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RUFUS E. BROWN
M. THOMASINE BURKE

November 10, 2010

Via FEDEX

Susan Lessard, Chair
Board of Environmental Protection
c/o Terry Dawson
17 State House Station
Augusta, Me. 04333

Re: *Appeal of Final Order in the Spruce Mountain Wind Project L-24838-24-A-N & L-24838-2G-B-N by Friends of Spruce Mountain and Other Aggrieved Parties*

Dear Ms. Lessard:

I am enclosing with this letter paper copies of Exhibits 1 through 32 and the unnumbered article by Dr. Alec Salt, "Responses to the Ear to Low Frequency Sounds, Infrasound and Wind Turbines" for the appeal of the DEP Order in Spruce Mountain. I have been informed by Ms. Dawson that last week, the Board received the paper copy of the Appeal Document and Exhibits A and B thereto.

Sincerely yours,

Rufus E. Brown

REB/encl.

Beth Nagusky, Acting Commissioner, U.S. Mail without encl.
Juliet Browne, Esq., U.S. Mail without encl.
Friends of Spruce Mountain via e-mail

158

EXHIBIT 1

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

In Re:

SPRUCE MOUNTAIN WIND LLC	)	
Woodstock, Oxford County	)	**AFFIDAVIT OF**
SPRUCE MOUNTAIN WIND PROJECT	)	**MICHAEL NISSENBAUM, MD**
L-24838-24-A-N	)	
L-24838-2G-B-N (approval)	)	

I, Michael Nissenbaum, M.D., being first duly sworn, do depose and say as follows:

1. I am a graduate from the University of Toronto Medical School with post-graduate training at McGill University and the University of California.

2. I am a specialist in diagnostic imaging, whose training and work involves developing and utilizing an understanding of the effects of energy deposition, including sound on human tissues. I am a former Associate Director of MRI at a major Harvard Hospital, a former faculty member (junior) at Harvard University, and a published author. A copy of my CV is attached to this, my Affidavit, and marked as *Exhibit A*.

3. I developed an interest in the health effects of wind turbine projects after becoming aware of complaints related to an industrial wind turbine installation in Mars Hill, Maine, and subsequently investigating the widespread and serious health effects suffered by most of the residents of Mars Hill, who live in proximity, within 1100 meters to a linear arrangement of twenty-eight 1.5 MW wind turbines. A summary of my preliminary findings for the Mars Hill study is attached hereto as *Exhibit B*. I have also, more recently, been studying the health effects of residents who are nearby the Vinalhaven Island Wind Project on Vinalhaven, Maine.

4. I give this Affidavit in support of citizens of Woodstock, Maine who are concerned about potential adverse health effects from the proposed Spruce Mountain Wind Project.

5. Based on my studies and my medical background and experience, it is my professional opinion that there is a high probability of significant adverse health effects for residents whose homes are located within 1100 meters of a 1.5 MW turbine installation. The health risks include:

a) Sleep disturbances/sleep deprivation and the multiple illnesses that cascade from chronic sleep disturbance. These include cardiovascular diseases mediated by chronically increased levels of stress hormones, weight changes, and metabolic disturbances, including the continuum of impaired glucose tolerance up to diabetes.

b) Psychological stresses which can result in additional effects including cardiovascular disease, chronic depression, anger, and other psychiatric symptomatology.

c) Increased headaches.

d) Unintentional adverse changes in weight.

e) Auditory and vestibular system disturbances.

f) Increased requirement for and use of prescription medication.

6. It is my further professional opinion that any future industrial wind projetcs build in an additional margin of safety to avoid the adverse health effects experienced at Mars Hill. At this point in time, I recommend a distance of at least 2000 meters, or the distance recommended by appropriately designed preconstruction sound modeling targeting a sound level of 35dBA at the building façade or property line (if buildable property values are to be maintained),whichever is greater. The 2000 meter recommendation is also consistent with recommendations of other physicians and acoustic engineers who are not employed by the wind industry.

7. I have reviewed the documents in the Spruce Mountain Wind Project file at the Maine DEP related to noise.

160

8. In my opinion, the turbines proposed for the Spruce Mountain Wind Project will be located too close to residents in the proximity of the project. Of the 22 receptor sites, all will be within 2000 meters of a wind turbine and 9 will be within 1100 meters of a turbine. I further note that the turbines proposed for Spruce Mountain Wind Project are 2.0 MW, larger than those installed in Mars Hill and Vinalhaven. Based on this information, I would expect that the residents at a minimum of 9 receptor sites will experience the same or similar adverse health effects, including and especially sleep disturbance, in the same proportions as the affected residents living within 1100 meters (3500ft) of the turbine installation at Mars Hill, and that other receptor sites will be exposed to an unknown risk of adverse health effects..

9. I have also reviewed the Draft DEP Order approving the licenses sought by Spruce Mountain Wind LLC relating to the human health effects of noise at pages 11 and 12 and I have profound disagreement with what is stated. Specifically, I disagree with the statement attributed to

a. Dr. Dora Mills of the Maine Center for Disease Control that that "no evidence in peer- reviewed medical and public health literature of adverse health effects from the kinds of noise and vibrations heard by wind turbines other than occasional reports of annoyance;

b. Exponet, Inc., a wind industry consultant, that "[a]nnoyance regarding the wind turbines is an elusive factor that could underlie a majority of health complaints being attributed to a majority of the health complaints being attributed to wind turbine operations;"

c. AWEA/CWEA, the wind industry associations, that the "sounds emitted by wind turbines are not unique" and that there is no reason to believe that wind turbine noise "could plausibly have direct adverse health consequences; and

d. Warren Brown of EnRad Consulting that the DEP Noise Rule standards "are close to if not less than, the WHO [2009] target limit."

9. As recognized by Dr. Mills in her private discussions with the DEP, there is not a single, non-industry biased, study or any peer reviewed literature that states that wind turbine

noise is harmless to human health. To the contrary, there is an emerging body of literature, some of which is peer reviewed, informing us that under certain circumstances wind turbine noise can have substantial physiological and psychological impact on a community. In support of this statement, I attach as *Exhibit C* a summary of some of the literature on this subject composed by Daniel Sheppard, PhD from the Auckland University of Technology in New Zealand.

10. Specifically, Dr. Mills does not appreciate or fails to acknowledge the progression of how new environmental toxins are evaluated by the medical community.

