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Ministerial Advisory Committee
Via email: info@epa-inquiry.vic.gov.au

EPA INQUIRY

I am making this submission as a former director of the Waubra Foundation and in my present position as a Patron of that organisation. I have noted the submission made by John McMahon on behalf of WIRV (Wind industry Review Victoria) and agree with his comments, but will not waste time repeating them here.

You will be aware that the Waubra Foundation was established by technically qualified volunteers in 2010 to try and fill the gap between DEWLP and the Department of Health (DOH) in the protection of the health of country Victorians in respect of industrial noise.

In 2011, I and the CEO of the Foundation, Dr Sarah Laurie, an experienced Rural GP, were somewhat encouraged by a meeting with the EPA Chair and its then Managing Director. We believed that the EPA at this level understood that there were serious health issues around wind energy projects but neither had the direction to become involved in the matter, which then squarely fitted into the EPA's broad definition of responsibilities, nor did the Authority have the human and equipment resources they would need to regulate and control the industry.

Well a problem defined is a problem half solved we thought, and went away hopeful.

In fact the problem was solved by an administrative or legislative move to specifically remove the EPA from anything to do with wind turbines.

This was exactly what the wind energy industry wanted; to keep the gap between DEWLP and the DOH wide enough to drive their machines right through with the minimum of regulation and oversight, whilst telling politicians and apparently malleable senior bureaucrats that there were no problems even though there is proof that they did know otherwise.

Not satisfied with just taking the EPA out of the equation, the "powers that be" tactically brilliantly, but quite superficially, closed the gap by placing Shire Councils in charge of the supervision of wind projects in their shire, knowing that such organisations would never be able to acquire the resources or skills to tackle such a task.

In all, this has been a great success for the industry with virtually no supervision, no proper complaints system and improper compliance testing.

(Without comment I attach a speech by Senator John Madigan, a truly independent politician, and the Chair of the recent Senate Select Inquiry on Wind Turbines describing corruption and fraud in this industry).

So, country Victorians have had to endure another few more years of denial, dissembling, destroying whistle-blowers, and spin from the industry. But oh how the money rolls in! And, if I may add, how many more homes are rendered sonically toxic and inhabitable and /or seriously dangerous

structures, and how many more neighbours have their health, well-being and assets destroyed and their Human Rights marched right over.

The present situation is that DEWLP is happy to apply existing noise guidelines to the siting and layout of wind turbines no matter how much hard scientific engineering and medical data is presented to them; their minds are closed, the “guidelines are the guidelines” and they are “amongst the best in the world”.

The facts are that ‘noise’ and therefore noise guidelines, only refers to audible noise; whereas any forms of gas or air compression, or in the case of wind turbines, wind decompression, emits pressure pulses that are damaging whilst not being in the audible range. What you cannot hear can and does harm you. Sound is a better descriptor than noise of the airborne pressure pulses as it covers both audible and inaudible noise. Everywhere else, yes, but the DEWLP hears no problem, and therefore is incapable of recognising inaudible infrasound and low frequency noise which any independent acoustician or otologist will tell you is the problem.

The DOH also have accepted political pressure to avoid any responsibility to protect rural Victorians from industrial machines in country areas. They have their heads so far in the sand one might presume they are searching for fossil fuels.

I have no doubt that the writing of the EPA out of responsibility was an effort by the very powerful and rich wind industry to make their life easier and allow them to keep making money (actually “qualifying” for massive subsidies funded by power users whilst harming country Victorians with their cruel and inhumane projects.

I also have little doubt that in this matter they were willingly assisted by senior bureaucrats and senior politicians.

We are long past the point where non-scientific statements by the NHMRC, the AMA, the PHAA, Friends of the Earth, etc., and some rubbish studies by unqualified academics, can hold back the now accelerating pressure from recent and planned research.

It is important for country Victorians that the EPA be restored to the position of responsibility to manage wind turbine noise as if it was just another source of industrial noise. This is the EPA’s business.

Please resolve this irregularity in the EPA’s responsibilities and move quickly to prevent environmental pollution and thereby Human Rights abuses and very serious health impacts on people whose houses have been rendered sonically toxic and unfit for human habitation.

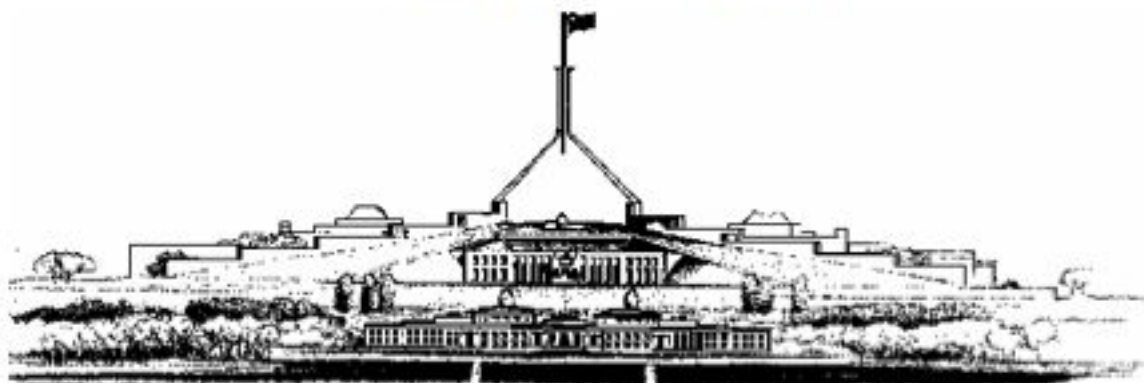
I enclose a number of documents which will bring the Committee up to speed on this and would welcome the opportunity to subject myself to questions from the Committee.

P R Mitchell



COMMONWEALTH OF AUSTRALIA

PARLIAMENTARY DEBATES



THE SENATE
PROOF
ADJOURNMENT
Renewable Energy
SPEECH

Tuesday, 15 September 2015

BY AUTHORITY OF THE SENATE

SPEECH

Date Tuesday, 15 September 2015
Page 91
Questioner
Speaker Madigan, Sen John

Source Senate
Proof Yes
Responder
Question No.

Senator MADIGAN (Victoria) (21:41): Firstly, I seek leave to table a document, and it was disclosed to all the whips earlier today.

Leave granted.

Senator MADIGAN: Tonight, I speak about corruption and fraud in the power generation industry. The Senate wind turbine inquiry's final report made 15 important recommendations. Tonight, I rise to speak in support the Labor senators' dissenting report's fifth recommendation:

... that state and territory government consider reforming the current system whereby wind farm developers directly retain acoustic consultants to provide advice on post-construction compliance.

Avoiding noise from wind turbines is an expensive bother that does not hold any appeal to wind farm operators. Slowing down turbines increases costs and slows down profits. So I was not surprised to learn that, in the seven years of its controversial operation, the adjustments necessary to ensure Cape Bridgewater wind farm operated in compliance with its planning permit have never been applied. Wind farm operators have found a simple and far less expensive process to game the system: they employ compliant 'experts'.

In 2006, Marshall Day Acoustics, with consultant Christophe Delaire, prepared a preconstruction noise impact assessment for the Cape Bridgewater wind farm. The report predicted that compliance could not be achieved at Cape Bridgewater wind farm without operating 13 of the 29 turbines in reduced operational noise modes. Before it was even built, developers knew this wind farm would operate in breach of permit unless adjustments were made. But Delaire told the committee of inquiry, 'following measurements on site, it was found that noise optimisation was not required.' How did Delaire's 'expert' preconstruction and post-construction reports come to draw such contrasting conclusions? The answer is simple. Pacific Hydro did not noise optimise turbines at Cape Bridgewater, because they knew they would not have to. They only had to commission a post-construction noise report to say the wind farm was compliant. On both occasions, Pacific Hydro got exactly the report they wanted from MDA, but the compliance assessments were not compliant with the standard and neither were the reports.

Questions of multiple reports reaching opposite conclusions were raised at the Portland hearing. During the Cape Bridgewater wind farm's noise monitoring program, measurements were taken every month and monthly noise reports were generated to assess compliance at dwellings. Let us look at a few from house 63. October 2008: 'Wind farm noise levels exceed the New Zealand noise limits'. June 2009: 'The New Zealand limits are significantly exceeded.' July 2009: 'The New Zealand limits are significantly exceeded.' MDA's original reports identified noncompliance at multiple homes and every wind speed. This did not satisfy the client.

On 22 July, MDA reissued revised monthly reports for every house and every month. These reports were to Pacific Hydro's satisfaction but not the permit's. The reissued versions for October and July said, 'There is reasonable correlation between measured noise levels and wind speeds.' References to exceeding the New Zealand limits were erased. Without incriminating original reports, MDA's final report concluded, 'Noise emissions from the Cape Bridgewater wind farm comply with the New Zealand noise limits at all houses and at all assessed wind speeds.' Pacific Hydro submitted it to the planning minister as 'proof' the Cape Bridgewater wind farm was compliant. But how? MDA combined all the reissued monthly reports and averaged them out for each property. There is nothing in the 1998 New Zealand standard that allows acousticians to find 'average' post-construction noise levels and yet Pacific Hydro told the committee, 'Current noise standards require the average post-construction wind farm noise level.'

