- **Radio Health Journal: Wind Farms: Is there a Health hazard? Interview with Reed Pence, August 1, 2010**

According to the American Wind Energy Association website (**http://awea.org/pubs/factsheets/Wind_Turbines_and_Health.pdf**, 11/2/2010), "The wind industry takes health concerns seriously. Any concern that wind turbines may impact someone negatively should be explored." These statements appear difficult to reconcile with the absence of any consideration of the effects of infrasound from wind turbines on humans, and with the exclusion of infrasound components from wind turbine noise by the use of A-weighted sound measurements.

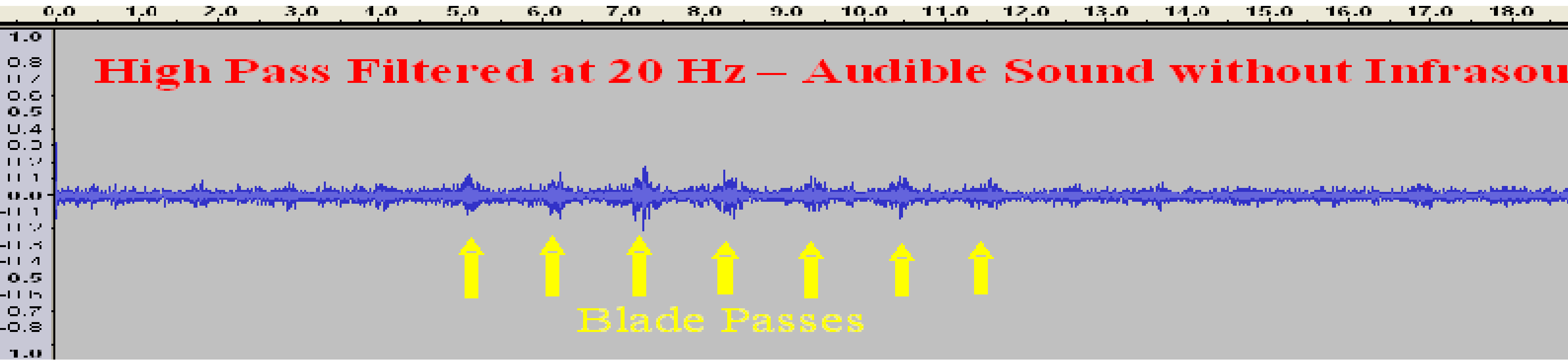
Industrial Wind Turbines Generate Infrasound.

This is a recording of 20 seconds of wind turbine noise (provided by Rick James) in the vestibule of a house located 1500' upwind of a wind turbine. The sound was recorded with a microphone capable of detecting sound frequencies as low as 1 Hz. Note that most recording systems (camcorders and camera systems used by TV stations) are NOT capable of detecting such low frequencies and do not represent the sound accurately. When this waveform is



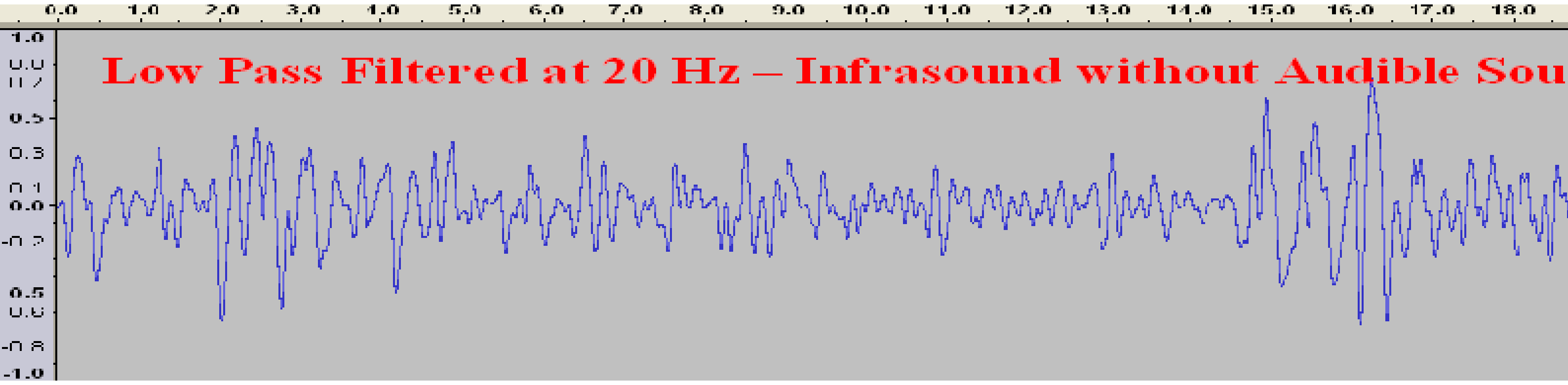
played by the computer you can hear the typical periodic swish of the blades rotating.

Below is the same sound recording after the infrasound has been removed (by high-pass filtering at 20 Hz). So this wave shows **the audible component** of the noise that is present in the waveform above. The two waveforms look very different because the upper one contains a large infrasound component that you cannot hear. **Even though the above and below waveforms look very different, they sound exactly the same** when played by a computer sound system. This is because you only hear the audible portion of the waveform and not the infrasound part. The waveform below represents the sound that most recording systems (such



as camcorders) detect.

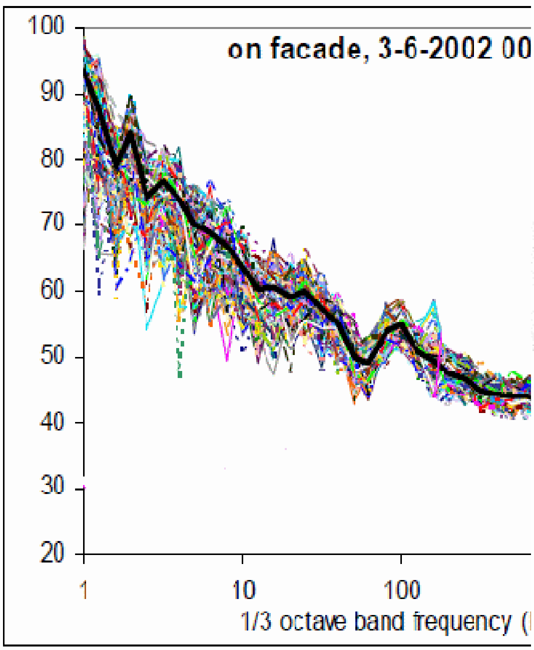
Below is the same sound recording in which now the audible sound has been removed (by low-pass filtering at 20 Hz). This shows the infrasound that dominated the initial recording. Even though the amplitude of this waveform is large, **you hear absolutely nothing when it is played back by the computer**. This is because the computer speaker system is not capable of generating such low frequencies, and even if it did, you probably would not be able to hear them at the level generated. This does NOT mean that your ears would not detect this sound. The ears are quite capable of responding to such sounds but infrasounds appear to be canceled out of conscious hearing. This is probably so that you are not distracted from environmental sounds by internal low frequency sounds such as from your respiration and heartbeat.