11. To quote Dr. Shepherd:

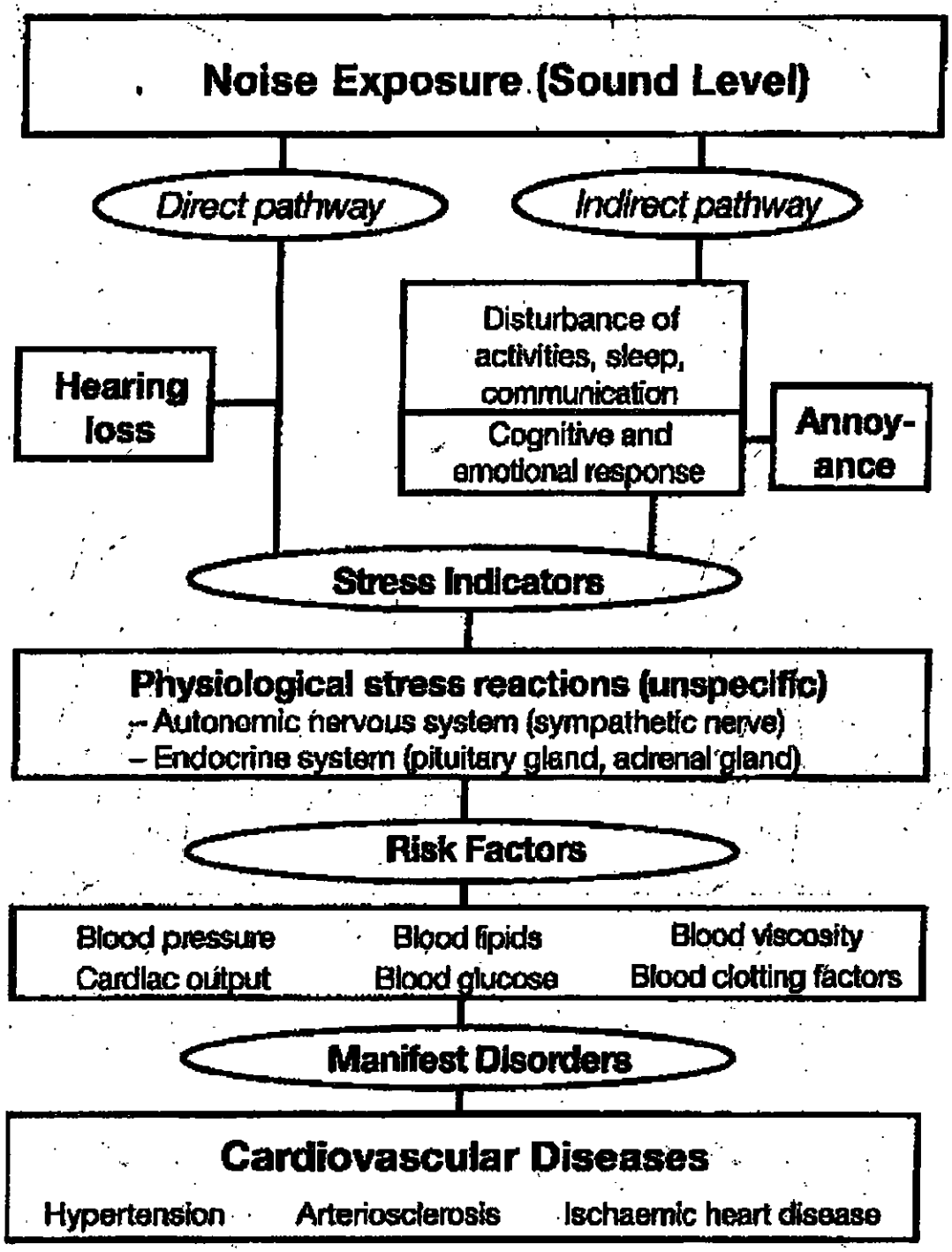
> Wind turbines are a new source of community noise, and as such their effects on public health are only beginning to emerge in the literature. The recognition of a new disease, disorder, or threat to health usually follows a set pathway. First, doctors and practitioners attempt to fit symptoms into pre-defined diagnostic categories or to classify the complaints as psychosomatic. Second, as evidence accumulates, case studies begin to appear in the literature, and exploratory research is undertaken to obtain better descriptions of the symptoms/complaints. Third, intensive research is undertaken examining the distribution and prevalence of those reporting symptoms, the factors correlating with the distribution and prevalence of those symptoms, and ultimately to cause-and-effect explanations of why those reporting symptoms may be doing so.
>
> In my reading of the literature the health effects of wind turbines are only beginning to be elucidated, and is caught somewhere between the first and second stage described in 2.3. The important point to note is that case studies (e.g., Harry, 2007; Pierpont, 2009) and correlation studies (e.g., Pedersen et al., 2007; van den berg, 2008) have already emerged in relation to the health effects of wind turbine noise, and so the possibility of detrimental health effects due to wind turbine noise must be taken with utmost seriousness.

12. While the word "annoyance" has been used in European studies relating to this turbine noise, the term has been misinterpreted by the Wind Industry and the MCDC to mean an inconsequential disturbance, whereas the authors, not being medical doctors, and not being

native English speakers, did not fully describe the health significance or severity of the "annoyance" in medical terms. A reading of the original papers upon which Dora Mills and other proponents of the wind industry base their opinions that "annoyance only may occur" quickly reveals that a more appropriate word in American English would be "disturbance." It further becomes clear that wind energy proponents appear to be exploiting the colloquial American English understanding of the word "annoyance" as an inconsequential "bother" of minor significance. In fact, the lead author of many of these studies (Eja Pedersen, PhD), erroneously quoted and interpreted by the wind industry and Maine CDC Director Dora Mills, stated to me in a personal communication that:

> Annoyance is a response, rather than an effect. However, to be annoyed means a lowered well-being and annoyance should therefore be avoided. The relationship between annoyance and symptoms of lowered health goes, from what I have found in my studies, two ways.
>
> People who have lowered physical or mental health are more vulnerable and therefore get annoyed.
>
> People who get annoyed may not get the physiological and psychological restoration that they need and annoyance could hence increase the risk for impaired health.

13. A review of the Mars Hill findings suggests that this "annoyance" is one of the root causes of the sleep disturbances and secondary adverse health effects suffered by the residents of Mars Hill, Maine. Mechanisms for how intrusive noise affects health are summarized in the the following diagram, which reflects longstanding and non controversial, settled medical knowledge, from a 2002 paper heavily referenced in the WHO *Guidelines for Nightime Noise in Europe* (2009):



14. "Annoyance" in the context of Industrial Wind Energy facilties is not only a critical

physiologic stressor and resultant symptoms and medical disorders, it is by no means "occasional," as claimed by the MCDC. Annoyance causes sleep disturbance and when sleep disturbance is chronic -- which will happen when turbines are sited too close to residents because turbine noise at night is in fact chronic, it is there much of the time, week after week, month after month, year after year – it results in sleep deprivation. Sleep deprivation will result, as surely as day follows night, in a host of adverse symptoms and, over time, diagnoses of real medical conditions. This is not conjecture. This is simple, known, medical fact.

15. Additionally, the logic employed by the Maine CDC is faulty: Everyone knows that intrusive noise causes sleep disturbance. Physicians, and some lay people, additionally, know that chronic sleep disturbance is sleep deprivation, and sleep deprivation has a host of acute, subacute, and chronic adverse health effects. Most of the symptoms described by the sufferers at Mars Hill are attributable to sleep deprivation. This includes headaches, changes in weight, psychiatric symptoms, cognitive dysfunction, possible increases in blood pressure, and the like in the near and medium term. Chronic effects, which have yet to be seen (it is too early, yet) may include, in the fullness of time, effects such as diabetes and heart disease.

16. Annoyance, in addition to being addressed in the WHO *Night Noise Guidelines for Europe 2009 and Guidelines for Community Noise 1999*, has been studied extensively by Swedish wind noise expert, Dr. Eja Pederson, and her colleagues in the following publications:

a. Eja Pederson and Kerstin Wayne, "Perception and Annoyance Due to Wind Turbine - a Dose – Response Relationship," J. Acoust. Soc. Am. 116 (2004). **Peer reviewed.**

b. Eja Pedersen and Kerstin Waye, "Wind Turbines-Low Level Noise Sources Interfering With Restoration?" Environmental Res. Lett. 3 (2008).

c. Frits van den Berg, Eja Pedersen, Jelte Bouma & Roel Bakker. " WINDFARMperception, Visual and Acoustic Impact of Wind Turbine Farms on Residents," June 3, 2008

d. Eja Pedersen, Frits van den Berg, Roel Bakker & Jelte Bouma. "Response to Noise from Modern Wind Farms in the Netherlands," J Acoust. Soc. Am 126 (2), August 2009. **Peer reviewed.**

e. Eja Pedersen. "Third International Meeting on Wind Turbine Noise," Aalborg Denmark 17-19 June 2009."

f. Kerstin Waye. "Perception and Environmental Impact of Wind Turbine Noise," Inter-Noise 2009 (August 23-26,2009).

