Appendix C

Evidence of Known Adverse Health Effects Related to Industrial Wind Turbines

Submitted to the

Appeal for Renewable Energy Approval issued to Kent Breeze Corp. and MacLeod Windmill Project Inc. (Kent Breeze Wind Farms) c/o Suncor Energy Services Inc., EBR Registry Number 011-1039Chatham-Kent

January 16, 2011

1. I am a physician and surgeon with experience in delivery of health care, health care policy and health policy.

Personal Background

2. Since 1965, I have been licensed as a Medical Doctor (M.D.) in the Province of Ontario. I also hold the following designations: F.R.C.S.(C) (Fellow of the Royal College of Surgeons of Canada) and F.A.C.S. (Fellow of the American College of Surgeons). I am presently a Professor (Emeritus) of Surgery at the University of Western Ontario and Orthopedic Consultant at St. Joseph's Health Care in London, Ontario. My current practice focuses on orthopedic medicine including a substantial portion of chronic stress and pain management. In addition to an active clinical practice, my work involves teaching and research.

3. At the same time, during my career I have maintained an interest and been involved in many other aspects of medicine and health policy.

4. Early in my career (1968-70) I spent 2 years in Africa. The first 11/2 years were in a missionary hospital in South Africa (Jane Furse Memorial Hospital) which strongly stimulated an interest in the determinants of health and the importance of both health care policy and health policy. This was followed by 6 months in Uganda (Makarere University, Mulago Hospital) sponsored by the Canadian International Development Agency. This reinforced and enriched my earlier experience.

5. In 1976 I became the founding director of the first comprehensive regional trauma centre in Canada, at Sunnybrook Hospital in Toronto. The process of initiating standards for the management of trauma first regionally then provincially and nationally engaged me in extensive health care policy development. I held the post of Director until December of 1987.

6. In 1988 I was appointed as Chair of Surgery at the University of Calgary and Chief of Surgery at Foothills Hospital. The policy focus during that appointment was

establishing standards for wait times and appropriateness of surgery. Until June 2008 I continued to serve as Chair of the International Advisory Board of the Alberta Bone and Joint Health Institute, which is a Canadian leader in the development of health care policy relating to delivery of surgical and related health services.

7. In 1992 I was appointed as Dean of Medicine at the University of Western Ontario, a post carrying considerable policy responsibility for education and research. I served in this post until 1997 when I became the Dean of Medicine and Dentistry, a post I held until 1999.

8. In 1995 I was appointed to the Medical Research Council of Canada which transitioned into the Canadian Institutes of Health Research (CIHR). I also served on the Interim Governing Council of the CIHR until its founding in 2000.

9. In 1999 I became the first Cameron Visiting Chair at Health Canada, a post carrying the responsibility for providing policy advice to the Deputy Minister and Minister of Health for Canada.

10. In 2000 I was appointed as the founding Assistant Deputy Minister of the Population and Public Health Branch of Health Canada.

11. I was also appointed to the Romanow Commission on the Future of Health Care in Canada in 2002, as a Special Advisor to Commissioner Romanow.

12. I was also Special Advisor to the Deputy Minister of Nunavut from 2002 to 2003 for the purpose of reviewing the Health Care System of the territory.

13. From 2003 to 2007 I was appointed to the Health Council of Canada and was Chair of the Wait Times and Accessibility Work Group from 2004 to 2006.

14. From 2003 to 2008 I served as chair of the National Working Group on the Canadian Index of Well-Being on behalf of the Atkinson Charitable Foundation. I currently serve on the Board of the Institute of Well-Being.

15. In 2010 I became an invited member of the Canadian Institutes of Health Research funded "Evidence Network" formed and funded for the purpose of enabling evidence based media reporting.

Interest and Involvement in Wind Energy Issues

16. As noted above, I am a resident of Prince Edward County, an area in which six (6) or more major wind energy projects have been proposed.

17. The primary physical structures associated with these types of projects are generally known and referred to as industrial wind turbines ("IWTs"). A typical IWT stands approximately the height of a 40 or 50 storey building.

18. If approved, the proposed projects could see the siting of more than 200 onshore and an additional 200 offshore IWTs within various parts of Prince Edward County. None of these projects have received final approval and consequently no IWTs have been constructed in the County to date. If these projects were to proceed, it is possible that an IWT could be located within 800m of my residence.

19. I first became aware of the issue of IWTs in Prince Edward County in early 2008. My wife and I were planning a new home and wished to be responsibly "green". As a consequence, we installed geothermal energy in our home, passive solar and are continuing to research opportunities for new technologies to capture solar energy. We also considered a wind turbine; however research revealed a number of issues including reports of adverse health effects. This led to a growing and ultimately serious concern regarding the health effects and safety of wind farms. Wind farms are defined as a collection of wind turbines located in the same area. [1]

20. After attending a learned presentation on the subject by Dr. John Harrison (Professor Emeritus of Physics of Queen's University) on August 2, 2008, I felt sufficient concern to write the municipal councillors of Prince Edward County, my elected Member

[1] Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities, Ministry of the Environment, October 2008, Document Number 53, Page 5, Section 4. "DESCRIPTION OF WIND FARM NOISE"

of Provincial Parliament, and the Honourable George Smitherman, Minister of Energy and Infrastructure. In the communication I questioned the advisability of exposing people to the noise emanating from IWT and wind farms.

21. I have continued to educate myself through research and consultation.

22. I am a member of the Executive of the Alliance to Protect Prince Edward County ("APPEC"). APPEC is a not-for-profit corporation registered in Ontario.

23. I have also had contact with, although I am not a member of, Wind Concerns Ontario ("WCO"). WCO was formed in October of 2008. Currently WCO has 54 member organizations from 32 counties and districts across Ontario. I was asked to serve on the executive of WCO and declined. My relationship is through APPEC and thereby indirect.

24. I am the Chair of the Society for Wind Vigilance. The Society is comprised of international members and affiliated consultants with expertise in various disciplines. Its purpose is to provide an objective clearing house for scientific, including medical, information on the environmental and health effects of IWTs. I have also had the opportunity to review the emerging body of scientific research and literature concerning IWTs and related issues.

25. IWTs have been in use for a number of years in other parts of Canada and in other parts of the world such as the United States, the United Kingdom, Europe, Asia, Australia and New Zealand.

26. I have had the opportunity to meet and discuss issues and concerns related to IWTs with hundreds of residents from across Ontario, and with experts from Ontario, Canada, Australia, the United States and the United Kingdom. It is clear there is a plethora of concerns relating to the impact of IWTs on human health.

27. Over the past 29 months I have devoted an average of 30 hours per week, or over 3700 hours, reading and researching the issue of adverse health effects and IWTs.

28. In addition to this research, as a practicing medical doctor I have met with and/or conducted in-person interviews with more than 40 people in Ontario alone who live in the environs of IWTs and who are clearly experiencing adverse health effects. Some of these effects are serious.

29. As part of both my personal role and my role in APPEC and the Society for Wind Vigilance, I have made a number of public presentations concerning health related matters. For example, I made presentations on November 23, 2008 to the Municipality of Prince Edward County (Municipal Council) [2], and on April 22, 2009 to the Standing Committee on General Government regarding Bill 150: *Green Energy and Green Economy Act, 2009*. [3]

30. As part of these and other presentations, I have discussed;

a) the lack of a comprehensive regulatory framework in Canada;

b) low frequency noise and infrasound;

c) reports of adverse health effects, and

d) proposals for moving forward on these issues,

31. Based on my general and specific knowledge as set out in part above, and on the foregoing conclusions that I had already previously reached, when I was asked if I would be able to provide evidence as part of this appeal, I agreed.

32. An analysis of the evidence included in this witness statement reveals that based on the best available science, the following conclusions can be drawn.

Conclusions

33. Persons living in the environs of IWTs in Ontario and in many other parts of the world are experiencing serious adverse health effects. Examples of these effects include

[2] Deputation to the Municipality of Prince Edward County, November 23 2008, Document Number 90
[3] Deputation to the Standing Committee on General Government Regarding Bill C-150,April 22 2009, Document Number 91

sleep disturbance, annoyance, stress or psychological distress, inner ear symptoms, headaches, excessive tiredness and loss of quality of life. In many cases these effects are serious.

34. Characteristically, these adverse health effects initially appeared (in the majority of cases) or substantially worsened following the commencement of IWT operations. They are exacerbated when individuals are near IWTs and subside when they remove themselves from the environment of IWTs. Symptoms recur when they return.

35. Some individuals living near IWTs have chosen not to live in their home due to the adverse health effects experienced.

36. These adverse health effects are more likely than not caused by exposure to infrasound and/or low frequency noise and/or audible noise and/or visual impact and/or shadow flicker produced by IWTs. The tonality, pulsating nature of the noise and the lack of nighttime abatement are further factors.

37. It should be noted that the precise patho-physiological mechanism(s) for these adverse health effects is not settled but important new evidence is emerging.

38. These adverse health effects are occurring at setback distances and modeled sound pressure levels which some residents living near the Kent Breeze Wind Farms will be exposed to.

39. The Kent Breeze Wind Farms have received a Renewable Energy Approval ("REA") even though there remains significant scientific uncertainty, and a lack of authoritative guidelines establishing the distance between residential homes/properties and IWTs where human health will be protected. I have previously stated:

(a) "… it must be made clear that there has not been any systematic epidemiological field study that could yield authoritative guidelines for the siting of wind turbines. Secondly no epidemiological study has been

conducted that establishes either the safety or harmfulness of Industrial Wind Turbines. In short there is an absence of evidence." [4]

(b) "(w)hen uncertainty exists and the health and well-being of people are potentially at risk, assuredly it is appropriate to invoke the precautionary principle. Until and unless there are authoritative guidelines in place based on the best available evidence the Province of Ontario ought not proceed with the development of Industrial Wind Turbines any further. The development of these guidelines must be based on a rigorous epidemiological evaluation of health effects of these turbines." [5]

40. Subsequent to making the above statements twenty months ago, new evidence has emerged which demonstrates IWTs sited close to humans will more likely than not cause serious adverse health effects. For example a health outcome study on residents in Maine living near IWTs (within approximately 1.5 km) and those living farther away from IWTs (approximately 3 to 7 km) has recently been completed. Living closer to IWTs was significantly associated with indicators of adverse health effects related to sleep quality, mental health, physical health, and quality of life.

41. I have also become aware of a much wider body of literature. I have also had the opportunity to interact with more individuals exposed to IWTs. I have also had the opportunity to interact with a wider group of experts in a variety of fields.

42. Adverse health effects caused by IWTs will more likely than not occur at distances and sound pressure levels in the proposed Kent Breeze Wind Farms as approved. None of the existing Ontario regulations or guidelines governing wind energy projects have been developed based on evidence addressing the types of adverse health effects listed above resulting from exposure to IWTs.

[4] Deputation to the Standing Committee on General Government Regarding Bill C-150,April 22 2009, Document Number 91, PDF Page 4 of 7, Paragraph 1
[5] Deputation to the Standing Committee on General Government Regarding Bill C-150,April 22 2009, Document Number 91, PDF Page 6 of 7,

43. Based on my current knowledge of adverse health effects related to exposure to IWTs, obtained through available scientific research, literature, reports, consultation with experts, and personal contact with individuals living in close proximity to IWTs, it is my professional opinion that that the Kent Breeze Wind Farms as approved more likely than not will cause serious harm to human health to many people in the environs of the wind farm.

Adverse Health Effects

44. The World Health Organization's definition of health states "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." [6] This definition has not been amended since 1948. I am not aware of it having been amended or negated either.

45. IWTs produce noise. [7] The World Health Organization defines noise as unwanted sound. [8]

46. Regarding adverse health effects of noise, the World Health Organization's 1999 Guidelines for Community Noise states:

> "According to the International Programme on Chemical Safety (WHO 1994), an adverse effect of noise is defined as a change in the morphology and physiology of an organism that results in impairment of functional capacity, or an impairment of capacity to compensate for additional stress, or increases the susceptibility of an organism to the harmful effects of other environmental influences. This definition includes any temporary or long-term lowering of the physical, psychological or social functioning of humans or human organs. The health significance of noise pollution is given in this chapter under separate headings,

[6] Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948. The Definition has not been amended since 1948. Document Number 1, Page 1

[7] Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities, Ministry of the Environment, October 2008, Document Number 53, Page 5, Section 4. "DESCRIPTION OF WIND FARM NOISE"

[8] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page vii, Paragraph 4

according to the specific effects: noise-induced hearing impairment; interference with speech communication; disturbance of rest and sleep; psychophysiological, mental-health and performance effects; effects on residential behaviour and annoyance; as well as interference with intended activities." [9]

47. The World Health Organization states "The recognition of the noise as a *serious* health hazard as opposed to a nuisance is a recent development and the health effects of the hazardous noise exposure are now considered to be an increasingly important public health problem." [10] (emphasis added)

48. The World Health Organization references the "Noise Effects Reaction Scheme" in the 2009 Night Noise Guidelines for Europe [11] (shown below). This scheme illustrates direct and indirect pathways for noise effects on human health. Annoyance, stress, and sleep disturbance are included as noise effects on health. Peer reviewed scientific research confirms noise induced annoyance, [12] stress, [13] and sleep disturbance [14] are serious adverse health effects which can cause other serious adverse health consequences.

[9] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 21, Paragraph 1
[10] World Health Organization, Occupational and community noise Fact sheet N°258
Revised February 2001, Document Number 3, Page 1, Paragraph 3
[11] World Health Organization, Night Noise Guidelines for Europe, 2009, Document Number 4, Page 62, Figure 4.3
[12] Niemann H, Bonnefoy X, Braubach M, Hecht K, Maschke C, Rodrigues C, Robbel N. Noise-induced annoyance and morbidity results from the pan-European LARES study. Noise Health 2006;8:63-79, Document Number 5, Page 1, Abstract Section and Page 10 Paragraph 1
[13] World Health Organization, Night Noise Guidelines for Europe, 2009 MOE Document Number 4, Page 61, Section 4.5.1 INTRODUCTION
[14] World Health Organization, Night Noise Guidelines for Europe, 2009 Document Number 4, Note health impacts of sleep disturbance documented throughout the reference

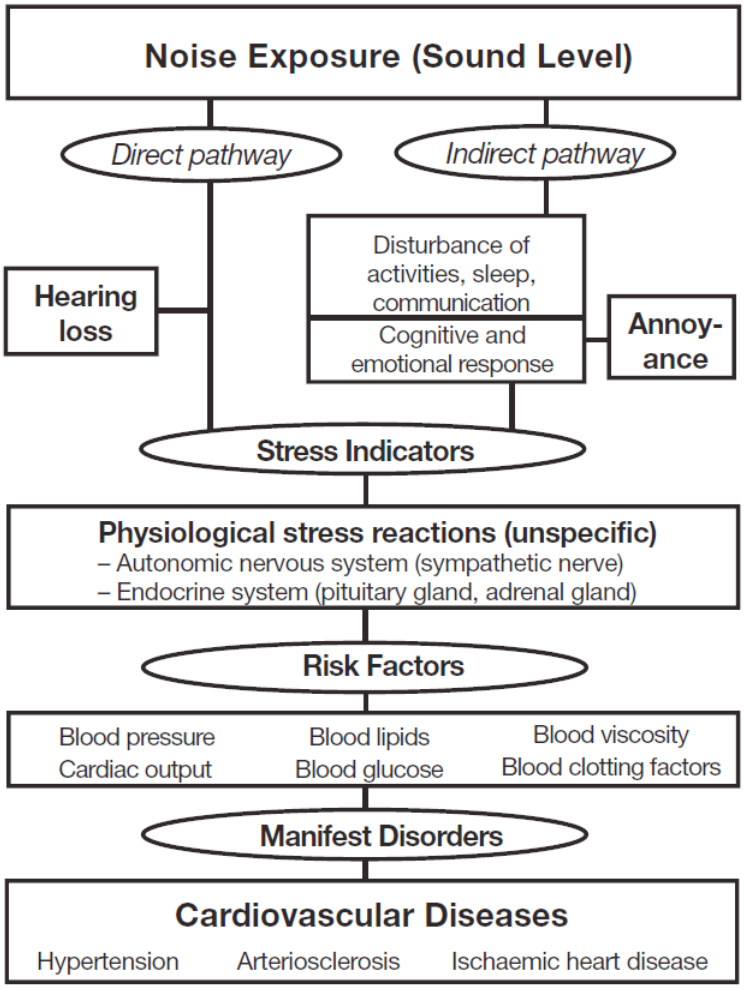

Fig. 4.3
Noise effects reaction scheme

Source:
Babisch, 2002.

49. Peer reviewed scientific research confirms humans must be protected from noise [15], [16] including low frequency noise [17] exposure that adversely affects human health and welfare.

50. Scientific understanding of the harmful effects of noise is incomplete and continues to evolve. For example in 2009 the World Health Organization released Night

[15] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page iii, Paragraphs 1, 2 and 3
[16] World Health Organization, Night Noise Guidelines for Europe, 2009, Document Number 4, Page vii, Paragraph 1
[17] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 43, Paragraph 1, Page 35, Paragraph 2

Noise Guidelines for Europe which incorporates new scientific knowledge related to health and sleep disturbance. This new knowledge builds on existing authoritative noise and health fundamentals. The 2009 guidelines complement the World Health Organization 1999 guidelines. This means that the recommendations on government policy on noise management in the 1999 guidelines should be considered valid and relevant.[18]

Evidence of Harm to Human Health Related to IWTs

51. An emerging body of international scientific research, literature, and reports have documented adverse health effects experienced by people exposed to IWTs. A peer reviewed scientific article states: "Some people with wind turbines located close to their homes have reported a variety of clinical symptoms that in rare cases are severe enough to force them to move away. These symptoms include sleep disturbance, headaches, difficulty concentrating, irritability and fatigue, but also include a number of otologic symptoms including dizziness or vertigo, tinnitus and the sensation of aural pain or pressure…." [19]

52. The National Academy of Medicine of France noted adverse health effects related to IWTs in their 2006 report "Repercussions of the Operation of Wind Turbines on the Health of Man".