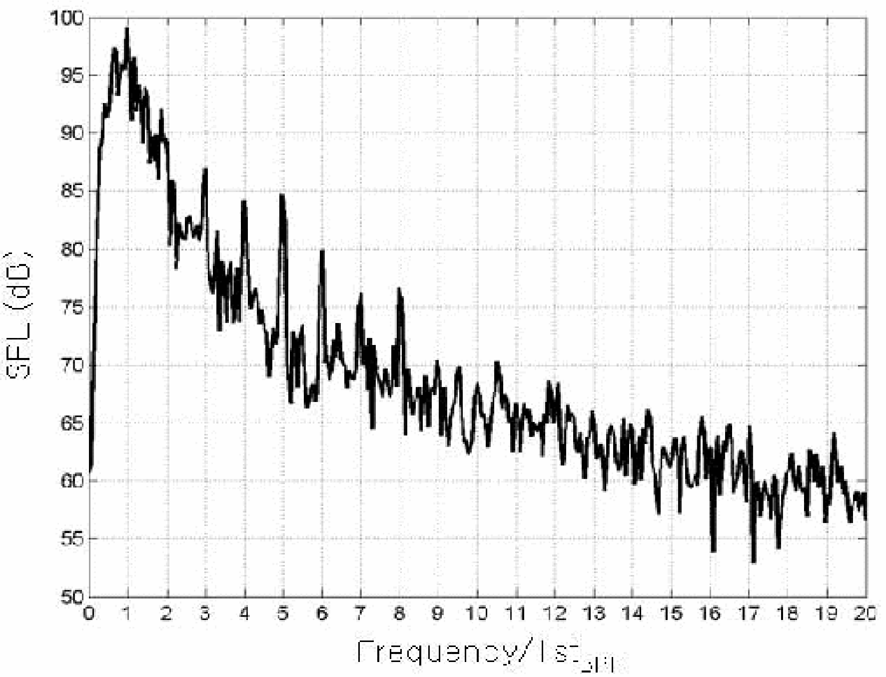


Also note that the biggest infrasound peaks (at 2 – 4 sec and 15 – 17 sec in waveforms 1 and 3) do not correspond to when the turbine sounds loudest (at 5 – 11 sec in waveform 2). **It is therefore impossible to judge the infrasound level from the sound that is heard or from A-weighted measurements**. Quantifying the sound with A-weighted measurements is analogous to having mustard and ketchup on a hamburger and trying to estimate the amount of mustard present by measuring the amount of ketchup. In order to know how much infrasound is present you have to measure the infrasound itself and not how loud the acoustic component of the sound is with A-weighted levels.

Below are shown wind turbine noise presented as a spectrum (Van den Berg, 2004 (left) and Jung and Cheung 2008 (right)). Both of these spectra show that most of the sound energy generated by wind turbines is in the infrasound range.

The level of infrasound a turbine makes depends on many factors. Unfortunately the factors that affect infrasound production are not widely presented in published literature but the wind turbine operators are certainly aware of them. **Generated infrasound depends on the size of the turbine, so small, personal turbines and the turbines in use up to about a decade ago do not present a problem.** In general, the biggest problems come from the bigger turbines, but even this will depend on the manufacturer and blade configuration. Infrasound generated depends on the loading of the turbine





(i.e. how much power it is generating) and will be lower when the turbine is “freewheeling”, i.e. when the blades are turning under low loads. Infrasound generation apparently depends on “inflow turbulence”, i.e. how much the wind speed varies across the diameter of the rotor. **For flat, open land, where the wind is not turbulent, windspeed over the rotor may be fairly uniform and infrasound production may be lower.** On the other hand, when turbines are built on ridgelines or in woodland, **where airflow is turbulent and is not uniform over the rotor, then infrasound generation may be greater**. Similarly, when wind turbines are grouped and the wind direction is such that the turbulent air downwind of one turbine hits a second turbine then infrasound generation by the second turbine will be greater. These location differences may account for why some communities have more problems with wind turbines than others. It also account for why some measurement studies find modest infrasound levels (around 70 dB SPL) while others, such as those above, find much higher levels. It is likely that infrasound generation is highly variable. But that isn't much consolation if you live near a turbine that generates high infrasound levels while the engineers are measuring similar turbines that have smoother airflow and which generate lower infrasound levels.

The wind industry makes highly misleading claims about the infrasound content of wind turbine noise. “Renewable UK”, the website of the British Wind Energy Association (www.bwea.com, 10/28/2010) use this quotation from one of their consultants.

“***I can state quite categorically that there is no significant infrasound from current designs of wind turbines”***

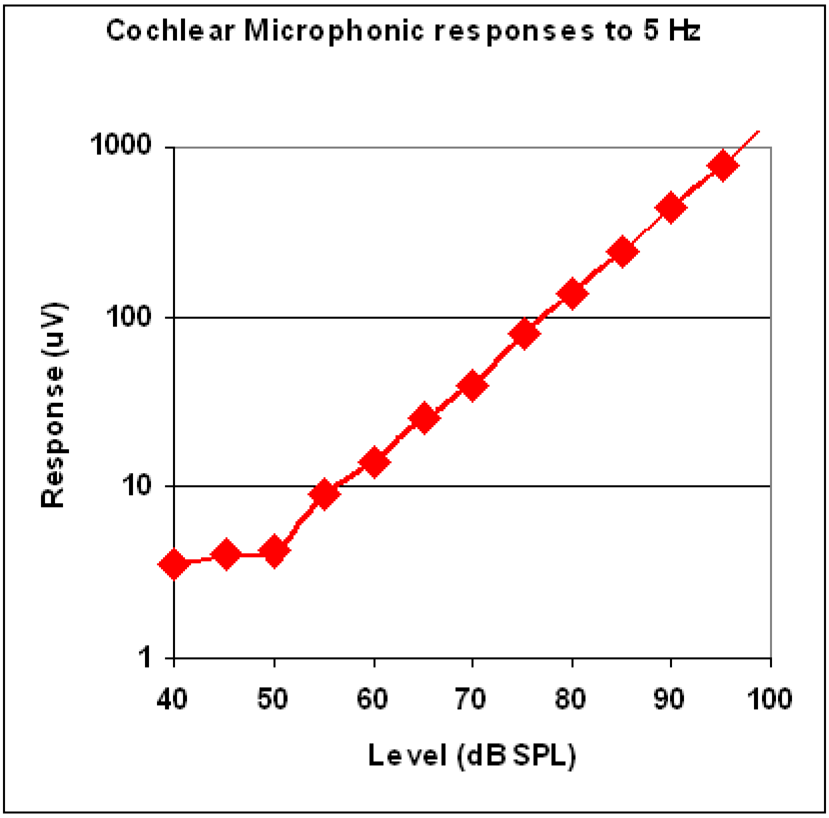
The critical word in this statement is the word “***significant”***. Although most naïve readers reading the statement would conclude that wind turbines do not generate infrasound, **nothing could be further from the truth**. As shown above, these devices do generate high levels of infrasound. The term “*significant”* is used to cover the fact that although turbines DO generate infrasound, it is assumed by the writer to have no consequence as humans cannot hear the infrasound at the levels produced. This is based on the invalid assumption that you must “hear” infrasound in order for it to affect you. This assumption is totally incorrect as discussed on other pages. Hearing is not the only way that infrasound can affect you. The infrasound is transduced by the ear at levels well below those that are heard and **can affect the body in a number of ways without being heard**.

Similarly, the reported quotation from Tom Gray of AWEA “*Wind turbine noise is as loud as your refrigerator heard from the living room.”* shows either a complete lack of understanding of the nature of wind turbine noise or an intentional misrepresentation of the true situation. Wind turbine noise is not comparable to the noise from a refrigerator. Refrigerators do not generate infrasound levels of over 90 dB at 1-2 Hz. I predict that IF THEY DID, NO ONE WOULD TOLERATE THEM IN THEIR HOUSES!!