In the third of these articles, the authors state that since 2005 it has been known that "the prevalence of noise annoyance [is], apart from the sound pressure level, strongly related to disturbed rest" and "[i]nhibited restoration or hindrance of psychological stress recovery due to disturbance from noise sources is today believed to have an important impact on not only mood but more long term health consequences." In the fifth article, the authors state that the "need for guidelines for maximum exposure to wind turbine noise is urgent .... To avoid possible health effects.

17. It is well established today that noise generated from the operation of wind turbine projects is unique and significantly different from noise generated from other common industrial and commercial operations, including traffic, rail and air transportation, as illustrated by the following graph published by Eja Pederson in 2004:

166

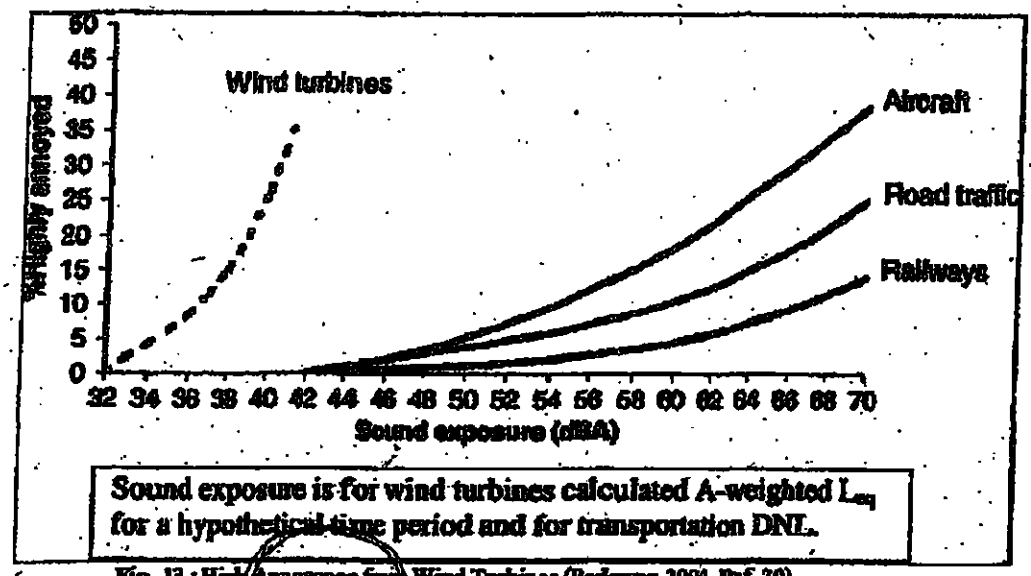


Fig. 13 : High Annoyance from Wind Turbines (Pedersen 2004, Ref. 20)

18. Differences include: (a) amplitude modulation of audible sounds, which is pulsating (or 'impulsive') in nature with a large component of lower frequency sounds, and therefore more ""annoying", or, more properly, more "disturbing" than other kinds of noise. (b) a dominance of dynamically modulated infrasonic and low frequency acoustic energy, can more easily penetrate facades of buildings, therefore creates a higher risk for adverse health effects and (c) noise is emitted from high above the ground resulting in a pervasive and omnipresent character that dominates the soundscape, and is, (d), capable of inducing building resonance and other structural responses to airborne acoustic energy. This last, (d), is critical, in that it can take sound that is inaudible to most (but not all) people, and convert it, via building resonance, into noise that is in fact audible, intrusive, and disturbing, to most people. These differences, combined with nighttime operation, make noise emitted by industrial scale wind turbines more intrusive and disturbing compared to noise from more common sources such as railroads and airports, and has therefore increased potential to casue adverse effects on the adjacent

community's health and welfare than sounds generated from other sources for which the current regulatory scheme for noise, in Maine, was developed.

19. Scientific literature that supports the statements made in paragraphs 17 and 18 of my affidavit, in addition to those articles cited in paragraph 10, include the following:

a. Keith Stelling & Carmen Krogh. "Summary of Recent Research on Adverse Health Effects of Wind Turbines" 20 October 2009.

b. Dr. Christopher Hanning, "Wind Turbine Noise, Sleep and Health," April 2010.

c. "Wind Energy Industry Acknowledgement of Adverse Health Effects", prepared by the Society for Wind Vigilance (January 2010).

d. Geoff Leventhall, "Low Frequency Noise. What We Know, What We do not Know and What We would Like to Know," 28 Journal of Low Frequency Noise, Vibration and Active Control No. 2 (2009).

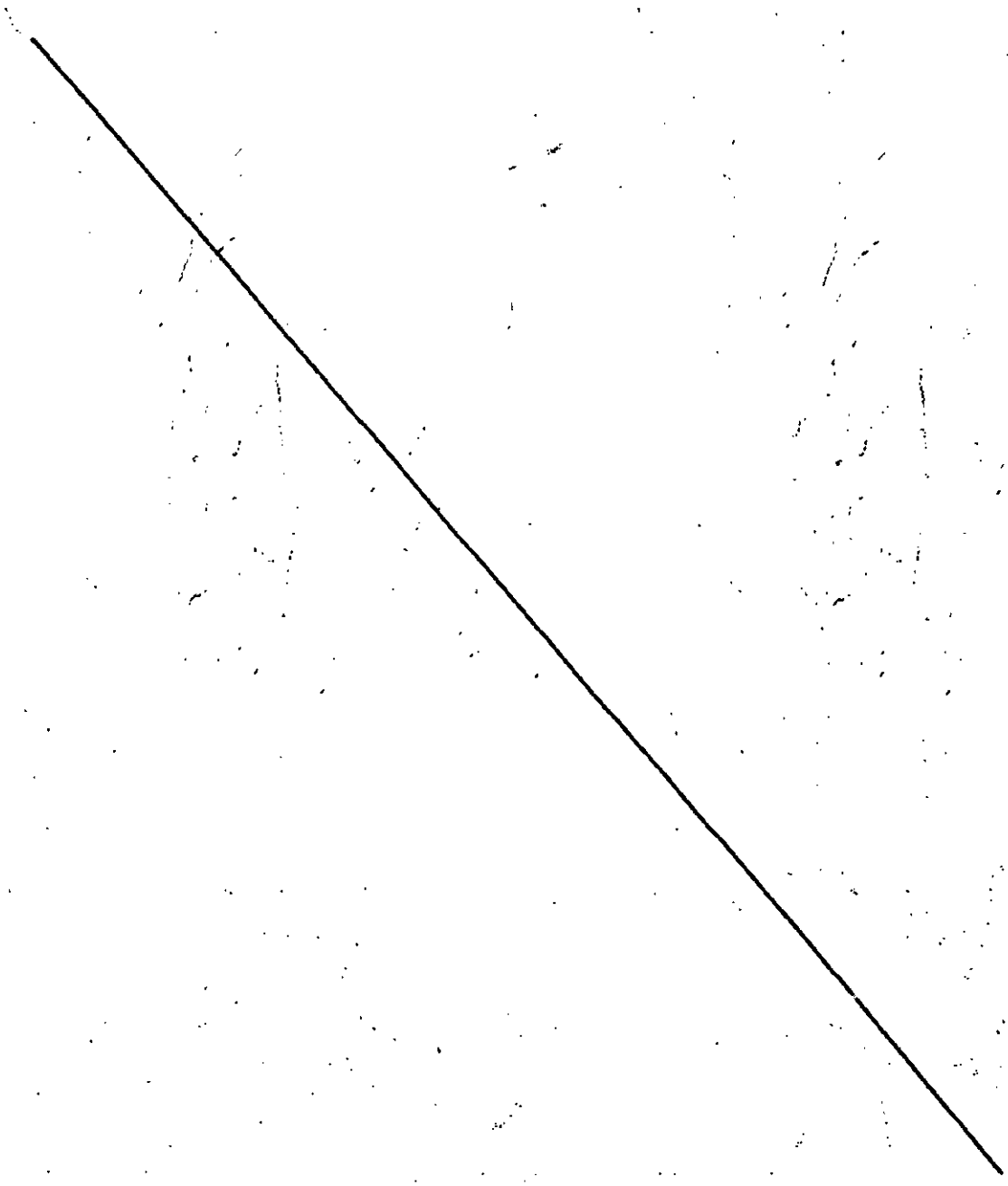
e. Hubbard, H.H., "Noise Induced House Vibrations and Human Perception," *Noise Control Engineering J.*, 19, 49-55 (1982).