There is no tolerance within the standard that would allow a wind farm to casually comply with its noise limits in some months but not others. Condition 13 does not allow the wind farm to occasionally comply with its permitted use. The New Zealand standard is supposed to protect amenity and night-time sleep. Wind farm planning permits are issued with conditions that decision makers expect will protect the communities that host them—in real time.

In February 2009, the panel assessing the Lal Lal wind farm stated:

There is little point in giving permission for a WEF to operate under certain conditions unless compliance with those conditions can and is demonstrated.

It added:

any exceedance of the limit should be considered as a breach of the condition ...

An 'average' noise level means absolutely nothing. That is why the permit requires that when the wind farm is operated it must comply with the New Zealand noise limits at all dwellings and, clearly, this one does not. The Cape Bridgewater wind farm has never been compliant, despite the falsified conclusions drawn by MDA and the claims of its master, Pacific Hydro. A Victorian Planning officer told the committee: 'Studies need to be done in a way which is robust. That is why the peer review of the work is important.' So why wasn't a review of the Cape Bridgewater report commissioned as a matter of due diligence, not to mention consistency?

When ACCIONA gave the minister its report, the minister sent a copy to the EPA, and within a week he had commissioned an independent technical review. He promptly wrote to ACCIONA, describing multiple breaches of permit and expressing his dissatisfaction that compliance had been achieved with the noise monitoring program required by condition 17. He said that the report shows that the operation of the Waubra wind farm does not comply with the noise standard at several dwellings and he was not satisfied in accordance with condition 14 that the operation of the facility complies with the relevant standard. Then he asked ACCIONA to 'noise optimise the turbines'. Delaire from MDA prepared Waubra's wind farm's preconstruction noise report, which predicted noise would exceed the New Zealand limits and would only comply if 50 of its 128 turbines were noise optimised. Same preconstruction formula, same post-construction problems. If not for that pesky peer review, ACCIONA might have got away with it. They had never intended to operate noise optimised turbines in compliance with the limits. Why? ACCIONA had an MDA post-construction noise report that concluded that Waubra wind farm operated in compliance with noise limits without needing to noise optimise any turbines, let alone 50 of them!

The Minister wrote to ACCIONA again a year later, stating that the MDA report it submitted showed non-compliance and that testing was not undertaken in accordance with the New Zealand standard. The minister queried who it was that undertook the assessment and whether this person or people were qualified and experienced to do so. MDA's website says that Delaire graduated with an engineering diploma in 2002, after beginning with MDA as a work experience student the year before. Delaire has prepared acoustic reports for 50 wind farms. MDA's website promotes its 'proven record of successful wind farm approvals' and credits Delaire for developing a 'specialty' in wind farm environmental noise assessments.

At the beginning of MDA's reports there is an extraordinary disclaimer which acknowledges that reports are written to satisfy the client's brief. It says their reports 'may not be suitable' for other uses. MDA's disclaimer proves they are not fit for purpose as independent compliance documents. MDA is a member firm of the Association of Australian Acoustical Consultants, whose code of professional conduct requires that members avoid making statements that are misleading or unethical and that they endeavour to promote the wellbeing of the community. They must not knowingly omit from any finalised report any information that would materially alter the conclusion that could be drawn from the report.

MDA has clearly failed the community consistently. There is no doubt that MDA's commercial arrangements with both ACCIONA and Pacific Hydro adversely affected the independence of reports and the legitimacy of conclusions. This example alone shows exactly why we needed an inquiry that examined the regulatory governance of wind farms and why the scrutiny of an independent national wind farm commissioner is essential. There must be arm's length relationships between acousticians and wind farm operators. Independence would put a stop to the practice where false compliance documents allow operators to gain pecuniary advantage.

Local, state and Commonwealth government authorities, departments and agencies have been duped by sham compliance reports

A wind farm that is 'compliant' with state laws can receive RECs. A 'compliant' wind farm can secure finance, like the \$70 million Pacific Hydro swindle from the Clean Energy Finance Corporation. But those who these reports fail most are decent rural people, left suffering the consequences of deception. A shonky noise report

can erase away the harm and nuisance it has caused for those living, working and suffering beside excessively noisy industrial machines.

Last month I asked the Victorian government to take a good hard look at all the submissions we received—in particular, those from the people duped by the regulatory failures of the Waubra and Cape Bridgewater wind farms. Samantha Stepnell's submission is No. 470. Melissa Ware's submission is No. 206.

While ACCIONA and Pacific Hydro were busy breaching their permits to maximise their profits, residents were and still are often exposed to horrendously excessive noise. Twenty or more of these same people had sent affidavits to former health minister and current Victorian Premier Daniel Andrews in June 2010. They reported severe sleep disturbances and a series of unexplained adverse health effects that were not present before the wind farms started operating. Local doctors and a sleep specialist confirmed concerns of a correlation.

By December 2010, 11 families around Waubra alone had vacated their homes, citing noise nuisance as the reason. But the Victorian government refused Pyrenees Shire Council's request for a health impact assessment, citing the NHMRC's rapid review. That very rapid review found that there was no evidence of adverse effects when planning guidelines were followed. At Waubra, we know that they were not. A simple peer review would have found that they were not followed at Cape Bridgewater either. With callous indifference, the Victorian government has consistently failed in its duty of care to these people. These people represent the human cost of corporate fraud, regulatory failure and political indifference. These families still have the right to be able to sleep at night, to work safely on their farms and to live in peace and have the quiet enjoyment of their homes. This is as much a human rights issue as it is an environmental one.

The nocebo theory is obliterated by the fact that the noise measured at Waubra and Cape Bridgewater exceeds World Health Organisation recommendations for sleep protection. Sleep deprivation is an indisputable health effect. Even the NHMRC now admits there are probably adverse health impacts for residents living within 1.5 kilometres of a wind turbine.

I have been writing to the AMA since May 2014 about its wind farm position statement, asking why audible noise impacts had not been considered. The AMA has failed to respond, but blindly endorses the disproven nocebo driven by Chapman and Crichton, stating:

The available Australian and international evidence does not support the view that the infrasound or low frequency sound generated by wind farms, as they are currently regulated in Australia, causes adverse health effects on populations residing in their vicinity.

That is because infrasound and low frequency sound from wind farms are not regulated in Australia. Irrespective of what the AMA has been told or wants to admit, exposures to excessive audible noise, low frequency pressure and vibration cause debilitating nuisance, sleep disturbance and compromised health and amenity that reduce quality of life.

So where does that leave those suffering the continuing nuisance at Cape Bridgewater? In submission No. 206, Melissa Ware said she was driven beyond despair and wretchedness. Last year, Pacific Hydro told residents: 'It is our goal to improve your quality of life or at least restore it to what it was before the wind farm was there.' They told me personally: 'We recognise that the wind farm has reduced their quality of life, and we want to help them get it back.' But that was before Steven Cooper's study found that all six residents surveyed are adversely impacted by the operation of the Cape Bridgewater wind farm. Funnily enough, Cooper was instructed not to test compliance. Despite the infamous screeching, thumping, whirring, whistling and siren-like audible sounds produced by the Cape Bridgewater wind farm, special audible characteristics were not assessed in MDA's report. If the five decibel SAC penalty were properly applied, an independent report would identify noncompliance at every dwelling, at every wind speed.

The Waubra and Cape Bridgewater reports were written within months of each other by the same acoustician from the same firm, using the same formula. Perhaps the planning minister has not commissioned a review of Cape Bridgewater's report because he already knows it shows noncompliance. Is this the real reason why the planning minister insists that it is Glenelg Shire's responsibility to enforce noise compliance at Cape Bridgewater, not his? Glenelg Shire cannot enforce compliance without any access to noise reports and the complaints procedure. Only the minister has that information. Condition 13 says compliance must be to the satisfaction of the minister. Council cannot legally exercise that judgement. Condition 13 remains unresolved. Cape Bridgewater

wind farm continues to operate at full capacity and maximum noise, without any regulatory authority accepting responsibility for enforcement.

In submission No. 456, Sonia Trist explains how officers from the Victorian planning department admitted noise limits are exceeded at her home, one apologising that: 'The department adjusts information to obtain the required results.' In June 2014, this retiring officer called me and later sent me an email, blowing the whistle on his department: 'There is so much more to convey and I am sorry that I cannot do so now. Department incompetence and indifference is the primary reason for the current situation. I found it hard to find the truth, working inside, so it must be hard for your side.' On 'my side' are those exposed to excessive and harmful, sleep-destroying, audible noise emissions at levels that exceed noise standards and breach permits. Those not on my side include complicit regulators, wilfully blind health bodies and greedy operators who put corporate profits before country people. And also not on my side are crooked acousticians flaunting a fraudulent reporting formula that concludes compliance when there is not.