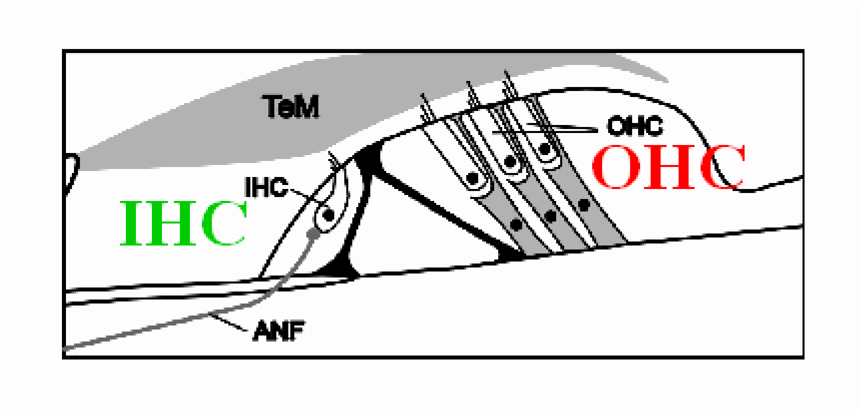
The Ear Detects Infrasound at Levels that are not Heard.

In humans an infrasonic tone at 5 Hz must be presented at approximately 109 dB SPL in order to be heard. In guinea pigs, measured hearing sensitivity to low frequency tones indicates their ears are approximately 10 dB LESS sensitive than the human, requiring 10 dB higher sound levels. It can therefore be inferred that for a guinea pig, a 5 Hz tone would need to be presented at approximately 119 dB SPL in order to be heard.

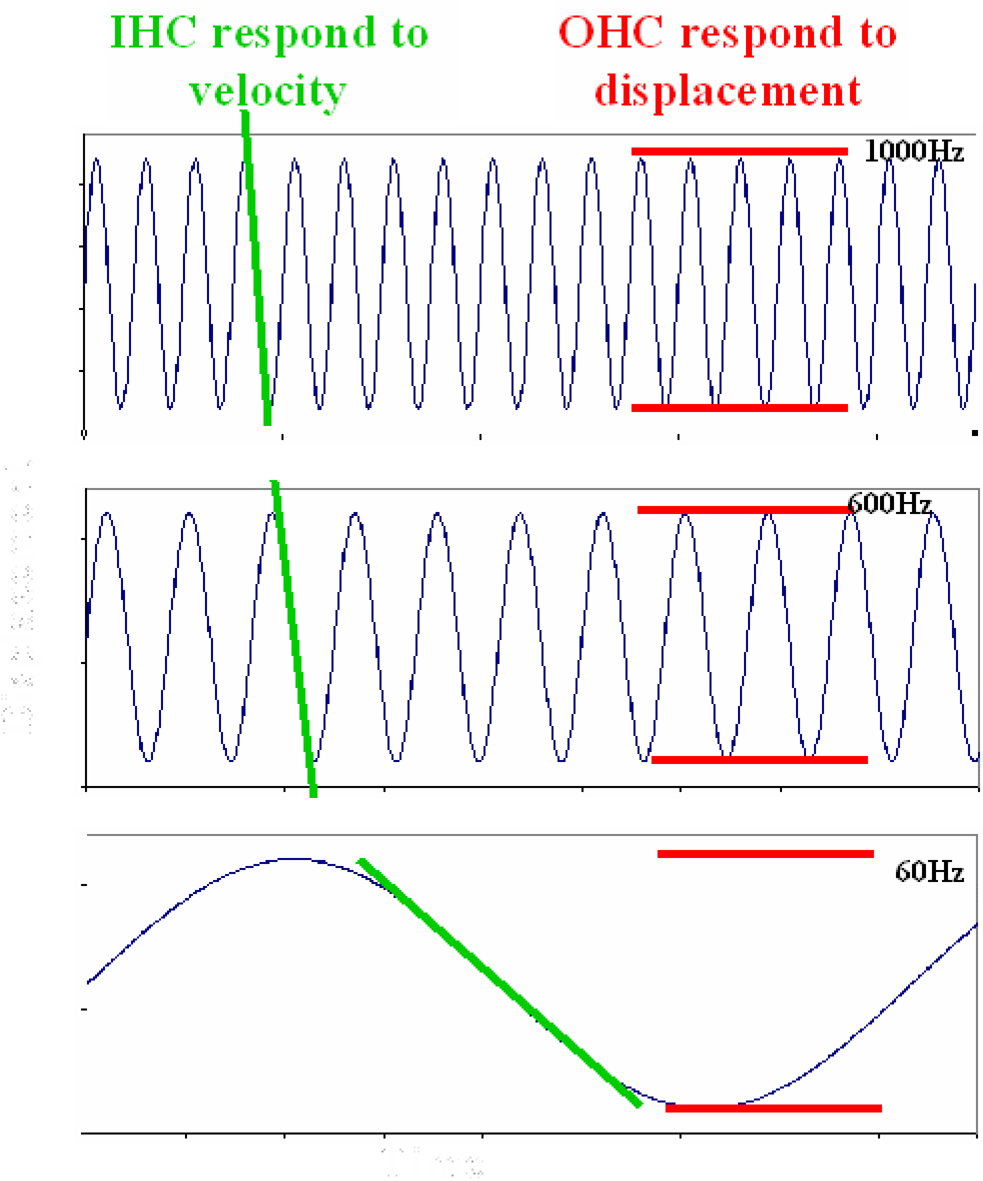
The graph below shows the amplitude of cochlear responses to 5 Hz tones in the guinea pig. These responses were recorded from an electrode inserted into scala media of the third cochlear turn. Responses were band-pass filtered around 5 Hz and in each case the responses to 20 stimulus presentations were averaged to reduce background noise. Using this methodology, it was found that consistent 5 Hz cochlear microphonic responses were recorded with sound levels down to 55 dB SPL, which is OVER 60 dB below the level that is heard by the guinea pig. This demonstrates that the mammalian inner ear responds well to infrasounds, even at levels well below those that are heard.