20. I agree with the statement attributed to EnRad Consulting in the Draft DEP Order that the recommended noise limits for 40 dBA outside the façade a residence contained in the WHO *Night Noise Guidelines* does not compare directly with the DEP Noise limits for protected locations, but, only in the context that one is a compliance criteria for Maine and the WHO limits are for health of the public.

21. However, I disagree with the statement attributed to Dr. Dora Mills that the 45 dBA Sound Level Limits for quiet areas in the DEP Noise Rule is close to, if not more protective than, the findings in the WHO *Guidelines*. This statement reflects a serious misunderstanding by Dr. Mills, who should be familiar with toxicology concepts, of the WHO *Guidelines for Community Noise (1999)*, which indicated that particular measures should be undertaken when assessing sources of noise with low frequency components. In addition, the peer reviewed WHO

164

Night Noise Guidelines for Europe (2009) work included the following chart, from which it was concluded that 30 dBA outside the façade of a home is safe (no observed effect level (NOEL)), and that 40dBA outside the façade results in unequivocal adverse health effects(lowest observed adverse effect level (LOAEL), with a grey area in between 30-40 dBA:



Average night noise level over a year $L_{night,outside}$	Health effects observed in the population
Up to 30 dB	Although individual sensitivities and circumstances may differ, it appears that up to this level no substantial biological effects are observed. $L_{night,outside}$ of 30 dB is equivalent to the no observed effect level (NOEL) for night noise.
30 to 40 dB	A number of effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbance, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example children, the chronically ill and the elderly) are more susceptible. However, even in the worst cases the effects seem modest. $L_{night,outside}$ of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise.
40 to 55 dB	Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected.
Above 55 dB	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.

Table 3
Effects of different levels of night noise on the population's health

A number of instantaneous effects are connected to threshold levels expressed in L_{Amax}. The health relevance of these effects cannot be easily established. It can be safely assumed, however, that an increase in the number of such events over the baseline may constitute a subclinical adverse health effect by itself leading to significant clinical health outcomes.

Based on the exposure-effects relationship summarized in Table 3, the night noise guideline values are recommended for the protection of public health from night noise as below.

Night noise guideline (NNG)	$L_{night,outside}$ = 40 dB
Interim target (IT)	$L_{night,outside}$ = 55 dB

Table 4
Recommended night noise guidelines for Europe

$L_{night,outside}$ is the night-time noise indicator (L_{night}) of Directive 2002/49/EC of 25 June 2002: the A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the night periods of a year, in which: the night is eight hours (usually 23.00 – 07.00 local time), a year is a relevant year as regards the emission of sound and an average year as regards the meteorological circumstances, the incident sound is considered, the assessment point is the same as for L_{den}. See *Official Journal of the European Communities*, 18.7.2002, for more details.

170

22. Moreover the WHO *Night Noise Guidelines* also included the following charts:

Effect		Indicator	Threshold, dB
Biological effects	Change in cardiovascular activity	*	*
	EEG awakening	[illegible]	35
	Motility, onset of motility	[illegible]	32
	Changes in duration of various stages of sleep, in sleep structure and fragmentation of sleep	[illegible]	35
Sleep quality	Waking up in the night and/or too early in the morning	[illegible]	42
	Prolongation of the sleep inception period, difficulty getting to sleep	*	*
	Sleep fragmentation, reduced sleeping time	*	*
	Increased average motility when sleeping	[illegible]	42
Well-being	Self-reported sleep disturbance	[illegible]	42
	Use of somnifacient drugs and sedatives	[illegible]	40
Medical conditions	Environmental insomnia**	[illegible]	42

Table 1
Summary of effects and threshold levels for effects where sufficient evidence is available

Effect		Indicator	Estimated threshold dB	Reference (chapter, section)
Biological effects	Changes in (stress) hormone levels	*	*	2.5
Well-being	Drowsiness/tiredness during the day and evening	*	*	2.2.3
	Increased daytime irritability	*	*	2.2.3
	Impaired social contacts	*	*	2.2.3
	Complaints	Leq, night	35	4.3
	Impaired cognitive performance	*	*	2.2.3
	Insomnia	*	*	4.6
	Hypertension	Leq, night	50	2.2.3; 4.5.6
	Obesity	*	*	2.2.3
	Depression (in women)	*	*	4.8
	Myocardial infarction	Leq, night	50	4.5.15
	Reduction in life expectancy (premature mortality)	*	*	2.2.3; 2.5
	Psychiatric disorders	Leq, night	60	4.8.15
	(Occupational) accidents	*	*	2.2.3; 2.4

+ *Note that as the evidence for the effects in this table is limited, the threshold levels also have a limited weight. In general they are based on expert judgement of the evidence.*

* *Although the effect has been shown to occur or a plausible biological pathway could be constructed, indicators or threshold levels could not be determined.*

23. There is no statement in the WHO *Guidelines* that the disease thresholds summarized in the foregoing charts are dependent on exposure for a year to observe all of the listed effects and there is nothing in the scientific literature that requires such a long exposure. Adverse health effects can be observed after only a few days of sleep disturbance. They are not

dependent on exposure for a year and there is nothing in the scientific literature that requires such exposure. Chronically impaired sleep over a period of time, much shorter than one year, results in adverse health effects.

23. To insist, as the Maine CDC does, that because the noise, if averaged over a year, is well within WHO 2009 *Guidelines* is to make the argument that precautions to prevent the damage caused by a hurricane of wind speed 100 MPH are unnecessary because, when averaged over a year, the wind speed of the hurricane is only 0.3 MPH. Additionally, of course, wind turbines reflect a chronic source of noise, as the residents of Mars Hill and other locales where industrial wind turbines have been placed close to homes, tell us.