> Noise is the most frequent complaint. It is described as piercing, preoccupying, continually surprising because it is irregular in intensity, but also includes grating and incongruous sounds, which distract the attention or disturb rest. The spontaneous recurrence of these noises disturb the sleep, suddenly awakening the subject when the wind rises, or preventing the subject from going back to sleep. Wind turbines have been blamed for other problems experienced by people living nearby. These are less precise, less well described, and consist of subjective

[18] World Health Organization, Night Noise Guidelines for Europe, 2009, Document Number 4, Page 110, Last Paragraph

[19] Salt, A.N., Hullar, T.E., Responses of the ear to low frequency sounds, infrasound and wind turbines, Hearing Research (2010), doi:10.1016/j.heares.2010.06.007, Document Number 7, Page 1, Introduction Section, Paragraph 1

manifestations (headaches, fatigue, temporary feelings of dizziness, nausea), and sometime objective (vomiting, insomnia, palpitations). [20] Their recommendation is for an interim set-back of 1.5 kilometers for 2.5 MW IWT from dwellings. They also recommend an epidemiological investigation into the possible medical effects of wind turbines. [21]

53. It is reported that a France 2009 court decision mandated that an IWT facility shut down operations at night in order to prevent the sleep disturbance that the local population had been experiencing. [22]

54. In Japan, residents living near IWTs report experiencing insomnia, headaches, dizziness, or buzzing in the ear according to media reports. In each town where complaints are notable, "…several to 60 residents have reported health problems". [23] The Japanese government has announced plans to conduct a 4 year epidemiological study starting in April, 2010 to investigate the influence of wind turbine sound on human health, including low frequency noise. [24]

55. In Denmark, it was reported that "State-owned energy firm Dong Energy has given up building more wind farms on Danish land, following protests from residents complaining about the noise the turbines make." [25]

56. In the United Kingdom, Dr. Amanda Harry documented 42 cases of people exposed to IWTs reporting adverse health effects. She concludes that "…there are people living near turbines who are genuinely suffering from health effects from the noise

[20] Claude-Henri Chouard, Impacts Of Wind Turbine Operation On Humans, National Academy Of Medicine, 2006, Document Number 9, Page 3, Paragraph 3
[21] Claude-Henri Chouard, Impacts Of Wind Turbine Operation On Humans, National Academy Of Medicine, 2006, Document Number 9, Page 9, Section 8 Recommendations
[22] France news report, December 7 2009, http://www.ouest-france.fr/actu/actuLocale_-La-justice-demande-l-arret-nocturne-des-huit-eoliennes-de-Cast_-1183050------29103-abd_actu.Htm, Document Number 10, Page 1
[23] Aya Ito And Tsuyoshi Takeda, Sickness claims prompt study of wind turbines, The Asahi Shimbun, January 19, 2010, Document Number 59, PDF Page 4, Paragraph 7
[24] Aya Ito And Tsuyoshi Takeda, Sickness claims prompt study of wind turbines, The Asahi Shimbun, January 19, 2010, Document Number 59, PDF Page 3, Paragraph 5
[25] The Copenhagen Post Online, Dong gives up on land-based turbines, September 1 2010, Document Number 60, Page 1, Paragraph 1

produced by wind turbines." [26] The Minnesota Department of Health summarises Dr. Harry's findings stating:

> "Harry (2007) describes a meeting with a couple in Cornwall, U.K. who live 400 meters from a wind turbine, and complained of poor sleep, headaches, stress and anxiety. Harry subsequently investigated 42 people in various locations in the U.K. living between 300 meters and 2 kilometers (1000 feet to 1.2 miles) from the nearest wind turbine. The most frequent complaint (39 of 42 people) was that their quality of life was affected. Headaches were reported by 27 people and sleep disturbance by 28 people. Some people complained of palpitations, migraines, tinnitus, anxiety and depression." [27]

57. In New Zealand, Dr. Robyn Phipps documented the experiences of residents living in proximity to IWTs. [28] The Minnesota Department of Health summarises Dr. Phipps findings stating:

> "Phipps (2007) discusses a survey of 619 households living up to 10 kilometers (km; 6 miles) from wind farms in mountainous areas of New Zealand. Most respondents lived between 2 and 2.5 km from the turbines (over 350 households). Most respondents (519) said they could see the turbines from their homes, and 80% of these considered the turbines intrusive, and 73% considered them unattractive. Nine percent said they were affected by flicker. Over 50% of households located between 2 and 2.5 km and between 5 and 9.5 km reported being able to hear the turbines. In contrast, fewer people living between 3 and 4.5 km away could hear the turbines. Ninety-two households said that their quality of life was affected by turbine noise. Sixty-eight households reported sleep disturbances: 42 of the households reported occasional sleep disturbances, 21

[26] Harry, A., 2007. Wind turbines, noise and health, Document Number 11, Page 21, Paragraph 1
[27] Minnesota Department of Health (MDH), Public Health Impacts of Wind Turbines, 2009, Document Number 12, Page 18, Paragraph 3
[28] Phipps, Robyn (2007) In the Matter of Moturimu Wind Farm Application. Evidence to the Joint Commissioners, Palmerston North. March 8-26, 2007, Document Number 40

reported frequent sleep disturbances and 5 reported sleep disturbances most of the time." [29]

58. In Australia and New Zealand, Dr. Robert Thorne investigated IWT noise at a number of wind farms:

(a) At one facility in New Zealand a total of 906 complaints over the course of a year have been made to the Wellington City Council New Zealand concerning IWT noise. Some of the reported adverse health effects include annoyance, stress, sleep disturbance, nausea, and headaches. In the most severely affected case known the residents have bought another property and moved away from their farm. [30]

(b) Dr. Thorne interviewed 5 families at the Waubra IWT facility in Australia and documented reports of adverse health effects subsequent to the commencement of IWT operations. Some of the symptoms reported include inability to get to sleep and sleep disturbance, anxiety, stress, pressure at top and around the head, memory problems, sore eyes, blurred vision, and chest pressure. The families lived approximately 1000 – 2000 metres from the IWT and had at least two sets of turbines near them.[31] It has been reported that some of the property owners in the Waubra IWT facility have been bought out by the wind energy proponent. [32]

59. In the United States, Dr. Nina Pierpont studied 38 people in 10 families living between 1000 feet (approximately 300 m) and slightly under 1 mile (approximately 1500

[29] Minnesota Department of Health (MDH), Public Health Impacts of Wind Turbines, 2009, Document Number 12, Page 18, Paragraph 4
[30] Thorne et al, Noise Impact Assessment Report Waubra Wind Farm Mr & Mrs N Dean Report No 1537 - Rev 1 - July 2010, Document Number 13, Page 115 and 119
[31] Thorne et al, Noise Impact Assessment Report Waubra Wind Farm Mr & Mrs N Dean Report No 1537 - Rev 1 - July 2010, Document Number 13, Page 110
[32] The Courier, Waubra Wind Farm Buys More Properties, November 18, 2010, Document Number 14, Page 1

m) from IWTs. [33] The Minnesota Department of Health summarises Dr. Pierpont's prepublication findings stating:

> "Pierpont (2009) postulates wind turbine syndrome, consisting of a constellation of symptoms including headache, tinnitus, ear pressure, vertigo, nausea, visual blurring, tachycardia, irritability, cognitive problems and panic episodes associated with sensations of internal pulsation. She proposes that the mechanism for these effects is disturbance of balance due to "discordant" stimulation of the vestibular system, along with visceral sensations, sensations of vibration in the chest and other locations in the body, and stimulation of the visual system by moving shadows. Pierpont does report that her study subjects maintain that their problems are caused by noise and vibration, and the most common symptoms reported are sleep disturbances and headache. However, 16 of the people she studied report symptoms consistent with (but not necessarily caused by) disturbance of equilibrium." [34]

60. Eight of the 10 families interviewed by Dr. Pierpont eventually moved away from their homes because they were so troubled by the symptoms, in some cases abandoning their homes. [35] The decision to leave or abandon a family home is one of the factors that may demonstrate the severity and seriousness of the effects they experienced.

61. In the United States, Dr. Michael Nissenbaum conducted a pilot study in Mars Hill, Maine following reports of adverse health complaints among residents living near IWTs in order to provide information to the Public Health Subcommittee of the Maine Medical Association. The pilot study reported on 15 cases of individuals living a mean distance of 2500 feet (762m) from IWT. Following the start of IWT operations, 93% of the respondents reported experiencing new onset of sleep disturbance. 53% of respondents reported new or increased incidence of headaches, and 20% reported

[33] Pierpont, N., 2009. Wind turbine syndrome. K-selected books. (Note the book "Wind Turbine Syndrome" is submitted electronically on a separate cd/dvd)
[34] Minnesota Department of Health (MDH), Public Health Impacts of Wind Turbines, 2009, Document Number 12, Page 19, Paragraph 2
[35] Pierpont, N., 2009. Wind turbine syndrome. K-selected books, Page 194, (Note the book "Wind Turbine Syndrome" is submitted electronically on a separate cd/dvd)

dizziness. Other reported symptoms included unusual body sensations, tinnitus, hypertension, nausea, and weight change. Psychiatric symptoms included stress, anger, anxiety, hopelessness and depression. 100% of respondents reported that they had considered moving away but notably 73% reported they could not afford to do so. [36]

62. In 2010, Dr. Nissenbaum expanded the pilot study and completed a larger more detailed study at two wind farm sites (Mars Hill and Vinalhaven, Maine) utilizing validated questionnaires. Health outcomes were assessed on residents living near IWTs (within approximately 1.5 km) and those living farther away from IWTs (approximately 3 to 7 km). Living closer to IWTs was significantly associated with indicators of adverse health effects related to sleep quality, mental health, physical health, and quality of life.

63. Dr. Nissenbaum presented the preliminary findings from the above study at the First International Symposium on The Global Wind Industry and Adverse Health Effects, held October 29-31, 2010 in Picton, Ontario.

64. In Ontario, a community based self-reporting health survey called WindVOiCe has been collecting data about adverse health effects being experienced by families living near IWTs. It follows the principles of Health Canada's "Canada Vigilance Programs", which encourages all consumers in Canada to self report suspected adverse health effects from prescription products, vaccines and other consumer products. [37] As of July 2010 WindVOiCe has documented 109 Ontario respondents who have reported experiencing adverse health effects from exposure to IWTs. "Victims report disturbed living conditions and loss of quality of life and enjoyment of their homes and property, and financial loss due to the negative impact to the health of their families. Sleep disturbance is the most common health complaint. Some describe the annoyance, stress concerns such as arrhythmias and palpitations, headaches and cognitive and mood disturbances. Several

[36] Michael A Nissenbaum, Presentation to the Maine Medical Association, March 2009, Document Number 15, PDF Pages 9, 11, 13, 15, 21, 27
[37] Canada Vigilance Program, http://www.hc-sc.gc.ca/dhp-mps/medeff/vigilance-eng.php, Document Number 96

suffered acute hypertensive episodes which are most concerning. Some have had to leave their homes in order to protect their health." [38]

65. At the Standing Committee on General Government for the Green Energy and Green Economy Act, 2009 a delegation of residents living near the Suncor Ripley Wind Farm in Ontario reported adverse health effects. Adverse health effects presented included stress, sleep disturbance, depression, anxiety, humming in the head by the ears, edginess, bad temper, headaches heart palpitations, heaviness in the chest, increased blood pressure, ringing in the ears, earaches, sore eyes, digestive problems which continued for months, inability to concentrate or form words and a severe feeling of being unwell. After five months of severe symptoms, these people had "begged" for sleep and were billeted at a hotel in the town of Kincardine at the expense of the wind company, Suncor. [39]

66. Melissa Wylde who lived near the Suncor Ripley Wind Farm experienced a threatened abortion (i.e. first trimester bleeding). She reported to me that her obstetrician suggested she move away from the environs of the wind farm. After the family moved to a motel her pregnancy stabilized and she has since delivered a healthy boy. In addition her then 2 year old daughter had problems of ear ache and sleep disturbance. Ten visits to physicians and the local emergency department yielded no explanation for the otalgia. However when her family moved into a motel away from the turbines the problem resolved. I have received permission from the Wylde family to share their story.

67. I am aware that a number of homes close to the Suncor Ripley Wind Farm have since been effectively abandoned as the families are now living in other locations.

68. In addition to this research, as a practicing medical doctor I have met with and/or conducted in-person interviews with more than 40 people in Ontario alone who live in the environs of IWTs who are clearly experiencing adverse health effects. Some of these

[38] Wind Vigilance for Ontario Communities (WindVOiCe©) Document Number 16, Page 1, Paragraph 5
[39] Hansard Reports, proceedings from April 15th, 2009 The Green Energy Act, Bill 150, Standing Committee on General Government, Section "RIPLEY GROUP" http://www.ontla.on.ca/web/committee-proceedings/committee_transcripts_details.do?locale=en&Date=2009-04-15&ParlCommID=8856&BillID=2145&Business=&DocumentID=23801#P686_202434, Ontario Document Number 17, Pages G-547 - G-550,

effects are serious. The health effects that the individuals I have met with and/or conducted in-person interviews with are listed in the Case Definition presented in Paragraph 70 below. The Case Definition is based upon individuals experiencing adverse health effects, most commonly psychological distress and sleep disturbance, when living in the environs of IWT installations. In more severe cases transient exposure is sufficient to provoke symptoms of psychological and physiological distress.

69. It is important to note that medically, annoyance is a recognized adverse health effect. The annoyance is associated with stress, psychological distress, and includes difficulty with sleep initiation and sleep disturbance, stress and physiological distress. Stress and sleep deprivation are well known risk factors for increased morbidity including significant chronic disease such as cardiovascular problems including hypertension and ischemic heart disease.

70. Case Definition: The criteria for making the diagnosis of probable adverse health effects in the environs of IWT being experienced by individuals are as follows:

> Diagnosis of Adverse Health Effects in the Environs of Industrial Wind Farms
>
> 1. Primary Criteria (all 4 of the following must be present)
>
> a) domicile within 5 km of IWT
>
> b) altered health status following the start-up, or initial exposure, and during the operation of IWT
>
> c) amelioration of symptoms when more than 5 km from the environs of IWT
>
> d) recurrence of symptoms upon return to environs of IWT within 5 km.
>
> 2. Secondary Criteria (at least 2 of the following occur or worsen after the initiation of operation of IWT)
>
> a) compromise of quality of life
>
> b) sleep disruption

c) annoyance producing increased levels of stress and/or psychological distress

d) preference to leave residence temporarily or permanently for sleep restoration or well-being

3. Tertiary Criteria (at least 3 of the following occur or worsen following the initiation of IWT)

a) headache

b) dizziness

c) palpitations

d) trouble concentrating

d) fatigue

e) hypertension

f) tinnitus

g) dizziness

h) otalgia (ear pain)

i) nausea

j) mood disorders (e.g. depression, anxiety, panic attacks)

k) worsening of diabetes or trouble with control

l) appearance of thyroid disorder or trouble with control of pre-existent hypo- or hyperthyroidism

*NB: Case Definition may evolve as further information becomes available.

71. In Ontario, a support and information network was formed in 2009 called "Victims of Wind" for individuals experiencing adverse health effects from exposure to IWTs.

72. In general the wind energy industry denies the plausibility of IWT induced adverse health effects. The Canadian Wind Energy Association ("CanWEA") is an

industry trade association and registered lobbyist organization [40]. In 2009, CanWEA produced a fact sheet to address concerns regarding wind turbines and human health stating "…findings clearly show there is no peer-reviewed scientific evidence indicating that wind turbines have an adverse impact on human health." [41]

73. However, Health Canada states "In fact, there are peer-reviewed scientific articles indicating that wind turbines may have an adverse impact on human health". [42]

Annoyance, Stress, and Sleep Disturbance:

74. Annoyance, and/or stress, and/or sleep disturbance are acknowledged as adverse health effects related to IWTs in reports, literature reviews and peer reviewed scientific articles. [43], [44], [45], [46], [47], [48], [49], [50], [51], [52], [53], [54], [55], [56]

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[40] Lobbyists Registration Act, 1998 Registry Search, Robert Hornung, President Canadian Wind Energy Association, , Document Number 92

[41] CanWEA fact sheet Addressing Concerns With Wind Turbines And Human Health, Revised: April 2009, Document Number 18, PDF Page 25 of 25, Last Sentence

[42] Safe Environs Program, Health Canada Environmental Assessment Nova Scotia, August 6, 2009, Document Number 8, Page 2, Paragraph 3

[43] Pedersen, E. and K. Persson Waye. 2004. Perception and annoyance due to wind turbine noise: A dose–response relationship, Journal of the Acoustical Society of America 116: 3460–3470. Document Number 22, Page 3469, Section C "Conclusion"

[44] Pedersen, E. and K. Persson Waye. 2007. Wind turbine noise, annoyance and self-reported health and well being in different living environments Document Number 23, Page 480, Top of page Section "Results"

[45] Pedersen et al., 2008,Project WINDFARMperception Visual and acoustic impact of wind turbine farms on residents, Document Number 24, Page 60, Section 8.3 Main conclusions, and Page 61, Paragraph 2

[46] Pederson, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page 634, Paragraph 1

[47] Minnesota Department of Health (MDH), Public Health Impacts of Wind Turbines, 2009, Document Number 12, Page 25, Paragraph 3

[48] Copes et al, Wind Turbines And Environmental Assessment, National Collaborating Centre for Environmental Health, June 23, 2009, Document Number 70, Page 54, Conclusion 1, Page 55, Conclusion 3

[49] Copes, R. and K. Rideout. Wind Turbines and Health: A Review of Evidence. Ontario Agency for Health Protection and Promotion, September 2009, Document Number 71, Page 40, Conclusions

[50] Rideout K, Copes R, Bos C. Wind turbines and health. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 June 3]. Document Number 21, Page 1, Bullet 1 Available from: http://www.ncceh.ca/files/Wind_Turbines_January_2010.pdf.

