

This is a DRAFT (and far from exhaustive) review of the information provided by Health Canada (HC) pertaining to the HC *Wind Turbine Noise Study* and is designed to serve as a starting point for further discussion.

A review of the information provided by Health Canada with regards to the preliminary results published on the HC Wind Turbine Noise Study requires the consideration of a number of reports / articles / pamphlets. Specifically, the following found on the HC Wind Turbine Noise web-site:

- Summary of Results
- A Primer on Noise
- Frequently Asked Questions
- Results Pamphlet
- Additional Information
- Health Impacts and Exposure to Sound from Wind Turbines: Updated Research and Design and Sound Exposure Assessment
- Notice to Stakeholders – HC Wind Turbine Noise and Health Study

Additionally, the following article can be found in the trade news publication *Noise News International*.

Self-reported and Objectively Measured Health Indicators among a Sample of Canadians Living Within the Vicinity of Industrial Wind Turbines: Social Survey and Sound Level Modelling Methodology

For ease of review, sections copied from the various reports / articles listed above will be presented in the following discussions in blue typeface.

STUDY DESIGN:

Although specified in the Michaud *Noise News International* publication, *Self-reported and Objectively Measured Health Indicators among a Sample of Canadians Living Within the Vicinity of Industrial Wind Turbines: Social Survey and Sound Level Modelling Methodology*, the *Summary of Results* section of the HC web-site does not state that this is an epidemiological cross sectional survey. Following is from the book, *Epidemiology in Medicine* (C. Hennekens, M.D., Dr.P.H. and Julie Buring, ScD).

For factors that remain unaltered over time, such as sex, race, or blood group, the cross-sectional survey can provide evidence of a valid statistical association. Such instances are rare, however, and for the vast majority of associations evaluated, the temporal relationship between exposure and disease cannot be clearly determined. Thus, cross-sectional studies are, in general, useful for

raising the questions of the presence of an association rather than for testing a hypothesis.¹

Additionally, several published methods for ranking study designs with respect to their individual “weight of evidence” have been developed, one of the most widely accepted is listed below.² While systematic reviews and meta-analyses are considered the gold standard of assessing a body of evidence, taken alone as an individual study, a cross sectional survey ranks as the least reliable method of study, marginally above individual case reports and expert opinion. The following is the hierarchical list in descending order of reliability:

1. Systematic reviews and meta-analyses
2. Randomized controlled trials (RCT) with definitive results (confidence intervals that do not overlap the threshold clinically significant effect)
3. Randomized controlled trials with non-definitive results (a point estimate that suggests a clinically significant effect but with confidence intervals overlapping the threshold for this effect)
4. Cohort studies
5. Case-control studies
- 6. Cross sectional surveys**
7. Case reports (individual patient evaluations)

The above hardly supports the claims listed in the HC Results Pamphlet:

[The Wind Turbine Noise and Health study is a landmark study and the most comprehensive of its kind. Both the methodology used and the results are significant contributions to the global knowledge base and examples of innovate, leading edge research.](#)

Updated Research Design and Sound Exposure Assessment Section: Statistical Power of Report

The following is from the [Statistical Power](#) section of the [Updated Research Design and sound Exposure Assessment](#):

[As sleep disturbance is a frequent health complaint associated with WTN in observational and case studies, one of the primary research objectives in the study is to quantify the magnitude of sleep disturbance due to WTN. There are currently no population-based normative data that are derived from actimetry](#)

¹ Epidemiology in Medicine (C. Hennekens, M.D., Dr.P.H. and Julie Buring, ScD. (1987 / Page 21)

² Guyatt GH, Sackett DL, Sinclair JC, Hayward R, Cook DJ, Cook RJ. Users' guides to the medical literature. IX. A method for grading health care recommendations. JAMA 1995; 274:1800-4.

from communities exposed to WTS. **Therefore, statistical power in the study is based on reported sleep disturbance.** Estimated sleep disturbance in the general adult population is approximately 10% (Riemann et al., 2011; Tjepkema, 2005), with some estimates as high as 40% (National Sleep Foundation, 2005). In calculating the sample size needed for statistical power to detect a sleep disturbance in this study, the conservative estimate of 10% will be used. Based on a sample of 2000 dwellings and assuming that 20% of the sample live in close proximity to wind turbines (at 40 dBA or above) investigators will be able to detect at least a 7% difference in prevalence rates between the general population and the sample of individuals living in closest proximity to wind turbines, with a 5% false positive rate and a power of 80%.