26. Therefore, if one is to look to the WHO *Guidelines* for *the science* (as opposed to politically impacted compliance requirements) in order to determine what levels of noise would generally be safe, those limits would be set somewhere between 30 dBA and 40dBA, with a margin of safety from the lower threshold.

27. Finally, I disagree with the conclusion in the Draft DEP Order at 12 that "compliance with Chapter 375 §10 is likely to ensure that there are no adverse health effects due to the proposed project" for the following reasons:

a. The current 45 dBA limit specified in the DEP Noise Rule is too high for rural and wilderness communities. The DEP Noise Rule does not address the higher annoyance and disturbance effects caused by the unique and pervasive noise of wind turbines. It does not take into consideration the impact on rural and wilderness communities with naturally low background sound levels, especially at nightime, which results in a level of noise, when measured in decibel level, significantly over and above the pre-development community noise levels in these rural communities, and of sufficient amplitude, when sited in close proximity to homes (such as has occurred at Mars Hill), to result in adverse health effects.

b. The DEP Noise Rule does not require any measurement or control of infrasonic and low frequency noise propagated by wind turbine projects which can cause adverse public health consequences even at levels that are not audible

to many people.

c. The DEP Noise Rule does not provide for minimum setback requirements.

d. The DEP Noise Rule does not take into account amplitude modulation, a feature of wind power noise that is an important component of its uniquely disturbing quality.

e. It is possible for a noise emitter to produce continuous noise during a night that results in sound levels between 40 and 45 dBA that exceed WHO's 40 dB ($L_{night\ outside}$) thresholds, where observable adverse health effects are known to occur, yet be in compliance with the DEP Noise Rules.

Dated: September 20, 2010

Michael Nissenbaum, M.D.

STATE OF MAINE
Aroostook, ss.

September 20, 2009

Personally appeared the above-named Michael Nissenbaum, M.D., and being sworn, made oath that the foregoing statements by him described are upon his own knowledge, information and belief and that, so far as upon information and belief, that he believes this information to be true.

Before me,

Notary Public/Attorney-at-Law
My commission expires: 10-27-2011

194

EXHIBIT A

Curriculum Vitae - Michael A. Nissenbaum, MD

Address: 194 E. Main St., Fort Kent, ME 04743

Citizenship: Canadian / American

Positions Held:

1998-current:	Solo Radiologist, Northern Maine Medical Center, Fort Kent, ME
1994-1998	Chief, MRI Clinical Services, MRI Scan Center, Ft. Lauderdale, FL
1992-1994	Associate Director to Bob Edelman, MRI, Beth Israel Hospital, Boston, MA, (Harvard Medical School)

Education:

1979	McGill University, Faculty of Arts and Science (Honours Anthropology)
1983 M.D.	University of Toronto, Faculty of Medicine

Postdoctoral Training:

Internships, Residencies, Clinical Fellowships:

1984-1988	Resident, Radiology, McGill University Faculty of Medicine, Montreal, Canada
1983	Intern, Internal Medicine, Mount Sinai Hospital, Toronto, Canada
1988	Armed Forces Institute of Pathology, Washington, DC
1991-1992	MRI Clinical Fellow, Long Beach Memorial Medical Center, Long Beach, CA Supervisor: William G. Bradley, Jr., M.D., Ph. D.

Research Fellowship:

1990-1991	Interventional Research Fellow, University of California at San Diego, CA

Licensures and Certifications:

1984	Quebec License Registration
1986	Ontario License Registration
1989	California License Registration
1991	Massachusetts License Registration
1994	Florida License Registration
1988	Fellow, Royal College of Physicians of Canada
1988	Diplomate, American Board of Radiology
1988	Diplomate, Quebec Board of Medical Specialists (Radiology)
1998	Maine Medical License

Academic Appointments:

1992-94	Harvard Medical School, Boston, MA.

Hospital Appointments:

1989-1990	Attending Radiologist, Alexandra Hospital, Ingersoll, Ontario.
1991-1992	Clinical Fellow; Memorial Medical Center, Long Beach, CA.
1992- 1994	Attending Radiologist, Associate Director of MRI, Beth Israel Hospital, Boston, MA
1998-present	Attending Radiologist, Northern Maine Medical Center

Awards and Honours:

1977, 1978, 1979	McGill Scholar–McGill University
1977, 1978, 1979	James McGill Award – McGill University
1988	Chief Resident, Royal Victoria Hospital

Memberships, Offices and Committee Assignments in Professional Societies:

American Roentgen Ray Society -L
Canadian Medical Association
American College of Radiology - L
Radiological Society of North America - L
Associate Member, American Society of Neuroradiology -L

Teaching Experience:

1990	Percutaneous Ethanol Ablation of Hepatic Neoplasia: Tissue Responses, Physiological Effects, and Imaging Characteristics in the Normal Liver, Dept. of Rad. Research Conference, Univ. of CA at San Diego
1991	Interventional Radiology, University of California at San Diego
1991-1992	Monthly Lecturer MR Visiting Fellowship, MRI Instruction to Radiology Residents, University at Irvine Memorial MRI Educational Institute
1992	Lecture: MRA- Current State-of-the-Art. To: Grand Surgical Rounds, Department of Surgery, Beth Israel Hospital, Harvard Medical School. Nov 1992
1993	Lecture: MRI Update: New Diagnostic Applications. To: Internal Medicine Group, Beth Israel Hospital, Harvard Medical School. October 1993
1993	Lecture: Optimization of Magnetic Resonance Angiography. To: Brigham and Womens' Hospital MRI and CT Update: October 1993, Harvard Medical School
1994	Lecture: Advanced MRI Techniques. To: Department of Radioology, Chinese University Hong Kong. December 1994
1995	Ongoing Lectures: Topics in Neurological and Body MRI and MRA (AMA category 1 credits) monthly at MRI Scan Center, Ft. Lauderdale, FL

Editorial Responsibilities:

1992-98	Reviewer, MRI related topics. American Journal of Roentgenology

Principal Clinical and Hospital Service Responsibilities:

1992-94	Associate Director, MRI, Beth Israel Hospital, Boston, MA.
1994-98	Chief, MRI Clinical Services and Advanced MR Applications MRI Scan Centers, Ft. Lauderdale, FL

Grant Support:

Seed grant for Tumor Ablation Research, Canadian Radiological Foundation Research Award (1988-1989).

Imaging Guided Tumor Ablation Project, Academic Senate of the University of California (1990-1991).

Principle Investigator: AMI-25, Superparamagnetic Iron Oxide Contrast Agent for use in Assessment of Hepatic Malignancy. 1991-1992 at Long Beach Memorial Medical Center
(Corporate-sponsored, non-peer reviewed)

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2. Wei L, **Nissenbaum MA,** Stehling MK, Goldmann A, Edelman RR. Differentiation between Hemangiomas and Cysts of the Liver with Nonenhanced MR Imaging: Efficacy of T2 Values at 1.5T. JMRI 1993

3. Muller MF, Prasad P, Siewert B, **Nissenbaum MA,** Raptopoulos V, Edelman RR. Abdominal Diffusion- Mapping Using a Whole Body Echo Planar System. Radiology, August 1993.

4. Ros PR, Freeny PC, Harms SE, Seltzer SE, Davis PL, Chan TW, Stillman AE, Muroff LR, Runge VM, **Nissenbaum, MA**. Hepatic MR Imaging with Ferumoxides: A Multicenter Clinical Trial. Radiology, August 1995.

