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Ms. Wallace

Please receive this as an official comment on the above mentioned document. When I first learned about the unpleasant experiences of some small town and rural residents, as a result of the proximity of industrial wind turbines, I was shocked. I was also taken back by the hostility being expressed toward them by others, and by the insensitivity expressed toward them by so many people in positions of power and responsibility.

As an in-town resident, I'm not directly affected by an industrial wind tubine facility. However, I cannot help but feel sympathy for my rural "brothers and sisters". In my own pursuit to understand more about the affects of industrial wind turbines, I've delved into a number of issues and factors, and have arrived at certain conclusions and impressions along the way.

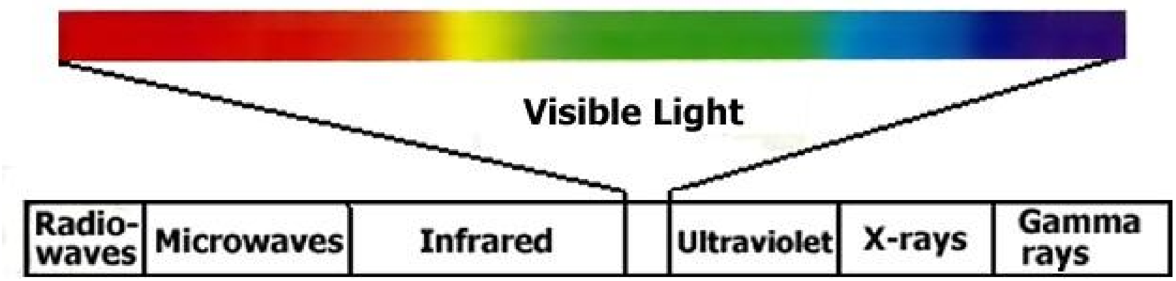
I want to make it clear that I have no technical credentials in science. I'm simply hoping to achieve an increased understanding of the problems of industrial wind turbines and a reduction in their negative impacts.

I believe that modern industrial wind turbines produce substantial levels of low frequency sound and infrasound which are incompatible with human habitation within distances of up to (and possibly beyond) 2 kilometers. It is my position that only by better understanding the effects of standing-waves and resonant-amplification of sound in this context (and the causative nature of high volumes of interacting air pressure variants) can we properly protect our citizens. Following are excerpts from a resource I've put together online. They are included here as part of my submission to explain how I have reached my position. They can also be accessed online under the title of Wayward Wind [1] .

1. Our Senses

The initial impression of wind turbines is upon our eyes and ears. By the light of day, the impression is visual. And, once the blades start turning, the impression is also auditory. These initial impressions are made through our senses of vision and hearing. As with the vast majority of our daily experiences, we tend to also consider wind turbines simply as an 'audio-visual' experience.

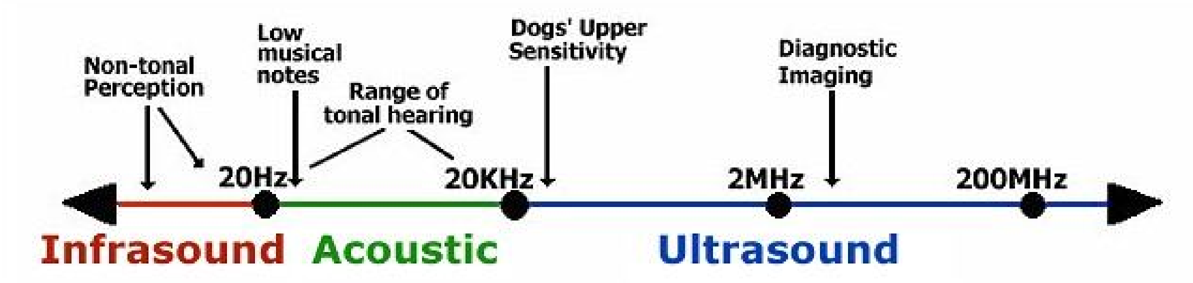
Our sense of sight is based on our eyes being sensitive to certain frequencies of electromagnetic radiation. Most of us realize that our eyes recognize only those frequencies of electromagnetic radiation known as visible light, and that the full spectrum of electromagnetic radiation also includes *radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays and gamma rays*.



In today's technologically enriched world, most of us are aware that radio frequencies of electromagnetic radiation provide much of our means of distant communications, that microwave frequencies of electromagnetic radiation conveniently heat our food, that infrared frequencies of electromagnetic radiation reheat convenience foods, that ultraviolet frequencies of electromagnetic radiation make some substances fluoresce and also causes sunburn, that X-ray frequencies of electromagnetic radiation provides penetrating medical insights, and that gamma ray frequencies of electromagnetic radiation are destructive to flesh.

Our sense of hearing is based on our ears being sensitive to certain frequencies of atmospheric compressions. Most of us know that our ears recognize those frequencies of atmospheric compressions known as audible tonal sound, and that there are higher and lower frequencies beyond this acoustic range of frequencies.