Notable for their refusal to attend the Senate inquiry and be questioned, the Australian Medical Association were not alone. Others who similarly refused were the authors of the two NHMRC-commissioned literature reviews from Adelaide University and Monash University, and Professor Gary Wittert.

In December 2013, I warned about the culture of noncompliance arising from systemic regulatory failure in Victoria. But that culture of noncompliance, aided, abetted and enabled by recklessly irresponsible reporting and regulatory indifference, will only continue for as long as we tolerate it. This industry demands root-and-branch regulatory reform. Those who have actively and deceptively harmed communities, gamed the planning system, rorted the RET and exposed the CEFC and the private sector to investment risk must be investigated and held to account. I urge the government to swiftly adopt the prudent recommendations of the wind turbine inquiry. We insist that the Labor senators' fifth recommendation is acted upon as a matter of urgency.

Human Rights and Wind Energy Projects

The Questions

The fundamental questions are:

- are the human rights of Australians protected by law, and if so,
- are any of the rights of country people living near wind turbines being breached;
- which human rights are being breached;
- what are the obligations of public sector employees in respect to breaches of human rights?.

Human Rights Legislation

Australia is a signatory to some seven international conventions or treaties on human rights. The Australian Human Rights Commission has published a “handbook” or guide to these documents.

By ratifying these conventions/treaties Australia has accepted these documents and their definition of specific rights as having “standing” in Australia. Whether the standing is that of an Act passed by the Australian parliament is not clear, but it is unlikely.

The Australian Human Rights Commission Act charges the Commission with the implementation, oversight and enforcement of a suite of rights that seem stronger perhaps on social and group rights rather than those of individuals.

No Commonwealth Act has been passed that is specific to actual human rights. However an Australian Bill of Rights Bill was drafted in 2001 but has not been passed. Whilst not in itself part of the Australian law, it is useful in that it draws from the treaties and repeats many of the matters and rights therein.

For the purpose of exploring what rights, if any, have been ignored by the Wind industry and government authorities, the following Rights have been expressed in various documents but, for convenience, the wording has been extracted from the above Bill.

In addition Victoria has a Charter of Human Rights and Responsibilities Act, which is quite limited but which does repeat some of the rights expressed in other documents.

Relevant Rights as Expressed in the Australian Bill of Rights

Article 12: Every person has the right to bodily and psychological integrity.

Article 14: No person shall be subject to torture or cruel, inhuman and degrading treatment.

Article 22: Every natural or legal person has the right to peacefully enjoy his possessions. No one may be deprived of his possessions except in the public interest and subject to conditions provided by law.

Article 27: Every person has the right to safe and healthy working conditions.

Article 29: Every person has the right to an environment that is not harmful to their health and wellbeing.

Most citizens and institutions uphold human rights as a key pillar of the obligations of a society, but it must be recognised that rights apply to all and to all equally: and a fundamental underpinning is a commitment that no one group should act to disadvantage another and that civil servants should act to prevent such behaviour.

Facts

Detailed technical arguments relating to the five Articles referred to above, are presented elsewhere (see the Waubra Foundation website). As a result of work performed in the 1980s in the US (but conveniently forgotten by the industry and its acoustic advisors) it has been known for some 30 years that airborne pressure pulses (sound) from wind turbines impact some people traumatically, causing the appearance of a range of debilitating health issues including chronic sleep deprivation. The longer the exposure the more a person's level of suffering, and the lower the body's tolerance of the impacts. People up to 10km from a wind project are trapped in their sonically toxic homes which become hugely devalued or, more often than not, unsaleable.

Those that are so trapped can expect physical and mental degradation to the point of breakdown. There is no recognition or admission by the owners of the wind projects, rather denial and a refusal of compensation. Farming workplaces become unsafe and similarly injurious.

So the conclusions are straight forward and unavoidable:

- bodily and psychological integrity are broken;
- residents are subject to cruel, inhumane and degrading treatment;
- the right to peacefully enjoy possessions is arbitrarily removed and the major possession rendered worthless;
- safe and healthy working conditions no longer exist;

- the right to an environment that is not harmful to health and wellbeing no longer exists.

It is not necessary that every one of the identified rights is breached. One is enough.

Obligations of Civil Servants

It is not easy to identify the legal responsibilities of public servants in relation to human rights and infringements by wind turbine projects on local populations.

One would think that where a public servant is involved whether in the permitting, compliance and continued operation of a wind project that is or will likely cause infringements on local residents, that they should take every care to avoid such infringement. This should include nighttime shutdown, rapid and independent investigation of the claimed infringement and, if proven, require the project owner to remove the mechanism of infringement before the project may restart.

To do nothing would infer complicity in the infringement of the victims' human rights. Given the analysis offered above these are no minor infringements.

WIND TURBINE NOISE

A Simple Statement of Facts – The Australian Experience

August 2014

Emission of Sound and Vibration

1. Wind turbine blades produce airborne pressure waves (correctly called sound but which, when unwanted, is called noise) and ground-borne surface motion (vibration).
2. Recent measurements have indicated that turbines generate vibrations even when shut down,¹ presumably from the wind causing the flexing of large blades and the tower structure, and that this vibration (when turbines are shut down) can be measured at significant distances.
3. The airborne energy manifests as sound across a range of frequencies from infrasonic (0 to 20 Hertz(Hz)) up through low frequency sound (generally said to be below 200 Hz), and into the higher audible frequency range above 200 Hz. (Hertz is the variation in a particular changing level of sound pressure, at the rate of one cycle (or period) per second).
4. Sound at 100 Hz is audible at sound levels of around 27dB (decibels) for an average person, whilst the level of sound required for average audibility rises quite quickly below frequencies of, say, 25 Hz. Sensation, being non-auditory but bodily recognition of airborne pressure waves, occurs at lower pressure levels of infrasonic frequencies than can be heard. At infrasonic frequencies the “sounds,” i.e., pressure waves, exist and may be detected by the body and brain as pressure pulses or sensations, but via different mechanisms to the perception of audible noise.
5. Periodic pressure pulses are created by each turbine blade passing the supporting pylon. This is an inherent consequence of the design of horizontal axis wind turbines. These energy pulses increase with increasing blade length, as does the power generating capacity. People living near turbines have described the effect of these pulses on their homes as “like living inside a drum”.
6. Larger turbines produce a greater percentage of their total sound emissions as low frequency noise and infrasound than do smaller

¹ <http://www.pacifichydro.com.au/english/our-communities/communities/cape-bridgewater-acoustic-testing-presentation/?language=en>

turbines.² Therefore replacing a number of small turbines to a lesser number of larger turbines, whilst keeping the total power output of a wind project constant, will increase the total infrasound and low frequency noise (ILFN) emitted by the development. This effect will be compounded by increased wake interference, unless the turbines have also been repositioned further apart in accordance with the spacing specifications for the larger turbines. Wake interference results in turbulent air flow into adjacent turbines, with a consequent loss of efficiency, and increased ILFN generation.

7. If estimated sound contours have been used in seeking planning permits then replacing the permitted turbines with larger turbines will significantly increase the persistence of the wake turbulence, and thereby the sound emitted by adjacent turbines (and the proportion of ILFN emitted) will be significantly above the predicted contours. This is what occurred at the Waubra development; and will occur when a lesser number of larger turbines are used to maintain the generating capacity of the development, as occurred at Macarthur, (both projects being in Western Victoria).

² <http://waubrafoundation.org.au/resources/moller-pedersen-low-frequency-noise-from-large-wind-turbines/>

Infrasound

1. Infrasound is common in our world, but most natural infrasound is irregular and random, or is caused by a transient event (e.g. earthquakes). Some frequency bands below 20 Hz have been shown experimentally to cause a physiological stress response in humans at below audible levels.³ Industrial machinery noises are often regular and repetitive, as is the case with wind farm noise emissions, across the audible and infrasonic frequency spectrum.
2. Infrasonic pulsations travel much larger distances than audible noise and easily penetrate normal building materials, and once inside can resonate building elements (i.e., increase in impact), inside rooms.⁴
3. Infrasonic pulsations from a single 4 MW wind turbine were measured 10km from their source by NASA researcher William Willshire in 1985.⁵ Recent data collected by acoustician Les Huson in Australia and in the United Kingdom at onshore and offshore wind developments has shown that attenuation (reduction in sound level with increasing distance from

³ <http://waubrafoundation.org.au/resources/numerical-simulation-infrasound-perception-with-reference-reported-laboratory-effects/>

⁴ <http://waubrafoundation.org.au/resources/kelley-et-al-methodology-for-assessment-wind-turbine-noise-generation-1982/>

⁵ <http://waubrafoundation.org.au/resources/nasa-long-range-down-wind-propagation-low-frequency-sound/>

the source) can be much less than the 3dB per doubling of distance found by Willshire in 1985.⁶