This sample size calculation incorporates the following assumptions: a) there will be an 80% occupancy rate for dwellings in rural areas and b) there will be a 70% participation rate for sleep actimetry. **A sample size of 1800 dwellings would be required, however given the possibility that not all assumptions may be met and that prevalence rates will be adjusted for other covariates in a logistic regression model (for example gender, age, receiving financial benefit, house construction type among others), the sample has been increased to 2000 dwellings.** Based on the estimated sample size of 2000 dwellings, **all other objective endpoints should be equally predicted with similar confidence.** Other studies that have used actimetry to characterize aircraft sound impacts on sleep are based on far fewer subjects (Passchier-Vermeer et al., 2002; Fidell et al., 1995; Horne et al., 1994; Ollerhead et al., 1992).

Issue: The number of participants in the study is listed at 1,234, not the 1,800 dwellings (upped to 2,000) required to establish a statistical power of 80%. Therefore, the “reported sleep disturbance” analyses and “all other objective endpoints” in this study are not considered reliable as a result of the study failing to meet its own sample size and target power calculations, as stated in the *Updated Research Design and Sound Exposure Assessment*. Assuming the study followed the study design identified in the *Updated Research Design and Sound Exposure Assessment*, the study cannot identify the key outcomes at the chosen incidence / prevalence levels. In short, the study does not have the statistical power to discern the prevalence of the key outcomes as identified in the protocol.

Therefore all statements along the lines of, “No evidence was found to support a link between exposure to wind turbine noise and (X outcome variable)” are not supported by the study and are not based on the results of the study. **Assuming the study followed the study design identified in the *Updated Research Design and Sound Exposure Assessment* this study cannot be used as the basis for the claims that are being made by Health Canada regarding the lack of association between wind turbines and health.** The study has insufficient sensitivity and specificity.

From the Frequently Asked Questions (FAQ) - Section: Why did Health Canada take noise measurements in the summer when there is very little wind?

It is true that wind is, on average, lower during the summer months compared to other times of the year. In order to minimize awareness bias, noise measurements in any given community only began after Statistics Canada had completed the in-home interview. This meant that noise measurements began in June 2013 and continued through October 2013. Some of the field measurements needed to be carried out during the summer months simply due to the timing of the collection period. Taking measures during summer months simply meant that it sometimes took longer to acquire enough data (waiting for windy periods). It is important to note that field measurements were taken only to the extent that enough data was collected to validate the calculated A-weighted values used in the study. This objective was met.

Issue: The following need to be clarified:

- Were noise measurements undertaken at all homes?
- How much time was spent at each home completing noise measurements?

A table detailing the number of homes within each sound / distance “bin” (group) at which noise measurements were undertaken would be expected in any peer-reviewed publication. This table would be expected to provide the amount of time spent at each home completing the noise measurements. The resulting table would provide data on “measured” versus “calculated” noise levels.

Of particular concern is the statement “Taking measures during summer months simply meant that it sometimes took longer to acquire enough data (waiting for windy periods). It is important to note that field measurements were taken only to the extent that enough data was collected to validate the calculated A-weighted values used in the study. This objective was met.” This seems to suggest that “validation” consisted of noise measurement equipment being installed in some homes during the relatively windless summer months. The equipment then remained at the home until the modeling-predicted average sound level was reached and then noise measurement ceased.

Data underwent several layers of modelling in order to 1) use a small sample of noise to predict overall means and 2) to work backwards from that data to enable cross-study comparisons. Each procedure introduces error and uncertainty. Importantly, the study fails to adequately explain why raw data at source could not be used.

Summary of Results - Section: Study Population and Participation

“All potential homes within approximately 600 m of a wind turbine were selected, as well as a random selection of homes between 600 m and 10 km.”