However, in today's visually pre-occupied world, our familiarity with extreme frequencies of atmospheric compression beyond acoustic sound is actually quite limited. Typically, most people are aware that 'dog whistles' utilize extremely high frequencies to get response from dogs' higher frequency range of hearing, and that 'movie theatre sound systems' utilize extremely low frequencies to produce 'ground-shaking vibrations'.



Society's limited appreciation of the potential of extreme frequencies of atmospheric compression has led to the entertainment, manufacturing, medical and environmental industries focusing the majority of their attention to the fully audible or 'acoustic' frequencies .. to the extreme practice of purposely filtering out non-tonal or 'inaudible' compression frequencies by using the 'dBA' filter in establishing production standards, legislation and regulations.

Society's general ignorance of the great energy that low frequencies of atmospheric compression can impart and of the health impacts these compressions can inflict, has allowed the wind turbine industry to produce and install increasingly larger and larger turbines with concerns only for the acoustic frequencies being produced. This societal bias has allowed the wind turbine industry to proceed unchecked so far, to the point where it is today.

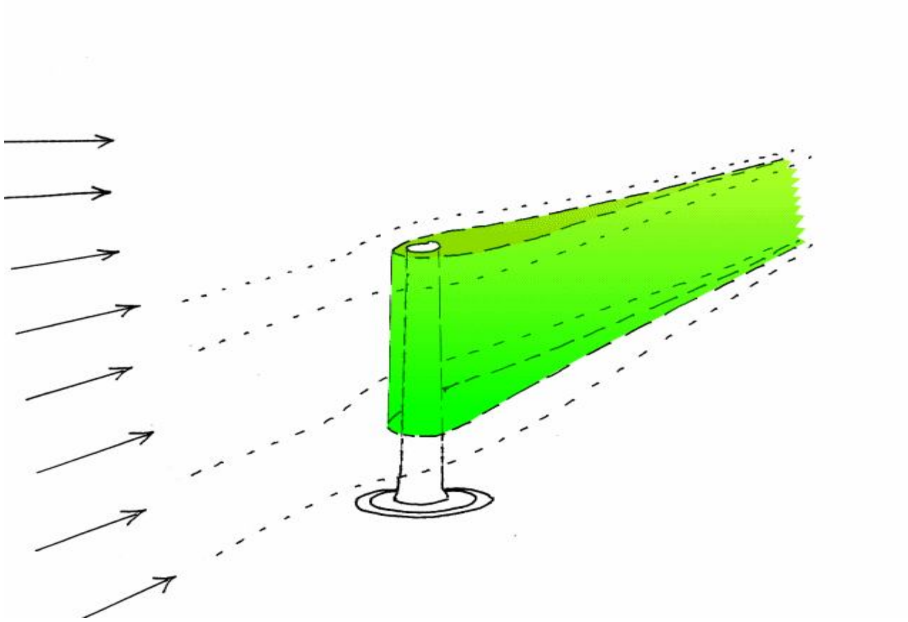
The study of infrasound (low frequencies of atmospheric compression) has been conducted sporadically over recent decades by numerous unconnected disciplines .. from the study of animal communications [2] to nuclear-test detection [3].

However, serious study of the effects of low frequencies of atmospheric compression on the human body has only been started recently, in part as a result of numerous rural populations being adversely impacted by the operation of industrial wind turbines. The irony of this situation is that only after the industrial wind turbine industry has become established and is supported by official government policies, does it belatedly become the subject of environmental health testing.