4. Some acoustic pressure pulsations are relatively harmless and indeed even pleasant to the body, including waves on a beach. Organ music at frequencies just below 20 Hz generates “feelings” in people that can be either pleasant or unpleasant, and have been designed to produce emotive effects.⁷ Once it is understood that different frequencies can have very different effects on humans it is easy to understand the importance of accurate acoustic measurement.
5. Dr Neil Kelley and his colleagues from NASA demonstrated in the 1980’s that wind turbine generated energy pulses and noise in the infrasonic and low frequency bands, which then penetrated and resonated inside the residents’ living structures, directly caused the range of symptoms described as “annoyance” by acousticians and some researchers.⁸ A more accurate general descriptor would be mild, serious or intolerable “impacts”.
6. Residents and their treating medical practitioners know these symptoms and sensations include repetitive

sleep disturbance, feelings of intense anxiety, nausea, vertigo, headaches, and other distressing symptoms including body vibration. American Paediatrician, Dr Nina Pierpont, gave this constellation of symptoms the name “**wind turbine syndrome**” in 2009.⁹ Dr Geoff Leventhall, a British acoustician who was one of two peer reviewers of the NHMRC’s 2010 Rapid Review, has accepted these symptoms and sensations as “annoyance” symptoms, which he attributes to a stress effect, known to him to be caused by exposure to environmental noise, one source of which is wind turbine noise.¹⁰

Wake Interference and Turbulence

1. Historically it was accepted that wind turbines should be no less than 5 - 8 rotor diameters apart, depending on the direction and consistency of the prevailing wind with the higher separation being for turbines in line with the major wind direction. This was accepted industry practice, and as an example, was explicitly specified in the 2002 NSW SEDA handbook.¹¹ The purpose of this specification is to minimise turbulent air entering the blades of an adjacent turbine. As noted above, turbulent air is

⁶ <http://waubrafoundation.org.au/resources/huson-wl-navitus-bay-wind-park-submission/>

⁷ <http://www.hearingaidblog.com/2013/01/infrasonic-experiments/>

⁸ <http://waubrafoundation.org.au/resources/kelley-et-al-methodology-for-assessment-wind-turbine-noise-generation-1982/>

⁹ <http://waubrafoundation.org.au/resources/dr-nina-pierpont-submission-australian-senate-inquiry/>

¹⁰ <http://waubrafoundation.org.au/resources/kelley-et-al-methodology-for-assessment-wind-turbine-noise-generation-1982/>

¹¹ <http://waubrafoundation.org.au/resources/nsw-wind-energy-handbook-2002/>

associated with increased sound levels and infrasonic pulsations.¹²

2. If a significant proportion of the wind blows at right angles (90°) from the major direction used for turbine layout it follows that turbine spacing should be 7 or 8 rotor diameters in both directions. It should be noted that the 7 to 8 rotor diameter number is a compromise between ensuring smooth air inflow to all turbines (and hence less noise and vibration), and packing as many turbines as possible into the project area. Research conducted at Johns Hopkins University in 2012 showed that the best design for efficient energy extraction suggests wind turbines should be 15 rotor diameters apart.¹³
3. It is increasingly evident that some projects are not laid out in accordance with accepted specifications to reduce turbulence, which in turn significantly increases acoustic emissions including audible noise and infrasonic pressure pulses. The consequences of increased turbulent air entering upwind-bladed wind turbines resulting in increased generation of impulsive infrasonic pressure waves and low frequency noise were known to the

industry in 1989.¹⁴ Recent projects with turbines positioned inappropriately too close together should not have been given final approval by the responsible authorities.

4. Yawing (side to side movement of the blades caused by minor wind direction changes) is also known to increase wake interference.

Transmission of Energy Pulses

1. Information on the different attenuative and penetrative properties of infrasound and audible sound are discussed above.
2. Topography, wind speed, wind direction, wind shear, and ambient temperature will also have an impact on noise emissions and how that sound travels.

Noise Guidelines for Turbines

1. Many acoustic consultants and senior acousticians have known that wind turbines produce pulsatile ILFN as the blades pass the tower. It was common knowledge, in the 1980's, from research conducted by Dr Neil Kelley¹⁵ and NASA researchers such as Harvey Hubbard¹⁶ that the

¹² <http://waubrafoundation.org.au/resources/shepherd-k-hubbard-h-noise-radiation-characteristics-westinghouse-wwg-0600-wind-turbine-generator/>

¹³ <http://www.windturbinesyndrome.com/2011/wind-farm-operators-are-going-to-have-to-space-turbines-farther-apart-johns-hopkins-univ-researcher/>

¹⁴ <http://waubrafoundation.org.au/resources/shepherd-k-hubbard-h-noise-radiation-characteristics-westinghouse-wwg-0600-wind-turbine-generator/>

¹⁵ <http://waubrafoundation.org.au/resources/kelley-et-al-methodology-for-assessment-wind-turbine-noise-generation-1982/>

¹⁶ <http://waubrafoundation.org.au/resources/hubbard-h-1982-noise-induced-house-vibrations-human-perception/>

pulsatile infrasound generated by a single downwind bladed wind turbine and other sources of ILFN such as military aircraft and gas fired turbines penetrated buildings, amplified and resonated inside the building structures, and that directly caused “annoyance” symptoms including repetitive sleep disturbance.¹⁷

2. Long term sleep disturbance and chronic stress symptoms (accepted as “annoyance” symptoms), are well known to medical practitioners and clinical researchers to damage human health. Dr Kelley was quoted in 2013 as advising that the conclusions from his research in the 1980’s were equally relevant to modern turbine designs,¹⁸ and this seems to have been confirmed in the preliminary results of acoustic measurements commissioned by Pacific Hydro and conducted by acoustician Steven Cooper at the Cape Bridgewater (Victoria) development.¹⁹
3. The NZ and Australian Noise Standards for wind projects were written by the then uninformed planning authorities. They were based on the UK ETSU 97, also an

uninformed document.^{20, 21}

4. Despite information being available from the Kelley research in 1985 specifying recommended exposure levels of ILFN which should not be exceeded,²² the respective **Australian guidelines only specified limits for audible, filtered, sound levels expressed as dBA outside homes; so there are no recommended limits or requirements to forecast, or to measure, ILFN levels or vibration inside homes neighbouring wind projects.**
5. Permitted sound levels across most Australian States for all industrial equipment are background noise levels plus 5dBA or 35dBA whichever is the **minimum**, whereas for wind turbines they are background plus 5dBA or 40dBA whichever is the **maximum**. There is no scientific evidence or reason for this difference. An increase of 5dBA represents an approximate doubling of the sound level. Most rural environments have a background noise level of 18dBA to 25dBA, approximately averaging 22dBA at night. **This represents a huge increase in audible sound.** Increases of 10 dBA at night are long known

¹⁷ <http://waubrafoundation.org.au/2013/explicit-warning-notice/>

¹⁸ <http://waubrafoundation.org.au/resources/lloydg-newer-wind-turbines-could-be-just-as-harmful-as-prototypes/>

¹⁹ <http://www.pacifichydro.com.au/english/our-communities/communities/cape-bridgewater-acoustic-testing-presentation/?language=en>

²⁰ <http://waubrafoundation.org.au/resources/cox-unwin-sherwin-where-etsu-silent-wind-turbine-noise/>

²¹ <http://waubrafoundation.org.au/resources/turnbull-c-turner-j-recent-developments-wind-farm-noise-australia/>

²² <http://waubrafoundation.org.au/resources/kelley-et-al-1985-acoustic-noise-associated-with-mod-1-wind-turbine/>

by acoustic consultants to raise complaints, and increases of 15 to 20 dB are associated with widespread complaints and legal action. Averaging measured levels of sound across too wide frequency bands also allows the hiding of sound pressure (level) peaks to which the ear responds, understating the true extent of facility noise emission levels.

6. WHO (World Health Organisation) Night Noise Guidelines for Europe quoted the 1999 WHO Community Noise Guidelines ***“If negative effects on sleep are to be avoided the equivalent sound pressure level should not exceed 30 dBA indoors for continuous noise”***.²³ Cities have a higher background noise than country areas. Denmark limits indoor noise from industrial sources, including wind turbines, to a maximum of 20 dBA at night.²⁴
7. The currently permitted outdoor noise level in NZ and some Australian states has been ameliorated somewhat by the addition of a deduction of 5dBA from the 40dBA limit to allow for

²³ <http://waubrafoundation.org.au/resources/who-night-noise-guidelines-for-europe/> see p 110 for background to 30dBA inside bedrooms – sourced from the 1999 WHO Community Noise document which can be accessed at

<http://waubrafoundation.org.au/resources/who-guidelines-for-community-noise-2/>

²⁴ <http://waubrafoundation.org.au/resources/sa-epa-resonate-infrasound-levels-near-windfarms-other-environments/> see page 9 for the Danish LFN criteria indoors overnight

especially quiet environments.

8. History has shown that these Australian guidelines were based on ETSU 97 from the UK, and were expressly designed to encourage development of the wind industry, **not to protect the health of rural residents from wind turbine noise**. Predictably, because the Kelley criteria limiting exposure to impulsive ILFN were ignored,²⁵ these guidelines have turned out to be completely unsafe.
9. **It is therefore necessary to predict and measure sound pressure levels across the full spectrum of frequencies in order to predict and control sound energy impacts on project neighbours.**

Compliance with Permitted Noise Conditions

There are several problems associated with validating compliance.