Issue: Although it could be argued that the low frequency sound component of the study required a review of homes out to a 10 km radius, the selection of a 10 km radius simply dilutes the information collected for all other aspects of the study. Please see below from Alec Salt, Professor, Department of Otolaryngology, Washington University School of Medicine

Why pro-wind studies often use a 10 km radius

by Alec Salt, Professor, Department of Otolaryngology, Washington University School of Medicine

Posted on 08/03/2011 by MA



Last week I was reading of an [Australian study](#), by a Professor Gary Wittert, which had shown sleeping pill usage for those living near wind turbines was no greater than the general population. The study compared those living within 10 km of turbines with those living more than 10 km away. There have been similar studies with property values using a 5 mile or 10 km radius that showed property values are not affected by wind turbines. Had you ever thought why they pick a 10 km radius?

Consider this graphic. It shows 1 km bands with the calculated area for each band shown in blue. Let's keep it easy and assume that households are evenly distributed and there is one household for every 10 square kilometers.

So, within 2 km (the two innermost bands) of the turbine, the area is 3.1 + 9.4 km² (=12.5 km²) which would represent 1.2 households.

Now let's consider the two outermost (9 km and 10 km) bands. The area of these bands is 53.4 + 59.7 km² (= 113.1 km²) which represents 113 households. So the outermost bands have about TEN TIMES the number of households of those living within 2 km, making sure that the contribution of the inner bands is diluted, swamped, covered up or however else you would describe it.

Or consider if you live within 2 km of a turbine. The outer bands of those living from 2 – 10 km from the turbine adds up to 301.6 km², which would represent 30.1 households – which is 24 TIMES the number of households within 2 km.

No wonder your voice is being “drowned out”. The bigger the circle, the more “dilution” occurs.

Add this to the list of things where “size matters”, and next time you see a study like this, consider the radius and area that was chosen. **The choice of the circle size plays a major role in the result obtained and speaks volumes about the motivation of the author.**

Dr. Alec Salt

Due to the “dilution” process explained above, it is critical to provide the information as to the number of homes that were located in each of the calculated distances from nearest wind turbine groupings selected by the researchers. (<500m, 500m-750m, 751m-1000m, 1001m-5km, 5km-10km) A table detailing the number of homes within each sound / distance “bin” would be expected in any peer-reviewed publication. Furthermore, this information must be included in the calculations for negative health effects.

Additionally, the *Dwelling and Respondent Selection* section of the *Updated Research Design and Sound Exposure Assessment* states, “As there are relatively few homes situated within 600 meters (~>40dBA) of the closest turbine, all of these dwellings will be recruited.” If there are relatively few homes within 600 meters, why were these turbine installations selected?

The *Statistical Power* section of the *Updated Research Design and Sound Exposure Assessment* states “...Based on a sample of 2000 dwellings and assuming that 20% of the sample live in close proximity to wind turbines (at 40 dBA or above), investigators....”) As the public is concerned with the proximity to turbines, why were turbine installations selected that would result in a 20% sample living in close proximity to homes?

Summary of Results - Section: Research Objectives and Methodology

To support the assessment and reporting of data, and permit comparisons to other studies, residences were grouped into different categories of calculated outdoor A-weighted WTN levels as follows: less than 25 dB; 25-<30dB; 30-<35dB; 35-<40dB; and greater than or equal to 40 dB (footnote below)

Footnote: Categories are mutually exclusive. Only six out of 1238 dwellings in the study were above 45dBA; an inadequate sample size to create an additional category.

Issue: As the calculated outdoor A-weighted WTN levels reported in the HC study are the result of a modeled annual average WNT, clearly the 6 dwellings with an annual average calculated above 45 dBA WTN cannot be compliant with Ontario Guidelines listed below. Additionally, of concern is the fact that the number of homes that fall within 41 to 45 dBA are not identified. It is very possible that these homes would also fall outside of the Ontario guidelines.

Below is from Ontario’s *Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities*. Please note, these are “sound level limits” – not annual averages.

Receptors in Class 3 Areas (Rural)

The sound level limits at a Point of Reception in Class 3 Areas (Rural) are given by the applicable values in Table 1, or by the sound level limits, established in accordance with requirements in Publication NPC-232. The wind turbine sound level limits are given at integer values of the wind speed. These sound level limits range from the lowest value of 40 dBA for Class 3 Areas and wind speeds at or below 4 m/s to the maximum value of 51 dBA for wind speeds at or above 10 m/s.