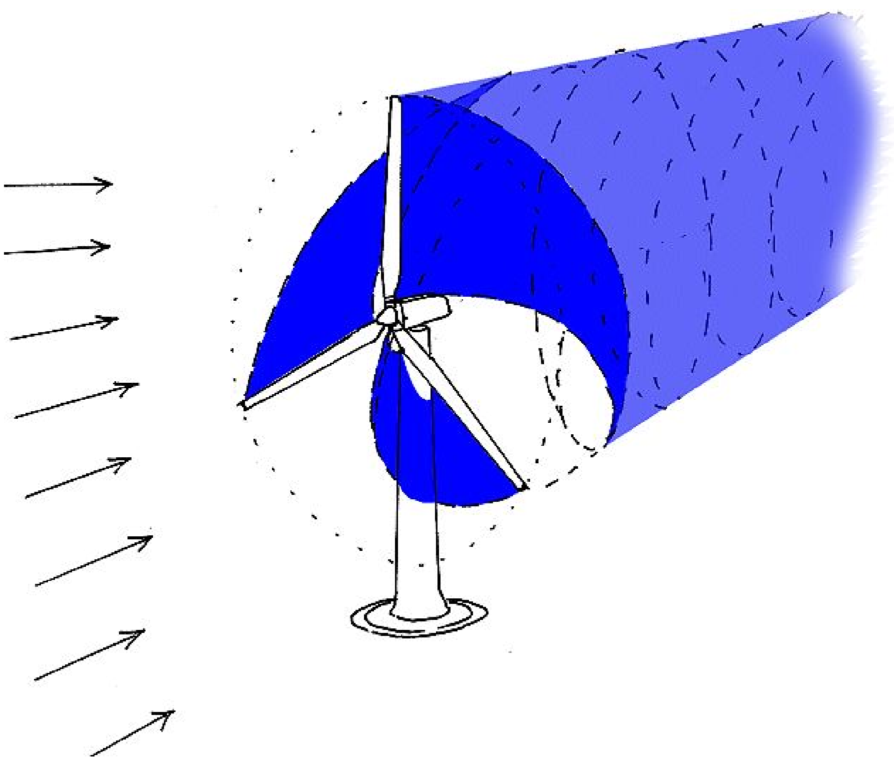
2. In The Wind

A typical large industrial wind turbine affects the wind that blows upon it in two distinct ways. I apologize for the crudeness of the following drawings. Just as I'm not a qualified scientist, I'm also not a qualified artist ...

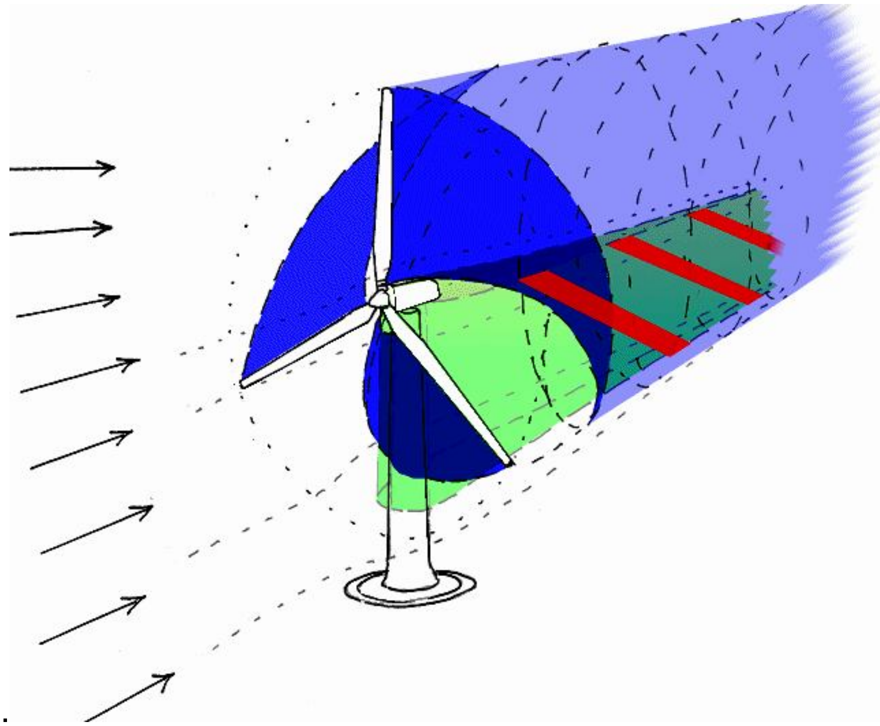
Firstly, the turbine's support column produces a vertical 'wall' of variant air pressure downwind of itself ...



Secondly, the turbine's rotating blades produce a triple-coiled 'spiral' of variant air pressure downwind of themselves. This effect is described on the Danish Wind Industry Association's website [4] ... *"In fact, there will be a wake behind the turbine, i.e. a long trail of wind which is quite turbulent and slowed down ..."*



I believe it's the angular impact of these two volumes of variant air pressure that produces sources of infrasound in the areas highlighted here in red .. sources located well behind the actual turbine.



...

Some of the recent investigations of the impacts of infrasound upon human health ...

2004 - Hearing at low and infrasonic frequencies - by H Moller, CS Pedersen, Department of Acoustics, Aalborg University, Denmark [5]

2007 - Vibroacoustic disease: biological effects of infrasound and low-frequency noise explained by mechanotransduction cillular - by Alves-Pereira M, Castelo Branco NA., Lisbon, Portugal. [6]

2008 - Wind Turbine Syndrome - by Doctor Nina Pierpont, Malone NY, USA [7]

2008 - Tuning and sensitivity of the human vestibular system to low-frequency vibration - by Todd NP, Rosengren SM, Colebatch JG., University of Manchester, Manchester, UK. [8]

These latest scientific findings are indicating that the distressing and harmful effects being reported from the proximity of industrial wind turbines come from infrasound they generate when in operation .. which appears to be impacting upon both physiological and neurological systems of the human body.

3. Audible Levels

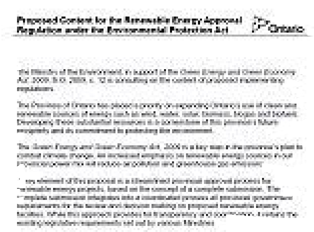
There's one particularly big glitch in the positions promoted by Industrial Wind Turbine proponents when it comes to the audible sound levels put out by these turbines.