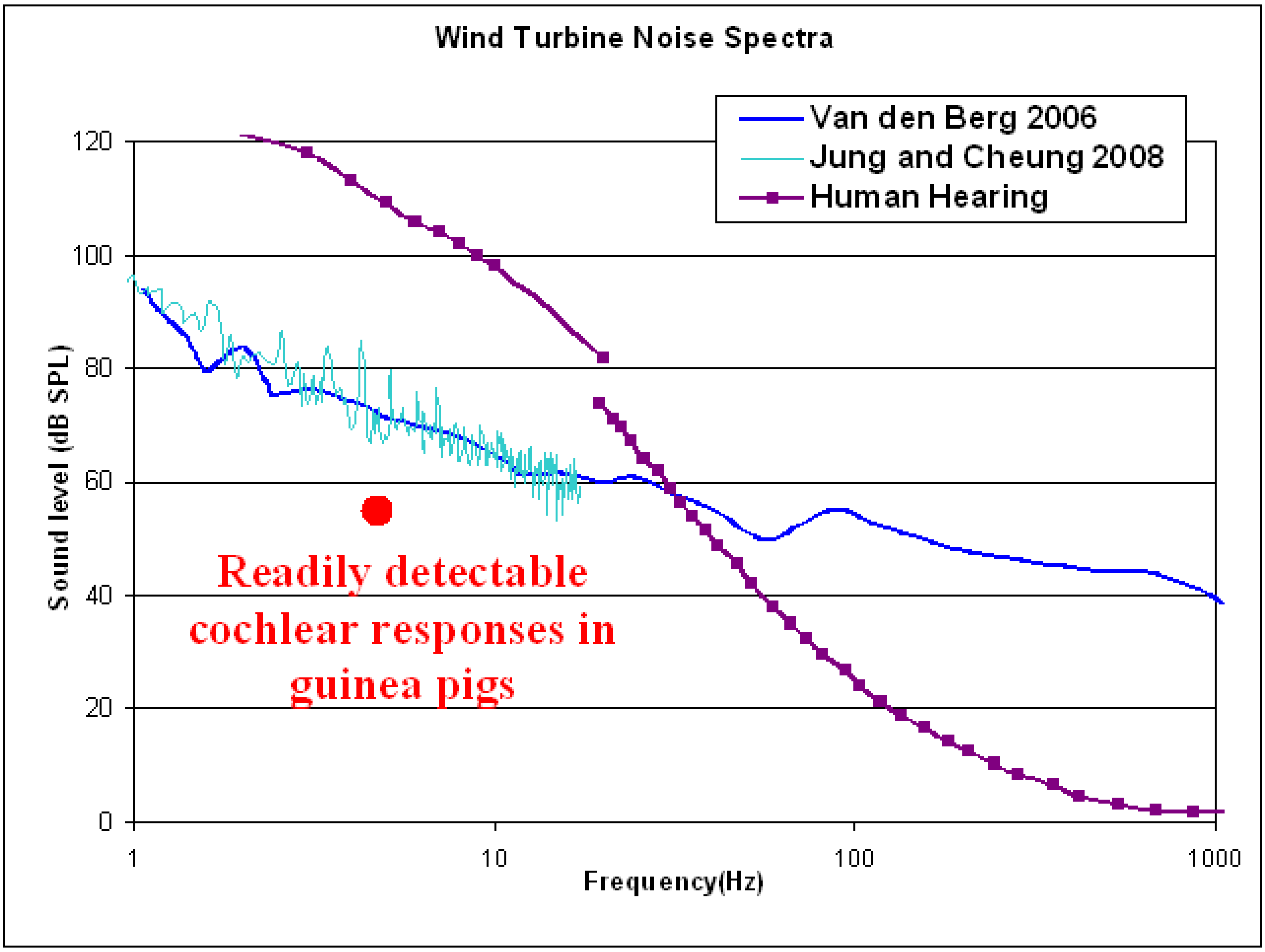
The explanation for this difference is provided by the fact that the cochlear microphonic responses are generated by the outer hair cells (OHC) of the cochlea while hearing is mediated by the inner hair cells (IHC) of the cochlea. The sensory hairs of the OHC are embedded in the gelatinous tectorial membrane so they respond to basilar membrane displacements. In contrast, the sensory hairs of the IHC do not contact the tectorial membrane but remain in the fluid filled subtectorial space. As a result, the two types of cell respond differently to low frequency stimuli



While the OHC respond to displacement, the IHC respond to the velocity of the stimulus. This is illustrated below for 3 stimuli of different frequency at the same presentation level. The OHC would be stimulated equally by the 3 stimuli of equal displacement, while the IHC would be stimulated less by the the lower frequency stimulus, because the maximum velocity of the the stimulus is reduced as frequency decreases. For this reason, the IHC (and hearing) becomes less sensitive at lower frequencies, while OHC responses such as the cochlear microphonic are better maintained.



The figure below shows low frequency sound levels generated by wind turbines (blue, cyan) compared with human hearing sensitivity (purple) and also the sound level which elicits cochlear responses in guinea pigs. Human cochlear responses would be expected to occur with sounds at similar levels or lower than those in the guinea pig.



It can be concluded that the ear responds to infrasonic sound stimuli at levels well below those that are heard. The infrasonic sounds generated by wind turbines are sufficient to stimulate the ear and elicit physiologic responses.

What you cannot hear CAN affect you.

The American Wind Energy Association state that a scientific panel they sponsored concluded that :

"***Subaudible, low frequency sound and infrasound from wind turbines do not present a risk to human health.***"

The erroneous assumption made by this committee was that effects of low frequency sound can only be mediated through **hearing,** so that if infrasounds could not be heard then they could not possibly affect human physiology.

Such an assumption is patently false when other sensory systems are considered.

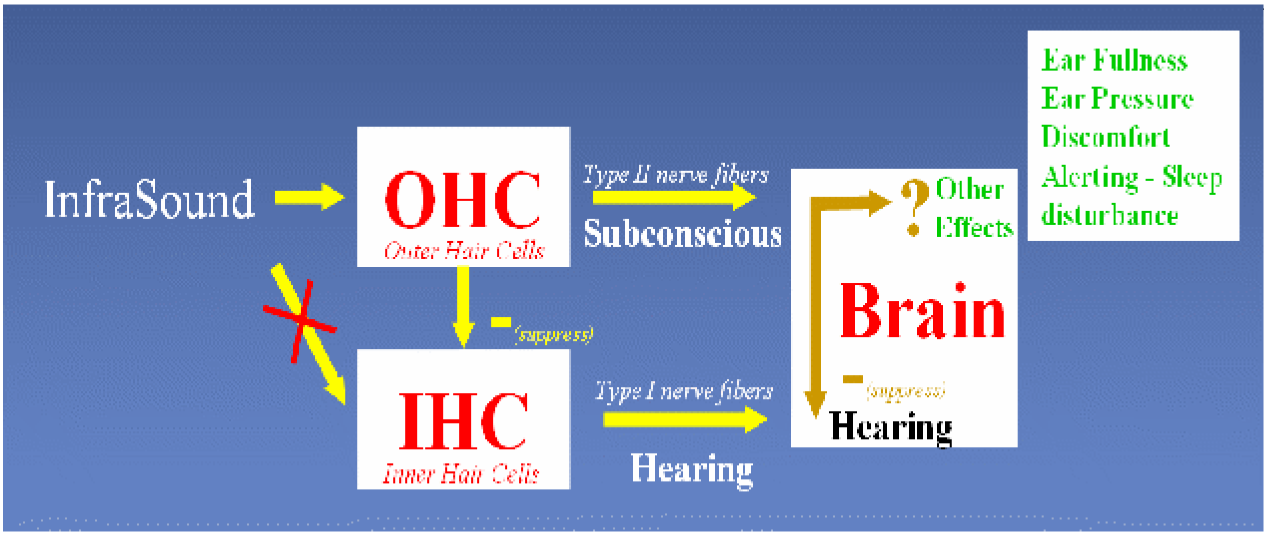
We know there are countless **things we cannot TASTE that can harm us**. From tetrodotoxin (puffer fish poison) to salmonella there are numerous examples of undetectable substances that can sicken or kill us.

We know there are **many things that we cannot SMELL that can harm us**. The lethal dangers of breathing carbon monoxide or carbon dioxide are well established.

We know there are **things that we cannot SEE that can harm us**. It is well established that ultraviolet light is invisible, yet it can make someone's life miserable, with skin burns and eye damage if they are exposed to excessive amounts.

So, one wonders what was the scientific basis of the assumption that sounds that could not be heard could have no influence on the body. According to Alves-Pereira and Castelo Branco (Prog Biophys Mol Biol 2007; 93:256) the statement that "What you can't hear, won't hurt you" is attributable to a 2001 newspaper article by a sound engineer (Campanella) related to the "Kokomo Hum". The point is that this concept was not established by a medical doctor or researcher with specific knowledge of the ear but was introduced by someone with limited knowledge of inner ear physiology. As such, this concept amounts to unfounded speculation, which nevertheless has been repeated over and over in many articles to the extent that it had apparently become accepted in some circles as if it were a proven fact.

What the illustration below summarizes is our knowledge of the physiologic pathways in the ear that show **sounds CAN affect the brain by pathways that are unrelated and are more sensitive than hearing**.