[51] Arlene King M.D., Ontario Ministry of Health and Long Term Care Memorandum, October 21, 2009, Document Number 78, Page 2, Paragraph 1

[52] Thorne et al, Noise Impact Assessment Report Waubra Wind Farm Mr & Mrs N Dean Report No 1537 - Rev 1 - July 2010, Document 13, Page 6, Paragraph 3

Annoyance Is An Adverse Health Effect:

75. Annoyance when chronic, is a serious adverse health effect related to IWTs.

76. Until recently the serious health consequences of noise induced annoyance has been underestimated. [57]

77. “"Annoyance" has been the term used to describe the community's collective feelings about noise ever since the early noise surveys in the 1950s and 1960s, although some have suggested that this term tends to minimize the impact. While "aversion" or "distress" might be more appropriate descriptors, their use would make comparisons to previous research difficult. It should be clear, however, that annoyance can connote more than a slight irritation; it can mean a significant degradation in the quality of life. This represents a degradation of health in accordance with the WHO's definition of health, meaning total physical and mental well-being, as well as the absence of disease.” [58]

78. Peer reviewed scientific research has established noise induced annoyance contributes to stress, [59] sleep disturbance [60] and there is a causal link with an increased risk to health i.e. morbidity. [61], [62], [63]

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[53] Keith, S. E., D. S. Michaud, and S. H. P. Bly. 2008. A proposal for evaluating the potential health effects of wind turbine noise for projects under the Canadian Environmental Assessment Act. Journal of Low Frequency Noise, Vibration and Active Control, 27(4):253-265. Document Number 34, Page 256, Paragraph 3, Last Sentence

[54] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 5-2, Conclusion 3 and 4

[55] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 4-3, Paragraph 5

[56] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 4-3, Paragraph 5

[57] Maschke et al, Health Effects Of Annoyance Induced By Neighbour Noise, Noise Control Eng. J. 55 (3), 2007 May-June, Document Number 20, Page 348, Paragraph 1

[58] Alice H. Suter, Dr., Noise and Its Effects, Administrative Conference of the United States, November 1991, Document Number 41, PDF Page 30 of 36 , Paragraph 6

[59] World Health Organization, Night Noise Guidelines for Europe, 2009, Document Number 4, Page 62, Fig. 4.3 Noise effects reaction scheme top of page, and Page 63, paragraph 2

[60] World Health Organization, Night Noise Guidelines for Europe, 2009, Document Number 4, Page 59, Section 4.4 NEIGHBOURHOOD NOISE AND NOISE FROM NEIGHBOURS

[61] Niemann H, Bonnefoy X, Braubach M, Hecht K, Maschke C, Rodrigues C, Robbel N. Noise-induced annoyance and morbidity results from the pan-European LARES study. Noise Health 2006;8:63-79, Document Number 5, PDF Page 10 of 12, Paragraph 1

79. The World Health Organization states noise "…limits should be based on annoyance responses to noise." [64]

80. A report entitled "Wind Turbines and Health" co-authored by Dr. Ray Copes, (now the Director of Environment and Occupational Health at the Ontario Agency for Health Protection and Promotion) states: "Annoyance and sleep disruption are common when sound levels are 30 to 45 dBA." [65] Residents living near the Kent Breeze Wind Farms will be exposed to modelled sound pressure levels within the range of 30 to 45 dBA. [66]

81. The World Health Organization classifies "moderate annoyance" and "serious annoyance" as "Critical Health Effects" from which humans must be protected for both indoor and outdoor noise exposures.[67]

82. The World Health Organization states "… practical action to limit and control the exposure to environmental noise are essential. Such action must be based upon proper scientific evaluation of available data on effects, and particularly dose-response relationships." [68] There is no one size fits all dose response relationship for noise. The World Health Organization states "Dose-response relations for different types of traffic

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[62] Maschke et al, Health Effects Of Annoyance Induced By Neighbour Noise, Noise Control Eng. J. 55 (3), 2007 May-June, Document Number 20, Page 355, Section 7 Conclusions

[63] Niemann Dr Hildegard, Maschke Dr Christian, LARES Final Report Noise Effects And Morbidity, World Health Organization 2004, Document Number 80, Page 18, Section ``Conclusion

[64] World Health Organization, Guidelines for Community Noise, 1999, Document Number 2, Page 56, Paragraph 2, Item b.

[65] Rideout K, Copes R, Bos C. Wind turbines and health. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 June 3]. Document Number 21, Page 4, Table 1. ``Summary of potential wind turbine hazards and mitigation options`` Available from: http://www.ncceh.ca/files/Wind_Turbines_January_2010.pdf.

[66] Kent Breeze Corporation Noise Assessment Report Kent Breeze Wind Farm and MacLeod Windmill Project H335112-0000-00-124-0001 0 May 14, 2010, Document Number 61, PDF 15 thru 25 of 52, Table 6.1 ``Wind Turbine Noise Impact Summary - Points of Reception - Non-Participating Receptors"

[67] World Health Organization, Guidelines for Community Noise, 1999, Document Number 2, Page 47, Table 4.1: Guideline values for community noise in specific environments

[68] World Health Organization, Guidelines for Community Noise,1999, Document Number 2 Page iii, Paragraph 2

noise (air, road and railway) clearly demonstrate that these noises can cause different annoyance effects at equal LAeq,24h values." [69]

83. Studies published in scientific journals investigated exposure to wind turbine noise and annoyance responses for both indoor and outdoor noise exposures. [70], [71], [72] A 2004 study conducted in Sweden and a 2009 study conducted in the Netherlands determined that a portion of respondents reported being "rather" or "very" annoyed by wind turbine noise.

a) The proportion of respondents in The Netherlands study who were rather annoyed or very annoyed by wind turbine noise when spending time indoors at their dwelling was 8% at 35-40 dBA, and 16% at 40-45 dBA. [73]

b) The proportion of respondents in The Netherlands study who were rather annoyed or very annoyed by wind turbine noise when spending time outdoors at their dwelling was 18% at 35-40 dBA, and 18% at 40-45 dBA. [74]

c) The proportion of respondents in the Swedish study who were rather annoyed or very annoyed by wind turbine noise when spending time outdoors at their dwelling was 28% at 37.5-40 dBA and 44% at 40dBA and greater (the sound intervals were defined differently in the Swedish

[69] World Health Organization, Guidelines for Community Noise,1999, Document Number 2 Page 42 , Paragraph 2
[70] Pedersen, E. and K. Persson Waye. 2004. Perception and annoyance due to wind turbine noise: A dose–response relationship, Journal of the Acoustical Society of America 116: 3460–3470. Document Number 22
[71] Pedersen et al., 2008,Project WINDFARMperception Visual and acoustic impact of wind turbine farms on residents, Document Number 24
[72] Pederson, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25
[73] Pederson, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page 637, Table II.
[74] Pederson, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page 637, Table II

study). [75]

d) 16% of the 128 Swedish respondents living at sound exposure above 35 dBA stated that they were disturbed in their sleep by wind turbine noise [76]

e) The graph below is based on the results of the 3 European studies of IWT facilities. [77] The percentage of the population "rather annoyed" or "very annoyed" by IWT noise is plotted.

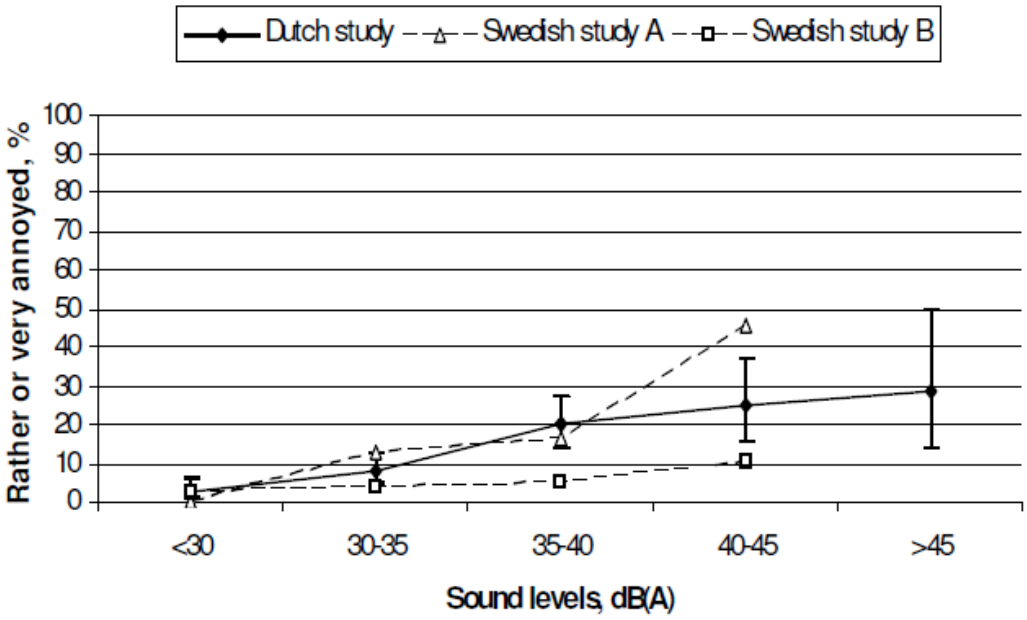

Figure G.2. Annoyance with wind turbine sound; comparisons between the Dutch study (only respondents that did not benefit economically) and the Swedish studies A and B (with 95% CI for the Dutch study).

f) In addition to these results, it is important to consider confounding variables in the research of Pedersen et al which are not generally

[75] Pedersen, E. and K. Persson Waye. 2004. Perception and annoyance due to wind turbine noise: A dose–response relationship, Journal of the Acoustical Society of America 116: 3460–3470 Document Number 22, Page 3465, Table V

[76] Pedersen, E. and K. Persson Waye. 2004. Perception and annoyance due to wind turbine noise: A dose–response relationship, Journal of the Acoustical Society of America 116: 3460–3470 Document Number 22, Page 3467, Paragraph 2

[77] Pedersen et al., 2008,Project WINDFARMperception Visual and acoustic impact of wind turbine farms on residents, Document Number 24, Appendix Page App. p. 19,

appreciated, including non-disclosure agreements. [78] For example, the existence of non-disclosure clauses and buyouts could result in underreporting among those receiving remuneration for turbines, or those whose properties and homes have been purchased by wind companies. These clauses may have skewed the results reported by Pedersen and Phipps toward a lower incidence of adverse health effects.

g) Occult adverse health effects could be occurring without people being aware of them. These adverse health effects that people would not have been captured by the survey methodology of Phipps and Pedersen et al. To uncover such adverse health effects, investigation such as sleep studies for individuals would be required. For populations, longitudinal epidemiological studies over a period of 5-10 years would be necessary.

84. Annoyance as an effect of exposure to IWT noise is acknowledged by HGC Engineering in their report for the Ministry of the Environment ("MOE") entitled "Low Frequency Noise and Infrasound Associated with Wind Turbine Generator Systems". HGC Engineering states:

> "The audible sound from wind turbines, at the levels experienced at typical receptor distances in Ontario, is nonetheless expected to result in a non-trivial percentage of persons being highly annoyed. As with sounds from many sources, research has shown that annoyance associated with sound from wind turbines can be expected to contribute to stress related health impacts in some persons. [79]

Stress Is An Adverse Health Effect:

85. Stress is a serious adverse health effect related to IWTs.

[78] Brendan Gullifer, Gagged property owners urged to give evidence, November 12, 2010, Document Number 104, Page 1

[79] Howe Gastmeier Chapnik Limited, Low Frequency Noise And Infrasound Associated With Wind Turbine Generator Systems A Literature Review Ontario Ministry Of The Environment Rfp No. Oss-078696 Final Draft, December 10, 2010, Document Number 27, Page 39, Bullet 5

86. Noise is an environmental stressor which can cause serious stress related adverse health effects. “The subjective experience of noise stress can, through central nervous processes, lead to an inadequate neuro-endocrine reaction and finally lead to regulatory diseases.” [80]

87. If left unchecked stress in general can cause serious harm to human health. For example Health Canada states stress “… is considered to be a risk factor in a great many diseases, including: heart disease, some types of bowel disease, herpes, mental illness … Stress also makes it hard for people with diabetes to control their blood sugar … Stress is also a risk factor in alcohol and substance abuse, as well as weight loss and gain … Severe stress can cause biochemical changes in the body, affecting the immune system, leaving your body vulnerable to disease.” [81]

88. Acute stress reaction is health enabling whereas chronic stress becomes pathogenic. As Dr Bruce S. McEwen states “The mind involves the whole body, and two-way communication between the brain and the cardiovascular, immune, and other systems via neural and endocrine mechanisms. Stress is a condition of the mind-body interaction, and a factor in the expression of disease that differs among individuals. It is not just the dramatic stressful events that exact their toll, but rather the many events of daily life that elevate and sustain activities of physiological systems and cause sleep deprivation, overeating, and other health-damaging behaviors, producing the feeling of being “stressed out.” Over time, this results in wear and tear on the body, which is called “allostatic load,” and it reflects not only the impact of life experiences but also of genetic load, individual lifestyle habits reflecting items such as diet, exercise, and substance abuse, and developmental experiences that set life-long patterns of behavior and physiological reactivity. Hormones associated with stress and allostatic load protect the body in the short run and promote adaptation by the process know as allostasis, but in the long run allostatic load causes changes in the body that can lead to disease. The brain is the key organ of stress, allostasis, and allostatic load, because it determines what is

[80] Maschke et al, Health Effects Of Annoyance Induced By Neighbour Noise, Noise Control Eng. J. 55 (3), 2007 May-June, Document Number 20, Page 348, Paragraph 1
[81] Health Canada, , Section ``Health Effects of Stress`` http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/life-vie/stress-eng.php Document Number 42, Page 2

threatening and therefore stressful, and also determines the physiological and behavioral responses. Brain regions such as the hippocampus, amygdala, and prefrontal cortex respond to acute and chronic stress by undergoing structural remodeling, which alters behavioral and physiological responses. Translational studies in humans with structural and functional imaging reveal smaller hippocampal volume in stress-related conditions, such as mild cognitive impairment in aging and prolonged major depressive illness, as well as in individuals with low self-esteem. Alterations in amygdala and prefrontal cortex are also reported. Besides pharmaceuticals, approaches to alleviate chronic stress and reduce allostatic load and the incidence of diseases of modern life include lifestyle change, and policies of government and business that would improve the ability of individuals to reduce their own chronic stress burden." [82] See also [83]

89. Peer reviewed research indicates social economic and psychological stress has implications for childhood asthma morbidity. [84], [85] Based on an ongoing longitudinal study "Children with asthma who experienced a major acute life event on top of having high chronic stress in their lives exhibited a 5.5-fold reduction in glucocorticoid receptor mRNA and a 9.5-fold reduction in b2-adrenergic receptor mRNA relative children with asthma without comparable stressor exposure. These findings suggest that stressful experience diminishes expression of the glucocorticoid and b2-adrenergic receptor genes in children with asthma. Given that glucocorticoids bronchodilators are often given as treatments for asthma, this study is important for suggesting a mechanism genomic level for why stress is associated with increased asthma morbidity." [86]

90. Scientific research reveals "With children the effects of noise-induced annoyance from traffic, as well as neighbourhood noise, are evident in the respiratory system. The

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[82] Bruce S. McEwen, PhD, Protective and damaging effects of stress mediators: central role of the brain, Dialogues in Clinical Neuroscience - Vol 8 . No. 4 . 2006, Document Number 84, Page 1, Abstract in box
[83] Bruce S. McEwen , The neurobiology of stress: from serendipity to clinical relevance, Brain Research 886 (2000) 172–189, Document Number 85, Page 1, Abstract
[84] Miller et al, Parental support and cytokine activity in childhood asthma: The role of glucocorticoid sensitivity, J ALLERGY CLIN IMMUNOL VOLUME 123, NUMBER 4, April 2009, Document Number 44, Page 824, Bottom of first column Section Conclusion
[85] Chen et al, Socioeconomic status and inflammatory processes in childhood asthma: The role of psychological stress, J ALLERGY CLIN IMMUNOL VOLUME 117, NUMBER 5, May 2006, Document Number 45, Page 1014, Bottom of first column Section Conclusion
[86] Chen UBC Psychobiological Determinants of Health Laboratory, http://www2.psych.ubc.ca/~healthpsych/edith.htm, Document Number 86, PDF Page 2 of 8, Bullet 2

increased risk of illness in the respiratory system in children does not seem to be caused primarily by air pollutants, but rather, as the results for neighbourhood noise demonstrate, by emotional stress." [87] The same study also reveals noise induced annoyance can cause serious adverse effects in adults.