Books and Monographs:

1. **Nissenbaum MA,** vanSonnenberg E, D'Agostino HB. Interventional Radiology in the Liver, Biliary Tract, and Gallbladder. In: Schiff E, ed. Diseases of the Liver. J.B. Lippincott Company, 1993. pp 279-298.

2. **Nissenbaum MA,** Adamis MK. Magnetic Resonance Imaging in Rheumatology- An Overview. In: Rheumarology Clinics of North America. Trentham, ed. May 1994.

3. **Nissenbaum MA.** MRI of Bone Marrow Disease, In Magnetic Resonance Imaging, Edelman and Hesselink, 1995.

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1. **Nissenbaum MA,** Atkinson DJ, Song SJ, Brown SM, Yan K, Widoff BE, Blitzer J, Bradley WG. Metastic Lesion Detection in the Liver; Increased Sensitivity of Dynamic Ultrafast MRI. Society for MRI in Med. 1992;

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10. **Nissenbaum MA,** Brown SM, Song SJ, Widoff BE, Yan K, Bradley WG. Decreased Intensity of Pathology in the Left Lobe of the Liver on T2 Weighted Imaging Related to Pulsation Induced Intravoxel Dephasing: Implications for Clinical Imaging. Society for MRI in Med. (1992).

178

EXHIBIT B TO AFFIDAVIT
OF MICHAEL NISSENBAUM, MD

PRELIMINARY FINDINGS ON THE MARS HILL HEALTH STUDY

1. I have recently conducted a study of the health effects of persons living within 1100 meters of the Mars Hill Wind Turbine Project in Aroostook County, Maine., which consists of 28 wind turbines. Each is 389 feet tall, from base to blade tip. This study is important because it represents the first controlled study of adverse health effects attributed to industrial wind turbines.

2. As part of the study, 22 of an estimated 30 adults living in the affected area were interviewed. Subjects interviewed included 10 females, ranging in age from 18 – 73, and 12 males, ranging in age from 43 – 79. The CONTROL group comprised of 27 individuals, 12 female and 13 male, age ranges and averages comparable to the subjects. The control group lived on average 5000 meters away from the turbine installation. A true copy of the map of the study area is attached to this my Affidavit as *Exhibit 1*.

3. Of the 22 subjects I interviewed, 18 of them (82%), reported a new onset or worsened sleep disturbance since the Mars Hill Wind Turbine Project went online in December 2006. 17 of those interviewed (77%) reported their sleep disturbance problems included waking up in the middle of the night, while 10 (45%) reported difficulty falling asleep. There were 5 new prescription medications for chronic sleep disturbance in this group of 22 subjects. In the CONTROL group, only 1 individual (4%) reported a new or worsened sleep disturbance in the same time period since the turbines went online. There were no new prescriptions for sleep disturbance in the CONTROL group.

4. Of the 22 subjects I interviewed, 9 of them (41%) reported increased headaches since the Mars Hills Wind Turbine Project went online in December 2006, with 7 of them (32%)

reporting a new onset of headaches and 2 of them (9%) reporting increased migraine frequency. There were three new prescriptions for headache mediation in this group. The CONTROL group had 1 individual (4%) with a worsened headache problem in this same time period.

5. Of the 22 subjects I interviewed, 3 of them (14%) reported new or worsened problems with dizziness since the Mars Hills Wind Turbine Project went online in December 2006, 3 (14%) reported tinnitus, 3 (14%) reported a new problem with ear pulsation sensations, and 1 (5%) reported periodic ear pain. There were no auditory or vestibular complaints in the CONTROL group.

6. Of the 22 subjects I interviewed, 7 of them (32%) reported they have been troubled by shadow flicker since the Mars Hills Wind Turbine Project went online in December 2006, with 2 (9%)of those reporting nausea, and 4 (18%) reported dizziness. 1 (5%) reported triggering migraine headaches by shadow flicker, and 2 (9%) reported a feeling of unease created by shadow flicker. There were no complaints related to shadow flicker in the CONTROL group.

7. Of the 22 subjects I interviewed, 8 of them (36%) reported they have experienced unintentional weight changes since the Mars Hills Wind Turbine Project went online in December 2006, with 6 of those reporting weight gain and 1 reporting weight loss. In the CONTROL group, there was 1 person (4%) who experienced unintentional weight change in that period.

8. Many of those affected by the Mars Hill Wind Turbine Project also reported new or worsened psychiatric symptomatology, including feelings of "stress" (13 people or 59%), "anger" (17 people or 77%), "anxiety" (7 people or 32%), "irritability" (6 people or 27%), "hopelessness" (12 people or 55%), and "depression" (10 people or 45%). Of those 8 persons who reported experiencing feelings of "depression," all of those reported that such feelings are

180

new since the Mars Hills Wind Turbine project went online in December 2006. There were 4 new or increased prescriptions for psychiatric medication in the subject group. The control group reported no new or increased psychiatric complaints.

9. In reporting feelings of "anger," a 67 year old woman described it as, "Absolute rage – you feel you want to kill someone, and don't know who to kill." A 65 year old man described it as, "So angry I could kill." And a 65 year old woman described it as, "Makes my blood boil."

10. In reporting feelings of "hopelessness," several of those affected by the Mars Hill Wind Turbine Project described those feelings, making the following comments:

a) "Nobody will help us."

b) "No options – can't leave, and can't live here."

c) "This is an awful thing to have happen to you."

d) "People don't believe us – (our complaints) fall on deaf ears."

e) "No one cares. No one listens."

f) "They just tread on us."

g) "It's very hard watching my child suffer."

11. Those I interviewed reported a total of 15 new and increased prescriptions for various health ailments since the Mars Hills Wind Turbine Project went online in December 2006. The CONTROL group reported 4 new or increased prescriptions in that time period.

12. 21 out of the 22 people in the subject group (95%) reported that their quality of life has been negatively affected by the Mars Hill Wind Turbine Project. Comments made by those persons when reporting that their lives have been affected include the following:

a) "Loss of joy in living … put a lot of life's plans on hold."

b) "No desire to go outside."

c) "Feel trapped."

d) "Dreams have been dashed."

e) "Was our dream home … it's all been stolen from us."

f) "We have no peace and quiet."

g) "My husband's (who has advanced MS) only pleasure in life was to see the wild animals. They are gone."

h) "No sleep."

i) "Sinking feeling every night when I (come home) and see them."

j) "I used to be able to hear it snow, before. Now, I do not look forward to going home."

There were no perceptions of reduced quality of life in the CONTROL group.

13. One hundred percent of the persons I interviewed reported they had considered moving away. None of the CONTROL group admitted to considering moving away during that time period.

EXHIBIT C

Appendix C

A SUMMARY OF RESEARCH UNDERTAKEN ON WIND TURBINE NOISE*

Preamble

There are now a number of studies showing that turbine noise is annoying, and that there is a link between annoyance to turbine noise and health as defined by the WHO. A brief description of this evidence is now listed, and where possible, technical jargon has been omitted or minimised. It should be noted that, without exception, all of these studies have shortcomings, and indeed, research of this type is vulnerable to inherent limitations that serve to dampen its impact. However, the studies selected represent credible researchers undertaking difficult research.