While the inner hair cells (IHC), which mediate hearing, are insensitive to infrasound the outer hair cells (OHC) are stimulated by infrasound. In addition there may be multiple additional mechanisms that actively eliminate infrasounds from hearing. It has been shown that Type II afferent fibers connect groups of OHC in the cochlea to the cochlear nucleus, so their activity is represented at the brainstem level. The fact that we cannot hear infrasounds suggests that stimulation of these pathways does not give a conscious percept, and instead may even contribute to the exclusion of the perception of infrasounds. Nevertheless, activation of these afferent pathways could give rise to symptoms such as ear fullness or pressure, discomfort and could be involved in sleep disturbance.

As this physiologic pathway between the OHC and the brain exists, the possibility of physiologic disturbances by inaudible sounds cannot be so easily dismissed.

It should also be stressed that this is not the only pathway by which infrasound could affect the body. Responses of vestibular (e.g. saccular) receptors to acoustic infrasound have never been reported. In view of the known high sensitivity of vestibular hair cells to infrasonic frequencies, such a possibility cannot yet be excluded. Similarly, infrasound-induced alterations of ion transport and cochlear fluid status could give rise to physiologic disturbance following prolonged exposure. Many such mechanisms remain to be studied.

So, we conclude that in view of the known physiology of the ear, the idea that sounds you cannot hear can have no effect on the body is totally incorrect.

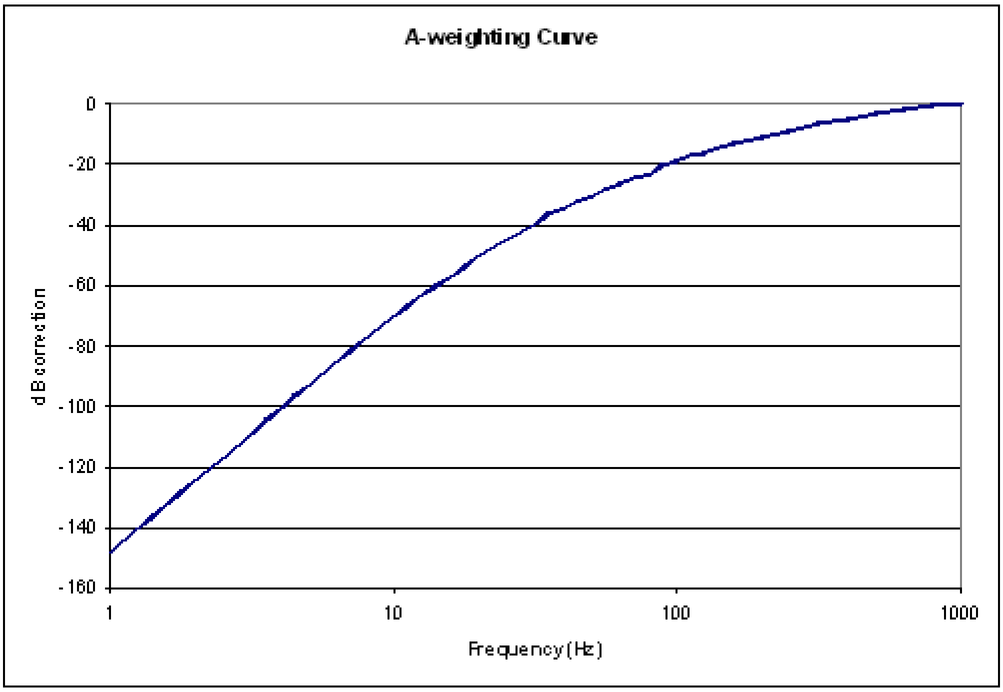
Wind Turbine Sound Measurements.

The majority of sound measurements presented to the public by the wind turbine industry are so-called "A-weighted" or dB A measurements.

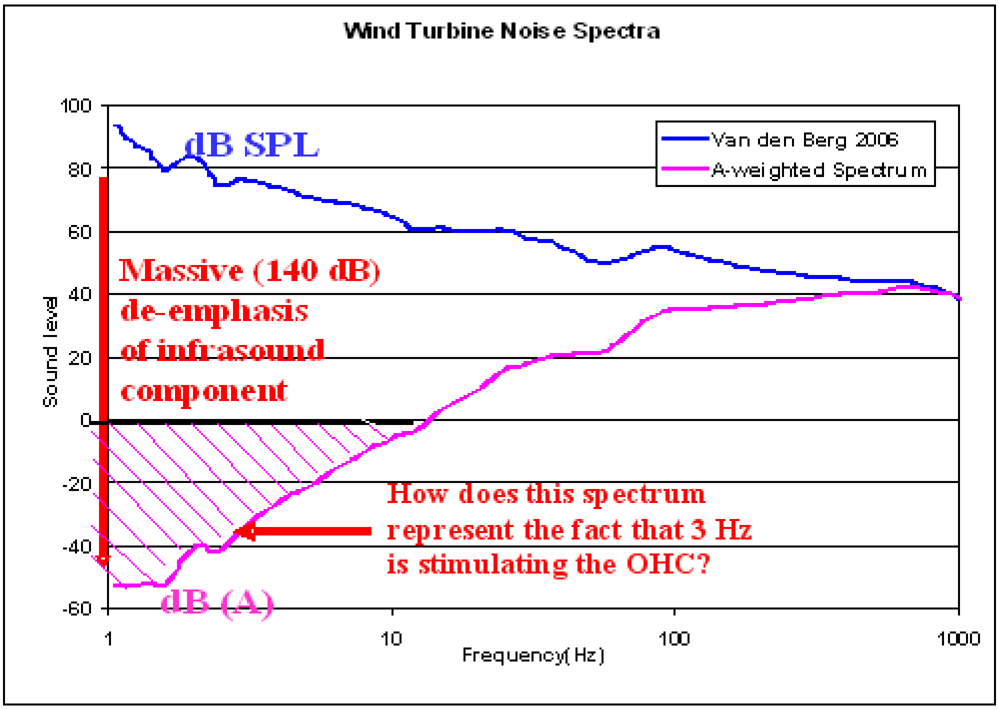
According to "RenewableUK", the website of the British Wind Energy Association (http://www.bwea.com/ref/noise.html, 11/2/2010) "the noise from wind turbines is very low. Outside the nearest houses, which are at least 300 metres away, and more often further, the sound of a wind turbine generating electricity is likely to be about the same level as noise from a flowing stream about 50-100 metres away or the noise of leaves rustling in a gentle breeze. This is similar to the sound level inside a typical living room with a gas fire switched on, or the reading room of a library or in an unoccupied, quiet, air-conditioned office." They then state that the noise level from a wind farm at 350m is typically 35-45 dB A.

The problem with such measurements is that they totally ignore the large infrasound component of wind turbine noise, which is the component that "bothers the heck out of people".

The A-weighting curve corrects measurements according to the sensitivity of human hearing, de-emphasizing low frequency components for which the ear is insensitive. It is valid to use this correction if **hearing** the sound is the prime concern, but is not appropriate to use this approach when processes unrelated to hearing (such as whether a low frequency sound affects your ear) are being considered.



The A-weighting curve is not by any means a "small correction". At 1 Hz (the dominant frequency of wind turbine noise) the correction amounts to over 140 dB, which is equivalent to dividing the measured voltage by over 25 million. If you take the quietest sound you can hear, and compare it with the sound of a 747 Jumbo jet flying 10 feet above your head under full power, then you may be approaching 140 dB. The point is that this is a massive correction.



This figure shows the influence of A-weighting the wind turbine noise spectrum obtained by Van den Berg 2006. A-weighting completely deemphasizes the low frequency components as if they didn't exist.

Because one of the main influences of wind turbine noise may be caused by the infrasound component of the noise, this manipulation has the effect of totally ignoring this potential source of the problem.