Sleep Disturbance Is An Adverse Health Effect:

91. Sleep disturbance is a serious adverse health effect related to IWTs.

92. "Recent epidemiological studies have shown a connection between disturbed sleep and later occurrence of stress-related disorders such as cardiovascular diseases … and diabetes type II …" [88]

93. In 2009, the World Health Organization released a peer reviewed summary of research regarding the risks to human health from noise induced sleep disturbance. Adverse health effects documented in the report include poor performance at work, fatigue, memory difficulties, concentration problems, motor vehicle accidents, mood disorders (depression, anxiety), alcohol and other substance abuse, cardiovascular, respiratory, renal, gastrointestinal, musculoskeletal disorders, obesity, impaired immune system function and a reported increased risk of mortality. [89]

Mental Health:

94. Impact to mental health is a serious adverse health effect related to IWTs.

95. A November 2009 presentation attributed to Geoff Leventhall lists symptoms associated with "Wind Turbine Syndrome", (a phrase coined by Dr. Nina Pierpont [90]):

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[87] Niemann H, Bonnefoy X, Braubach M, Hecht K, Maschke C, Rodrigues C, Robbel N. Noise-induced annoyance and morbidity results from the pan-European LARES study. Noise Health 2006;8:63-79, Document Number 5, PDF Page 1 of 12, Abstract First Paragraph

[88] World Health Organization, Night Noise Guidelines for Europe, 2009, Document Number 4, Page 34, Last Paragraph

[89] World Health Organization, Night Noise Guidelines for Europe, 2009, Document Number 4, Documented through out the reference

[90] Pierpont, N., 2009. Wind turbine syndrome. K-selected books, (Note the book "Wind Turbine Syndrome" is submitted electronically on a separate cd/dvd)

> "…sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal pulsation or quivering which arise while awake or asleep" [91]

The same presentation also lists symptoms associated with noise annoyance:

> "…insomnia; headache; pressure in the ears or head; Dizziness; nausea; eye strain; fatigue; distraction; nose bleeds; feeling vibration; muscle spasms; palpitations; skin burning; stress; tension etc" [92]

The same presentation states:

> "Wind Turbine Syndrome Symptoms … [*sic are the*] same as those of noise annoyance. Psychological, not physiological" [93]

96. The World Health Organization states "Modern science is discovering that, while it is operationally convenient for purposes of discussion to separate mental health from physical health, this is a fiction created by language. Most "mental" and "physical" illnesses are understood to be influenced by a combination of biological, psychological and social factors." [94]

97. "In an integrated and evidence-based model of health, mental health (including emotions and thought patterns) emerges as a key determinant of overall health. Anxious and depressed moods, for example, initiate a cascade of adverse changes in endocrine and immune functioning, and create increased susceptibility to a range of physical illnesses." [95]

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[91] Leventhall Geoff, Wind Turbines Large Small and Unusual, November 11, 2009, Document Number 56, Slide Page 46,
[92] Leventhall Geoff, Wind Turbines Large Small and Unusual, November 11, 2009, Document Number 56, Slide Page 46
[93] Leventhall Geoff, Wind Turbines Large Small and Unusual, November 11, 2009, Document Number 56, Slide Page 45
[94] World Health Organization, The World Health Report: 2001: Mental Health: New Understanding, New Hope, Document Number 30, Page 7 Last Paragraph Before Box 1.1
[95] World Health Organization, The World Health Report: 2001: Mental Health: New Understanding, New Hope, Document Number 30, Page 9, First Paragraph After Box 1.3

98. "Mental health is as important as physical health. In fact, the two are intertwined. Our mental health directly affects our physical health and vice versa…mental health factors can increase the risk of developing physical problems such as, diabetes, heart disease, weight gain or loss, gastrointestinal problems, reductions in immune system, efficiency, and blood biochemical imbalances." [96]

Summary of Evidence:

99. In summary, the available evidence regarding harm to human health related to IWTs leads me to the conclusion that the effects of chronic exposure are serious. This exposure increases the risk for chronic diseases, serious mood disorders and thereby not only for increased morbidity but mortality as well. The similarity and consistency of adverse health effects reported in the above scientific research, literature, reports, and my personal meetings and/or interviews with people living near IWTs is also remarkable.

Characteristics of IWTs

100. The precise cause of adverse health effects related to IWTs is not settled science. However, there are some characteristics of IWTs that are more likely than not responsible for adverse health effects related to IWTs.

IWT Noise:

101. Peer reviewed scientific research confirms that wind turbine noise is very easily perceived. [97], [98]

102. The following graph demonstrates that the proportion of respondents highly annoyed by wind turbine noise is higher than that for other types of community noise

[96] Health Canada Document Number 31, Page 2, Section "Health Effects of Mental Illness"
[97] Pedersen, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page 642, Last Paragraph
[98] Pedersen et al, Can road traffic mask sound from wind turbines? Response To Wind Turbine Sound At Different Levels Of Road Traffic Sound, Energy Policy 38 (2010) 2520–2527, Document Number 26, Page 2526 Paragraph 2

(aircraft, road traffic, railway noise) at the same sound pressure levels, and that the proportion annoyed by wind turbine noise increased more rapidly.[99]

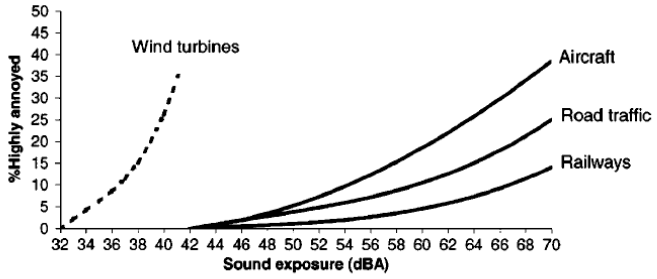

FIG. 3. A comparison between the dose–response relationship for transportation noise estimated by third order polynomials suggested by Miedema and Oudshoorn (2001) and wind turbine noise (dotted line). The latter ($\%HA = 4.38*10^{-2}(LEQ-32)^3 - 2.413*10^{-1}(LEQ-32)^2 + 2.4073(LEQ-32)$) were derived using regression based on five points interpolated from sound categories used in this study and the assumption that "very annoyed" in this study equals "highly annoyed" (Miedema and Voss, 1998).

Note: "The established curves describing annoyance from transportation noise are based on a large amount of data, and the wind turbine curve on only one study, so interpretations should be done with care." [100]

103. A 2009 peer reviewed scientific article which summarizes the results of studies of three European wind turbine facilities determined "Wind turbine noise was more annoying than transportation noise or industrial noise at comparable levels …" [101]

104. IWT noise is comprised of a number of characteristics including broad band noise, low frequency noise, infrasound, tonal noise, amplitude modulation, and impulse noise. [102], [103]

[99] Pedersen, E. and K. Persson Waye. 2004. Perception and annoyance due to wind turbine noise: A dose–response relationship, Journal of the Acoustical Society of America 116: 3460–3470, Document 22, Page 3468, Top of page

[100] Pedersen, E. and K. Persson Waye. 2004. Perception and annoyance due to wind turbine noise: A dose–response relationship, Journal of the Acoustical Society of America 116: 3460–3470, Document 22, Page 3467, Last paragraph

[101] Pederson, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page Number 634, Paragraph 1

[102] Soysal et al, Wind Farm Noise and Regulations in the Eastern United States, , Second International Meeting onWind Turbine Noise Lyon France September 20 –21 2007, Document 57, Page 3 of 12, Section "Characteristics of Wind Turbine Sound", Items 1, 2, 3, 4 also Page 11 of 12, Section "Conclusions", Paragraph 1

[103] National Research Council (NRC). Environmental Impacts of Wind-Energy Projects, 2007 NRC, Washington, DC, Document Number 28, Pages 157, 158, 159

105. Modulated broad band noise, low frequency noise, infrasound, tonal noise, impulse noise and night time noise have a particularly pronounced effect on people exposed to them. [104], [105]

106. The World Health Organization states "The capacity of a noise to induce annoyance depends upon many of its physical characteristics, including its sound pressure level and spectral characteristics, as well as the variations of these properties over time." [106]

IWT Noise - Amplitude Modulation:

107. Modern upwind IWTs produce a characteristic "swish swish swish" sound, which is the audible modulation of aerodynamic noise. This amplitude modulation can be intrusive, [107] very disturbing, [108] and is acknowledged to contribute to higher levels of wind turbine induced annoyance and/or stress and/or sleep disturbance in the exposed population. [109], [110], [111]

108. "From various studies it follows that this modulation is equivalent in annoyance to the un-modulated sound at an approximately 5 dB higher level." [112]

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[104] Health Council of the Netherlands (HCN). 2004 The Influence of Night-time Noise on Sleep and Health. The Hague: Health Council of the Netherlands, 2004; publication no. 2004/14E, Document Number 58, Page 82, Section 4.2

[105] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page xi, Paragraph 3

[106] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 42 , Paragraph 2

[107] Thorne et al, Noise Impact Assessment Report Waubra Wind Farm Mr & Mrs N Dean Report No 1537 - Rev 1 - July 2010, Document 13, Page 75, Paragraph 3

[108] Leventhall G. Infrasound from wind turbines: fact, fiction or deception. Can Acoust. 2006;34(2):29-36., Document Number 29, Page 34, Paragraph 4

[109] Pedersen, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page Number 634, Paragraph 1

[110] Development of Regulatory Requirements for Wind Turbines in Alberta; D.C. DeGagne and A. Lewis; Alberta Energy and Utilities Board; Journal of the Canadian Acoustical Association; V34,N2; June 2006, Document Number 88, Page 23, Paragraph 6

[111] Keith, S. E., D. S. Michaud, and S. H. P. Bly. 2008. A proposal for evaluating the potential health effects of wind turbine noise for projects under the Canadian Environmental Assessment Act. Journal of Low Frequency Noise, Vibration and Active Control, 27(4):253-265. Document Number 34, Page 260, Paragraph 3

[112] Pedersen Eja, van den Berg Frits, Why Is Wind Turbine Noise Poorly Masked By Road Traffic Noise? Inter Noise 2010, June 13-16 2010, Document Number 32, Page Number 8, Paragraph 1

109. For sources of noise other than IWTs, Ontario specifies a +5 dB adjustment for a project that contains an audible cyclic variation in sound level such as beating or other amplitude modulation. However this adjustment is not applied to Ontario wind farms. [113] No scientific justification is offered for this exemption.

110. There is no evidence that during the engineering stage of the proposed Kent Breeze Wind Farms a 5 dB penalty for IWT beating or other amplitude modulation was applied in order to protect human health.

IWT Noise – Difficult to Mask:

111. Peer reviewed scientific research confirms that wind turbine noise is difficult to mask[114], see also [115].

112. Peer reviewed scientific research confirms noise masking may only be successful if the "…noises have the same frequency composition and if they actually occur at the same time." [116] For example wind turbine and road traffic sound spectral distribution are not very different [117] however: "The presence of road traffic sound did not in general decrease annoyance with wind turbine noise, except when levels of wind turbine sound were moderate (35–40 dB(A) Lden) and road traffic sound level exceeded that level with at least 20 dB(A)." [118]

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[113] Keith, S. E., D. S. Michaud, and S. H. P. Bly. 2008. A proposal for evaluating the potential health effects of wind turbine noise for projects under the Canadian Environmental Assessment Act. Journal of Low Frequency Noise, Vibration and Active Control, 27(4):253-265 Document Number 34, Page 260, Paragraph 5

[114] Pedersen, E. and K. Persson Waye. 2004. Perception and annoyance due to wind turbine noise: A dose–response relationship, Journal of the Acoustical Society of America 116: 3460–3470, Document Number 22, Page 3468, Paragraph 2

[115] Thorne et al, Noise Impact Assessment Report Waubra Wind Farm Mr & Mrs N Dean Report No 1537 - Rev 1 - July 2010, Document Number 13, Page 75, Paragraph 3

[116] World Health Organization, Night Noise Guidelines for Europe, 2009, Document Number 4, Page 12, Paragraph 3

[117] Pedersen et al, Can road traffic mask sound from wind turbines? Response To Wind Turbine Sound At Different Levels Of Road Traffic Sound, Energy Policy 38 (2010) 2520–2527 Document Number 26, Page 2521, Paragraph 1

[118] Pedersen et al, Can road traffic mask sound from wind turbines? Response to wind turbine sound at different levels of road traffic sound, Energy Policy 38 (2010) 2520–2527, Document Number 26, Page 2520, Abstract

113. The MOE allows wind turbine noise emissions to increase with wind speed. Current Ontario guidelines for wind farms permit, in principle, up to 51 dBA at the noise receptor such as a family home.[119] The Kent Breeze Wind Farms is permitted, with increased wind speed to exceed 40 dBA up to a limit of 51 dBA as approved. [120] This special consideration is permitted on the unsubstantiated premise that increased background wind noise will cause masking of the sound levels from the turbines.

114. This is 11 dBA more than is permitted for other forms of industrial noise sources in quiet areas in Ontario. [121] This increase is considerable, as a doubling of the energy of a sound source corresponds to a 3 dB increase, a change in sound level of 5 dB will typically result in a noticeable community response, and a 10 dB increase is subjectively heard as an approximate doubling in loudness. [122]

115. These allowable increases are permitted despite the finding that "… the probability of being annoyed by wind turbine sound increased with increasing levels of wind turbine sound". [123] See also [124],[125]

116. Regarding IWT noise masking, Health Canada advises proponents to "…omit statements about noise masking as they can be misleading;" [126]

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[119] Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities, Ministry of the Environment, October 2008, Document Number 53, Page 6, Table 1
[120] RENEWABLE ENERGY APPROVAL NUMBER 7988-8AVKM5 Issue Date: November 10 2010, Document Number 94, PDF Page 3 of 8
[121] Michaud et el, A Proposal For Evaluating The Potential Health Effects Of Wind Turbine Noise For Projects Under The Canadian Environmental Assessment Act, Second International Meeting onWind Turbine Noise Lyon France September 20 –21 2007, Document Number 35, PDF Page 9 of 14, Paragraph 1
[122] Wind Turbine Acoustic Noise, A White Paper, Dr. Anthony Rodgers Renewable Energy Research Laboratory Department of Mechanical and Industrial Engineering, University of Massachusetts at Amherst. June 2002 Amended January 2006, Document Number 93, Page 5 bottom and Page 6 top
[123] Pedersen et al., 2008,Project WINDFARMperception Visual and acoustic impact of wind turbine farms on residents, Document Number 24, Page 60, Paragraph 3
[124] Pedersen, E. and K. Persson Waye. 2007. Wind turbine noise, annoyance and self-reported health and well being in different living environments Document Number 23, Page 480, Top of page Section "Results"
[125] Pedersen, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page Number 637, Paragraph 1, First sentence
[126] Safe Environs Program, Health Canada Environmental Assessment Nova Scotia, August 6, 2009, Document Number 8, Page 2, Paragraph 1

IWT Noise - Lack of Nighttime abatement:

117. Unlike other sources of noise, IWT noise does not abate at night. [127]

118. Lack of nighttime abatement is an important characteristic to consider given that sleep disturbance is consistently reported as an adverse health effect related to residential exposure to IWTs. In Ontario, noise limits for IWTs are not reduced at night when people are trying to sleep and achieve restoration.

IWT Noise – Low Frequency Noise and Infrasound:

119. The human auditory range is from 20 – 20,000 HZ, or cycles per second. Low frequency noise ("LFN") is, depending on the definition used, sound being generated in the range of 20-200 HZ. "Sounds with frequencies below the audible range are termed infrasound. The boundary between the two is arbitrary and there is no physical distinction between infrasound and sounds in the audible range other than their frequency." [128] Infrasound is considered to be SPL up to 20 hertz.

120. The World Health Organization states "Health effects due to low-frequency components in noise are estimated to be more severe than for community noises in general…The evidence on low-frequency noise is sufficiently strong to warrant immediate concern." [129]

121. To protect people from the adverse health effect of noise induced annoyance World Health Organization states "Noise with low-frequency components require lower guideline values." [130]

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[127] Pedersen, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page Number 642, Paragraph 2

[128] Salt, A.N., Hullar, T.E., Responses of the ear to low frequency sounds, infrasound and wind turbines, Hearing Research (2010), doi:10.1016/j.heares.2010.06.007, Document Number 7, Page 2, Section 2 "The physics of infrasound", Paragraph 1

[129] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 35, Paragraph 2

[130] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page xii,

122. Some of the symptoms associated with LFN exposure include annoyance, stress, sleep disturbance, headaches, difficulty concentrating, irritability, fatigue, dizziness or vertigo, tinnitus, anxiety, heart ailments and palpitation. [131], [132], [133]

123. LFN induced annoyance and stress can be serious as it can cause "…immense suffering to those who are unfortunate to be sensitive to low frequency noise … ." [134] and "…chronic psychophysiological damage may result from long-term exposure to low-level low frequency noise." [135] "…LFN *(low frequency noise)* does not need to be considered "loud" for it to cause such forms of annoyance and irritation." [136]

124. IWTs produce LFN which is routinely audible. [137], [138]

125. Dr. David Manley (since deceased) a Chartered Physicist, Acoustician and Engineer who worked with Dr. Harry has stated: "(m)uch work has been done by me near windfarms to evaluate the acoustic effects. It is found that people living within five miles of a windfarm cluster can be affected and if they are sensitive to low frequencies, they may be disturbed. … It has been found that an extensive seismic signal passes through the earth and may well at night time affect peoples' sleep. It is admitted by fellow

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[131] Schust M. Effects of low frequency noise up to 100 Hz. Noise Health [serial online] 2004 [cited 2010 May 7];6:73-85. Document Number 43, PDF Pages 6, 7, 8 Section "Discussion Available from: http://www.noiseandhealth.org/text.asp?2004/6/23/73/31662,

[132] A Review of Published research on Low Frequency Noise and Its Effects, Dr. Geoff Leventhall et.al., May 2003, Document Number 47, Page 49, Table 5. Health comparison of exposed and control group for a partial summary of symptoms

[133] DeGagne et al., Incorporating Low Frequency Noise Legislation for the Energy Industry in Alberta, Canada Source: Journal of Low Frequency Noise, Vibration and Active Control, Volume 27, Number 2, September 2008 , pp. 105-120(16), Document Number 48, Page 107, Section 3. LITERATURE REVIEW ON THE IMPACTS OF

[134] A Review of Published research on Low Frequency Noise and Its Effects, Dr. Geoff Leventhall et.al., May 2003, Document Number 47, Page 5, Paragraph 4

[135] Leventhall HG. Low frequency noise and annoyance. Noise Health [serial online] 2004 [cited 2009 Dec 31];6:59-72. Document Number 46, PDF Page 9 of 15, Paragraph 2, Available from: http://www.noiseandhealth.org/text.asp?2004/6/23/59/31663

[136] DeGagne et al., Incorporating Low Frequency Noise Legislation for the Energy Industry in Alberta, Canada Source: Journal of Low Frequency Noise, Vibration and Active Control, Volume 27, Number 2, September 2008 , pp. 105-120(16), Document Number 48, Page 107, Section 3. LITERATURE REVIEW ON THE IMPACTS OF LFN, Paragraph 6

[137] Safe Environs Program, Health Canada Environmental Assessment Nova Scotia, August 6, 2009, Document Number 8, Page 2, Paragraph 1