Harry (2007)

Dr Amanda Harry, a British General Practitioner, conducted surveys of 42 residents living near several different turbine sites and reported a similar constellation of symptoms from all sites. Of the 42 respondents, 81% felt their health had been affected, in 76% it was sufficiently severe to consult a doctor and 73% felt their quality of life had been adversely impacted. This study is open to criticism for a design that invited symptom reporting and was not controlled. While the proportion of those affected may be questioned it nevertheless indicates strongly that some members of the public are severely affected by wind turbine noise at distances thought by governments and industry to be safe.

Harry, A. (2007), Wind Turbines, Noise and Health. Retrieved from: http://www.flat-group.co.uk/pdf/wtnoise_health_2007_a_barry.pdf

Pederson et al., (2003, 2004, 2007, 2008 and 2009)

Pedersen and co-investigators have undertaken a series of investigations examining the relationship between turbine noise and health. In a 2004 paper (n=351) Pedersen reports the importance of individual and contextual factors alongside noise parameters, and the danger in generalising findings from other sources of community noise (e.g., road, rail, aircraft) to the wind turbine context (see Figure 3.0, mainbody). In a 2007 paper (n=754), Pederson further explores these individual and contextual influences. They noted that those living in rural areas are more likely to be annoyed than those from suburban areas, and that those living in complex terrain (e.g., hills or rocky terrain) were more likely to be annoyed than those living on flat ground. The study found a strong association between annoyance and both lowered sleep quality and negative emotions. A paper

published in 2008 (n=1822) reanalysed pre-existing turbine noise and annoyance data and concluded that turbine noise can impede health, especially for susceptible individuals. The paper also discussed the dangers of using noise level as a sole predictor of annoyance, and the strength of noise sensitivity indices in predicting annoyance.

Pedersen and others (2009) reported that annoyance increased with increasing sound levels, both indoors and outdoors (see Table 1). The proportions who were rather and very annoyed at different sound levels are shown in Table I. In summary, when outside, 18% were rather or very annoyed at sound levels of 35-40 and 40-45 dB(A) compared to 7% at 30-35 dB(A) and 2% at <30 dB(A). When inside, the equivalent figures were 1% at <30 dB(A), 4% at 30-35 dB(A), 8% at 35-40 dB(A) and 18% at 40-45 dB(A). Those respondents who had an economic interest in the turbines had lower levels of annoyance while negative views of the visual impact of turbines increased the likelihood of annoyance.

Although the authors do not seek to recommend minimum sound levels, they do note that turbine noise was more annoying than other sources, with the possible exception of railway shunting yards and was more noticeable at night. Reported associations between annoyance and symptoms of stress (headache, tiredness, tension and irritability) confirmed that "annoyance" is more than irritation and is a marker of impaired health. They conclude that (Pedersen et al, 2009):

"...night time conditions should be treated as crucial in recommendations for wind turbine noise limits."

Nevertheless, it is clear from this analysis that external predicted turbine sound levels should be less than 35 dB(A), considerably less than those permitted by European noise standards, in order to reduce effects on nearby residents to acceptable levels.

Table 1: Percent responding to level of annoyance towards outdoor and indoor wind turbine noise levels for five categories of level in 5-dB(A) sound level intervals. Parentheses present 95% confidence intervals. (From Pedersen 2009)

	Predicted *A*-weighted sound pressure levels dB(A)				
	<30	30–35	35–40	40–45	>45
Outdoors	n=178	n=213	n=159	n=93	n=65
Do not notice	75 (68–81)	46(40–53)	21(16–28)	13 (8–21)	8(3–17)
Notice, but not annoyed	20 (15–27)	36(30–43)	41(34–49)	46 (36–56)	58(46–70)
Slightly annoyed	2 (1–6)	10(7–15)	20 (15–27)	23 (15–32)	22(13–33)
Rather annoyed	1 (0–4)	[illegible]0)	12 (8–18)	6 (3–13)	6(2–15)
Very annoyed	1 (0–4)	1(0–4)	6 (3–10)	12 (7–20)	6(2–15)
Indoors	n=178	n=203	n=159	n=94	n=65
Do not notice	87 (81–91)	73(67–79)	61(53–68)	37 (28–47)	46(35–58)
Notice, but not annoyed	11(7–17)	15(11–20)	22 (16–29)	31(22–31)	38(28–51)

Slightly annoyed	1 (0–4)	8(5–12)	9 (6–15)	16 (10–25)	9(4–19)
Rather annoyed	0 (0–2)	3(1–6)	4 (2–8)	6 (3–13)	5(2–13)
Very annoyed	1 (0–4)	1(0–4)	4 (2–8)	10 (5–17)	2(0–8)

Pedersen, Hallberg, and Waye (2007) conducted in-depth interviews with 15 people living within close vicinity of wind turbines. A qualitative method known as grounded theory was selected to inform both data collection and data analysis. Respondents opinions of the turbines and the turbine noise was largely determined by their personal values about the living environment. The feeling of intrusion was associated with feeling a lack of control, subjected to injustice, a lack of influence, and not being believed. Various coping strategies were engaged, such as rebuilding their houses or complaining. Most however displayed learned helplessness and simply tried to ignore wind turbine noise.

Pedersen, E., Hallberg, L.R.M., and Persson Waye, K. P. (2007). Living in the Vicinity of Wind Turbines - A Grounded Theory Study. Qualitative Research in Psychology, 4: 1, 49 – 63.

Pedersen, E., and Nielsen, K.S. (1994). Annoyance due to noise from wind turbines. Delta Acoustic and Vibration Ltd. Report 150, Copenhagen, Denmark.

Pederson, E. W. (2005). Human Response to Wind turbine Noise – Annoyance and moderating factors. Wind Turbine Noise: Perspectives for control, Berlin, INCE/European Conference.

Pedersen, E., and Persson Waye, K. P. (2004). Perception and annoyance due to wind turbine noise: a dose-response relationship. Journal of the Acoustical Society of America, 116(6), p3460-3470.

Pedersen, E., and Persson Waye, K. (2007). Wind turbine noise, annoyance and self-reported health and well-being in different living conditions. Occupational Environmental Medicine, 64, p480-486.

Pedersen, E., and Waye, K. P. (2008). Wind Turbines – low level noise sources interfering with restoration? Environmental Research Letters, 3, 1-5.

Pedersen, E., van den Berg, F., Bakker, R., and Bouma, J. (2009). Response to noise from modern wind farms in The Netherlands. Journal of the Acoustical Society of America. 126:634-643.

van Der Berg (2008)

van den Berg and colleagues (2008) from the University of Groningen in the Netherlands have recently published a major questionnaire study of residents living within 2.5km from wind turbines. A random selection of 1948 residents were sent a similar questionnaire to that used by Pedersen in her studies in Sweden (2003, 2004, 2007 and 2008), questions on health, based on the validated General Heath Questionnaire (GHQ), were added. 725 (37%) replied which is good for a survey of this type but, nevertheless may be a weakness. Non-respondents were asked to complete a shortened questionnaire. Their responses did not differ from full respondents suggesting the latter are representative of the population as a whole.

Questions on wind turbine noise were interspersed with questions on other environmental factors to avoid bias. The sound level at the residents' dwellings was calculated, knowing the turbine type and distance, according to the international ISO standard for sound propagation, the almost identical Dutch legal model and a simple (non spectral) calculation model. The indicative sound level used was the sound level when the wind turbines operate at 8 m/s in daytime, that is, at high, but not maximum power. Noise exposure ranged between 24 and 54 dB(A). It is worth noting that the industry was approached for assistance in the research but refused. Complaints such as annoyance, waking from sleep, difficulty in returning to sleep and other health complaints were related to the calculated noise levels.