1. Compliance is generally carried out by an acoustician or acoustics consultancy, paid directly by the owner or operator of the project. In one case a wind turbine manufacturer has contracted the acousticians directly, making the results even more questionable.
2. Compliance is of utmost importance to all parties with a financial interest in the development, but it is critical

²⁵ <http://waubrafoundation.org.au/2013/explicit-warning-notice/> see footnote number 10

to families that neighbour the projects.

3. There are many ways that data measurements can be rigged (faux compliance): measuring instruments placed under trees or too close to buildings; waiting for optimum weather and wind conditions; not measuring for long enough continuously, recording in octave bands that are too broad and other averaging techniques. Operators may also reduce operational noise by reducing power output (with blade angle changes and slowed rotation) to reduce the noise during the monitoring period. Operators may also refuse to provide wind turbine facility operating data from test periods, claiming that it is 'commercial in confidence', thus making it impossible to verify actual operating conditions.
4. **It would therefore be both appropriate and necessary for all projects to have their compliance independently audited.**
5. **Sufferers will not escape disturbance to their sleep and damage to their health, even if a project is properly compliant with its permit conditions and noise guidelines, as preliminary findings of the acoustic survey commissioned by Pacific Hydro, conducted by Steven Cooper, have**

recently demonstrated. ²⁶

6. A compliant project may still cause damage to neighbours for numerous reasons. First, **the standard only refers to dBA** and thereby omits reference to ILFN; and secondly, even with regard to audible noise, the standard **refers to a maximum of 40 dBA outdoors, whereas every other form of industrial or other noise in country and city is limited to 35 dBA maximum.** There is no technical basis for such an aberration, and it is clearly, (intended or not), discriminatory. Thirdly, **in quiet rural environments, even 35 dBA will be intrusive and loud, if the background level is below 25dBA, which is not uncommon.** The ear responds to the peaks of sound levels, not the averages. The wind turbine noise standards all refer only to averages, and exclude ILFN, and do not account for the human response, so cannot protect people from predictable serious harm to their health.

²⁶ <http://www.pacifichydro.com.au/english/our-communities/communities/cape-bridgewater-acoustic-testing-presentation/?language=en>

Wind Turbine Separation Distances Matter

June 2014

Summary

Siting wind turbines too close together has a number of predictable consequences resulting from the turbulent nature of the air exiting turbines and entering adjacent turbines. The consequences include:

- increased wear on the turbine components, ultimately increasing early failure rates;
- increased audible noise;
- increased infrasound and low frequency noise.

These predictable and long known consequences of placing turbines too close are frequently ignored by both wind turbine manufacturers and developers; particularly if they are operating in a country with systemic regulatory failure of the wind industry, such as Australia.

Evidence is that the manufacturer-recommended separation distances of 7 to 8 rotor diameters for turbines in line with the prevailing wind and 5 rotor diameters for turbines abreast, still allows turbulent air exiting one turbine to retain significant turbulence when entering the next; so the manufacturers' recommended spacings can be considered as an unfortunate compromise and inadequate to contain noise.

The most efficient turbine spacing, i.e., that which allows the turbines to economically extract the most energy from the wind, has been shown to be

some 15 rotor diameters. Most efficient extraction of useful energy will approximately coincide with the least production of waste energy, namely sound and vibration.

The Waubra Foundation currently considers that for a block of turbines that is likely to be subject to changing wind directions, noise will be minimised if the turbine spacing in all directions approaches the most efficient spacing of about 15 rotor diameters.

The way renewable energy subsidies work in Australia almost certainly rewards spacing below the most economically (without subsidies) efficient. Clearly this is beneficial to both developers and manufacturers, but damaging to residents.

Financial modelling, with and without subsidies, and acoustic measurements of wind projects with significantly different turbine separation distances, would be useful.

Noise guidelines in Australia and in other jurisdictions fail to address turbine spacing, but should include some minimum specification levels.

Specifically the closer the spacing the greater noise and vibration effects on project neighbours. These include repetitive sleep disturbance; physiological stress; symptoms and sensations called "annoyance"; greater impairment of their quality of life; plus destruction of amenity; reduction in property values, and occasionally bushfires and "component liberation" (windspeak for disintegration) resulting from catastrophic turbine failure.

Increased Turbine Wear

Wind turbines are not designed to run continuously on turbulent air. Doing so results in additional load on, and vibration of, bearings, brakes and rotating parts and ultimately breakages, fires and, catastrophic failure. The

useful life of a turbine is thereby shortened as a result of turbines being too close.

There are public safety consequences from the increased risk of catastrophic failure, which can include nacelle fires scattering burning material, disintegration of rotating parts and blades, flying debris and bushfires. There have been three such wind turbine fires in Australia, at Cathedral Rocks (Acciona), Lake Bonney, (Infigen) and Starfish Hill at Cape Jervis (Transfield/Ratch), all in South Australia.

At Starfish Hill, Cape Jervis, the turbine air brakes failed, resulting in the turbine spinning out of control for days. This eventually resulted in wind turbine “component liberation” with 20kg metal brake components flying off the spinning turbine, subsequently found within metres of one of the surrounding homes, some 400 metres away from the turbine base.

For a comprehensive list of turbine failures see: www.caithnesswindfarms.co.uk Whilst all these failures are, by definition, mechanical and premature, it is quite possible that excessive turbulent air inflow played a part .

Consequences of Increased Wind Turbine Acoustic Emissions

Turbines subject to turbulent inflow produce less power and more waste energy in the form of airborne pressure waves (sound) and ground-borne pressure waves (vibration or seismic vibrations). The increased sound energy will be expressed as an elevation of the sound level (effectively loudness in the audible sound range) across all the frequencies composing the signature sound output from wind turbines.

Consequences for the neighbours are, as one would expect, worsened symptoms such as **sleep disturbance**, an **impaired quality of life** and an increase in “**annoyance**,” symptoms well identified in the field work of the Waubra Foundation and others, and identified in the limited research literature and confirmed by the recent Australian National Health and Medical

Research Council (“NHMRC”) 2014 Draft Information Paper “Evidence on Wind Farms and Human Health”, (2014) (Pages 11 and 14)

Vigorous and repetitive denial and dissembling by the industry about the cause of the symptoms demonstrated by wind turbine neighbours has managed, quite surprisingly, to maintain doubt in certain, (not particularly scientific), quarters about causality.

Definitive research omitted by the NHMRC Systematic Literature Review, which enabled the reviewers to collectively but erroneously assert there was no evidence of direct causation of symptoms from wind turbine noise, is detailed in the Waubra Foundation’s critique of the NHMRC draft statement at:

<http://waubrafoundation.org.au/resources/waubra-foundation-open-letter-nhmrc-re-systematic-literature-review/>

The omitted research headed by Dr Neil Kelley was funded by the US Department of Energy, and involved two branches of NASA and some fifteen different research institutions. **Direct causation of the “annoyance” symptoms and sensations by impulsive wind turbine generated infrasound and low frequency noise, which then resonated inside some homes, was identified by Dr Neil Kelley’s teams’ acoustic field research, and subsequently confirmed with laboratory research.** The 1987 laboratory research was presented at the Windpower Conference in 1987, attended by US and international wind companies.

This Kelley research resulted in a dramatic change in wind turbine design, from downwind bladed to upwind bladed turbines, to try and reduce the generation of these health-damaging frequencies. However in 1989, NASA researchers Shepherd and Hubbard showed that contrary to their expectations, significant levels of ILFN could also be generated by upwind-bladed wind turbines, **when the inflowing air was turbulent.**

<http://waubrafoundation.org.au/resources/shepherd-k-hubbard-h-noise-radiation-characteristics-westinghouse-wwg-0600-wind-turbine-generator/>

This is precisely what happens when turbines are sited too close together.

The omission of the Kelley/Hubbard research by the NHMRC is a demonstration of the limits of literature studies. The research has been well known but “forgotten” by the wind industry for nearly thirty years. However it was sent to the NHMRC on being “rediscovered” in July 2013.

What Is the Optimum Turbine Separation Distance for Cost Efficient Power Generation?

Scientists from the USA (Meneveau, Johns Hopkins Fluid Mechanics and turbulence expert) and Belgium (Meyers, Katholieke Universiteit Leuven) recommended in 2011 **that 15 rotor diameters was the optimal turbine separation distance in order to maximise cost efficient power generation**. Their new research took into account interaction of arrays of wind turbines with the atmospheric wind flow.

<http://www.theengineer.co.uk/video/wind-turbines-need-to-be-farther-apart-suggests-study/1007037.article>

What Turbine Separation Distances Are Supported by the Scientific Evidence?

Researchers from Adelaide University have recently established that turbine blade tip vortices have only just started to be broken down at 7 rotor diameters, (at a wind speed of 10 metres/second) providing independent scientific empirical support for adopting a minimum of 7 rotor diameters as a separation distance.

<https://www.adelaide.edu.au/imer/news/newsletter/2013/using-wakes.html>

What Turbine Separation Distances Have Been Generally Accepted?