[138] Howe Gastmeier Chapnik Limited, Low Frequency Noise And Infrasound Associated With Wind Turbine Generator Systems A Literature Review Ontario Ministry Of The Environment Rfp No. Oss-078696 Final Draft, December 10, 2010, Document Number 27, Page Number 38, Bullet 2

acousticians that much more research in this subject is needed and that none has been done since 1996 by the DTI. [139]

126. In Australia significant amounts of IWT sound energy in the low frequency and infrasonic ranges have been documented. [140]

127. Noise Control Engineer Richard James monitored 3 Ontario wind farms and demonstrated significant levels of LFN associated with IWTs. [141]

128. Regarding IWTs, the Minnesota Department of Health states "Most available evidence suggests that reported health effects are related to audible low frequency noise." [142]

129. In August 2009 Geoff Leventhall, who has written extensively on LFN, wrote a critique in which he accepts the reported wind turbine related symptoms including sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic attack episodes associated with sensations of internal pulsation or quivering when awake or asleep are from extreme psychological stress from environmental noise, *particularly low frequency noise*.[143] (emphasis added)

130. In December 2009 Geoff Leventhall co-authored a literature review funded by the American Wind Energy Association and the Canadian Wind Energy Association, entitled "Wind Turbine Sound and Health Effects: An Expert Panel Review" ("AWEA/CanWEA

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[139] Dr. David Manley Chartered Physicist, Acoustician and Engineer, http://www.socme.org/acoustic.html, Document Number 87

[140] Thorne et al, Noise Impact Assessment Report Waubra Wind Farm Mr & Mrs N Dean Report No 1537 - Rev 1 - July 2010, Document Number 13, Page 34, Paragraph

[141] E-coustic Solutions Submission of Comments Related to EBR – 010 – 6708 EBR-10-6516 Comment ID: 123842 Proposed Ministry of the Environment Regulations to Implement the Green Energy and Green Economy Act, 2009, Document Number 63, Page 9, Paragraph 2

[142] Minnesota Department of Health (MDH), Public Health Impacts of Wind Turbines, 2009, Document Number 12, Page 25, Paragraph 3

[143] Leventhall, H.G., (2009). Wind Turbine Syndrome - An appraisal August 26, 2009, Document Number 73, Bottom of Page 8 and top of Page 9, Section "9.1 Results of interviews."

panel review"). That report acknowledges that wind turbine LFN may cause annoyance. [144]

131. The AWEA/CanWEA panel review critiques Dr. Pierpont's published case studies described above. The report does not deny that the symptoms documented in Dr. Pierpont's case studies may be caused by wind turbine noise, but disputes the mechanism of action proposed by Dr. Pierpont and concludes:

> ""wind turbine syndrome" symptoms are not new and have been published previously in the context of "annoyance" to environmental sounds …. The following symptoms are based on the experience of noise sufferers extending over a number of years: distraction, dizziness, eye strain, fatigue, feeling vibration, headache, insomnia, muscle spasm, nausea, nose bleeds, palpitations, pressure in the ears or head, skin burns, stress, and tension…." [145]

132. The AWEA/CanWEA panel review states the symptoms documented by Dr. Pierpont are "The collective symptoms in some people exposed to wind turbines are more likely associated with annoyance to low sound levels." [146] The use of the phrase "*low sound levels*" appears to be referring to LFN as the references cited in the supporting paragraphs (Nagai et al., 1989 [147]; Møller and Lydolf, 2002 [148]; Mirowska and Mroz, 2000 [149]; Leventhall, 2002 [150]) are all specifically related to human response to "*low frequency noise and infrasound*". (emphasis added)

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[144] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 4-1, Last Paragraph

[145] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 4-10, Paragraph 1

[146] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 4-10, Paragraph 3

[147] Nagai, N., M. Matsumoto, Y. Yamsumi, T. Shiraishi, K. Nishimura, K. Matsumoto, K. Myashita, and S. Takeda. 1989. Process and emergence of the effects of infrasonic and low frequency noise on inhabitants. Journal of Low Frequency Noise and Vibration 8: 87-89.

[148] Møller, H., and M. Lydolf. 2002. A questionnaire survey of complaints of infrasound and low frequency noise. Journal of Low Frequency Noise and Vibration 21: 53-65.

[149] Mirowska, M., and E. Mroz. 2000. Effect of low frequency noise at low levels on human health in light of questionnaire investigation. Proceedings of the Inter-Noise 2000 Conference. 5: 2809 - 2812.

133. Whether infrasound produced by IWTs can adversely affect human health is under considerable debate.

134. In general wind energy proponents state that infrasound produced by IWTs is below the level of human perception and therefore cannot adversely affect human health. [151],[152],[153] In a 2010 peer reviewed scientific article, Dr. Alec Salt, professor of Otolaryngology and Dr Timothy Hullar state "…this view fails to recognize the complex physiology that underlies the ear's response to low frequency sounds." [154]

135. "…non-aural physiological and psychological effects may be caused by levels of low frequency noise below the individual hearing threshold." [155]

136. The National Research Council states "Low-frequency vibration and its effects on humans are not well understood. Sensitivity to such vibration resulting from wind-turbine noise is highly variable among humans." [156] and "… studies on human sensitivity to very low frequencies are recommended." [157]

137. "There is no consensus whether sensitivity below 20 Hz is by a similar or different mechanism than sensitivity and hearing above 20 Hz …" [158]

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[150] Leventhall, H.G. 2002. 35 Years of Low Frequency Noise—Stephens Medal Lecture. Proceedings of Institue of Acoustics. Stratford, UK: Institute of Acoustics.
[151] CanWEA fact sheet Addressing Concerns With Wind Turbines And Human Health, Revised: April 2009, Document Number 18, PDF Page 25 of 25, Item 6
[152] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 5-2, Conclusion 2.
[153] CanWEA EBR Posting 010-6516 (Proposed Ministry of the Environment Regulations to Implement the Green Energy and Green Economy Act. 2009) – CanWEA's Supplemental Submission Dated July 24, 2009, EBR Comment ID 123788 EBR Signed Robert Hornung President, Document Number 97, PDF Page 6 of 7, Paragraph 4
[154] Salt, A.N., Hullar, T.E., Responses of the ear to low frequency sounds, infrasound and wind turbines, Hearing Research (2010), doi:10.1016/j.heares.2010.06.007, Document Number 7, Page 2, Paragraph 1
[155] Schust M. Effects of low frequency noise up to 100 Hz. Noise Health [serial online] 2004 [cited 2010 May 7];6:73-85. Document Number 43, PDF Page 1, Section Abstract Available from: http://www.noiseandhealth.org/text.asp?2004/6/23/73/31662 , Document Number 43, PDF Page 1, Section Abstract
[156] National Research Council (NRC). Environmental Impacts of Wind-Energy Projects, 2007 NRC, Washington, DC, Document Number 28, Page 158, Paragraph 5
[157] National Research Council (NRC). Environmental Impacts of Wind-Energy Projects, 2007 NRC, Washington, DC, Document Number 28, Page 176, Section Information Needs, Paragraph 1
[158] Minnesota Department of Health (MDH), Public Health Impacts of Wind Turbines, 2009, Document Number 12, Page 10, Paragraph 1

138. Wind turbines also produce infrasound which may be audible or inaudible. [159]

139. Currently it is generally accepted infrasound can be heard by humans at 95dBG or higher. [160]

140. "Using appropriate instrumentation, Van den Berg showed that wind turbine noise was dominated by infrasound components, with energy increasing between 1000 Hz and 1 Hz (the lowest frequency that was measured) at a rate of approximately 5.5 dB/octave, reaching levels of approximately 90 dB SPL near 1 Hz Sugimoto et al. (2008) reported a dominant spectral peak at 2 Hz with levels monitored over time reaching up to 100 dB SPL. Jung and Cheung (2008) reported a major peak near 1 Hz at a level of approximately 97 dB SPL. In most studies of wind turbine noise, this high level, low frequency noise is dismissed on the basis that the sound is not perceptible. This fails to take into account the fact that the OHC (*sic outer hair cells*) are stimulated at levels that are not heard." [161] See also [162], [163]

141. Dr. Salt and Dr Hullar confirm that OHC stimulation occurs at infrasound levels of 60 dBG or higher. [164]

142. In their 2010 peer reviewed article, Dr. Alec Salt and Dr. Timothy Hullar conclude:

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[159] Howe Gastmeier Chapnik Limited, Low Frequency Noise And Infrasound Associated With Wind Turbine Generator Systems A Literature Review Ontario Ministry Of The Environment Rfp No. Oss-078696 Final Draft, December 10, 2010, Document Number 27, Page 5, Paragraphs 1 and 2

[160] Alec Salt, Ph.D., Infrasound: Your Ears Hear It But They Don't Tell Your Brain, Proceedings First International Symposium on Adverse Health Effects from Wind Turbines The Global Wind Industry and Adverse Health Effects: Loss of Social Justice? Picton, Prince Edward County, Ontario, Canada October 29-31, 2010, [cited November 16, 2010], Document Number 6, Page 25 http://windvigilance.com/symp_2010_proceedings.aspx

[161] Salt, A.N., Hullar, T.E., Responses of the ear to low frequency sounds, infrasound and wind turbines, Hearing Research (2010), doi:10.1016/j.heares.2010.06.007, Document Number 7, Page 8, Paragraph 5

[162] Alec Salt Ph.D., Conflict of Interest Statement, December 15 2010, Document Number109

[163] Alec Salt Ph.D Responses to Criticisms of our Paper December 15 2010, Document Number 110

[164] Alec Salt, Ph.D., Infrasound: Your Ears Hear It But They Don't Tell Your Brain, Proceedings First International Symposium on Adverse Health Effects from Wind Turbines The Global Wind Industry and Adverse Health Effects: Loss of Social Justice? Picton, Prince Edward County, Ontario, Canada October 29-31, 2010, [cited November 16, 2010] Document Number 6, Page 25 http://windvigilance.com/symp_2010_proceedings.aspx

"1) Hearing perception, mediated by the inner hair cells of the cochlea, is remarkably insensitive to infrasound.

2) Other sensory cells or structures in the inner ear, such as the outer hair cells, are more sensitive to infrasound than the inner hair cells and can be stimulated by low frequency sounds at levels below those that are heard. *The concept that an infrasonic sound that cannot be heard can have no influence on inner ear physiology is incorrect.* (emphasis added)

3) Under some clinical conditions, such as Meniere's disease … may be hypersensitive to infrasound.

4) A-weighting wind turbine sounds underestimates the likely influence of the sound on the ear. A greater effort should be made to document the infrasound component of wind turbine sounds under different conditions.

5) Based on our understanding of how low frequency sound is processed in the ear, and on reports indicating that wind turbine noise causes greater annoyance than other sounds of similar level and affects the quality of life in sensitive individuals, there is an urgent need for more research directly addressing the physiologic consequences of long-term, low level infrasound exposures on humans." [165]

143. Dr. Alec Salt's presentation at the First International Symposium on The Global Wind Industry and Adverse Health Effects, held October 29-31, 2010 stated:

"As the inner ear DOES respond to infrasound at levels that are not heard, people living near wind turbines are being put at risk by infrasound effects on the body that no-one presently understands. Until a scientific understanding of this issue is

[165] Salt, A.N., Hullar, T.E., Responses of the ear to low frequency sounds, infrasound and wind turbines, Hearing Research (2010), doi:10.1016/j.heares.2010.06.007, Document Number 7, Page 8, Section 7 "Conclusions"

established we should not be dismissing these effects, but need to be erring on the side of caution." [166]

144. Possible sensations from infrasound below the level of human hearing include ear pressure or fullness, discomfort, arousal from sleep, ear fullness, tinnitus, unsteadiness, stress and anxiety. [167] "Auditory and balance disorders, effects of sleep deprivation are *serious* …**"** [168] health effects which may have other consequences. (emphasis added)

145. Wind turbine sound energy including LFN and infrasound noticeably fluctuates in loudness. [169]

146. Research related to low frequency noise "…confirms the importance of fluctuations as a contributor to annoyance and the limitation of those assessment methods, which do not include fluctuations in the assessment." [170] see also [171]

147. LFN and infrasound from IWTs travel large distances. "Wind turbines are generally located in areas devoid of trees and other large vegetation. Instead, ground cover usually consists of grass, sagebrush, plants, and low shrubs, which are minor impediments to noise propagation except at very high frequencies. At frequencies below about 1000 Hz, the ground attenuation is essentially zero." [172]

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[166] Alec Salt, Ph.D., Infrasound: Your Ears Hear It But They Don't Tell Your Brain, Proceedings First International Symposium on Adverse Health Effects from Wind Turbines The Global Wind Industry and Adverse Health Effects: Loss of Social Justice? Picton, Prince Edward County, Ontario, Canada October 29-31, 2010, [cited November 16, 2010], Document Number 6, Page 29
http://windvigilance.com/symp_2010_proceedings.aspx

[167] Alec Salt, Ph.D., Infrasound: Your Ears Hear It But They Don't Tell Your Brain, Proceedings First International Symposium on Adverse Health Effects from Wind Turbines The Global Wind Industry and Adverse Health Effects: Loss of Social Justice? Picton, Prince Edward County, Ontario, Canada October 29-31, 2010, [cited November 16, 2010], Document Number 6, Page Number 27
http://windvigilance.com/symp_2010_proceedings.aspx

[168] Alec Salt, Ph.D., Infrasound: Your Ears Hear It But They Don't Tell Your Brain, Proceedings First International Symposium on Adverse Health Effects from Wind Turbines The Global Wind Industry and Adverse Health Effects: Loss of Social Justice? Picton, Prince Edward County, Ontario, Canada October 29-31, 2010, [cited November 16, 2010], Document Number 6, Page Number 28
http://windvigilance.com/symp_2010_proceedings.aspx

[169] Thorne et al, Noise Impact Assessment Report Waubra Wind Farm Mr & Mrs N Dean Report No 1537 - Rev 1 - July 2010, Document Number 13, Page 6, Paragraph 2

[170] A Review of Published research on Low Frequency Noise and Its Effects, Dr. Geoff Leventhall et.al., May 2003, Document Number 47, Page 36, Paragraph 1

[171] A Review of Published research on Low Frequency Noise and Its Effects, Dr. Geoff Leventhall et.al., May 2003, Document Page 35, Last Paragraph

[172] Hubbard H. H., Sheppard K. P., (1990), Wind Turbine Acoustics, NASA Technical Paper 3057

148. LFN and infrasound are not effectively filtered by buildings. "The effects of infrasound or low frequency noise are of particular concern because of its pervasiveness due to numerous sources, efficient propagation, and reduced efficiency of many structures (dwellings, walls, and hearing protection) in attenuating low frequency noise compared with other noise." [173]

149. "Unlike higher frequency noise issues, LFN is very difficult to suppress. Closing doors and windows in an attempt to diminish the effects sometimes makes it worse because of the propagation characteristics and the low-pass filtering effect of structures. Individuals often become irrational and anxious as attempts to control LFN fail, serving only to increase the individual's awareness of the noise, accelerating the above symptoms" [174]

150. "Low-frequency noise may also produce vibrations and rattles as secondary effects." [175]

151. A NASA technical paper on wind turbine noise states "People who are exposed to wind turbine noise inside buildings experience a much different acoustic environment than do those outside….They may actually be more disturbed by the noise inside their homes than they would be outside." [176] "One of the common ways that a person might sense the noise-induced excitation of a house is though structural vibrations. This mode of observation is particularly significant at low frequencies, below the threshold of normal hearing." [177] see also [178],[179]

DOE/ NASA/20320-77, Document Number 81, Page 24, Paragraph 1

[173] A Review of Published research on Low Frequency Noise and Its Effects, Dr. Geoff Leventhall et.al., May 2003, Document Number 47, Page 54, Section 13.2 Effects on humans, Paragraph 1

[174] DeGagne et al., Incorporating Low Frequency Noise Legislation for the Energy Industry in Alberta, Canada Source: Journal of Low Frequency Noise, Vibration and Active Control, Volume 27, Number 2, September 2008 , pp. 105-120(16), Document Number 48, Page 107, Last Paragraph

[175] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 35, Paragraph 2

[176] Hubbard H. H., Sheppard K. P., (1990), Wind Turbine Acoustics, NASA Technical Paper 3057 DOE/ NASA/20320-77, Document Number 81, Page 35, Paragraph 3

[177] Hubbard H. H., Sheppard K. P., (1990), Wind Turbine Acoustics, NASA Technical Paper 3057 DOE/ NASA/20320-77, Document Number 81, Page, 38 Paragraph 1

[178] Punch et al, Wind-Turbine Noise: What Audiologists Should Know, Audiology Today, JulAug 2010, Document Number 82, Page 24, Paragraph 3

[179] Thorne et al, Noise Impact Assessment Report Waubra Wind Farm Mr & Mrs N Dean Report No 1537 - Rev 1 - July 2010, Document Number 13, Page 153, Paragraph 5

152. "Those exposed [*sic to LFN*] may adopt protective strategies, such as sleeping in their garage if the noise is less disturbing there. Or they may sleep elsewhere, returning to their own homes only during the day." [180] In Ontario some residents have resorted to sleeping in a tent, trailer, been billeted by the wind energy proponent, or have abandoned their homes, to escape the wind turbine noise that has invaded their home environment. In some cases the wind energy proponent has purchased the homes of victims. Typically buy-out agreements by wind energy proponents require the victims to sign non-disclosure agreements which prevent them from discussing the details of their situation. [181]

153. The World Health Organization confirms "Pollution and degradation of the indoor environment cause illness, increased mortality, loss of productivity, and have major economic and social implications.…The health effects of indoor noise include an increase in the rates of diseases and disturbances… these illnesses, and the related reduction in human productivity, can result in substantial economic losses." [182]

154. HGC Engineering in their report for the MOE entitled "Low Frequency Noise and Infrasound Associated with Wind Turbine Generator Systems" acknowledge that there is a degree of disagreement and uncertainty in the literature [183] regarding some of the subjects discussed in their review of IWTs and LFN/infrasound.