This "glitch" is well illustrated by the **Ontario Ministry of the Environment backgrounder for Proposed Requirements and Setbacks for Wind Turbines** [9]

... in conjunction with the official **Proposed Content for the Renewable Energy Approval Regulation under the Environmental Protection Act** [10].

The backgrounder for the Ontario Ministry of the Environment's backgrounder for Proposed Requirements and Setbacks for Wind Turbines states that their proposed regulations will "ensure noise levels do not exceed 40 decibels at the receptor. Forty decibels is approximately the noise level experienced in a quiet office or library."

The Proposed Content for the Renewable Energy Approval Regulation under the Environmental Protection Act states "Proposed setbacks in the noise matrix are consistent with the Ministry of the Environment's Noise Guidelines for Wind Farms (October 2008) and the noise level limit of 40 dBA at the Point of Reception regardless of wind speed."



A "quiet office or library" is a tranquil environment condusive to both contemplation and concentration .. to work and reading .. without distractions or loud noises. We can honestly expect that a "quite office or library" would possess sound levels consistently no higher than 40 dBA.

However, in my opinion, the industry's and government's use of these comparisons, examples and figures is rife with misrepresentation and resulting deception. In typical highway noise studies, the Ontario Ministry of the Environment chooses to gather "One Hour Equivalent Sound Level", by averaging all the readings taken continuously over one hour. Unfortunately, this same methology has been adopted by both the Industrial Wind Turbine Industry and the regulating government agencies.

The audible sound produced by the industrial wind turbines is cyclical in nature, resulting from the three-bladed rotors rotating and producing their characteristic "whoosh, whoosh, whoosh". The "highway noise study" methodology fails to capture the fact that these regular, repeated cyclical instances of "whoosh" can substantially

surpass the 40 dBA noise level limit during their individual durations. This same methodology also fails to recognize the contrasts in sound levels which occur with constant repetition .. in themselves extremely dynamic, distressful and distracting.
An extremely interesting explanation of Fast Response Sound Level Meters, Fast Meter Responses, Single Event Levels, and Impulse Sound Levels (dBAl) is to be found at the Royal Canadian Mounted Police's website [11].

The repetitive and cyclical "whoosh" of an industrial wind turbine is truely "industrial" in nature .. definitely more akin to a mechanical production process or a repeated pistol discharge than the hum of distant traffic or the subtle sounds of a "quiet office or library".

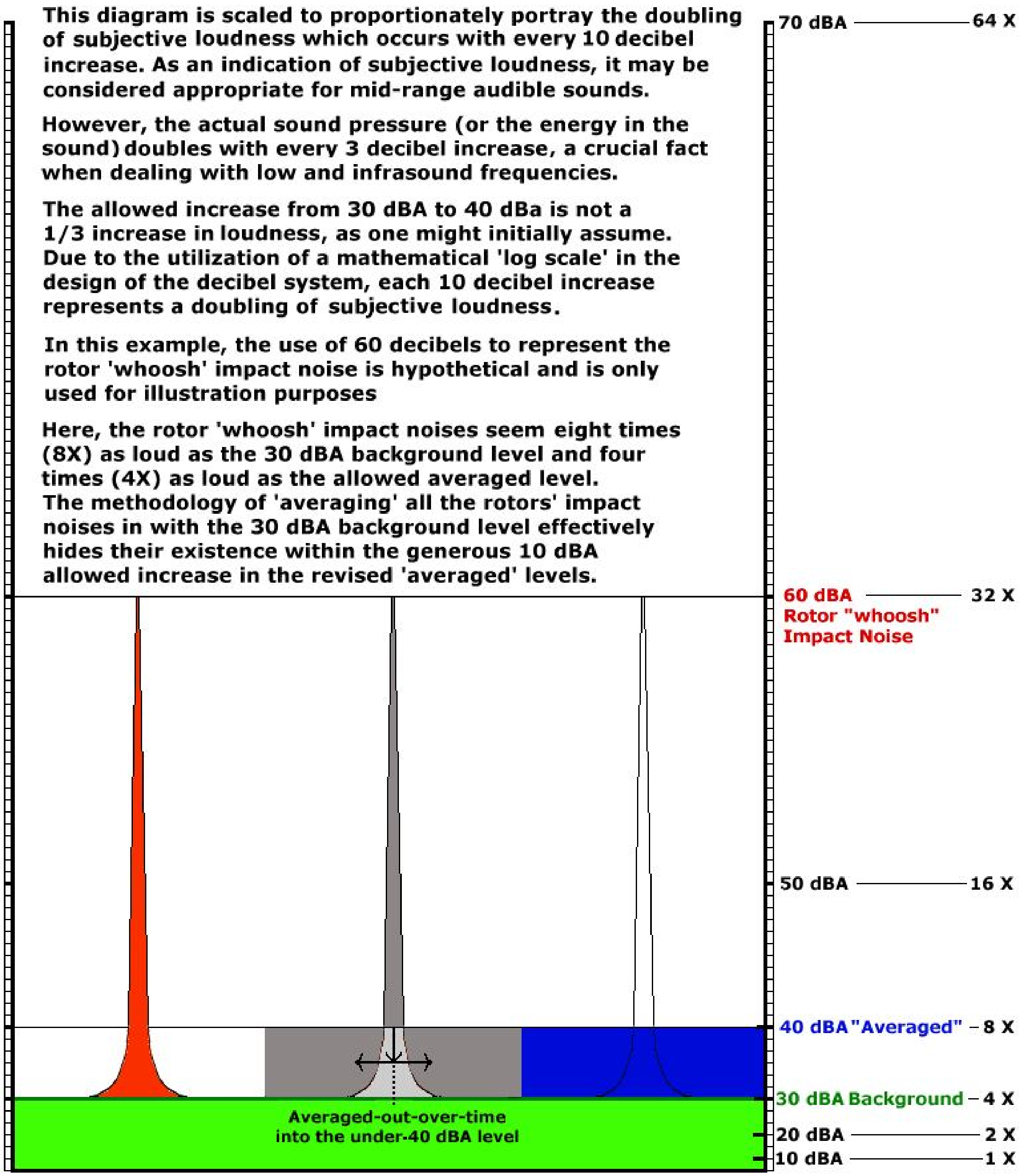
To replicate an industrial wind turbine's "whooshes" in a library, one would have to either repeatedly "rip-up" all the metal venetian blinds or repeatedly dump books from the shelves .. with the same repetitive frequency of the turbine's "whooshes".