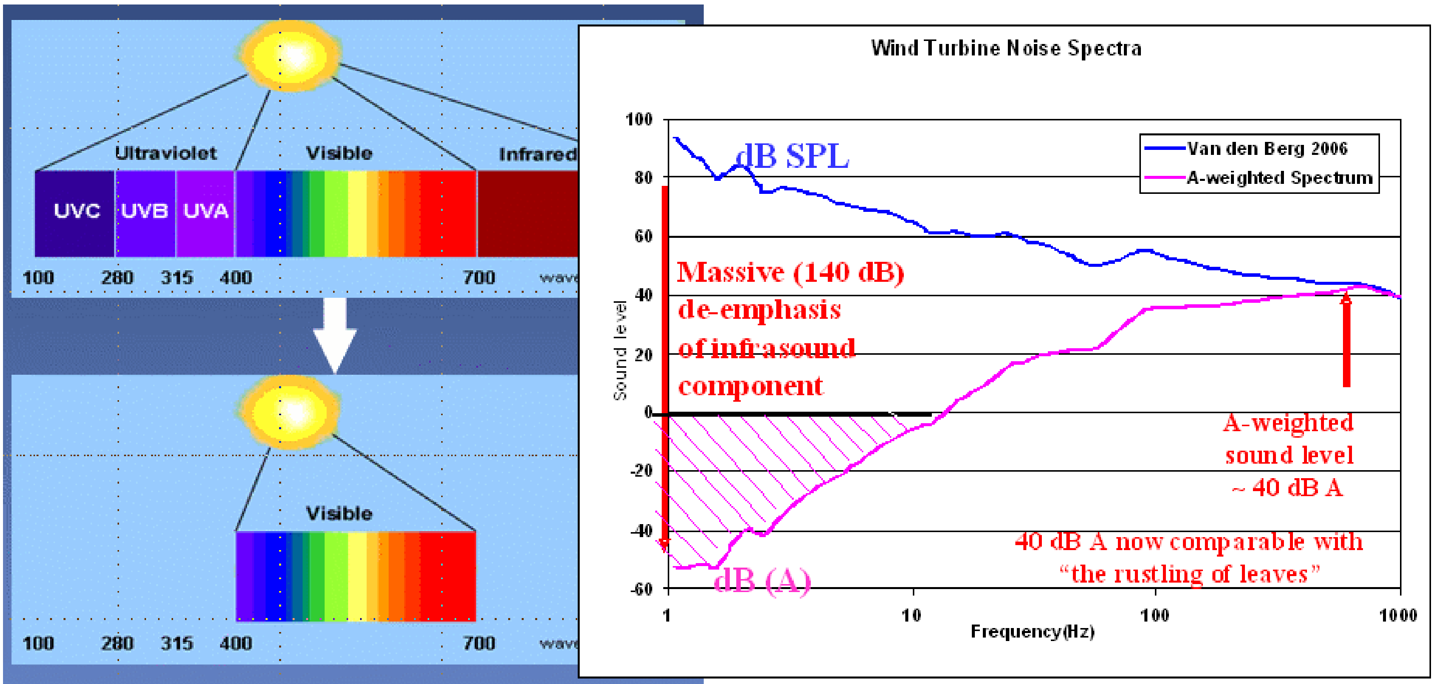
The A-weighted spectrum does not take into account that **other structures in the ear are more sensitive to infrasound** and are affected to a greater degree than hearing.

A-weighting wind turbine noise is equivalent to taking sunlight and considering only the visible portion of the spectrum, then concluding that sunlight is completely safe and there will be no adverse effects if you spend all day laying in the sun.

We know this logic is not valid for sunlight and the same logic is just as invalid in justifying A-weighted measurements of wind turbine noise.

Once the sound has been A-weighted (taking out all the infrasound component, the remaining peak is then about 40 dB, representing the 40 dB A measure.

Now the level is comparable with "the rustling of leaves". Comparing wind turbine noise with the "rustling of leaves" and the sound of a "flowing stream" is disingenuous at best. It may be what is heard BUT it is totally misleading because the noise from rustling leaves and flowing

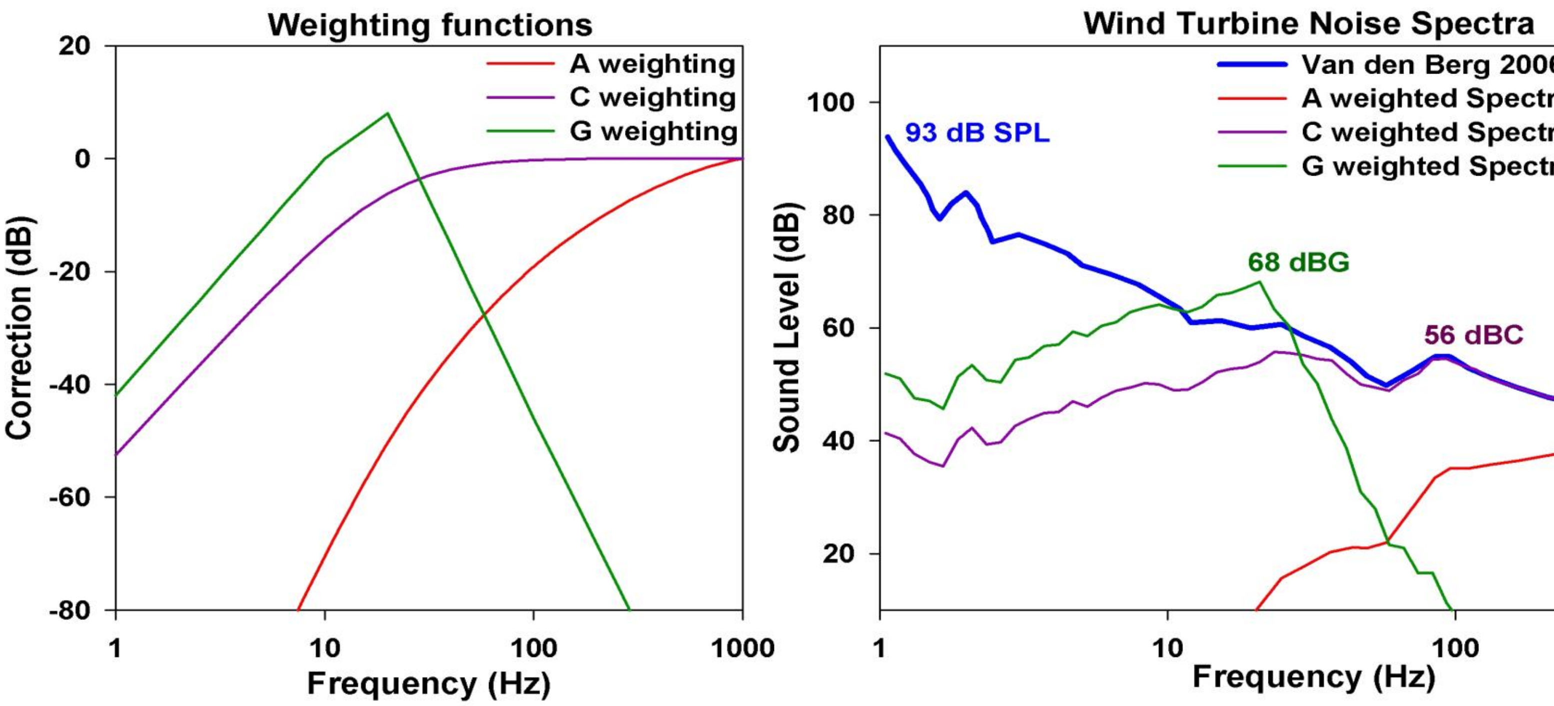


streams is NOT DOMINATED BY INFRASOUND.

It is well established that infrasound does have effects on people. Indeed it bothers them intensely. So, to ignore this component of the noise is to ignore the major problem that this noise causes to people, by disturbing sleep and with subsequent damage to their health.