155. HGC Engineering in their report for the MOE states "It is recommended that the MOE continue to monitor technical developments in this area and keep informed of regulatory policies that may be introduced in other jurisdictions." [184]

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[180] Leventhall HG. Low frequency noise and annoyance. Noise Health [serial online] 2004 [cited 2009 Dec 31];6:59-72. Document Number 46, PDF Page 9 of 15, Paragraph 3 , Available from: http://www.noiseandhealth.org/text.asp?2004/6/23/59/31663

[181] Chris Braithwaite, Wind tower neighbor bought out for health reasons, The Barton Chronicle ,December 22, 2009, Document Number 76

[182] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 57, Paragraph 5

[183] Howe Gastmeier Chapnik Limited, Low Frequency Noise And Infrasound Associated With Wind Turbine Generator Systems A Literature Review Ontario Ministry Of The Environment Rfp No. Oss-078696 Final Draft, December 10, 2010, Document Number 27, Page 41, Bullet 2

[184] Howe Gastmeier Chapnik Limited, Low Frequency Noise And Infrasound Associated With Wind Turbine Generator Systems A Literature Review Ontario Ministry Of The Environment Rfp No. Oss-078696 Final Draft, December 10, 2010 Document Number 27, Page 41, Bullet 2

156. HGC Engineering also recommends "Since it is evident that complaints related to low frequency noise from wind turbines often arise from the characteristics of the sound impact indoors, and since the indoor low frequency sound levels and frequency spectra can differ markedly from those outdoors, it is recommended that the MOE consider adopting or developing a protocol to provide guidance for addressing such complaints." [185]

157. HGC Engineering also recommends "… that the MOE consider adopting or endorsing measurement procedures described in the literature that could be used to quantify the infrasonic levels in specific situations." [186]

Measurement of IWT Noise

A-Weighted Measurements:

158. "Noise is multidimensional. A one dimensional view of noise is the A - weighting, which considers only [*sic sound pressure*] levels and neglects frequencies. Another one-dimensional view is to consider only frequencies and neglect [*sic sound pressure*] levels. Developing the dimensions further, two dimensions include both frequency and level (the spectrum), three dimensions adds in the time variations of the noise, whilst higher dimensions include subjective response." [187]

159. Ontario's 2008 noise guidelines for wind farms are based on the A-weighting metric. [188]

[185] Howe Gastmeier Chapnik Limited, Low Frequency Noise And Infrasound Associated With Wind Turbine Generator Systems A Literature Review Ontario Ministry Of The Environment Rfp No. Oss-078696 Final Draft, December 10, 2010, Document Number 27, Page 41, Bullet 3
[186] Howe Gastmeier Chapnik Limited, Low Frequency Noise And Infrasound Associated With Wind Turbine Generator Systems A Literature Review Ontario Ministry Of The Environment Rfp No. Oss-078696 Final Draft, December 10, 2010, Document Number 27, Page 41, Bullet 4
[187] Leventhall G. Infrasound from wind turbines: fact, fiction or deception. Can Acoust. 2006;34(2):29-36., Document Number 29, Page 31, Paragraph 5
[188] Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities, Ministry of the Environment, October 2008, Document Number 53, Page 5, Section 5.1 Limits for Wind Turbine Generators

160. It is widely affirmed that A-weighting underestimates the sound pressure level of noise with low-frequency components. [189], [190], [191] "A-weighted level is very inadequate…" [192] when assessing low frequency noise and infrasound.

161. The World Health Organization states "Noise measures based solely on LAeq values do not adequately characterize most noise environments and *do not adequately assess the health impacts of noise on human well-being.* It is also important to measure the maximum noise level and the number of noise events when deriving guideline values. If the noise includes a large proportion of low-frequency components, values even lower than the guideline values will be needed, because low-frequency components in noise may increase the adverse effects considerably. When prominent low-frequency components are present, measures based on A-weighting are inappropriate." [193] (emphasis added)

Tonal Noise:

162. HGC Engineering acknowledges wind turbines can emit tonal noise which is often a low frequency problem. [194] Experience indicates tones can be more prominent than the wind turbine manufacturers' published data may indicate. [195]

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[189] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 35, Paragraph 2

[190] DeGagne et al., Incorporating Low Frequency Noise Legislation for the Energy Industry in Alberta, Canada Source: Journal of Low Frequency Noise, Vibration and Active Control, Volume 27, Number 2, September 2008 , pp. 105-120(16), Document Number 48, Page 117, Section 8. Conclusion, Last Paragraph

[191] Salt, A.N., Hullar, T.E., Responses of the ear to low frequency sounds, infrasound and wind turbines, Hearing Research (2010), doi:10.1016/j.heares.2010.06.007, Document Number 7, Page 8, Section 6. Wind turbine noise, Paragraph 1

[192] Leventhall HG. Low frequency noise and annoyance. Noise Health [serial online] 2004 [cited 2009 Dec 31];6:59-72. Available from: http://www.noiseandhealth.org/text.asp?2004/6/23/59/31663, Document Number 46, PDF Page 12 of 15, Paragraph 1

[193] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 43 , Paragraph 1

[194] Howe Gastmeier Chapnik Limited, Low Frequency Noise And Infrasound Associated With Wind Turbine Generator Systems A Literature Review Ontario Ministry Of The Environment Rfp No. Oss-078696 Final Draft, December 10, 2010, Document Number 27, Page 40, Bullet 9

[195] Howe Gastmeier Chapnik Limited, Low Frequency Noise And Infrasound Associated With Wind Turbine Generator Systems A Literature Review Ontario Ministry Of The Environment Rfp No. Oss-078696 Final Draft, December 10, 2010, Document Number 27, Page 3, Paragraph 3

163. Reliance on wind turbine manufacturers' statements showing the degree of tonality can have serious health consequences. For example the Ontario Melancthon II Wind Project installed GE 1.5 MW IWTs. The proponent did not apply a 5 dB penalty for tonality during the engineering stage of the project. [196] A subsequent field audit determined wind turbines were found to be tonal. [197] In this particular case the family members reported experiencing adverse health effects. The home was eventually purchased by the proponent, but the family members are not permitted to speak about their ordeal due to a non-disclosure clause.

164. The Kent Breeze Wind Farms proposes to install GE 2.5 MW IWTs. There is no evidence that the proposed Kent Breeze Wind Farms applied a 5 dB penalty for tonality during the engineering stage of the project.

Modeling is Not a Worst Case Scenario:

165. Proposed industrial facilities including wind turbine facilities must be designed with appropriate noise control considerations so that the likelihood of compliance is strong. Wind turbine developers should model noise assessments based on worst case conditions and should maximize setback distances. [198]

166. "The genuine difficulty that developers face is that noise levels are difficult to predict fully in advance…" [199]

167. The NASA Technical paper "Wind Turbine Acoustics" illustration below demonstrates how IWT noise propagation is complex due to the wind induced refraction on acoustic rays radiating from an elevated point source. [200]

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[196] Stantec Consulting Ltd., Melancthon II Wind Project Environmental Screening Report / Environmental Impact Statement, File No. 160960105 31 March 2006, Document Number 62
[197] Howe Gastmeier Chapnik Limited, Canadian Hydro Developers, Inc., Acoustical Investigation, February 20, 2009, Document Number 33, Page 11, Paragraph 4
[198] Development of Regulatory Requirements for Wind Turbines in Alberta; D.C. DeGagne and A. Lewis; Alberta Energy and Utilities Board; Journal of the Canadian Acoustical Association; V34,N2; June 2006, Document Number 88, Page 24, Paragraph 3
[199] Development of Regulatory Requirements for Wind Turbines in Alberta; D.C. DeGagne and A. Lewis; Alberta Energy and Utilities Board; Journal of the Canadian Acoustical Association; V34,N2; June 2006, Document Number 88, Page 24, Paragraph 7
[200] Hubbard H. H., Sheppard K. P., (1990), Wind Turbine Acoustics, NASA Technical Paper 3057 DOE/ NASA/20320-77, Document Number 81, Page 21, Top of page

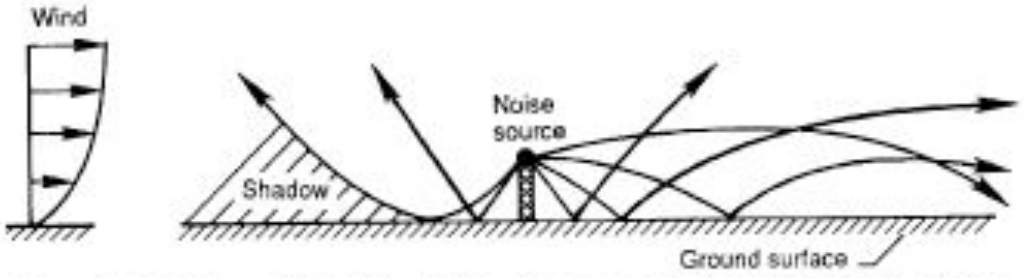

Figure 7-20. Effects of wind-induced refraction on acoustic rays radiating from an elevated point source [Shepherd and Hubbard 1985]

168. The noise modeling used for Ontario wind projects does not represent a worst case scenario, are subject to uncertainty and as a result actual impact will exceed that predicted. [201] HGC Engineering acknowledges "… there remains in practice variations of at least +/- 5 dB between the predicted impacts and sound levels measured in the field." [202]

169. MOE Noise Guidelines for wind turbines do not adhere to authoritative World Health Organization guidance on noise management. For example the World Health Organization states: "When making environmental noise measurements it is important that the measurement sample is representative of all the variations in the noise in question including variations of the source and variations in sound propagation such as due to varying atmospheric conditions." [203]

170. Specifically for IWT noise "Health Canada advises that noise monitoring be undertaken under varying climatic conditions in order to ensure that noise levels do not exceed the acceptable level, and if exceedences are identified, that appropriate mitigation be implemented to reduce the noise level to an acceptable level." [204]

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[201] HGC Engineering, Wind Turbines and Sound: Review and Best Practice Guidelines, 2007, Prepared for the Canadian Wind Energy Association, Document Number 74, Page 9, Paragraph 1

[202] Howe Gastmeier Chapnik Limited, Recent developments in assessment guidelines for sound from wind power projects in Ontario, Canada, with a comparison to acoustic audit results, Inter-noise 2009, Ottawa Canada, August 23-26, 2009, Document Number 75, PDF Page 8 of 8, Section 4. " Conclusions"

[203] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 13, Paragraph 3

[204] Safe Environs Program, Health Canada Environmental Assessment Nova Scotia, August 6, 2009, Document Number 8, Page 1, Paragraph 2

IWT Noise Limits

171. Ontario's 2008 "Noise Guidelines for Wind farms" circumvent Ontario's own existing noise standards. While IWTs can emit 40 dBA at residences, "For industrial sources in quiet areas in Ontario the regulated noise limit is 40 dBA at the property line of the nearest noise sensitive receptor." [207]

172. The World Health Organization Night Noise Guidelines for Europe state adverse health effects caused by sleep disturbance occur at sound pressure levels above 40 dB but also stipulate: "Closer examination of the precise impact will be necessary in the range between 30 dB and 55 dB as much will depend on the detailed circumstances of each case." [208] Based on the unique characteristics of IWT noise, a closer examination of the precise impact of this noise source on human health is critical.

173. In summary to protect humans from adverse effects of IWT noise, authoritative noise management policy and guidance indicates the following standards are required: a 5 dB penalty for amplitude modulation, a 5dB penalty for tonal noise, and noise with low frequency components require lower guideline limits. Noise modeling should represent a worst case scenario, requiring a penalty for uncertainty in modeling methodologies. With the exception of a possible 5dB penalty for tonal noise Ontario IWT noise guidelines do not meet these standards.

Compliance Monitoring

174. Noise regulations must be enforceable. [209], [210]

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[207] Michaud et el, A Proposal For Evaluating The Potential Health Effects Of Wind Turbine Noise For Projects Under The Canadian Environmental Assessment Act, Second International Meeting onWind Turbine Noise Lyon France September 20 –21 2007, Document Number 35, PDF Page 9, Paragraph 1

[208] World Health Organization, Night Noise Guidelines for Europe, 2009, Document Number 4, Page vii, Last Paragraph

[209] Development of Regulatory Requirements for Wind Turbines in Alberta; D.C. DeGagne and A. Lewis; Alberta Energy and Utilities Board; Journal of the Canadian Acoustical Association; V34,N2; June 2006, Dcoument Number 88, Page 21, Abstract, Paragraph 1

[210] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 61, Paragraph 3

175. The inability of the MOE to measure IWT noise makes the noise regulation unenforceable.

176. MOE correspondence states “There is currently no scientifically accepted field methodology to measure wind turbine noise to determine compliance or non compliance with a Certificate of Approval limits.” [211]

177. A 2010 Request for Proposal issued by the MOE states "Unlike typical industrial noise sources, measurement of audible noise from wind turbines in general raises technical challenges" [212] The request for proposal also states "...the MOE Noise Guidelines for Wind Farms, October 2008 do not contain a measurement method for assessing the actual noise impact." [213]and that "The Ministry requires a consultant to assist in the development of a measurement procedure to assess noise compliance of existing wind farms with the applicable sound level limits" [214]

Addressing Noise Complaints at Kent Breeze Wind Farms

178. The Kent Breeze Wind Farms Design and Operations Report states:

> “If the testing confirms that the Operators are compliant with the Certificate of Approval, no further action will be taken by the Operator. The Neighbour(s) will be asked to acknowledge, in a letter, all site visits, impact assessments and mitigation measures taken, if any, to resolve the issue, within 30 days of the complaint resolution. Where no written acknowledgement is received within the time frame, it will be determined the issue is resolved.” [215]

[211] Correspondence from Ministry of Environment September 30, 2009 ENV1283MC2009-4305, Document Number 36, Page 1, Paragraph 2
[212] MERX 189608: MGS - RFP Provision of Expert Advice on Measuring Audible Noise from Wind Turbines - OSS-078695 www.merx.ca, Document Number 39, Page 1, Last Paragraph
[213] MERX 189608: MGS - RFP Provision of Expert Advice on Measuring Audible Noise from Wind Turbines - OSS-078695 www.merx.ca, Document Number 39, Page 1, 2nd Last Paragraph
[214] MERX 189608: MGS - RFP Provision of Expert Advice on Measuring Audible Noise from Wind Turbines - OSS-078695 www.merx.ca, Document Number 39, Page 2, Top of page
[215] Kent Breeze Wind Farms Design and Operations Report May 2010, Document Number 69, PDF Page 40 of 54, Paragraph 4

179. There is no commitment by the proponent to address any serious adverse health effects related to IWTs such as annoyance, stress, sleep disturbance and other adverse physiological and psychological symptoms.

180. In my opinion the proponent's intention to operate in compliance with MOE regulations and noise guidelines will not protect people from serious adverse health effects.

No Protection for Human Exposure Outside Noise Receptors

181. The World Health Organization states guidelines or noise abatement measures should also take into account residential outdoor activities. [216] Ontario guidelines for wind turbine noise are measured at noise receptors such as family homes not at the property line. There is no protection of human health outdoors from serious adverse health effects related to IWTs.

182. Peer reviewed research reveals that wind turbine annoyance levels usually increase when individuals are exposed outside of buildings. [217]

Visual Impact

183. IWTs are elevated sound sources visible from afar and hence intrude both visually and aurally into private space. [218]

184. "Higher visibility of the turbines was associated with higher levels of annoyance, and annoyance was greater when attitudes toward the visual impact of the turbines on the landscape were negative. However, the height of wind turbines means that they are also most clearly visible to the people closest to them and those who also receive the highest sound levels. Thus, proximity of the receiver to wind turbines makes it difficult to

[216] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 13, Paragraph 4
[217] Pederson, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page 637, Table II
[218] Pedersen, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page 641, Last Paragraph, Page 635, Paragraph 3

determine whether annoyance to the noise is independent of annoyance to the visual impact." [219]

185. "It is difficult to separate the visual from the acoustic impact, because they are so closely related: when turbines are closer and bigger they are usually better audible. However, when wind turbines are less visible they are less easily noticed by their sound and cause less annoyance. " [220]

186. The health impacts of visual landscapes should not be underestimated. "(T)the main health aspects of exposure to landscapes related to reduced stress, improved attention capacity, facilitating recovery from illness, ameliorating physical well-being in elderly people, and behavioural changes that improve mood and general well-being. These effects have been addressed by means of viewing natural landscapes during a walk, viewing from a window, looking at a picture or a video, or experiencing vegetation around residential or work environments." [221]

187. An epidemiology study conducted by World Health Organization determined a "bad view out of window" increased the risk for depression by 40%. [222]

188. Rotating wind turbine blades interrupt the sunlight producing unavoidable flicker bright enough to pass through closed eyelids, and moving shadows cast by the blades on windows can affect illumination inside buildings. [223] This effect is commonly known as shadow flicker.