But, oh dear, you would no longer be in a "quiet library"!

This ambiguity is a big glitch in the positions promoted by Industrial Wind Turbine proponents when it comes to the audible sound levels put out by these turbines.

Incorrect Methodology For Measuring Audible Industrial Impact Noise

An industrial wind turbines' typical "whoosh, whoosh, whoosh" audible sounds are cyclical industrial-impact sounds. Government agencies have incorrectly chosen to use the 'average-over-time' method of measurement to determine their decibel levels. This method was designed for continuous sound mixtures of low-differential components .. such as those consistently produced by busy highways and ventilation systems.



By using the 'average-over-time' method of measurement to determine the decibel levels of these audible "whoosh, whoosh, whoosh" sounds, the low decibel levels of the much quieter background intervals between the "whoosh's" are averaged into the end result. This method gives a false result by allowing what is in effect a misrepresentative 'erosion' or 'dilution' of the loud decibel levels of the "whoosh's".

The following informative and helpful reference "Comparative Examples of Noise Sources, Decibels & Their Effects" is found on the website of Industrial Noise Control Inc. of North Aurora, Illinois [12] ...

Comparative Examples of Noise Levels

Comparative Examples of Noise Sources, Decibels & Their Effects

Noise Source	Decibel Level	Decibel Effect
Jet take-off (at 25 meters)	150	Eardrum rupture
Aircraft carrier deck	140	
Military jet aircraft take-off from aircraft carrier with afterburner at 50 ft (130 dB).	130	
Thunderclap, chain saw. Oxygen torch (121 dB).	120	Painful. 32 times as loud as 70 dB.
Steel mill, auto horn at 1 meter. Turbo-fan aircraft at takeoff power at 200 ft (118 dB). Riveting machine (110 dB); live rock music (108 - 114 dB).	110	Average human pain threshold. 16 times as loud as 70 dB.
Jet take-off (at 305 meters), use of outboard motor, power lawn mower, motorcycle, farm tractor, jackhammer, garbage truck. Boeing 707 or DC-8 aircraft at one nautical mile (6080 ft) before landing (106 dB); jet flyover at 1000 feet (103 dB); Bell J-2A helicopter at 100 ft (100 dB).	100	8 times as loud as 70 dB. Serious damage possible in 8 hr exposure
Boeing 737 or DC-9 aircraft at one nautical mile (6080 ft) before landing (97 dB); power mower (96 dB); motorcycle at 25 ft (90 dB). Newspaper press (97 dB).	90	4 times as loud as 70 dB. Likely damage 8 hr exp
Garbage disposal, dishwasher, average factory, freight train (at 15 meters). Car wash at 20 ft (89 dB); propeller plane flyover at 1000 ft (88 dB); diesel truck 40 mph at 50 ft (84 dB); diesel train at 45 mph at 100 ft (83 dB). Food blender (88 dB); milling machine (85 dB); garbage disposal (80 dB).	80	2 times as loud as 70 dB. Possible damage in 8 hr exposure.
Passenger car at 65 mph at 25 ft (77 dB); freeway at 50 ft from pavement edge 10 a.m. (76 dB). Living room music (76 dB); radio or TV-audio, vacuum cleaner (70 dB).	70	Arbitrary base of comparison. Upper 70s are annoyingly loud to some people.
Conversation in restaurant, office, background music, Air conditioning unit at 100 ft	60	Half as loud as 70 dB. Fairly quiet
Quiet suburb, conversation at home. Large electrical transformers at 100 ft	50	One-fourth as loud as 70 dB.
Library, bird calls (44 dB); lowest limit of urban ambient sound	40	One-eighth as loud as 70 dB.
Quiet rural area	30	One-sixteenth as loud as 70 dB. Very Quiet
Whisper, rustling leaves	20	
Breathing	10	Barely audible