The research team concluded that *"Sound was the most annoying aspect of wind turbines"* and was more of an annoyance at night. Interrupted sleep and difficulty in returning to sleep increased with calculated noise level as did annoyance, both indoors and outdoors. Even at the lowest noise levels, 20% of respondents reported disturbed sleep at least one night per month. At a calculated noise level of 30-35 dB(A), 10% were rather or very annoyed at wind turbine sound, 20% at 35-40 dB(A) and 25% at 40-43 dB(A). van den Berg concluded also that, contrary to industry belief, road noise does not adequately mask turbine noise and reduce annoyance and disturbance. Bolin (2009) has shown that vegetation noise does not mask turbine noise as well as expected. With regard to health it was concluded that:

"There is no indication that the sound from wind turbines had an effect on respondents' health, except for the interruption of sleep. At high levels of wind turbine sound (more than 45 dB(A)) interruption of sleep was more likely than at low levels. Higher levels of background sound from road traffic also increased the odds for interrupted sleep. Annoyance from wind turbine sound was related to difficulties with falling asleep and to higher stress scores. From this study it cannot be concluded whether these health effects are caused by annoyance or vice versa or whether both are related to another factor."

Though the conclusion appears to contradict itself, and the assertion that only sleep is a factor cannot be concluded from their data as they did in fact find a relationship between annoyance and stress, but they could not conclude which one caused the other.

van den Berg, F., Pedersen, E., Bouma, J., and Bakker, R. (2008). Visual and Acoustic impact of wind turbine farms on residents. FP6-2005-Science and Society-20, Project no. 044628. A report financed by the European Union.

Thorne (2009)

As part of his research into the perception of low amplitude intrusive sound Thorne has found that there are significant differences in response between people living in rural areas near wind farms and people living in urban communities. Based on a series of sound simulations he found that the rural people interviewed found the sound of the turbines 'unpleasant, annoying and disturbing' whereas the urban community, who had not seen the wind farms or turbines, found the sounds 'pleasant and gentle'. A series of

noise sensitivity questionnaires also indicated a statistically significant difference between the two communities with the rural community more sensitive. Further research at two different locales near wind farms show that individuals initially accepting of wind farms can become increasingly sensitised to very low levels (outdoor LAeq 30 dB or less) of sound from wind farms due to the visual dominance of the turbines themselves and to noise that causes sleep disturbance or perceived adverse health effects. Sleep disturbance is caused by the varying nature of the wind farm noise; the 'rumble-thump' or 'swishing' sound heard inside the home at levels of LAeq 15 to 20 dB or less and cannot be avoided. The work of Thorne (2009) was to establish a practical methodology to integrate human perception of sound, personal sensitivity and relevant sound character analysis.

Thorne. R. (2008). Assessing intrusive noise and low amplitude sound. PhD thesis available online from Massey University, Palmerston North, New Zealand.

Jabben (2009)

Jabben and colleagues (2009) from RIVM, the Dutch National Institute for Public Health and Environment, were commissioned by the Dutch Government to examine the impact of different values of loudness on the ability to meet targets for onshore wind power generation. They reviewed current evidence and noted that, at present, 440,000 inhabitants (2.5% of the population) were; *"receiving significant noise contribution from wind turbine noise of which 1,500 are expected to suffer severe annoyance. It is remarkable that almost half of this number already occurs within the range Lden 30-40db(A)".*

Jabben J, -Verheijen E and Schreurs E. 2009. Impact of wind turbine noise in the Netherlands. Third International Meeting on Wind Turbine Noise, Aalborg 17-19 June 2009.

Pierpont (2009)

Pierpont (2009) has recently completed a very detailed case-series study of ten families around the world who have been so affected by wind turbine noise that they have had to leave their homes, nine of them permanently. The turbines ranged from 1.5 to 3MW capacity at distances between 305 to 1500m. The group comprised 21 adults, 7 teenagers and 10 children of whom 23 were interviewed. While this is a highly selected group, the ability to examine symptoms before, during and after exposure to turbine noise gives it a strength rarely found in similar case-series studies. The subjects described the symptoms of wind turbine syndrome outlined above and confirmed that they were not present before the turbines started operation and resolved once exposure ceased. There was a clear relationship between the symptoms, even in children, and the noise exposure. Pierpont reports also that all (actually 14 of 21) adult subjects reported *"feeling jittery inside"* or *"internal quivering"*, often accompanied by anxiety, fearfulness, sleep disturbance and irritability. Pierpont hypothesises that these symptoms are related to low frequency sound and suggests physiological mechanisms to explain the link between turbine exposure and the symptoms.

Of particular concern were the observed effects on children, include toddlers and school and college aged children. Changes in sleep pattern, behaviour and academic performance were noted. Seven of the ten children had a decline in their school performance while exposed to wind turbine noise which recovered after exposure ceased. In total, 20 of 34 study subjects reported problems with concentration or memory.

Pierpont's study mostly addresses the mechanism for the health problems associated with exposure to wind turbine noise rather than the likelihood of an individual developing symptoms. Nevertheless, it convincingly shows that wind turbine noise is strongly associated with the symptoms she describes, including sleep disturbance. She concludes by calling for further research, particularly in children, and a two-kilometre setback distance. A recent paper (Todd et al, 2008) has shown that the vestibular system in the human ear, the part concerned with detection of movement and balance, is exquisitely sensitive to vibration at frequencies of around 100 Hz. Pierpont claims that these findings support her hypotheses.

Pierpont N. (2009). Wind Turbine Syndrome: A Report on a Natural Experiment. K Selected Publications. Santa Fe, New Mexico.

Nissenbaum (2010)

Nissenbaum (2010) has presented the preliminary results of a study of residents living downwind and within 300-1100m (mean 800m) of a wind farm at Mars Hill, Maine, USA. The 28 1.5MW turbines are sited on a 200m high ridge overlooking the homes. Thus far 22 of about 35 adult residents have been interviewed and compared with a randomly selected control group living approximately six kilometres away. Of the 22, 18 report new or worsened sleep onset disturbance at least twice a week, for 9 at least 5 times per week (controls 1/28). A further eight of the 22 report new or worsened headaches (controls 1/28) and 18/22 reported new or worsened mental health symptoms (stress 12/22; anger 18/22; anxiety 8/22; hopelessness 12/22; depression 10/22; controls 0/28).

The 22 subjects received 15 new or increased prescriptions from their physicians in the 18 months between the start of turbine operation and the study, the majority for psychoactive medication (control group: 4 prescriptions, none for psychoactive medication). All but one of the 22 participants have reported reduced quality of life and 20 are consider moving away (controls: 0/28 for both). The study may be criticised for it's relatively small numbers of subjects but the presence of a control group, well matched for age and gender, adds considerable power. All differences between the groups are statistically highly significant. The turbine noise levels at this site may be enhanced by the high concentration of turbines and the geography but the severe sleep disturbance, psychiatric symptomatology and increased medication requirement in the study group confirms the potential of wind turbine noise to adversely affect health at distances claimed to be safe.

Nissenbaum, M. A. (2010). Industrial Wind Turbines and Health Effects in Mars Hill, Maine, A Retrospective Controlled Study – Preliminary Findings as of November, 2009. Personal Communication.