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[219] Punch et al, Wind-Turbine Noise: What Audiologists Should Know, Audiology Today, JulAug 2010, Document Number 82, Page 24, Paragraph 1

[220] Pedersen et al., 2008,Project WINDFARMperception Visual and acoustic impact of wind turbine farms on residents, Document Number 24, Page 61, Paragraph 4

[221] Velarde et al., Health effects of viewing landscapes – Landscape types in environmental psychology, Urban Forestry & Urban Greening 6 (2007) 199–212, Document 68, Page 210, Section "Conclusions" Paragraph 2

[222] World Health Organization, Large analysis and review of European housing and health status (LARES) Preliminary overview, 2007, Document Number 67, Page 20, Paragraph 1

[223] Graham Harding, Wind Turbines, Flicker, And Photosensitive Epilepsy: Characterizing The Flashing That May Precipitate Seizures And Optimizing Guidelines To Prevent Them, 2008, Document Number 66, Page 1, Section "SUMMARY", Page 1, Paragraph 2

189. Regarding visually induced adverse health effects it is acknowledged IWT shadow flicker may cause annoyance and/or stress. [224], [225], [226], [227], [228]

190. It is acknowledged that "…shadow flicker can be an issue both indoors and outdoors when the sun is low in the sky. Therefore, shadow flicker may be an issue in locations other than the home." [229]

191. Wind turbine shadow flicker has the potential to induce photosensitive epilepsy seizures; however the risk is low with large modern models and if proper planning is adhered to. Planning should ensure the flash frequency does not exceed three per second, and the shadows cast by one turbine on another should not have a cumulative flash rate exceeding three per second. [230]

192. Wind turbines must be sited to protect humans from the adverse health effect of visually induced annoyance as well as noise induced annoyance. Detailed shadow flicker modelling during the design stage of a wind turbine project is considered a best engineering practice to ensure human protection from shadow flicker health impacts. [231], See also [232], [233]

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[224] National Research Council (NRC). Environmental Impacts of Wind-Energy Projects, 2007 NRC, Washington, DC Document Number 28, Page 175, Section Noise and Shadow Flicker, Paragraph 2
[225] Pedersen et al., 2008,Project WINDFARMperception Visual and acoustic impact of wind turbine farms on residents, Document Number 24 Page 36, Section 7.4.1 Response to exposures from wind turbine, Paragraph 1
[226] Copes et al, Wind Turbines And Environmental Assessment, National Collaborating Centre for Environmental Health, June 23, 2009, Document Number 70, Page 55, Conclusion 3
[227] Copes, R. and K. Rideout. Wind Turbines and Health: A Review of Evidence. Ontario Agency for Health Protection and Promotion, September 2009, Document Number 71, Page 40, Conclusions
[228] Rideout K, Copes R, Bos C. Wind turbines and health. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 June 3]. Available from: http://www.ncceh.ca/files/Wind_Turbines_January_2010.pdf., Document Number 21, Page 1, Bullet 3
[229] Minnesota Department of Health (MDH) 2009 Public Health Impacts of Wind Turbines, Document Number 12, Page 14, Section B. Shadow Flicker, Paragraph 3
[230] Graham Harding, Wind Turbines, Flicker, And Photosensitive Epilepsy: Characterizing The Flashing That May Precipitate Seizures And Optimizing Guidelines To Prevent Them, 2008, Document Number 66, Page 1, Section "SUMMARY", Page 4, Section "DISCUSSION"
[231] National Research Council (NRC). Environmental Impacts of Wind-Energy Projects, 2007 NRC, Washington, DC, Document Number 28, Page 176, Section Best (or Good) Practices
[232] Minnesota Department of Health (MDH) 2009 Public Health Impacts of Wind Turbines Document Number 12, Page 25, Last Sentence
[233] Copes et al, Wind Turbines And Environmental Assessment, National Collaborating Centre for Environmental Health, June 23, 2009, Document 70, Page 54, Conclusion 3

193. A recommended shadow flicker setback for current wind turbine designs are 10 rotational diameters which would typically translate to approximately 1000 m. [234]

194. Regulation 359/09 does not provide any regulations which address shadow flicker to protect humans from annoyance or stress, or other adverse health effects caused by IWT shadow flicker.

195. The Kent Breeze Wind Farms Consultation Report states that a shadow flicker assessment would be undertaken and the results of the shadow flicker assessment would be made public on their finalization. [235] However, there is no evidence that a detailed shadow flicker assessment was conducted for the Kent Breeze Wind Farms.

196. The Consultation Report submitted for the Kent Breeze Wind Farms states only:

> Indications are that shadow flicker will not be an issue at the project area given the required 550 metre setback for noise purposes. However, should unexpected situations arise, common mitigation measure may be employed to avoid flicker nuisances such as window treatments, awnings, or tree planting. [236]

Scientific Basis for Distance Setback and Noise Guidelines

197. There is no scientific evidence to demonstrate Regulation 359/09 and/or the 2008 Noise Guidelines for Wind farms will protect individuals from the adverse health effects associated with IWT noise and/or low frequency noise and/or infrasound and/or shadow flicker.

198. The only minimum setback from noise receptors contained in Regulation 359/09 is 550 metres from the centre of a defined noise receptor. There is no scientific evidence to demonstrate that a minimum setback of 550 metres will protect the health and safety of the exposed population. On the contrary, the best available evidence on IWTs suggests

[234] Minnesota Department of Health (MDH), Public Health Impacts of Wind Turbines, 2009 Document Number 12, Page 14, Section B. Shadow Flicker, Paragraph 2
[235] Kent Breeze Wind Farms, REA Consultation Report, MAY 2010 Document Number 65, PDF Page 32 of 226, Last Paragraph
[236] Kent Breeze Wind Farms, REA Consultation Report, MAY 2010 PDF Document Number 65, PDF Page 8 of 226, Paragraph 3

that at 550 metres and at greater distances, serious adverse health effects will occur in the exposed population.

199. There is no evidence that at the A-weighted sound pressure levels contained in the 2008 Noise Guidelines for Wind Farms, human health will be protected. On the contrary, the best available evidence on IWTs suggests that at the allowable noise limits, serious adverse health effects will occur in the exposed population.

200. MOE relied on acoustical engineers and other program and operational staff to develop Regulation 359/09 "…the proposed requirements for wind turbine projects were developed by ministry engineers and scientists and are based on the October 2008 Noise Guidelines for Wind Farms…the noise requirements outlined in the October 2008 Noise Guidelines for Wind Farms were developed in consultation with Dr. Ramani Ramakrishnan, representatives from the major acoustical consulting firms in Ontario, ministry scientists and engineers, representatives from the Canadian Wind Energy Association, as well as members from the local community interested in wind energy. At the time, Dr. Ramani Ramakrishnan, Ph. D., P.Eng., was the Lead Acoustician with Aiolos Engineering Corporation, the third party retained by the ministry in 2007 to review wind turbine facilities noise issues. This report led to the 2008 wind guidelines." [237]

201. Acoustical engineers are not professionals who are qualified to assess impacts to human health.

202. Email correspondence from the Dr. Ramakrishnan states "I am not a medical doctor or a psychoacoustician or a physiological acoustician. I am an acoustician from the engineering science perspective. So, to comment on health issues is outside my area of expertise." [238]

[237] MOE correspondence from Kevin Perry July 20, 2009, Document Number 37, Page 1, Last Paragraph
[238] Email from Ramani Ramakrishnan 2009, Document 79 Page 1

Research Gaps and Scientific Uncertainty

203. References including peer reviewed scientific articles, reports, literature reviews, medical and health association resolutions, and MOE Requests for Proposals have identified research gaps regarding IWTs and adverse health effects.

204. Population-based epidemiological studies are required, specifically on IWTs and a range of health outcomes, to establish exposures at which human health will be protected. Furthermore, research is recommended on specific IWT issues such as amplitude modulation, low frequency noise, infrasound, and shadow flicker. A sample of these references include:

205. Recent peer reviewed scientific articles have identified the *urgent* need for research into human health responses to IWT noise. [239], [240]

206. Dose-response data from published field studies [241]

207. Research into health effects of LFN and/or infrasound [242], [243], [244], [245], [246]

208. Scientific methods to assess wind turbine noise [247], [248]

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[239] Salt, A.N., Hullar, T.E., Responses of the ear to low frequency sounds, infrasound and wind turbines, Hearing Research (2010), doi:10.1016/j.heares.2010.06.007, Document Number 7, Page 8, Section7. Conclusions, Bullet 5

[240] Pederson, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page 634, Last Paragraph

[241] Pedersen, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America, Document Number 25, Page Number 642, Last Paragraph

[242] National Research Council (NRC). Environmental Impacts of Wind-Energy Projects, 2007 NRC, Washington, DC, Document Number 28, Page 176, Section Information Needs, Paragraph 1

[243] Copes et al, Wind Turbines And Environmental Assessment, National Collaborating Centre for Environmental Health, June 23, 2009 Document Number 70, Page 53, Bullet 1

[244] Salt, A.N., Hullar, T.E., Responses of the ear to low frequency sounds, infrasound and wind turbines, Hearing Research (2010), doi:10.1016/j.heares.2010.06.007, Document Number 7, Page 8, Section7. Conclusions, Bullet 5

[245] Howe Gastmeier Chapnik Limited, Low Frequency Noise And Infrasound Associated With Wind Turbine Generator Systems A Literature Review Ontario Ministry Of The Environment Rfp No. Oss-078696 Final Draft, December 10, 2010, Document Number 27, Page 41, Bullet 2

[246] Rideout K, Copes R, Bos C. Wind turbines and health. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 June 3]. Available from: http://www.ncceh.ca/files/Wind_Turbines_January_2010.pdf., Document Number 21, Page 3, Section " Key Gaps in Evidence" Bullet 1

209. Research on wind turbine induced sleep disturbance [249], [250], [251]

210. Epidemiological studies on humans [252], [253]

211. Research on wind turbine amplitude modulation [254], [255]

212. Research on dizziness and migraine from shadow flicker [256]

213. Research on stress-induced health effects from noise, visual impact, shadow flicker [257], [258]

214. To further address public health concerns about wind turbines the MOE has established and is funding a Research Chair of Renewable Energy Technologies and

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[247] National Research Council (NRC). Environmental Impacts of Wind-Energy Projects, 2007 NRC, Washington, DC. , Exhibit V from May 12, 2010, Document Number 28, Page 176, Section Information Needs, Paragraph 1

[248] Rideout K, Copes R, Bos C. Wind turbines and health. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 June 3]. Available from: http://www.ncceh.ca/files/Wind_Turbines_January_2010.pdf., Document Number 21, Page 3, Section " Key Gaps in Evidence" Bullet 2

[249] Copes et al, Wind Turbines And Environmental Assessment, National Collaborating Centre for Environmental Health, June 23, 2009 Document Number 70, Page 53, Bullet 2

[250] Pedersen et al., 2008, Project WINDFARMperception Visual and acoustic impact of wind turbine farms on residents Document Number 24 Page 57, Paragraph 4 to Page 58 Paragraph 1

[251] Development of Regulatory Requirements for Wind Turbines in Alberta; D.C. DeGagne and A. Lewis; Alberta Energy and Utilities Board; Journal of the Canadian Acoustical Association; V34,N2; June 2006, Document Number 88, Page 23, Section 3 Wind Turbine Noise and Heath, Paragraph 4

[252] Rideout K, Copes R, Bos C. Wind turbines and health. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 June 3]. Available from: http://www.ncceh.ca/files/Wind_Turbines_January_2010.pdf., Document Number 21, Page 3, Section " Key Gaps in Evidence" Bullet 6

[253] Claude-Henri Chouard, Impacts Of Wind Turbine Operation On Humans, National Academy Of Medicine, 2006, Document Number 9, Page 9, Section 8 Recommendations

[254] Leventhall G. Infrasound from wind turbines: fact, fiction or deception. Can Acoust. 2006;34(2):29-36. Document Number 29, Page 34, Section 5 Conclusions, Bullets 3 and 4

[255] Wind Turbine Facilities Noise Issues. Acoustic Consulting Report, prepared for the Ontario Ministry of Environment by Ramani Ramakrishnan (Lead Acoustician), December 28 2007, Document Number 95, Page 51, Section 4.5, Item D

[256] Copes et al, Wind Turbines And Environmental Assessment, National Collaborating Centre for Environmental Health, June 23, 2009, Document Number 70, Page 53, Bullet 4

[257] Copes et al, Wind Turbines And Environmental Assessment, National Collaborating Centre for Environmental Health, June 23, 2009, Document Number 70, Page 53, Bullet 3

[258] Minnesota Department of Health (MDH), Public Health Impacts of Wind Turbines, 2009, Document Number 12, Page 26, Section VII. Recommendations

Health. [259], [260] See also [261], [262] To my knowledge the Research Chair has not made public any research results related to IWTs and adverse human health effects to date.

215. It is notable that the AWEA/CanWEA panel review does not "…advocate for funding further studies …" into adverse health effects alleged to be associated with wind turbines. [263]

216. It is my understanding that the President of CanWEA, Robert Hornung, reportedly stated "We don't support the implementation of an epidemiological study." [264]

217. The MOE outlined in their Decision Document for the Kent Breeze Wind Farms REA how the Statement of Environmental Values was considered. [265] Despite the above noted research gaps and scientific uncertainty about how to protect human health from exposure to IWT, there is no mention of considering the precautionary principle, which provides that where there is a known risk to the environment or human health, and uncertainty regarding that risk, no further development should take place until the risk is resolved.

AWEA/CanWEA Panel Review - "Wind Turbine Sound and Health Effects: An Expert Panel Review"

218. In response to publicized concerns that the sounds emitted from wind turbines cause adverse health consequences [266], the American Wind Energy Association and

[259] Arlene King M.D., Ontario Ministry of Health and Long Term Care Memorandum, October 21, 2009, Document Number 78, Page 2, Paragraph 3
[260] News release $1.5-million awarded to new Ontario Research Chair at Waterloo, Document Number 83
[261] MHLTC Letter January 11 2011, Document Number 89, Page 1
[262] MOE correspondence December 20, 2010, Document 99, Page 1 Last paragraph
[263] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 5-2, Paragraph 1
[264] Robert Hornung, President Canadian Wind Energy Association, On The Bay Summer 2010, Document Number 72, PDF Page 4 of 5, Paragraph 3
[265] Kent Breeze Corp. MacLeod Windmill Project Inc. Kent Breeze Wind Farms, Renewable Energy Approval Decision Document, November 9, 2010, PDF Pages 8, 9, 10
[266] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page ES-1, Paragraphs 2 and 3

Canadian Wind Energy Association funded a literature review entitled "Wind Turbine Sound and Health Effects: An Expert Panel Review".[267]

219. Caution must be exercised when relying on the findings of an industry sponsored panel. Experience has consistently demonstrated that reliance on industry convened and sponsored expertise is inappropriate when assessing health risks associated with the industry's product. [268], [269]

220. On January 11, 2010 The Society for Wind Vigilance released a critique of the AWEA/CanWEA panel review, and concluded that it is:

> "…neither authoritative nor convincing. The work is characterized by commission of unsupportable statements and the confirmation bias in the use of references. Many important references have been omitted and not considered in the discussion…." [270]

> "The conclusions of the A/CanWEA Panel Review are not supported by its own contents nor does it have convergent validity with relevant literature. The A/CanWEA Panel Review acknowledges that wind turbine noise may cause annoyance, stress and sleep disturbance and that as a result people may experience adverse physiological and psychological symptoms. It then ignores the serious consequences." [271]

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[267] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19

[268] Bulletin of the World Health Organization Print version ISSN 0042-9686Tobacco industry tactics for resisting public policy on health, Yussuf Saloojee & Elif Dagli http://www.who.int/bulletin/archives/volume78_7/en/index.html, Document Number 64, Page 903, Section "Mobilizing corporate resources"

[269] McCulloch, Jock, Saving the Asbestos Industry, 1960 to 2006, Public Health Rep. 2006 Sep–Oct; 121(5): 609–614. [cited July 10, 2010] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1564458/#__secid500104, Document Number 77

[270] The Society for Wind Vigilance, Wind Energy Industry Acknowledgement of Adverse Health Effects, An Analysis of the American/Canadian Wind Energy Association sponsored "Wind Turbine Sound and Health Effects An Expert Panel Review, December 2009", 2010, Document 51, Page 2, Paragraph 5

[271] The Society for Wind Vigilance, Wind Energy Industry Acknowledgement of Adverse Health Effects, An Analysis of the American/Canadian Wind Energy Association sponsored "Wind Turbine Sound and Health Effects An Expert Panel Review, December 2009", 2010 Document 51, Page 3, Paragraphs 3 and 4,

"Despite the acknowledgement that wind turbine noise may cause annoyance, stress and sleep disturbance the A/CanWEA Panel Review fails to offer any science based guidelines that would mitigate these health risks." [272]

221. On January 28, 2010 the NHS Knowledge Service of the UK National Health Service, the largest publicly funded health care service in the world, also released a critique of the AWEA/CanWEA panel review and concluded:

"The link between psychological distress and physical symptoms has not been explored by this report. The acknowledgment that some people exposed to wind turbine noise suffer annoyance suggests that monitoring and maximum permitted levels need to be considered carefully in areas where turbines are planned. Overall, this review will probably not resolve this controversy as there was a lack of high-level evidence on which to base any solid conclusions. What is now needed are studies that compare people exposed to turbine noise with well-matched control subjects who have not had that exposure…This review panel was commissioned by an industry group, and included a variety of academic perspectives, but not an epidemiologist. Someone with this specific skill set should be included when environmental health hazards are assessed…" [273], See also [274]

222. Sleep specialist Dr. Christopher Hanning reviewed the AWEA/CanWEA Panel Review and noted:

"The quality and authority of this review and its conclusions are open to considerable doubt. The medical members of the panel comprised a microbiologist, an otolaryngologist and an occupational health physician

[272] The Society for Wind Vigilance, Wind Energy Industry Acknowledgement of Adverse Health Effects, An Analysis of the American/Canadian Wind Energy Association sponsored "Wind Turbine Sound and Health Effects An Expert Panel Review, December 2009", 2010 Document 51, Page 3, Paragraph 6
[273] NHS Knowledge Service, Wind turbine sound 'needs research', NHS Choices, Thursday January 28, 2010, http://www.nhs.uk/news/2010/01January/Pages/Wind-turbine-sound-and-health.aspx, Document Number 49, Page 4 of 4, Section Conclusion
[274] Countryside News, Wind turbines set to get bigger, January 28 2010 http://www.walesonline.co.uk/countryside-farming-news/countryside-news/2010/01/28/wind-turbines-set-to-get-bigger-91466-25701853/ Document Number 55

specialising in respiratory disease. From their biographies, none seems to have any expertise in sleep medicine or in psychology. The reference list shows that the literature review was far from complete. The panel admits that wind turbine noise causes annoyance which can lead to sleep disturbance but dismisses these findings. It is clear that they did not understand the significance of "annoyance" in a health context and neither did they comprehend the importance of sleep disturbance in causing ill health." [275]

223. Despite the above noted inadequacies, the AWEA/CanWEA panel review does acknowledge that wind turbine noise may cause annoyance, [276] stress, [277] and sleep disturbance, [278] and as a result people may experience adverse physiological and psychological symptoms. [279] The authors state "…"wind turbine syndrome" symptoms are not new and have been published previously in the context of "annoyance" to environmental sounds …. The following symptoms are based on the experience of noise sufferers extending over a number of years: distraction, dizziness, eye strain, fatigue, feeling vibration, headache, insomnia, muscle spasm, nausea, nose bleeds, palpitations, pressure in the ears or head, skin burns, stress, and tension…." [280]

224. The above interpretation of the report's findings was confirmed by CanWEA President, Robert Hornung, when he stated "The study does acknowledge that wind

[275] Hanning, Wind Turbine Noise, Sleep And Health, November 2010, http://windvigilance.com/noise_sleep_health.aspx, Document Number 50, Page 39 ,Paragraph 2
[276] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 5-2, Conclusion 3 and 4
[277] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 4-3, Paragraph 5
[278] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 4-3, Paragraph 5
[279] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 4-10, Paragraphs 1 and 2
[280] W. David Colby, M.D et al., Wind Turbine Sound and Health Effects, An Expert Panel Review 2009, Prepared for American Wind Energy Association and Canadian Wind Energy Association, Document Number 19, Page 4-10, Paragraph 1

turbines can be annoying, the sound of wind turbines can be annoying for some individuals and that may cause them to feel some stress etcetera,…" [281]

225. The AWEA/CanWEA panel review makes speculative statements referring to the "nocebo effect" as possible cause of the IWT adverse health effects being reported.