Accepted turbine separation distances in the industry have generally been 5 – 8 rotor diameters. For example, the NSW government

Wind Farm Planning Handbook from 2002, developed in conjunction with the wind industry stated (p53):

“A wind-farm layout must take into account that turbines have substantial ‘wakes’, which interfere with each other depending on wind direction and spacing. The general rule of thumb for spacing (the ‘5r-8r rule’ is five times rotor diameter abreast and eight times rotor diameter downwind.. On very directional sites the ‘abreast spacing’ can be decreased by around 15 per cent, but the down-wind spacing is not as variable. Layout geometry can be primarily driven by the need to follow narrow ridgelines or to align arrays across the prevailing wind. On more complex terrain, individual sites need to be carefully evaluated to make best use of the wind resource, so the spacing may be quite variable.”

The Waubra Foundation does not consider the generally accepted industrial practice as optimal. At this stage the Foundation is of the opinion that blocks of turbines in a location where winds are variable in direction should be a minimum of 8 rotor diameters apart in all directions. To further control turbulence of entering wind it would be advisable to approach the economic spacing of 15 rotor diameters indicated by Meneveau which indicates the turbine is operating at its most efficient and will thereby be producing the least noise.

Why Are Turbine Separation Recommendations Ignored?

Turbine manufacturers are clearly keen to maximise their sales, and developers are equally keen to maximise the subsidies they are paid – in Australia called Renewable Energy Certificates. There is a clear financial incentive on both to site the maximum possible number of wind turbines in a given area. Noise predictions used for planning approvals do not generally feature adjustments for turbine placements closer than manufacturers’ recommendations.

Acoustic Engineering Investigation into Airborne Pressure Pulses from Wind Turbines at Cape Bridgewater

A Professional Explanation of a Complicated Matter
March 2015

1. What the Reader Needs to Know Before Getting Started

- Wind turbines create “waste energy” in the form of airborne pressure waves (*sound*) and ground-borne pressure waves (*vibration*).
- *Noise* is that part of the sound frequency spectrum which is audible.
- The *strength* (sometimes expressed as a loudness in the case of noise) of the sound is measured in decibels (“dB”).
- The wave length of the sound pressure waves is the distance between the peaks of the pressure waves. The number of peaks per second is the *frequency* of the sound and is expressed as hertz.
- Where the frequency of the sound waves is below 20 hertz, the distance between the waves is relatively long, and the general term for this portion of the frequency spectrum is known as *infrasound*. Infrasound is only audible at very high levels. However it can be damaging to the human body at levels well below audibility. Generally infrasound is considered as inaudible.
- Infrasound has long been known to be dangerous and harmful to humans, especially with chronic exposure. Infrasound persists for much greater distances than audible sound and, unlike audible sound, penetrates virtually all building structures (including double glazing) with ease; and often increases the impact by resonating with internal structures in the house.
- Standards in Australia for wind turbine noise are set in audible decibels (“dBA”) outside houses. The standards do not require infrasound (either within or without dwellings) to be predicted and considered in planning submissions nor to be measured in the required compliance testing for the planning permit noise conditions.
- Wind turbines produce infrasound along with audible noise. *The larger the turbine the larger the proportion of infrasound*. Most turbines are now 3 MW or 3.5 MW, compared to 2 MW at Cape Bridgewater where wind turbine infrasound has been identified at dangerous levels inside homes.
- Placing turbines closer together than the manufacturers’ recommended separation distances causes the exiting turbulent wind from one turbine

to enter nearby turbines. Turbines are designed to extract energy from wind in streamline flow; dealing with incoming turbulent flow increases the percentage of infrasound and places greater mechanical stress on the turbines.

- By the use of different sound meters and by measuring sound in narrow (frequency) bands it is quite possible to isolate and measure infrasound from wind turbines.
- Substantial numbers of residents living in once quiet environments and now living within 10km of turbines, have suffered, and are still suffering, severe impacts since the turbines started operating. Many have left their homes to live in greatly diminished circumstances, as their houses are no longer habitable or saleable. Some become unable to work or study
- Wind projects involve very large sums of money in construction, in revenues and in public subsidies. It is not uncommon to find companies with large investments and large cash flows going to great and even improper lengths to maintain their cash flows.
- The wind industry has never been asked to prove that their machines are safe. When queries are raised about impacts on neighbours, the industry and its acolytes trigger the “Four Ds” of denial, dissemble, delay and destroy (the messenger).

2. The Purpose of the Investigation

The purpose of the Cape Bridgewater investigation was simply to find out what was causing the symptoms and sensations resulting in sleep disturbance and health damage reported by the residents of three houses to the operator in the period 2009 to 2014. The houses are sited between 600 and 1600 metres from the wind turbines of the Cape Bridgewater Wind Project.

3. What Are the Key Findings of the Cooper Investigation?

The findings include:

- Noise measurements in dBA represent audible sound only; and do not include any measurement of infrasound. However by using sound meters that can measure infrasound and recording the infrasound levels in narrow (one tenth of an octave) frequency bands *it was clear that infrasound was present in the three homes.*
- *Wind turbines emit a recognisable and repeatable sound signature* (or profile), being the relationship between power level in dB and frequency across the full frequency spectrum. Further *this signature, whilst it contains significant energy in the infrasound range, is in no way comparable to other sources of infrasound* such as waves on the beach, other fast rotating machinery, refrigerators, trains, road traffic, etc. as

claimed by wind industry “experts” and sundry acolytes. The signature is now identified as dB(WTS).

This discovered profile does not need further research. It has been independently documented by other acousticians and is now a necessary tool for investigating noise from wind turbines anywhere.

- The intensity of the infrasound levels inside the houses varied between and within rooms (probably due to resonance), *but was often present at levels known to be dangerous to humans and to trigger the flight response.*

A potentially causative energy problem is identified in each of the three houses.

- It was determined from early testing that recording of impacts solely by the previously used parameters of noise and vibration was not enough. *A third impact being “sensation” needed to be added to cover, as it transpired, the reaction of the body to infrasound.*

Diaries used by the South Australian EPA at the Waterloo project, which did not include sensation, were not competent to produce the necessary evidence. The EPA’s conclusions in that study were wrong and therefore irrelevant.

The form of the Cape Bridgewater diaries must be the minimum standard for future investigations.

- Since measurements in dBA and predictive noise models for turbines being expressed in dBA *exclude infrasound*, it follows that *dBA is useless as a proxy for predicting damage on neighbours, or for setting standards to protect them from harm.* Even before Cooper’s investigation the noise standards were known to be useless. *Responsible authorities should have altered the standards to include sound as a whole and infrasound in particular. Cooper’s work reinforces the need for urgent revision.*

These standards must never be used again. They are both meaningless and dangerous.

- Methods of measuring wind turbine sound must: utilise instruments able to monitor the whole spectrum of sound; be undertaken inside houses; produce results in narrow bands, not one third octaves as is standard; and continue over sufficient periods of time, say six weeks or more, to cover most if not all environmental conditions (wind speed and direction etc.).

Meaningful investigations of sound should be required at all homes where there has been a history of complaints to demonstrate how widespread are the impact of wind turbines on the habitability of the houses involved and the impact on the life and health of the inhabitants.

- Changes in wind speed, wind direction, turbine start up and operating at near shutdown speed coincided with sensations being at the highest level (which was characterised as a compulsive need to flee the house).

Causality established. Goodbye to nocebo nonsense.

Without any argument the investigation showed that the six residents in the three houses were subject to wind turbine derived infrasound in the 4 to 5 hertz range at levels known to be dangerous; and that all of the residents were severely impacted.

4. **Commentary**

With better instruments, more reliable and useful diaries, plus six weeks of data and the opportunity to measure sound when the turbines were shut down, this investigation was geared to find the truth whatever it may be.

A number of lesser studies exist that do not reach the conclusions above. They evidence signs of intellectual corruption and/or ineptitude and/or of being designed to find no problems. These studies thereby shield the flow of cash to wind project owners, whilst holding off the liability for supposedly expert, but incorrect opinions, delivered by acousticians on behalf of project operators and of companies seeking planning permits.

The wind turbine product defence team are spinning their wheels trying to fault the Cooper investigation. A guide to understanding the key claims of the wind turbine defence cabal follow.

a) Misrepresenting an engineering investigation as an all embracing academic research project.

This was an investigation into why these three houses were virtually uninhabitable. The answer was found and the cause established. Evidence of court quality has been established.

b) No Peer Review

This objection is actually irrelevant for a limited engineering investigation. Unlike the academic world, engineers do not seek, or need, peer reviews; despite this, favourable and supportive comments have been flowing in to Cooper from the more intelligent and scientifically curious acousticians around the world.

Engineers seek a repeatable result. Peer reviews are by their nature subjective. The way a repeatable result is sought includes: checking the suitability and location of the instruments, then painstakingly calibrating them before measurements start. The calibration and measurement processes are repeated ad nauseum *until it is clear, without out any doubt, that the results are repeatable; and cover most conditions.*

c) No Control Group

One struggles to find practical and useful application of this concept in this investigation. Measurements with turbines locked down is certainly a useful control style comparison.

d) Sample Size

This was an investigation into three houses. Each house was investigated, and the findings correlated between houses. Sample size was fixed.