Wind Speed (m/s) at 10 m height	4	5	6	7	8	9	10
Wind Turbine Sound Level Limits Class 3 Area, dBA	40.0	40.0	40.0	43.0	45.0	49.0	51.0
Wind Turbine Sound Level Limits Class 1 & 2 Areas, dBA	45.0	45.0	45.0	45.0	45.0	49.0	51.0

Summary of Results - Section: Study Population and Participation

“Of the 2004 locations sampled, 1570 were found to be valid dwellings of which a total of 1238 households with similar demographics participated, resulting in an overall participation rate of 78.9%.

[Foot note to above](#): 434 were not valid dwellings; upon visiting the address Statistics Canada noted that the location was either demolished for unknown reasons, under construction, vacant for unknown reasons, an unoccupied seasonal dwelling, residents were outside the eligible age range, or not a home at all.”

Issue: 434 “not valid” dwellings is not an inconsequential number and I do not believe representative of the norm in epidemiological studies. This low responder rate (1238 of 2004 dwellings selected) could easily compromise the validity of any conclusions drawn by the researchers as a result of selection bias. A table detailing the number of homes within each sound / distance “bin” with “reason for exclusion” provided for being considered “not valid” would be expected in any peer-reviewed publication. How many were simply not home? Were they not home due to aversion to being home due to wind turbine concerns / health issues? This needs to be explored more carefully in the paper. Furthermore, this information must be included in the calculations for health outcomes.

Questions that might be addressed with available data (depending on the thoroughness of the data collection) include:

- How many of these homes were located in each of the calculated distances from nearest wind turbine groupings selected by the researchers? (<500m, 500m-750m, 751m-1000m, 1001m-5km, 5km-10km)
- What was the breakdown of “demolished, vacant, unoccupied, etc.,)

Also, according to discussions with the WCO membership, when a Health Canada representative was asked why they did not follow up on the former occupants of the “abandoned” homes, the response was that that action would remove the random nature of the subject selection.

This is NOT a valid argument. The home residents had already been randomly selected. It does not negatively impact the study if they are interviewed in their “old” home or their “new” home. In fact, since we know that people are forced to leave their homes, have their homes purchased by the wind companies and destroyed or left vacant, seeking these individual home-owners out in their new residences may be a critical component to the study. Additionally, the [Bias and Non Participation](#) section of the [Updated Research Design and Sound Exposure Assessment](#) states:

[Finally, challenges associated with non-response may exist for a variety of reasons. Subjects may have abandoned their dwelling or they may be participating receptors under pressures that preclude them from participating. Health Canada has no way of knowing in advance the extent to which non-response may impact this study, but refusal conversion strategies will be](#)

employed by the interviewers and attempts will be made to acquire limited self-reported results from non-responders.

It would seem that contrary to study design, no attempts were made to “acquire limited self-reported results from non-responders who had potentially vacated their homes due to wind turbine related health issues, clearly a key sub-group...”.

Summary of Results - Section: Study Population and Participation

From these, one person between the ages of 18 and 79 years from each household was randomly selected to participate.

From the FACT section of the Website: [Why are no children included in the study?](#)

A primary objective of the study was to assess the potential impacts that WTN had on measured sleep. Sleep patterns among children are very different from those of adults, making it difficult to identify potential impacts that might be due to WTN exposure. Furthermore, the questionnaire in the study included questions that would not be suitable for a minor to respond to.

Issue: Children, especially very young children/infants/babies are considered a most important and vulnerable population, and Health Canada makes that very clear when they review and approve new drugs for sale in Canada. Children are physically and mentally in varying stages of development that might be sensitive to low frequency sound exposure, including but not limited to broad neurological development, major organ and hormonal development, physical and emotional growth, and others. These may effect more than headaches, and sleep but may play a role in cognition and performance, yet children have been conspicuously omitted from this study as if they were not important to the researchers. This fact is a travesty for health Canada when considering that Public Health advocates embrace the Precautionary Principle” which means that in the event of any concerns about any group, especially a vulnerable one like children, one takes extreme caution in making any changes without extremely reliable data i.e. do no harm.

The rationale presented as to why this study was not designed in such a fashion as to contain a component targeted to children via cortisol testing.