How different frequency-weighting functions affect wind turbine noise measurements

The common weighting functions related to low frequency noise are shown in the panel at the left, below. This includes the A-weighting (red) , C-weighting (purple) and G-weighting (green) curves. To see how these functions affect sound measurements, consider the panel at the right which shows an unweighted wind turbine spectrum (blue) and the same spectrum subjected to A-, C-, or G-weighting. As shown above, A-weighting cuts most of the low frequency sound out, leaving the peak of the A-weighted spectrum at around 42 dBA. (*Ah – Did I hear a leaf rustle over there? No, it was just the refrigerator in the next room turning on.*)



C-weighting (purple) does not cut out low frequencies so much, so the peak of the C-weighted spectrum of the same noise is higher, in this case around 56 dBC

G-weighting (green) emphasises the higher infrasound frequencies (10-20 Hz) and cut out frequency components lower and higher than this. The peak of the G-weighted spectrum is higher (68 dBG) which compares well with the G-weighted measurements by *Jakobsen, J., 2005 Infrasound emission from wind turbines Journal of Low Frequency Noise Vibration and Active Control 24, 145-155.*

These comparisons show that the measurements of wind turbine noise depends highly on exactly how the different frequency components are considered in, or excluded from, the measurement.

A-weighting cuts out most low frequency sound and gives the lowest reading.

C-weighted allows more low frequency sound and gives a measure intermediate between A- and G-weighting.

G- weighting gives a measure of the infrasound (10-20 Hz) components

Unweighted measures give the highest peak readings

Question to the group: Why do **you** think the wind turbine industry typically characterizes wind turbine noise with only A-weighted measurements?

Documenting Wind Turbine Sound

Do you know why welders use a heavy mask? **This picture doesn't show you.** It is because the welding arc generates an intense amount of ultraviolet (UV) light. Even if the welder is just a little slow in covering his eyes with the mask, the UV light may be enough to cause welder's flash, which is sore, red, painful eyes. (I know, because it caught me once and it is a lesson you never forget).

But you would never know that from this picture. Because the camera is insensitive to UV light and pictures cannot show what the real problem is.

To identify the real problem you need a camera or other measurement system that is sensitive to UV light.

Similarly, most systems used to record wind turbine noise are not sensitive to the "unheard" (equivalent to invisible) infrasound component. So when camcorder videos are posted on You-tube, or when news crews turn up to record a segment about wind turbine noise for the local news, **their equipment is incapable of demonstrating the problem.** Many types of microphone (such as moving coil types) are insensitive to infrasound. And if the microphone does detect it, the infrasound is often filtered out electrically so that it doesn't "saturate" the recording system. These devices are designed to reproduce the sounds you normally hear. They are not designed to reproduce the unusual infrasound component of wind turbine noise that you cannot hear.

Even if the wind turbine sound was recorded with a condenser microphone and amplifier system capable of accurately reproducing the infrasound, it would still be hard to demonstrate this sound to people away from the wind turbines. Most speaker systems or headphones cannot generate infrasound adequately. It is possible that with headphones carefully sealed to the external ear canal, the sound could be replicated but at present there are no commercial systems available to do this.

This means that it is very difficult to show people away from wind turbines (politicians, doctors, etc.) what the effects of the noise are. So it is important to be aware of this important limitation of present technology. The sounds you hear from recorded media do not represent the "real", "complete" sound of a wind turbine. **As in the picture above, such recordings are missing what may be the most important component with regard to human health, which is the infrasound portion.**

Detailed documentation of wind turbine noise characteristics (such as unweighted sound spectra) under different wind and load conditions is, surprisingly, virtually absent from the scientific literature. There are a few publications in "obscure" journals that we cited in our publication. It is notable that there are no recent publications in the Acoustical Society of America (of which I am a member) that document the noise characteristics of wind turbines. One would think that no-one was interested in the topic ! Since many of these measurements are "proprietary data", commissioned by wind turbine operators, the fact that they are not made public itself speaks volumes about the nature of this noise.

Finally, visits to windfarms by politicians, neighbors-to-be and the like is easily subject to manipulation. It has been suggested that turbines may be set to "freewheel" during such visits (with minimal generator loading and blades orientated at a shallow angle to the wind) so that their noise generation is minimized. Any assessment or demonstration of wind turbine noise needs to be performed under normal functional conditions. The most appropriate monitoring of such noise should be through "dosimeters" recording noise levels within people's homes, 24 hours per day. This should include both A-weighted sound (representing the sound you can hear) and G-weighted sound levels (which represents the infrasound component). It is estimated that you can hear infrasound at about a 95 dB G levels, but the cells of the inner ear are stimulated by about 60 dB G. So dB G measurements of over 60 dB must be considered significant. Alternatively, wide band spectra (sensitive down to at least 1 Hz) could be measured.

550 Meter Setbacks are INSANE !

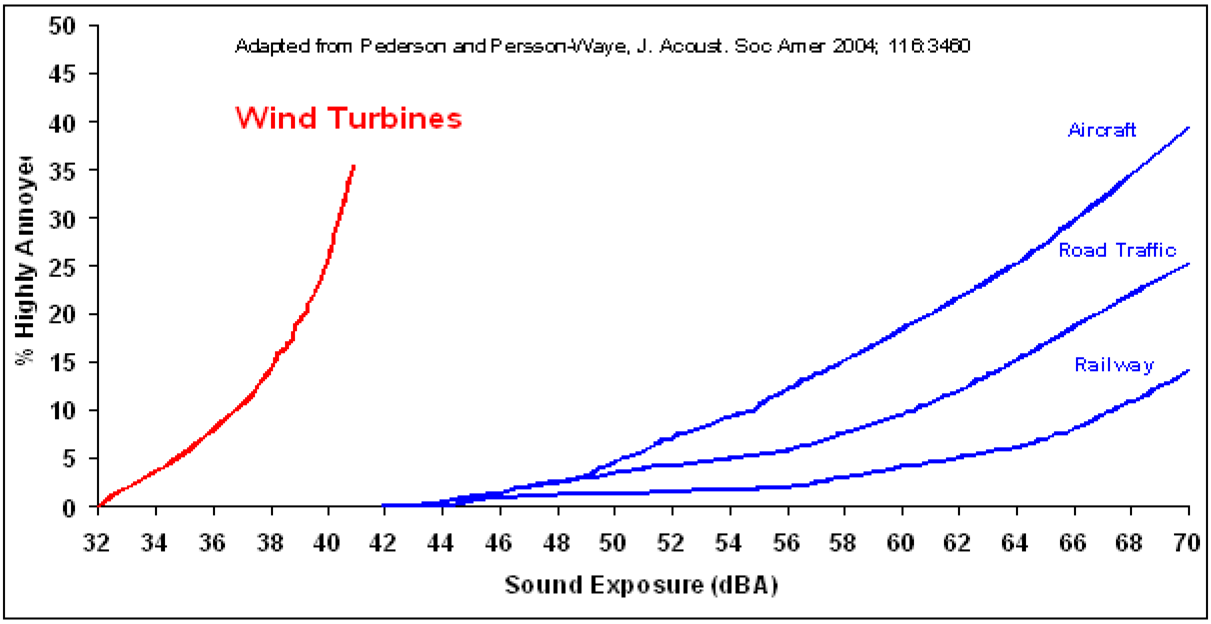
In a radio interview on 11/3/2010 with Dale Goldhawk on Zoomer Radio AM 740 Toronto, I made the statement that "the 550 meter setback distance between wind turbines and people's homes was absolutely insane". I stand by that statement.