If others want to extend the conclusions to other houses or wind projects, or if the industry is required to prove that the results cannot be extrapolated, then such others should arrange for funding and repeat the measurements elsewhere. With one caveat: use the proper instruments, diaries and methods as established by Cooper's work (unless of course the purpose is to overturn the truth).

e) Can the Results be Extrapolated?

Here it is necessary to consider probabilities. The relevant inputs are:

- modern turbines produce infrasound;
- infrasound can and does cause serious impacts on humans;
- infrasound from wind turbines penetrates houses at distances of at least 8km and up to 10km from turbines;
- multiple house abandonments at multiple wind projects have taken place because of owners suffering symptoms associated with proximity to turbines;
- nearly every wind project with turbines of 1.5MW or more have generated complaints from residents;
- no owner of a wind project has heretofore sought to arrange or support thorough field research into health impacts.

The answer is: *where there are or have been multiple complaints by residents, there is a very high probability of infrasound at dangerous levels being present inside that home and being the cause of the complaints.*

Note: an earlier draft of this document was used by the Waubra Foundation in the preparation of a broader document posted at:

<http://waubrafoundation.org.au/resources/acoustic-engineering-investigation-at-cape-bridgewater-wind-facility/>

Management of Sound Emissions from Wind Turbines

Existing Regulations

The current Noise Guidelines (“Regulations”) for wind turbine noise pollution set by the States never have, and never will, **provide a safe sleeping, living, or working environment** for many of those living near wind projects.

The Regulations fail because they focus on a weighted average (dBA) of audible sound (commonly labelled ‘noise’) and completely ignore the largely inaudible sound produced by the turbines in the infrasound or low frequency sound (together ILFN) range.

Information that wind turbines produce impulsive ILFN was available in the 1980s from work done by NASA affiliated researchers in the USA, led by Dr Neil Kelley, and has been reaffirmed in more recent work in the USA, Australia, Canada, the UK, Russia and elsewhere.

It has long been known that infrasound can be extremely dangerous at certain combinations of power and frequency and that ongoing exposure to ILFN can induce rising sensitivity in some people thereby progressively increasing their symptoms.

It has always been true that sound emitted by wind turbines significantly and cruelly impacts far too many neighbours. Steven Cooper’s excellent investigation of the problem at Cape Bridgewater has verified and extended the known technical information identifying and explaining this problem.

We now have sufficient understanding of the deficiencies of the present Regulations to reinforce the claims that the present Regulations are dangerous and unsafe, and how to replace them with regulations that are far safer.

Sound Limits For Wind Turbine Projects

This document (Appendix 7) creates the basis for the urgently needed new regulations.

There will be considerable reaction to these changes from the wind industry and its acolytes (many of whom hold relevant positions in governments and bureaucracies). However that industry have known for some twenty five years that there was a major health impact but have fought remarkably successful campaigns to maintain their cash flows by denying and evading the problem of sound emissions, and by ignoring suggestions that the industry should have to demonstrate the safety of their machines.

Neither this industry, nor any other, has the right, or social licence, to harm its neighbours from excessive noise pollution. Only the Federal government can protect country people from the depredations of this industry.

Compliance Testing

Whilst proving compliance to incompetent regulations protects no-one, there is of course a need for compliance testing to safe regulations and specific permit conditions in order to protect neighbours.

Unsafe regulations are not the only problem with determining compliance. The second problem is that there is no defined protocol that must be followed in determining compliance.

A third problem is the lack of transparency in the current process of compliance testing. The requirement to undertake measurements inside homes requires consultation and cooperation with both the wind farm operator and the residents reporting noise nuisance.

The fourth problem is the lack of mandatory provision of wind farm data to independent acoustic investigators to ascertain the hub height wind speed, the operating mode of the turbines and the

power output of the turbines.

The absence of protocols for compliance testing has led to serious doubts about some claims of compliance. In order to build confidence in compliance, specific protocols need to be drafted for this process.

Rigorous compliance to a new, simple standard for sound pressure suggested above will lead to minimising and hopefully eliminating adverse health impacts.

Credible compliance is also clearly relevant in protecting the public from subsidising non-complaint projects.

Weak or sham compliance is not identified or investigated by the Clean Energy Regulator (CER), which is responsible for issuing Renewable Energy Credits (RECs) for projects that meet “all state and federal” requirements. **Clearly the CER needs better direction in this matter.**

Appendix 8 **Compliance Testing Protocol For Wind Turbines** provides further information.

Sound Limits For Wind Turbine Projects

1. The Purpose

The purpose of the Sound Guidelines and/or Regulations (hereinafter the Regulations) is to protect the basic right of citizens to continue to live and sleep in their houses without encountering disturbing and dangerous physiological and psychological impacts and mounting health problems (formerly inadequately classified as annoyance or nuisance), from sound emissions emitted by wind turbines.

2. Units of Sound and Measurement

The unit of sound to be used is decibels (dB).

The project sound profile (dB plotted against frequency of the sound emitted) is to be forecast and measured across the full spectrum of frequency from 0.1Hz to 20kHz, thereby including infrasound and low frequency sound (ILFN) and audible sound where relevant.

Please excuse the quite technical language in the following three paragraphs.

The prediction/measurement of sound levels is to incorporate the dBA parameter (indoors and outdoors) for audible sound (with adjustments for special characteristics), the Danish dBA_{LF} for the low frequency components indoors and the indoor L(S-WT) to signify the wind turbine signature.

Audible sound must be forecast, measured and presented in 1/3 octaves over the audible frequency range, 1/12 octave bands over the low frequency range and narrow band (FFT) minimum 400 lines for the infrasound region. Whilst the 1/3 and 1/12 octave band data may be presented as rms Leq levels over 10 minutes, the narrow band results should be presented as PSD values to permit comparison of different bandwidths/number of lines.

Sound forecasts are to be **turbine specific**, i.e., to turbine rated capacity, turbine model and manufacturer.

If the permit holder wishes to change capacity or model to those previously approved in a project permit, then the **sound forecasts must be reworked and the layout adjusted to meet the maximum allowable ILFN sound inside houses**. Any such proposed changes and the reworking of the sound contours must be made public and local residents allowed 90 days to engage an independent acoustician and to receive his or her advice on the impact of the changes sought.

3. Sound Limit

The **maximum permissible level of sound** inside nearby houses, workplaces and public buildings is not to exceed $L(S-WT)$ **45dB** or 20 dBA_{LF} indoors or background + 5 dB(A) outdoors at wind speeds equal to 70% to 100% of the maximum power output of the turbine.

In preparing sound estimates a permit applicant must make any allowances necessary for sound peaks likely to occur when:

- a) blade adjustments are made to enable operation at or around the prescribed maximum wind speed;
- b) start-up of one or more turbines;
- c) sudden changes in wind direction.

In all cases the acoustician who provided the expert opinion on behalf of the permit applicant must personally sign off on the opinion; and where that person is part of a multi-professional practice, partnership or corporation, then the senior person in that entity must also sign off on the opinion.

Compliance Testing Protocol For Wind Turbines

1. Purpose

Compliance testing is to ensure that a wind project does not exceed 45dB L(S-WT) indoors, or 20 dBA_{LF} indoors or background + 5 dB(A) outdoors in any combination of wind speed and wind direction.

2. Independent Acoustician to Be Appointed

Unless or until there is a National Noise Pollution Regulatory Authority an independent acoustician(s) or acoustical practice (herein the investigator) is to be engaged to undertake the compliance testing. Under no circumstances is the same organisation or individual that provided opinions or expert advice at the planning permit hearings, or pre-construction noise predictions, to be engaged to undertake this work.

Whilst the owner of the wind project will be responsible for the investigator's costs, the investigator's appointment documents must clearly state that the investigator has an equal and separate responsibility to the neighbors for the accuracy of his findings; and that such findings and data will be made publically available.

In all cases an investigator who provides a compliance opinion must personally sign off on the opinion; and where that person is part of a multi-professional practice, partnership or corporation, then the senior person in that entity must also sign off on the opinion.

The reporting of noise from the wind farm must accord with the Uniform Civil Rules (or equivalent) so that the document can be automatically tendered in court with the required acknowledgment by the author(s) of the report that the report has been prepared in accordance with the relevant expert witness code of conduct.

3. Instruments

Sound levels for compliance are to be measured using instruments that can measure unweighted sound from 0.5 Hz hertz to 20 kHz and analyse the data in 1/3 octave bands across the audible range, 1/12 octave bands across the LF range and narrow band (FFT) over the infrasound range. The use of micro-barometers for the infrasound measurements is permitted.

4. Instrument Location

Whilst the turbine layout and the topography may indicate to the compliance investigator that certain buildings and workplaces are the most likely locations where the sound limit might be exceeded, the project operator will provide the investigator with copies of all noise complaints received. The investigator will then decide which houses and other places need investigation and will then seek permission from the occupants to place measuring equipment within their homes.