[modified from http://www.wenet.net/~hpb/dblevels.html] on 2/2000.
SOURCES: *Temple University Department of Civil/Environmental Engineering (www.temple.edu/departments/CETP/environ10.html), and Federal Agency Review of Selected Airport Noise Analysis Issues, Federal Interagency Committee on Noise (August 1992). Source of the information is attributed to Outdoor Noise and the Metropolitan Environment, M.C. Branch et al., Department of City Planning, City of Los Angeles, 1970.*

http://www.industrialnoisecontrol.com/comparative-noise-examples.htm

4. Sound Energy

In the previous "Audible Levels", I examined the 'subjective loudness' of sound. In this context, we realize how our sense of hearing interprets an increase in decibel levels.

As our eyes co-ordinate different 'receptors and processors' for seeing in dim and bright light levels, so do our ears utilize different 'receptors and processors' for hearing in low and high sound levels.

It is because of these selective sensory receptors that our primary senses are able to subjectively function over such a wide range of levels.

While our sense of hearing can subjectively adapt to considerable variations in decibel levels, the balance of our biological functions are not subjectively adaptive.

Just like the rest of the physical and biological world, the rest of our bodies have to respond objectively to the true energy levels of sound, whether audible or inaudible.

If one found the progressive rate of the subjective loudness of increasing decibels of audible sound to be surprising, then that of the true energy level of increasing decibel levels of all sound will be even more so.

Whereas the subjective increase of loudness was "double for each increase of 10 decibels", the actual objective increase in energy imparted is "double for each increase of 3 decibels (approx.)". It's this amazing rate of increase in sound energy levels that has the potential to impact heavily upon the human body.

A reference for these distinctly different rates of increase in 'subjective loudness' and 'objective energy' are described thusly ... *"... as you double the sound pressure (or the energy in the sound) the index increases by approximately 3. A sound level of 100 dB(A) thus contains twice the energy of a sound level of 97 dB(A). The reason for measuring sound this way is that our ears (and minds) perceive sound in terms of the logarithm of the sound pressure, rather than the sound pressure itself ... Most people will say, that if you increase the dB(A) by 10, you double the subjective loudness of the sound."* ... at the Danish Wind Industry Association website [13].

As shown in the following diagram, while 70 decibel sound is subjectively only 8 times louder than 40 decibel sound, objectively it actually bears 1,024 times as much energy!

Decibel Levels				
76	33,554,432	32,768	4,096	
73	16,777,216	16,384	2,048	
70	8,388,608	8,192	1,024	8 X
67	4,194,304	4,096	512	
64	2,097,152	2,048	256	
61	1,048,576	1,024	128	4 X
58	524,288	512	64	
55	262,144	256	32	
52	131,072	128	16	
49	65,536	64	8	2 X
46	32,768	32	4	
43	16,384	16	2	
40	8,192	8	1	1 X
37	4,096	4		
34	2,048	2		
31	1,024	1		
28	512			
25	256			
22	128			
19	64			
16	32			
13	16			
10	8			
7	4			
4	2			
1	1			

Sound pressure amounts (energy in the sound), increases 2 times with approx. each 3 decibels increase.

Objective increase in energy between 40 and 70 decibels is 1,024 times.

Subjective increase in loudness between 40 and 70 decibels is only 8 times.

5. Standing Waves

Next, I'm examining the behavior of 'industrial-wind-turbine-generated' infrasound in initially impacting the occupied structures on affected properties (houses, rooms and barns), and subsequently in impacting the physical structures of people, livestock and wildlife.

I recommend the online Wavelength Calculator Tool [14], courtesy of "www.sengpielaudio.com" to help compare the relationship between the 'pitch', 'tone' or 'frequency' of atmospheric compressions (sound) and those compressions' actual physical lengths.

Standing waves are produced whenever two waves of identical frequency of compression interfere with one another while traveling opposite directions along the same medium.

A standing wave pattern is a vibrational pattern created within a medium when the vibrational frequency of the source causes reflected frequencies of compression from one end of the medium to interfere with incident frequencies of compression from the source.

This interference occurs in such a manner that specific points along the medium appear to have frequencies of compression that are standing still .. re-inforced into a stronger "standing wave".