It is often said that the definition of insanity is to do the same thing over and over and expect a different outcome. Engineers have known for years that low frequency sound disturbs people intensely. In a presentation given on Sept 9 in Birmingham, UK, Malcolm Swinbanks, an engineer with years of experience in infrasound issues presented data from his own work with gas turbine sounds in the 1980's, as well as NASA research showing that low frequency sounds disturbed people. He estimated that modern wind turbines are likely to influence about 10% of young adults.

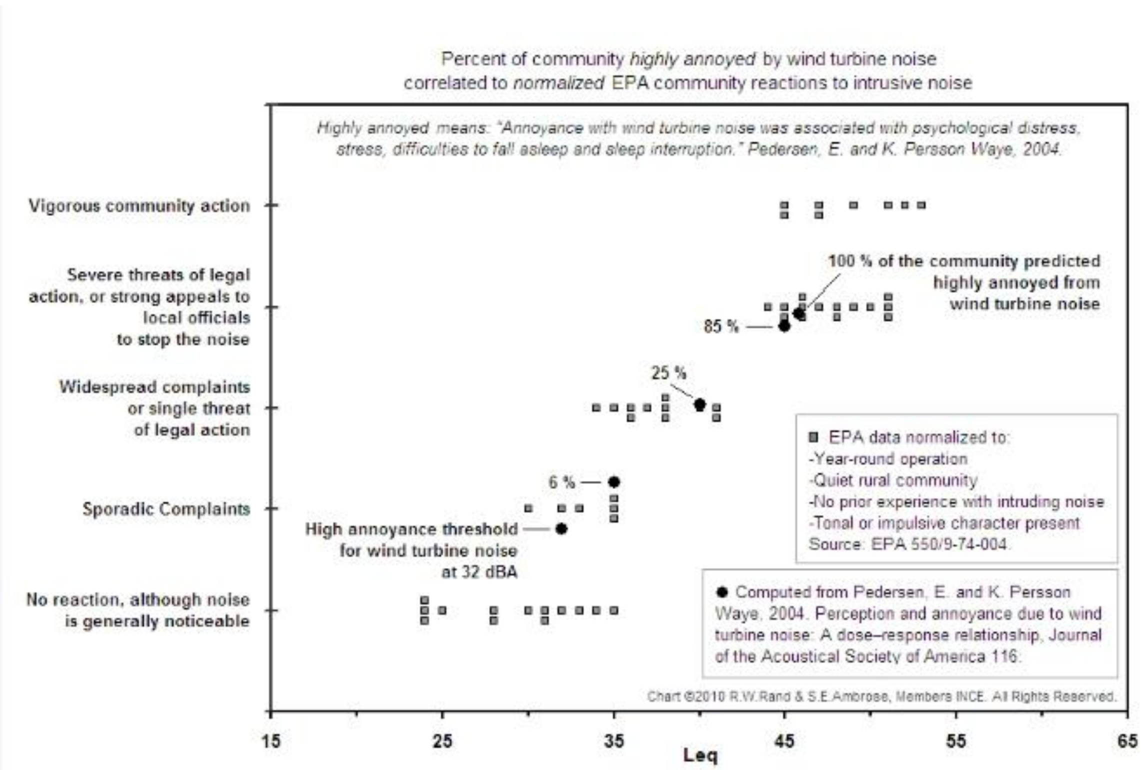
This was all known 20 years ago !!!

So putting up wind turbines, which are known to generate infrasound, near peoples houses and to expect to NOT cause problems in my view is the height of insanity. It is just generating more and more people with problems.

If you look at the relationship between annoyance and different noise sources you can see that wind turbine noise is clearly "different" from other types of noise . Comparing with aircraft, automobile or rail traffic wind turbine noise at about 30 dB lower levels (40 dBA rather than 68 dB A or higher) annoys 30 % of people. There are attempts to justify the increased annoyance by other (e.g. visual) factors but the possibility remains that the noise itself could be more annoying, due to the **infrasound that is present in the noise but which is excluded from the A-weighted measurement.**



The problem is also well demonstrated by the following chart put together by Stephen Ambrose and Robert Rand of Rand Acoustics (click link for more details). It shows how annoyance and complaints are related to the sound generated by turbines.



The first thing to note is that the Leq represents the A-weighted noise level (i.e. only the sound you can hear). In order to get very few complaints, the Leq of wind turbine noise must be 30-35 dBA or lower. This is a remarkably LOW level compared to other types of noise such as road traffic. This alone tells you that wind turbine noise is “different” from other types of noise. **It is more annoying.** And the reason people find it annoying is because of the **high infrasound component which is not measured in this dBA reading, but is detected by the human ear.** So, even though your refrigerator may make a higher sound level, your refrigerator isn't so annoying and doesn't keep you awake at night because your refrigerator is not generating infrasound to the same degree. If you keep following the readings up the curve, at 35 dB, 6% of people will be bothered/annoyed, at 40 dB about 25%, and then at 45 dB about 85% will be annoyed by the noise. (Note that the upper part of the curve is an interpolation based on Pederson et al.'s report of 45% of people annoyed at 42 dB A).

So, when the wind turbine companies negotiate allowable Leq levels of 45 dB or higher, and then put in their turbines which generate noise at that level, and then are **surprised** when people start complaining. That is totally insane. The complaints, the annoyance and the subsequent health problems from the chronic annoyance and sleep deprivation that result are **ALL TOTALLY PREDICTABLE**.

Why turbine companies want to keep putting these devices close to peoples houses is difficult to understand. One quick answer could be that $ matter more than people. But it is more complex than that. The real answer is that those whose jobs depend on the wind turbine companies, the consultants, the engineers, and the politicians who support wind energy for green reasons, they have all drunk the "Kool-Aid". None of them want to hear that they may be a problem. Now, the situation has become so dire that no-one associated with the wind turbine companies dares raise their head and accept there is a problem. It has become like a religion or cult. It is the "If you are not for us, you are against us" mentality. Anyone who accepts there may be a problem will be immediately cast out. In my view, it is the engineers and experts **who should have known better** who are the real cause of this problem. **They have let the wind turbine companies down by not preparing them for this possibility.** To me, I see the data above and have no doubt there is a problem. For those in the wind turbine community, they see the data above and say it just can't be true. How can such a low sound level cause such a problem? Gosh darn it, my refrigerator is louder than that and I live with it.

The reason why wind turbine noise is more annoying than a refrigerator is because the wind turbine produces high levels of INFRASOUND !

If you don't understand the infrasound problem then these Leq annoyance curves do not make sense. The annoyance Leqs are low because they are only looking at part of the noise, the part you can hear. And the part you can hear is not the most annoying part.

So, the problem is that in most cases, setback distances are either not based on sound generation or they are based on A-weighted sound levels. In some cases they are based on safety aspects, so flying parts don't come through the roof of one of these machines falls over. These setbacks are typically much lower than those based on sound levels. The 550 meter setback is apparently intended to keep the sound level at people's homes below 40 dB A. As we can see from the above graph, that will leave 25% of the people living there annoyed for the rest of their lives living in their home, except on calm days or until they decide to move. So instead of claiming that these are really low sound levels that couldn't possibly affect anyone, the sound levels considered need to include G-weighted or comparable measures of the INFRASOUND, bearing in mind that infrasound at approximately 60 dB G stimulates the inner ear. The A-weighted (dB A) measurements on which decisions are presently based totally ignore the infrasound component and thus ignore the documented infrasound problem. Pretending the infrasound problem doesn't exist, won't make it go away. Instead, putting up more of these devices close to people's homes just gives us more subjects to study, more people to file lawsuits, and more people who quite predictably get annoyed. The wind turbine industry has to come to terms with this reality. *Last edited 12/28/2010*