Summary of Results - Section: Study Population and Participation

The study locations were drawn from areas in ON and PEI where there were a sufficient number of homes within the vicinity of wind turbine installations. Twelve (12) and six wind turbine developments were sampled in ON and PEI, representing 315 and 84 wind turbines respectively.

Issue: There is no indication of a breakdown of the types / height of turbines included in the calculation. There is no indication of a minimum length of time turbines were operational prior to “participation / selection” in the study. A table detailing this information would be expected in any peer-reviewed publication. Furthermore, this information must be included in the calculations for all health outcomes.

Summary of Results - Section: Self-Reported Questionnaire Results

Results are presented in relation to WTN levels. For findings related to WTN annoyance, results are also provided in relation to distance to allow for comparisons with other studies. WTN is a more sensitive measure of exposure level and allows for consideration of topography, wind turbine characteristics and the number of wind turbines at any given distance.

Issue: WTN levels used in this study are in fact averages. It is important to remember that an average WTN level of 46 dBA could have outliers of 60 dBA and 0 dBA. It is the upper end of the scale that is of concern.

The *Wind Turbine Sound Characterization* section of the *Updated Research Design and Sound Exposure Assessment* states “Due to the large number of subjects, sound exposures will be based on predictions. A sub-sample of measurements will be taken at each selected site to validate predictions. This approach is considered preferable due to the technical limitations of measurement. Modeling is considered more accurate in representing average wind turbine sound levels than discrete measurements, which are sensitive to fluctuating variables and do not discern between sources of sound.”

Furthermore, in order to provide some level of certainty with regards to interpretation of results, additional analysis should have been included for all self-reported questionnaire results and not simply for Annoyance. Specifically, in addition to the analysis that was carried out, all outcomes should have been analyzed using a subgroup based on distance from turbines so that the outcomes can be compared.

It is interesting to note that the only value (Annoyance) that included an analysis linked to distance from turbines is the only value that resulted in statistical association health concerns with increasing levels of WTN. This is not a spurious or unimportant observation, and it suggests reporter bias by the authors of this paper.

The following was found to be statistically associated with increasing levels of WTN:

- Annoyance towards several wind turbine features (i.e. noise, shadow flicker, blinking lights, vibrations, and visual impacts).

Summary of Results - Section: Self-Reported Questionnaire Results (Sleep /Illness / Chronic Disease / Stress / Quality of Life)

Results are presented in relation to WTN levels. For findings related to WTN annoyance, results are also provided in relation to distance to allow for comparisons with other studies..... while some individuals reported some of the health conditions above (sleep disorders, dizziness, tinnitus, migraines, stress), the prevalence was not found to change in relation to WTN levels.

Issue: The *Statistical Power* section of the *Updated Research Design and Sound Exposure Assessment* states “....Based on a sample of 2000 dwellings and assuming that 20% of the sample live in close proximity to wind turbines (at 40 dBA or above), investigators.....) . It is critical that “distance” to a turbine be included in the calculations related to self-reported questionnaires as apparently only 20% live in “close” proximity to turbines. This 20% no doubt makes up the “some individuals” who reported health conditions.

This 20% becomes diluted in the statistical analysis, allowing for the lack of association of negative health effects with WTN. Additionally, the estimate is 20% of 2,000 homes, but actual participation was 1,238 homes, and as a result does that 20% of this smaller than planned responder group actually move closer to 10%? This question cannot be answered with the information provided in the report, as the breakdown of number of homes within each distance to turbine “bin” has not been provided.

Additionally, what are the confidence limits for no association between self-reported sleep disorders, illness and quality of life and wind turbine noise?

Summary of Results - Section: Community Annoyance Findings

At the highest WTN levels (≥ 40 dBA in both provinces), the following percentages of respondents were highly annoyed by wind turbine noise: ON-16.5%; PEI-6.3%.

Issue: As the calculated outdoor A-weighted WTN levels reported in the HC study are the result of modeled annual average WNT, it is very concerning that a number of respondents were subjected to $WTN \geq 40$ dBA. It is very possible that these homes would also fall outside of the Ontario guidelines.

Below is from Ontario’s *Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities*. Please note, these are “sound level limits” – not annual averages.