The above definition may be a bit hard to visualize. The following example may prove easier to envision. This example is taken from How to Build a Small Budget Recording Studio from Scratch, By Mike Shea and Frederick Alton, Edition: 3 - 2002 - 352 pages. References to the book was made by a Google Books preview [15].

Chapter 1, page 2 describes how to find the fundamental frequency (or 1st harmonic) of a structure. In the example given, the sound studio in question has pair of parallel walls 20 feet apart (the room's length). One starts with the speed of sound in feet per second ... 1130 feet/second ... and divides it by twice the room's length (2L) ... to arrive at the fundamental frequency of resonance of the room which will set up a standing wave across that dimension.

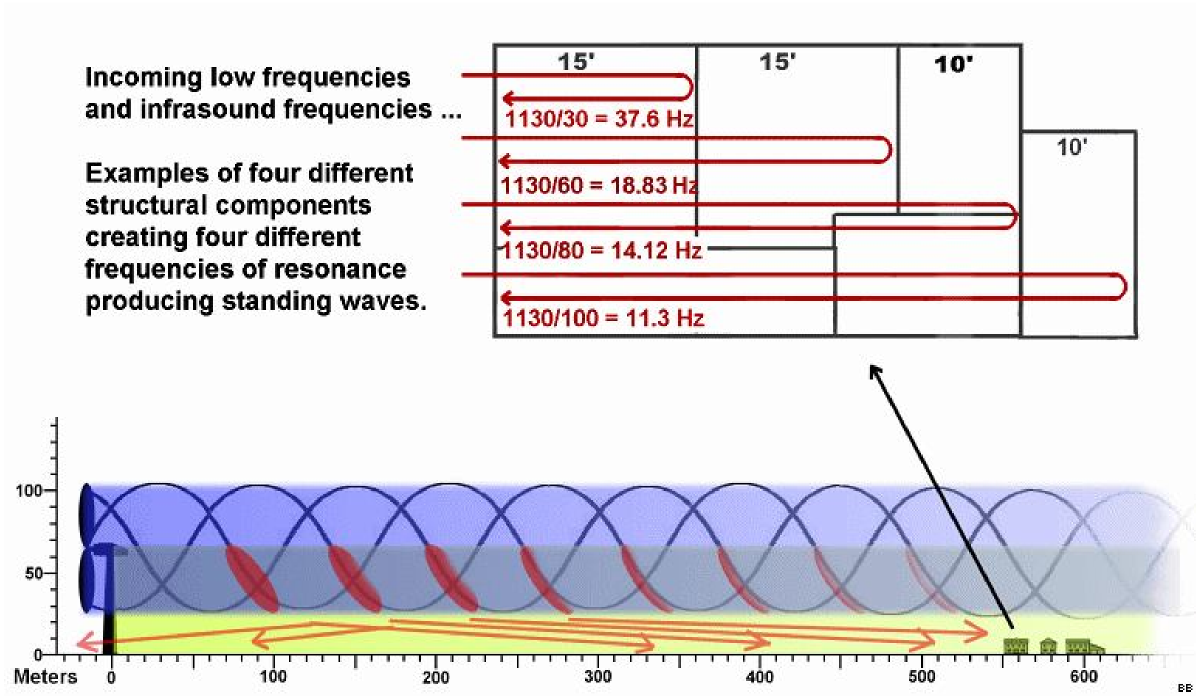
Here's the calculation ...

1130 / 2L = structure's fundamental frequency

1130 / 40 = 28 Hz. (approx.)

It is worth noting that similar resonance will also occur between parallel walls which are 40, 80, 120 .etc feet apart. In addition, frequencies of 56, 84, 112 Hz, .etc. would also generate "harmonic resonance" across this dimension of the structure.

Following is an illustrated example I've drawn up, of rooms producing four different "axial" standing waves within one structure.



Note: In situations where the incoming sound impacts a structure at other than 90 degrees, all four walls of the structure and their greater sum of dimensions can become involved, responding to even lower frequencies in the production of a "tangential standing wave".

The "axial" standing-wave effect can also be described as follows ... Houses, barns, and any partitioned structures have different depths and widths, as well as different orientations. When one of these structures is impacted at right-angles by low frequency sound and infrasound, the physically long compressions of which either equals twice that structure's depth (relative to that impact) or is an even divisor of the compressions' full length, a "standing wave" is generated. A resonating amplification results between the affected walls of the structure. While such a resonating amplification's full intensity is for the most part specific to being within the structure in question, it's secondary vibrations can extend somewhat beyond the actual 'receptor' structures for short distances. There have been accounts of burrowing animals abandonning the immediate vicinity of such structures.

This phenomenon cannot be measured by a simple sound meter's microphone being located outside at an equal distance from a wind turbine. The phenomenon is unique and dependant on a number of variables .. including the size, composition and orientation of the structure in question.