5. Timing

For projects of less than 30 turbines, compliance measurements must start within 60 days of commencing full operation.

For larger projects compliance testing shall commence within 60 days of the first 30 turbines being brought into operation and then repeated within 60 days of the whole project being completed, or, if the project is to be built in distinct stages, then 60 days after each stage becomes operational.

6. Duration

The testing must be of sufficient duration to investigate the conditions described in paragraph 3 of “Sound Limits for Wind Turbines”, and of the variation between night and day and atmospheric conditions.

7. Shutdown

The investigator may require one or more short shutdown periods where no turbines are operating to obtain information on background noise and confirm the narrow band signature for the subject turbines. The operator must comply with such requests.

If the proposal requires turbines to be operated in a certain mode, then normal operation and the different modes of operation relevant to the particulars when the modes are necessary, shall be included in the testing.

8. Compliance Check of Existing Projects

The fundamental purpose of a compliance check is to ensure that existing projects with wind turbines of 600 kW or greater capacity have actually been properly investigated before being deemed compliant to the guidelines existing at the time they received permits.

At the time of the compliance check, the investigator will also be required to investigate the levels of the wind turbine signature inside any house (hereinafter “limited habitability” houses) which residents thereof are reporting sleep and health impacts. Should the levels inside these houses exceed 45dB L(S-WT) then the houses will be reclassified as “unsafe”.

9. Remedies and Enforcement

If a **new project** is non-compliant to the new maximum sound levels it cannot be issued Renewable Energy Certificates (RECs) until it is rendered compliant. It is the owners’ responsibility to build a compliant project and to only operate that project in a compliant mode, and in a manner in which it does not cause a noise nuisance to neighbours. The issue of RECs may only commence when the project is considered compliant by the investigator and accepted as so by the CER.

If an existing project is checked and shown to be non-compliant to the previous maximum sound levels then it may not claim or receive RECs. The issue of RECs may be reinstated only when the project is returned to compliance and signed off as so by the investigator.

If an operator of a new or existing project wishes to challenge a declaration by the investigator that a project is non-compliant, then RECs will be suspended during the period of the challenge, but will be accumulated in case the challenge by the operator is successful, in which case the accumulated RECs will be issued to the operator.

In the case of a legal challenge the operator will be required to pay all reasonable technical and legal costs of the investigator unless the investigator is shown to have been negligent.

An Information Report Prepared for the Multi-Municipal Wind Turbine Working Group

Compiled by Keith Stelling, July 2015

A Summary

Page 5

The health risk of infrasound from wind turbines has been dismissed by the wind industry as insignificant.

That industry has maintained that since the typical loudness and frequency of wind turbine sound within a home is not audible, it cannot have any effect on human health.

Such observations fail to take appropriate account of the distinguishing signature of the sound from a wind turbine.

One recognisable pattern is of sharply rising and falling pulses in the infrasound range typically 0.75, 1.5, 2.25, 3.0 hertz and so on. At this frequency these pulses may be felt or sensed more than heard by ears.

Research by Dr Alec Salt and others has demonstrated that sub-audible infrasound does result in a physiological response from various systems within the body.

Page 6

We now know that sub-audible pulsating infrasound can be detected inside homes near wind turbines and up to 10 km distant.

We know that very low levels of infrasound and low frequency sound are registered by the nervous system of the body even though they cannot be heard.

The research cited in this report implicates these infrasonic pulsations as the cause of the most commonly reported sensations experienced by many people living close to wind turbines including chronic sleep disturbance, dizziness, tinnitus, heart palpitations, vibrations and pressure sensations in the head and chest, etc.

Similarly there is medical research which demonstrates that pulsating infrasound can be a direct cause of sleep disturbance.

In clinical medicine, chronic sleep interruption and deprivation is acknowledged as a trigger of serious health problems.

Page 9

The NASA investigation by Dr Neil Kelley and his colleagues established a link between turbine generated impulsive infrasound and low frequency noise and the symptoms reported by the residents.

Pages 9 to 12 - Dr Kelley's Findings

Wind turbines emit infrasound.

Wind turbine infrasound and low frequency noise is often sub-audible and is characteristically impulsive containing spikes or peaks and valleys.

Community annoyance included many saying that they could feel, more than hear the sounds (and also) spoke of repetitive sleep disturbance.

We (the study team) concluded the annoyance was real and not imagined.

Wind turbine disturbance is detected more inside houses than outside.

A-weighted measurements are not an adequate indicator of annoyance when low frequencies are dominant.

The acoustic pressure patterns radiated from large wind turbines have a definite structure as compared with the natural wind-induced background.

There is evidence that the strong resonances found in the acoustic pressure field within rooms actually measured, indicates a coupling of sub-audible energy to human body resonances at 5, 12 and 17-25 hertz resulting in a sensation of whole body vibration.

Page 13

For nearly three decades Kelley's work has been overlooked or intentionally side stepped.

Page 14

In a recent interview Dr Kelley re-confirmed the studies he conducted in the 1980s apply to the modern upwind turbines in use today. He challenged acousticians to install infrasound measurement instruments inside homes if they doubted his opinion.

Page 15

The wind industry has opposed all attempts to change standards to include the measurement of low frequency noise and infrasound or to set controls for low frequency noise and infrasound inside homes.

Pages 16 to 29

Detailed verification of Kelley's work by Malcolm Swinbanks; Rick James; the Falmouth, Massachusetts Study of 2011; Investigation of the Shirley, Wisconsin Wind Farm and Cooper's work at Cape Bridgewater and a note by Dr Paul Schomer on the Cape Bridgewater Report.

This whole body of work is infinitely more scientifically sound than assertions about nocebo, and the downgrading of victim affidavits and evidence by sufferers to the latest Senate Inquiry as anecdotal evidence, etc.

Pages 30 to 42

This section deals with “Medical evidence on chronic infrasound exposure.”

Pages 30 and 31 refer to the WHO report “Guidelines for Community Noise” and include statements expressing concern about the impacts of low frequency sound which coincide with the symptoms described by neighbours of wind turbine projects.

Page 32 refers to the 2003 DEFRA report “A Review of Published Research on Low Frequency Noise and its Effects” by Dr Geoff Leventhall et al which concludes by saying:

“there is no doubt that some humans exposed to infrasound experience abnormal ear, CNS, and resonance induced symptoms that are real and stressful”

Page 33 notes that Professor Hedge of Cornell University states that vibrations in the frequency of 0.5 to 80 hertz have significant effects on the human body and goes on to discuss resonance frequencies of different parts of the body and notes that:

“whole body vibration may create chronic stresses and sometimes even permanent damage to the affected organs or body parts.”

Pages 34 and 35 notes the work of Basner et al published in the Lancet in 2014 “Auditory and non auditory effects of noise on health” and an additional article “Cardiovascular effects of environmental noise exposure” published in the European Heart Journal and concludes:

“noise not only causes annoyance, sleep disturbance, or reductions in quality of life, but also contributes to a higher prevalence of the most important cardiovascular risk factor, arterial hypertension, and the incidence of cardiovascular diseases.”

Page 34 quotes from an article by Moller and Pedersen, acousticians at Aalborg University, Denmark, titled “Hearing at Low and Infrasonic Frequencies” which explains mechanisms and impacts.

Page 37 quotes from Bob Thorne an acoustician and a psycho-acoustician with considerable field experience in “Wind Farm Noise and Human Perception A Review”:

“The findings suggest that the individuals living near the wind farms of this study have a degraded Health-related Quality of Life through annoyance and sleep disruption and that their health is significantly and seriously adversely affected (harmed) by noise.”

and

“some individuals will more likely than not be so affected that there is a known risk of serious harm to health.”

Pages 38 to 42 quote work and evidence by doctors Michael Nissenbaum and Chris Hanning which is supportive of conclusions reached by others, but is largely limited to relatively close distances from turbines.

In part, Dr Hanning said under oath;

“the only study of wind turbine noise and well being which does not demonstrate harm is that of Mroczek which included subjects not exposed to turbine noise and the conclusions are not justified by the data. Every other study shows harm.”

and goes on:

“there is no single, well conducted, controlled and reliable piece of original research which shows that wind turbines do not cause harm at the distances proposed here. Not one.”

Still under oath he states: with respect to causality:

“affected subjects improve when exposure ceases and relapse when exposure restarts. This is prima facie evidence of causality. The studies of Pedersen as well as those of Nissenbaum and Bigelow show a clear dose-response relationship. This too is prima facie evidence of causality.”

Pages 42 and 43 present Stelling’s Conclusions repeated here in full:

Based on the information presented above, infrasound generated by wind turbines must be considered a potential direct cause of the adverse health reactions widely reported from wind turbine host communities.

Now that so many indicators point to infrasound as a potential agent of adverse health effects, it is critical to re-examine the approach to this aspect of wind turbine operation, revise regulations and immediately implement protective public health measures based on the precautionary principle.

(The only fault in this conclusion is the use, twice, of the adjective “potential.”)