Receptors in Class 3 Areas (Rural)

The sound level limits at a Point of Reception in Class 3 Areas (Rural) are given by the applicable values in Table 1 (see below), or by the sound level limits, established in accordance with requirements in Publication NPC-232. The wind

turbine sound level limits are given at integer values of the wind speed. These sound level limits range from the lowest value of 40 dBA for Class 3 Areas and wind speeds at or below 4 m/s to the maximum value of 51 dBA for wind speeds at or above 10 m/s.

Wind Speed (m/s) at 10 m height	4	5	6	7	8	9	10
Wind Turbine Sound Level Limits Class 3 Area, dBA	40.0	40.0	40.0	43.0	45.0	49.0	51.0
Wind Turbine Sound Level Limits Class 1 & 2 Areas, dBA	45.0	45.0	45.0	45.0	45.0	49.0	51.0

Summary of Results - Section: Objectively Measured Results

Objectively measured health outcomes were found to be consistent and statistically related to corresponding self-reported results. WTN was not observed to be related to hair cortisol concentrations, blood pressure, resting heart rate or measured sleep (e.g., sleep latency, awakenings, sleep efficiency)

Issue: Again, the *Statistical Power* section of the *Updated Research Design and Sound Exposure Assessment* states “....Based on a sample of 2000 dwellings and assuming that 20% of the sample live in close proximity to wind turbines (at 40 dBA or above), investigators.....) . It is critical that “distance” to a turbine be included in the calculations related to objectively measured results as apparently only 20% live in “close” proximity to turbines. This 20% no doubt makes up the “some individuals” who reported health conditions.

This 20% becomes diluted in the statistical analysis, allowing for the lack of association of negative health effects with WTN. Additionally, the estimate is 20% of 2,000 homes, as actual participation was 1,238 homes, does that 20% move closer to 10%? This question cannot be answered as the breakdown of number of homes within each distance to turbine “bin” has not been provided.

Summary of Results - Section: Wind Turbine Noise Measurement Results

Calculated outdoor A-weighted WTN levels for the homes participating in the study reached 46 dBA for wind speeds of 8m/s. This approach is the most appropriate to quantify the potential adverse effects of WTN. The calculated WTN levels are likely to be representative of yearly averages with an uncertainty of about +/- 5dB and therefore can be compared to World Health Organization (WHO) guidelines. The WHO identifies an annual outdoor night time average of 40 dBA as the level below which no health effects associated with sleep disturbance are expected to occur even among the most vulnerable people (WHO (2009) *Night Noise Guidelines for Europe*).

Issue: The above statement is very unclear. Does the above represent the average, or a certain % of homes reaching 46 dBA at specific times? This is very concerning as the majority of industrial wind turbine installations in Ontario provide modeling that indicates they are compliant with the 40dBA MOE guidelines “at all times”. Which modeling is incorrect?

Additionally, the following information is from the World Health Organization (WHO) Regional Office for Europe’s “Noise” page.

The WHO guidelines for night noise recommend **less than 40 dB(A)** of annual average (Lnight) outside of bedrooms to prevent adverse health effects from night noise.”³

It is important to note that the night noise recommended is LESS than 40 dBA and not 40 dBA as stated in the report.

Summary of Results – Section: Wind Turbine Noise Measures Results

Infrasound

Long-term measurements over a period of 1 year were also conducted in relation to infrasound levels.

- Infrasound from wind turbines could sometimes be measured at distances up to 10km from the wind turbines, but was in many cases below background infrasound levels.
- The levels were found to decrease with increasing distance from the wind turbine at a rate of 3dB per doubling of distance beyond 1km, downwind from a wind turbine.
- The levels of infrasound measured near the base of the turbine were around the threshold of audibility that has been reported for about 1% of people that have the most sensitive hearing.

Due to the large volume of acoustical data, including that related to infrasound, analysis will continue over subsequent months with additional results being released at the earliest opportunity throughout 2015.

Issue: As infrasound is clearly an important component of this study, it is unclear as to why HC chose to release preliminary results without including some information regarding infrasound. Below is from *Wind Turbines can be Hazardous to Human Health, Alec N. Salt, Ph.D., Cochlear Fluids Research Laboratory, Washington University in St. Louis. (Updated 4/2/2014)*

³ <http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/noise/facts-and-figures>

Large wind turbines generate very low frequency sounds and infrasound (below 20 Hz) when the wind driving them is turbulent. The amount of infrasound depends on many factors, including the turbine manufacturer, wind speed, power output, local topography, and the presence of nearby turbines (increasing when the wake from one turbine enters the blades of another). **The infrasound cannot be heard and is unrelated to the loudness of the sound that you hear.** Infrasound can only be measured with a sound level meter capable of detecting it (and not using the A-weighted scale). Video cameras and other recording devices are not sensitive to infrasound and do not reproduce it.