226. A key word search of "nocebo" in "Noise and Health Journal", [284] World Health Organization's "Guidelines for Community Noise" and "Night Noise Guidelines for Europe" yields no results. A key word search of "nocebo noise" in Pubmed yields no results which support these assertions. [285] A key word search of "nocebo" in peer reviewed literature on the subject of human response to wind turbine noise returns no results. [286], [287], [288], [289], [290] It appears the term "nocebo" has questionable relevance in the context of wind turbines noise.

"The Health Impact of Wind Turbines: A Review of the Current White, Grey, and Published Literature", Chatham-Kent Public Health Unit

227. "The Health Impact of Wind Turbines: A Review of the Current White, Grey, and Published Literature" by the Chatham-Kent Public Health Unit in 2008 is a literature review. There is no original research that has been reported in the review. The report is neither peer reviewed, nor-authoritative, nor would it be accepted in a responsible peer review journal.

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[281] Robert Hornung, President Canadian Wind Energy Association BNN Business News Network, March 4, 2010, Document Number 54
[284] Based on a key word search "nocebo" http://www.noiseandhealth.org/search.asp conducted July 10, 2010
[285] Based on a key word search "nocebo noise" http://www.ncbi.nlm.nih.gov/pubmed conducted July 10, 2010
[286] Pedersen, E. and K. Persson Waye. 2004. Perception and annoyance due to wind turbine noise: A dose–response relationship, Journal of the Acoustical Society of America 116: 3460–3470., Document Number 22
[287] Pedersen, E. and K. Persson Waye. 2007. Wind turbine noise, annoyance and self-reported health and well being in different living environments, Document Number 23
[288] Pedersen, E., R. Bakker, J.Bouma and F van den Berg 2009. Response To Noise From Modern Wind Farms in The Netherlands. Journal of the Acoustical Society of America Document Number 25
[289] Keith, S. E., D. S. Michaud, and S. H. P. Bly. 2008. A proposal for evaluating the potential health effects of wind turbine noise for projects under the Canadian Environmental Assessment Act. Journal of Low Frequency Noise, Vibration and Active Control, 27(4):253-265.
[290] Salt, A.N., Hullar, T.E., Responses of the ear to low frequency sounds, infrasound and wind turbines, Hearing Research (2010), doi:10.1016/j.heares.2010.06.007, Document Number 7

228. The Chatham-Kent review quotes wind industry sources 26 times (out of 83 citations). The review cites numerous references from members of the wind energy industry such as the Canadian Wind Energy Association, American Wind Energy Association, British Wind Energy Association, Danish Wind Energy Association and HGC Engineering. [291] This is unusual as the review has been written for a municipal government and purports to be neutral about the health impact of wind turbines.

229. The Chatham-Kent review contains errors of commission. Quoting Geoff Leventhall and his paper "Infrasound from Wind Turbines – Fact, Fiction or Deception" (citation #54) is appropriate. Quoting him selectively is not. Leventhall discounts IWT infrasound as an issue. However he goes on to point out that "Attention should be focused on the audio frequency fluctuating swish, which some people may well find to be very disturbing and stressful, depending on its level." [292]

230. The review fails to consider authoritative research related to noise and health such as the World Health Organization Community Noise Guidelines 1999.

231. As a result of the above examples of deficiencies, the report provides an incomplete risk assessment related to human health including the failure to adequately consider the serious health impacts of wind turbine induced annoyance, stress or sleep disturbance (based on a key word searches of "annoyance", "stress" and "sleep disturbance").

232. The report fails to identify the risk of IWT audible LFN induced annoyance.

233. The report fails to identify the issue of IWT shadow flicker induced annoyance and stress.

234. The conclusion of the Chatham-Kent review states:

[291] CanWEA member directory http://canwea.ca/about/membersdirectory_e.php?letter=H Document Number 101, Page 2
[292] Leventhall G. Infrasound from wind turbines: fact, fiction or deception. Can Acoust. 2006;34(2):29-36., Document Number 29, Page 34, Paragraph 4

> "This paper concludes and concurs with the original quote from Chatham-Kent's Acting Medical Officer of Health, Dr. David Colby,[293] "In summary, as long as the Ministry of Environment Guidelines for location criteria of wind farms are followed, it is my opinion that there will be negligible adverse health impacts on Chatham-Kent citizens. Although opposition to wind farms on aesthetic grounds is a legitimate point of view, opposition to wind farms on the basis of potential adverse health consequences is not justified by the evidence."" [294]

235. The guidelines Dr. Colby endorsed in June 2008 [295] were subsequently replaced four months later in October 2008. [296]

236. In summary Chatham-Kent, 2008, is an inadequate public health document.

"The Potential Health Impact of Wind Turbines", Chief Medical Officer of Health

237. The Chief Medical Officer of Health's Report "The Potential Health Impact of Wind Turbines" ("CMOH Report") released in May, 2010 was relied upon by MOE in their consideration of public consultation comments in their decision to issue a REA for Kent Breeze Wind Farms. [297]

238. Under "Effect(s) of Consultation on this Decision", the Ministry of the Environment stated:

> "The Chief Medical Officer of Health agreed to undertake a review of existing information and to consult with the Ontario Agency for Health Protection and Promotion and local medical officers of health on health effects related to wind turbines. The results of the review and consultation were published on

[293] The College of Physicians and Surgeons, Correspondence, Document Number 112
[294] Chatham-Kent Public Health Unit, (2008): The Health Impact of Wind Turbines: A Review of the Current White, Grey, and Published Literature. Chatham-Kent Municipal Council, Chatham Ontario, Document Number 100, Page 17
[295] Interpretation For Applying MOE NPC Technical Publications To Wind Turbine Generators, 2004, Document Number 102
[296] Noise Guidelines for Wind Farms, Interpretation for Applying MOE NPC Publications to Wind Power Generation Facilities, Ministry of the Environment, October 2008, Document Number 54
[297] Kent Breeze Corp. MacLeod Windmill Project Inc. Kent Breeze Wind Farms, Renewable Energy Approval Decision Document, November 9, 2010, Document Number 98

> May 20, 2010 and released in a report titled "The Potential Health Impacts of Wind Turbines". The review concluded that scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects. The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other direct health effects, and there is no scientific evidence to date that vibration from low frequency wind turbine noise causes adverse health effects. [298]

239. The CMOH Report, as well as its references, acknowledge the symptoms that some people living near wind turbines are experiencing, stating "…some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance…" [299]

240. Regarding the sound level from wind turbines, the CMOH Report states "some people might find it annoying" [300]

241. The CMOH Report references a report entitled "Wind Turbines and Health" co-authored by Dr. Ray Copes from the Ontario Agency for Health Protection and Promotion, an organization that assisted in the preparation of the CMOH Report. In "Wind Turbines and Health", Dr. Copes et al. state: "The sound level associated with wind turbines at common residential setbacks is not sufficient to damage hearing, but may lead to annoyance and sleep disturbance". [301] Annoyance and sleep disturbance are adverse health effects.

242. The CMOH Report also references the AWEA/CanWEA panel review. As noted above (paragraph 223), even though this wind industry panel concludes that wind turbine sound does not pose a risk for adverse health effects, and that the authors do not advocate

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[298] Kent Breeze Corp. MacLeod Windmill Project Inc. Kent Breeze Wind Farms, Renewable Energy Approval Decision Document, November 9, 2010, Document Number 98, PDF Page 7
[299] Chief Medical Officer of Health (CMOH) of Ontario, The Potential Health Impacts of Wind Turbines, May 2010, Document Number 52, Page 10, Paragraph 2
[300] Chief Medical Officer of Health (CMOH) of Ontario, The Potential Health Impacts of Wind Turbines, May 2010, Document Number 52, Page 10, Paragraph 3
[301] Rideout K, Copes R, Bos C. Wind turbines and health. Vancouver: National Collaborating Centre for Environmental Health; 2010 Jan [cited 2010 June 3]. Available from: http://www.ncceh.ca/files/Wind_Turbines_January_2010.pdf., Document Number 21, Page 1, Paragraph 1

further studies, it paradoxically acknowledges some of the adverse health effects people are experiencing.

243. The symptoms that are acknowledged in the CMOH Report such as sleep disturbance, dizziness, headaches, and annoyance are all considered to be adverse health effects.

244. The CMOH Report cited "four cross-sectional studies, published in scientific journals, which investigated the relationships between exposure to wind turbine noise and annoyance in large samples of people (351 to 1,948) living in Europe near wind turbines" [302] . The CMOH Report states that the studies found:

> "The sound was annoying only to a small percentage of the exposed people; approximately 4 to 10 per cent were very annoyed at sound levels between 35 and 45 dBA". [303]

245. While the annoyance reported in the CMOH Report is important, it is a narrow reporting of the results of the studies. It leaves out the study results for the Swedish respondents, the respondents who were "rather" annoyed, and the respondents who reported annoyance when spending time outdoors at their dwelling. Reporting a range of at least 5-28% would have been more accurate. Please see paragraph 83 of this witness statement for a more complete reporting of the study results.

246. The CMOH Report does acknowledge the unique characteristics of IWT noise, and the unique human response to IWT noise, stating: "Wind turbine noise was perceived as more annoying than transportation or industrial noise at comparable levels, possibly due to its swishing quality, changes throughout a 24 hour period, and lack of night-time abatement". [304]

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[302] Chief Medical Officer of Health (CMOH) of Ontario, The Potential Health Impacts of Wind Turbines, May 2010, Document Number 52, Page 5, First Bullet
[303] Chief Medical Officer of Health (CMOH) of Ontario, The Potential Health Impacts of Wind Turbines, May 2010, Document Number 52, Page 6, Paragraph 4
[304] Chief Medical Officer of Health (CMOH) of Ontario, The Potential Health Impacts of Wind Turbines, May 2010, Document Number 52, Page 6, Paragraph 4

247. The CMOH Report comments on noise limits stating: "These setbacks are based on modeling of sound produced by wind turbines and are intended to limit sound at the nearest residence to no more than 40 dB. This limit is consistent with limits used to control noise from other environmental sources." [305]

248. First, this limit is not consistent with limits used to control noise from other environmental sources as noted earlier in this witness statement: "For industrial sources in quiet areas in Ontario the regulated noise limit is 40 dBA at the property line of the nearest noise sensitive receptor." [306] Limiting noise to 40 dBA at the property line is substantially different than limiting noise to 40 dBA at the residence.

249. Second, as noted earlier in this witness statement, the WHO Night Noise Guidelines for Europe state adverse health effects occur at sound pressure levels above 40 dB but stipulates: "Closer examination of the precise impact will be necessary in the range between 30 dB and 55 dB as much will depend on the detailed circumstances of each case." [307] The World Health Organization also states: "The capacity of a noise to induce annoyance depends upon many of its physical characteristics, including its sound pressure level and spectral characteristics, as well as the variations of these properties over time." [308]

250. The CMOH Report comments on the evidence available regarding adverse health effects, stating "…the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects." [309]

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[305] Chief Medical Officer of Health (CMOH) of Ontario, The Potential Health Impacts of Wind Turbines, May 2010, Document Number 52, Page 8, Paragraph 4

[306] Michaud et el, A Proposal For Evaluating The Potential Health Effects Of Wind Turbine Noise For Projects Under The Canadian Environmental Assessment Act, Second International Meeting onWind Turbine Noise Lyon France September 20 –21 2007, Document Number 35, PDF Page 9, Paragraph 1

[307] World Health Organization, Night Noise Guidelines for Europe, 2009, Document Number 4, Page vii, Last Paragraph

[308] World Health Organization, Guidelines for Community Noise,1999, Document Number 2, Page 42 , Paragraph 2

[309] Chief Medical Officer of Health (CMOH) of Ontario, The Potential Health Impacts of Wind Turbines, May 2010, Document Number 52, Page 10, Bullet 10

251. First, the use of the word direct ignores the possibility of indirect adverse health effects from noise. Please see the Noise Effects Reaction Scheme cited by the World Health Organization in paragraph 48 of this witness statement which outlines both the direct and indirect pathways for noise-induced adverse health effects.

252. Second, this conclusion could easily be misinterpreted to mean that population health studies on residential exposure to wind turbine noise have been done, and those studies found no causal link between wind turbine noise and adverse health effects. This is not the case. On the contrary, the CMOH Report lists on page 5 the limited health related research specifically on wind turbines that was reviewed by the CMOH. The CMOH Report states: "The main research data available to date on wind turbines and health include:

> "Four cross-sectional studies, published in scientific journals, which investigated the relationships between exposure to wind turbine noise and annoyance in large samples of people (351 to 1,948) living in Europe near wind turbines"
>
> "Published case studies of ten families with a total of 38 affected people living near wind turbines in several countries (Canada, UK, Ireland, Italy and USA) (Pierpont 2009)."
>
> "Research on the potential health and safety hazards of wind turbine shadow flicker, electromagnetic fields (EMFs), ice throw and ice shed, and structural hazards".

253. The above list of research reviewed by the CMOH does not include population health studies on exposure to IWTs at various distances which evaluate a range of health outcomes such as sleep disturbance, quality of life, mental health, inner ear symptoms, headaches, stress, etc. It does include turbine specific studies on annoyance and one case series study conducted by Dr. Pierpont, both of which do report adverse health effects.

254. One of the main conclusions of the CMOH Report is: "The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other direct adverse health effects." [310]

255. The CMOH Report's statement that other direct adverse health effects will not be caused by exposure to wind turbine sound has no basis in any study reviewed by the CMOH that evaluates the relationship between residential exposure to IWT sound and human health.

256. The Chief Medical Officer of Health was aware that Dr. Nissenbaum's study was underway, and that early results revealed adverse health effects reported by the pilot study respondents. [311]

257. The expanded 2010 study results were presented by Dr. Nissenbaum at the recent First International Symposium: The Global Wind Industry and Adverse Health Effects on October 29-31, 2010. [312]

258. Both the Ministry of the Environment and the Chief Medical Officer of Health were invited to this Symposium and were sent program material about the type of evidence that would be presented at the Symposium, but no representatives attended. [313]

259. Notably, the Ministry of Health and Long-Term Care and the MOE have stated that they will continue to monitor new scientific information on the topic of health and wind turbines. [318], [319] Dr. Nissenbaum's study is an example of emerging scientific information on IWT and human health that should be investigated and considered by the

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[310] Chief Medical Officer of Health (CMOH) of Ontario, The Potential Health Impacts of Wind Turbines, May 2010, Document Number 52, Page 10,
[311] Teleconference November 23, 2009, Arline King, Chief Medical Officer of Health Ontario and Dr. Robert McMurtry, Dr. Michael Nissenbaum, Carmen Krogh, Beth Harrington
[312] Symposium Program, Proceedings First International Symposium on Adverse Health Effects from Wind Turbines The Global Wind Industry and Adverse Health Effects: Loss of Social Justice? Picton, Prince Edward County, Ontario, Canada October 29-31, 2010, Document Number 103, PDF Page 5 of 8, http://windvigilance.com/symp_2010_proceedings.aspx
[313] Invitation to First International Symposium on Adverse Health Effects from Wind Turbines, Document Number 113
[318] Correspondence, Minister of Environment, February 11, 2010, ENV1283MC-2009-5090, Document Number 107
[319] Correspondence, Ministry of Health and Long-Term Care, July 27, 2009, Document Number 108

MOE prior to issuing a REA for the Kent Breeze Wind Farms which will expose residents to IWTs at similar distances where adverse health outcomes were observed in Dr. Nissenbaum's study.

260. The CMOH Report briefly refers to shadow flicker, and states:

> "Shadow flicker occurs when the blades of a turbine rotate in sunny conditions, casting moving shadows on the ground that result in alternating changes in light intensity appearing to flick on and off. About 3 per cent of people with epilepsy are photosensitive, generally to flicker frequencies between 5-30Hz. Most industrial turbines rotate at a speed below these flicker frequencies." [320]

261. The CMOH Report does not refer to planning considerations that would minimize the impact of shadow flicker, as well as the full potential for shadow flicker to impact people in their homes, on their properties, or on roads. See Paragraphs 183-196 of this witness statement for more details on shadow flicker.

262. To date I am not aware of any clinical evaluation or formal investigation of Ontario wind turbine victims conducted by the Chief Medical Officer of Health of Ontario or her department.

[320] Chief Medical Officer of Health (CMOH) of Ontario, The Potential Health Impacts of Wind Turbines, May 2010, Document Number 52, Page 7