In addition, there are effects pertaining to the impact of the unique range and sequence of frequencies of audible atmospheric compressions (sound waves) which produce an industrial wind turbine's "whoosh".

Skeletal structures (cranium, pelvis, etc.) have specific dimensions, dependant on orientation. When a range and sequence of sounds of specific frequencies impact these structures, momentary "standing waves" can be generated .. when half a sound frequency's actual wavelength either equals the structure's interior depth or its full length is an even divisor of the structure's depth. A resonating amplification results between the affected sides of the structure.

As the a turbine "whoosh" sequences through its range of frequencies, organs located close by will either sense the amplified resonancies that occur at those critical frequencies.These amplified resonances will be actually sensed at much greater energy levels than an externally located sound meter's microphone would be able to pick-up.

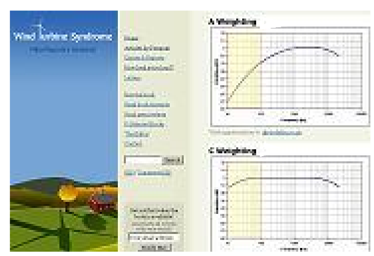
These resonating amplifications are experientially subjective experiences. These phenomena cannot be measured by a simple sound meter's microphone. They are unique and dependant on a number of variables .. including the size, composition and orientation of the skeletal structures in question.

6. Infrasound Impacts

The impact of resonating amplifications or standing waves of infrasound upon the human body is becoming more common as more and more industrial wind turbines are being constructed within proximities of human populations.

Warnings of its detrimental health aspects have only recently come to society's attention. Unfortunately, the resistance against those trying to raise the warnings is still entrenched.

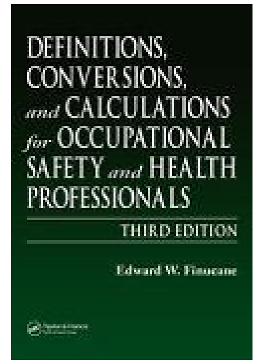
Doctor Nina Pierpont of New York state has written an extensive book about what she calls the Wind Turbine Syndrome. She and her husband Calvin maintain an informative website by the same name ... www.windturbinesyndrome [16].



Doctor Pierpont details many instances of the debilatating symptoms experienced by people forced to live near industrial wind turbines, firsthand experiences, associated scientific submissions and regularly updated commentaries. I stongly recommend Doctor Pierpont's book and website as a source of medical and scientific insight.

Recognition of the medical impact of infrasound isn't forthcoming from many governments and industrial interests due to the intellectual, emotional, political and financial commitments they have made to industrial wind turbines. However, each year there are more and more examples of diverse disciplines recognizing the debilitating impacts made by infrasound.

I show the following references here as a prime example of how the world at large is starting to formally recognize the existence and nature of the effects of infrasound upon the human body. These references are to page 7-4 of a book titled "Definitions, Conversions, and Calculations for Occupational Safety and Health Professionals" Edition: 3 - 2006, by Edward W. Finucane, 552 pages (Chapter 7: Mechanical Vibration / Effects Of Vibration On The Human Body / Resonance Whole Body Vibration (WBV) Frequencies). These references were acquired from a Google Books preview [17].... **http://books.google.ca**.



- Mr Finucane says that every object, including human body organs and parts exhibits a unique resonant frequency.

- He goes on to say that WBV frequencies from 2 to 30 hertz correspond to most of the resonance responses of various human body organs and parts .. that exposures to these frequencies can produce organ and body part vibration responses which can result in breathing difficulties, abdominal and/or chest pains, headaches, and even speech or vision impairment.

- Mr Finucane concludes the section by indicating that vibrations from 2 to 5 Hertz generate strong resonance responses in neck and lumbar regions, often with amplifications of up to 140% .. and that for WBV frequency exposures in the 4 to 6 Hertz range, body organ resonances exhibiting amplifications of more than 150% have been observed in the human trunk .. and that vibrations between 20 and 30 Hertz produce strong resonance responses in the head and shoulder areas, with amplifications often of well over 300%.

It is for all the preceding reasons, I believe that modern industrial wind turbines produce substantial levels of low frequency sound and infrasound which are incompatible with human habitation within distances of up to (and possibly beyond) 2 kilometers.

Submitted by ...

Barry Bridgeford
(July 9, 2009)

7. References

[1] Wayward Wind
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[2] animal communications
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[3] nuclear test-detection
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[7] Wind Turbine Syndrome
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[8] Tuning and sensitivity of the human vestibular system to low-frequency vibration
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[9] Ontario Ministry of the Environment backgrounder for Proposed Requirements and Setbacks for Wind Turbines
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[11] Fast Response Sound Level Meters, Fast Meter Responses, Single Event Levels, and Impulse Sound Levels (RCMP)
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Note: A PDF file of this entire submitted commentary can be downloaded at ...
http://www.algonquinadventures.com/EBR/EBR-010-6516-Bridgeford.pdf