You cannot hear the infrasound at the levels generated by wind turbines, but your ears certainly detect and respond to it. The picture shows the **enormous** electrical potentials that infrasounds generate in the ear. The potentials (18.7 mV pk/pk amplitude in this case) are about 4 times the amplitude of sounds in the normal frequency range that are heard. **These measurements show that the low frequency part of the ear is extremely sensitive to infrasound.**⁴

ISSUES WITH OVERALL “PRESENTATION” OF THE DATA / INFORMATION

Below are some issues with how Health Canada presented it’s “findings” on their web site.

Summary of Results - Section: Research Objectives and Methodology:

Detailed information on Health Canada's *Wind Turbine Noise and Health Study* methodology, including the 60-day public consultation and peer review process is available on the [Health Canada website](#). The detailed methodology for the study is also available in the peer reviewed literature (*Michaud et al., Noise News International, 21(4): 14-23, 2013*).

Additionally, the link to “[Scientific Journal Publications](#)” in HC Wind Turbine Noise Page takes us to the *Michaud et al., Noise News International* reference.

Issue: *Noise News International* is NOT a Peer Reviewed Medical Journal, or a Scientific Journal Publication, it is an Industry News Publication that does not require peer review. Stating that it is a peer reviewed publication is in error and has the effect of lending undeserved legitimacy to the article submitted by Mr. Michaud. The sentence should read, “[The detailed methodology for the study is also available in the Trade News](#)

⁴ <http://oto2.wustl.edu/cochlea/wind.html>

[Publication, Noise News International...](#)” And the reference should be removed from the Scientific Journal Publications section of the HC website.

Summary of Results - Section: Preliminary Research Findings

- [results do not permit any conclusions about causality;](#)

Issue: In fact, it is not only the results that do not permit any conclusions about causality, it is the study design that does not permit any conclusions about causality. The study design selected is an epidemiological cross sectional survey. Epidemiological studies DO NOT establish causality. They establish association of varying degrees, basically as estimates of risk in the very best case, which this study is not. The above statement erroneously suggests that had the “results” been “different” that causality between health concerns and wind turbine noise could have been established. The point should read “[Retrospective observational epidemiological study designs, including this one, do not permit any conclusions to be drawn about causality](#)”. Below from Cornell University:

Epidemiology is the study of diseases in populations of humans or other animals, specifically how, when and where they occur.

Epidemiologists attempt to determine what factors are associated with diseases (risk factors), and what factors may protect people or animals against disease (protective factors). The science of epidemiology was first developed to discover and understand possible causes of contagious diseases like smallpox, typhoid and polio among humans. It has expanded to include the study of factors associated with non-transmissible diseases like cancer, and of poisonings caused by environmental agents.

Epidemiological studies can never prove causation; that is, it cannot prove that a specific risk factor actually causes the disease being studied. Epidemiological evidence can only show that this risk factor is associated (correlated) with a higher incidence of disease in the population exposed to that risk factor. The higher the correlation the more certain the association, but it cannot prove the causation.⁵

Summary of Results - Section: Annoyance

[5.1 Community Annoyance as a Measure of Well-being](#)

⁵ Cornell University Epidemiology:
<http://pmep.cce.cornell.edu/profiles/extoxnet/TIB/epidemiology.html>

The questionnaire, administered by Statistics Canada, included themes that were intended to capture both the participants' perceptions of wind turbines and reported prevalence of effects related to health and well-being. In this regard, one of the most widely studied responses to environmental noise is community annoyance. There has been more than 50 years of social and socio-acoustical research related to the impact that noise has on community annoyance. Studies have consistently shown that an increase in noise level was associated with an increase in the percentage of the community indicating that they are "highly annoyed" on social surveys. The literature shows that in comparison to the scientific literature on noise annoyance to transportation noise sources such as rail or road traffic, community annoyance with WTN begins at a lower sound level and increases more rapidly with increasing WTN.

Issue: This section as presented does not indicate in any fashion that the World Health Organization (WHO) classifies annoyance as an adverse health effect. Below is from the WHO publication "*Burden of Disease from Environmental Noise*" published in 2011.

WHO defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. Therefore, a high level of annoyance caused by environmental noise should be considered as one of the environmental health burdens.⁶

Summary of Results - Section: Data Availability and Application

Raw data originating from the study is available to Canadians, other jurisdictions and interested parties through a number of sources: [Statistics Canada Federal Research Data Centres](#), the Health Canada website (noise data), open access to publications in scientific journals and conference presentations.

Issue: The Health Canada web-site has been searched for noise data to no avail. A link should be provided to the appropriate section. The Statistics Canada Federal Research information is only available to individuals affiliated with Universities. No raw data is available to the general public at this time, therefore this paragraph is very misleading and should be modified or the data be made available to the public or through the freedom of Information Act.

Entire Report:

"Wind turbine noise (WTN) levels"

Issue: All references to WTN levels should in fact read "modeled average WTN levels". It needs to be 100% clear that these results are not based on long term sound

⁶ http://www.euro.who.int/__data/assets/pdf_file/0008/136466/e94888.pdf

measurements at homes, but are in fact based on sound modeling that selected the “average”. As the 4000 hours of WTN measurements were conducted at 1238 homes, this means that each home received a total of 3.23 hours of actual sound measurements, or a number of homes received no actual sound measurements. This breakdown needs to be provided and should be addressed in the statistical modeling.

Summary of Results - Section: Data Availability and Application

Detailed descriptions of the above results will be submitted for peer review with open access in scientific journals and should only be considered final following publication.

Issue: It is not acceptable scientific practice to present a summary in a Trade-based journal in order to establish Health Canada’s public and media claims prior to publication in a *bone fide* medical journal and certainly not without greater clarity in the research.

“Results” Pamphlet Section: Key Findings

Calculated noise levels were found to be below levels that would be expected to directly affect health (World Health Organization- Community Noise Guidelines [1999]). This finding is consistent with self-reported and measured results of the study.

Issue: Calculated noise levels at what distance to turbines? This statement has no frame of reference. How does this statement reconcile with the following statement found in the [Wind Turbine Noise Measurement Results](#) section of this report, “Calculated outdoor A-weighted WTN levels for the homes participating in the study reached 46 dBA for wind speeds of 8m/s.” In fact the WHO guidelines for night noise recommend **less than 40 dB(A)** of annual average (Lnight) outside of bedrooms to prevent adverse health effects from night noise.”⁷

“Results” Pamphlet Section: Key Findings

No evidence was found to support a link between exposure to wind turbine noise and

Issue: As the majority of the homes were not considered to be “near” turbines, (at least 80% see Report Section: Objectively Measured Results below) the pamphlet must be substantially edited / corrected. The following should be made clear:

⁷ <http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/noise/facts-and-figures>

- Homes included in the study ranged from <600 meters to 10 km distance from the nearest turbine and that less than 20% of the homes were considered “near” turbines.
- The WTN is based on sound modeling that provides dBA that is a yearly average.
- The information provided so far is preliminary and a great deal more review / interpretation of the data is required.
- The study failed to meet its main design objective in terms of sample size requirements and the resulting study power, and therefore cannot be used as a basis to detect association, or lack thereof, between distance to wind turbines and adverse health effects.

Frequently Asked Questions (FAQ) Section Question: What was the rationale for measuring sound at some locations but not all?

This study included short term field measurements indoors and outdoors at several homes and near the base of the turbines. The purpose of these measurements was both observational and to acquire enough data to support the modelling used to calculate the A-weighted values used in the study. This objective was satisfied with the amount of measures taken.

The Michaud paper states “The predicted levels are checked against at least one acoustical and meteorological measurement at each survey location for each model of wind turbine to which the survey subjects are exposed.”

Issue: The FAQ statement seems to indicate that not all homes were subjected to field measurements, yet the Michaud paper indicates that each survey location was visited “at least once”. Which one is correct? Is there a table available that indicates which homes were “checked”.

I feel that the above listed issues result in misleading information being provided to the general public and that Health Canada should address them immediately....