Renewable Energy Consultation

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Context: We’ve lived on our farm at 188 Whites Road St Kitts for the past 46 years. When the application for approval for the Twin Creek Wind Farm was flagged we were prompted to investigate the implications for our business and our wellbeing.

1. Setback distances for rural dwellings
   The suggested setback distance of 1.2 km is manifestly inadequate. If this was based on advice from the EPA then the basis for such advice needs further examination. In our submission to SCAP regarding the Twin Creek wind farm we made reference to numerous scientific articles justifying such examination. These included –

(a) Wind Turbine Noise and Human Health: A Four-Decade History of Evidence that Wind Turbines Pose Risks by Jerry L. Punch and Richard R. James (October 2016)
   Five (of 12) conclusions were:
   (1) **Large wind turbines generate infrasound**, which is not normally experienced as sound by most human listeners. Some people, however, experience it in the form of pathological symptoms such as headache, dizziness, nausea, or motion sickness, which appear to be caused by the excitation of resonances inside closed structures and the human body itself.
   (2) **WTN (Wind Turbine Noise) has unique acoustic characteristics** when compared to other environmental noises. These characteristics include low-amplitude, amplitude-modulated, intermittent occurrences of tones that mirror the peak energy of the blade-pass frequency and the first several harmonics. The coupling mechanisms in the inner ear prevent internally generated sound, but not externally generated sound, from being perceived, which means that perception of wind turbine infrasound is far more disturbing than infrasound generated within the human body.
   (3) The scientific evidence regarding factors other than amplitude-modulated ILFN as an explanation for most of the health complaints near IWTs, including electromagnetic fields (dirty electricity), is weak; the preponderance of research suggests that ILFN (infrasound and low frequency noise) is the most viable explanation for such complaints.
   (4) The A-weighted decibel scale, which effectively excludes infrasound and substantial amounts of low-frequency noise, is inadequate to predict the level of outdoor or indoor infrasound, to reveal correlations to infrasound, or to show a definitive
relationship with AHEs, and achievement of these goals requires the development of new measurement methods.

(5) The available literature, which includes research reported by scientists and other reputable professionals in peer-reviewed journals, government documents, print and web-based media, and in scientific and professional papers presented at society meetings, is sufficient to establish a general causal link between a variety of commonly observed AHEs and noise emitted by IWTs.

(b) Special Noise Character in Noise from Wind Farms Valeri V. Lenchine; Jonathan Song SA Environment Protection Authority, Australia

...... Noise produced by wind farms may exhibit a multitude of different noise characters, ranging from amplitude modulation, tonality and low frequency noise. The presence of the noise characters is able to increase the annoyance factor caused by a noise source significantly.

...... The wind farm manufacturers may have to consider potential for low frequency impact of wind turbines and presence of prominent components at the design stage.

...... In spite of the fact that the overall noise levels met regulatory requirements, it is possible that people who have a higher sensitivity to the lower frequencies in particular may detect these characteristics, which may cause increased annoyance for those who have been aware of it for a prolonged period. Also, due to the very low A-weighted noise levels that were recorded during these events, it may be possible that listeners are more sensitive to frequencies between 30-50Hz.


...... In summary, this study is the first to demonstrate that infrasound near the hearing threshold may induce changes of neural activity across several brain regions, some of which are known to be involved in auditory processing, while others are regarded as key players in emotional and autonomic control.

(d) Physiological effects of wind turbine noise on sleep - Swedish Study 2016 By Michael G. Smith, Mikael Ögren, Pontus Thorsson, Eja Pedersen and Kerstin Persson Waye.

...... Exposures involved periods of different amplitude modulation strengths, the presence or absence of beats, different blade rotational periods, and outdoor LAeq,8h = 45 or 50 dB with indoor levels based on the windows being fully closed or slightly open.

Physiological measurements indicate that nights with low frequency band amplitude modulation and LAeq,8h = 45 dB, slightly open window (LAeq,8h = 33 dB indoors) impacted sleep the most. The presence of beats and strong amplitude modulation contributed to sleep disturbance, reflected by more electrophysiological awakenings, increased light sleep and wakefulness, and reduced REM and deep sleep.

(e) Are Wind Farms Too Close to Communities? Steven Cooper The Acoustic Group Pty Ltd, SYDNEY

...... Another issue is that wind turbines are getting bigger and more powerful over time. Measurements indicate stronger low frequency components from larger turbines.

...... It is by use of the linear relationship and narrow band analysis that the unique
spectral (frequency distribution) characteristics associated with turbines become evident. There are frequencies that occur below the range of sounds audible to the human ear, and are signals that are readily detected if one has the instrumentation capable of measuring down to such frequencies and measures in a linear format rather than A-weighted format.

...... The propagation characteristics of the infrasound measurements are entirely different to the general A-weighted propagation assumed for turbines.

...... Therefore in terms of acoustic criteria applicable to the low frequency and infrasound components associated with turbines the use of dB(A) is entirely inappropriate.

...... The recent research of Salt and Lichtenhan (2011) and Salt Kaltenbach (2011) as reported by Richard James has confirmed that there is physiological response to modulated infrasound at levels below the threshold of perception (for pure tones) that may start at amplitudes as low as 60dB(G).

...... When one considers the low frequency and infrasound noise and the reduced capacity of a building to attenuate such noise, then the issue of concern with respect to wind turbines becomes more of an indoor problem than an outdoor problem.

...... Therefore at the present point in time the separation distances that exist from wind farms, that are generally based upon a dB(A) noise level are clearly inadequate.


...... A repeatable and transparent method of predicting the expected sound pressure level was presented. A rigorous method of monitoring the actual sound conditions was described. This was used to conduct assessments at two different wind power developments with two different turbine types. Using the method it was possible to generate reproducible evidence of some of the special acoustical properties that are affecting quality of life. Thus it could verify that conditions identified by residents as troublesome do exist, when the current acceptance criterion was unable to detect problems.


...... Sound’s effects on human health are not only determined by its intensity, or amplitude, but also by its frequency and the rate of change in amplitude.

...... There is increasing evidence that Infrasound is perceived by the brain, and possibly by other sensory systems’ vibratory receptors, in the vestibular organ of balance, skin and joints, rather than by those transmitting auditory sensation. Another problem with noise in the lower registers is that it persists longer, travels further and, thanks to diffraction, can turn corners.

...... Wind farms emit noise, sometimes for days on end, and this is a problem because they are being constructed in rural areas where background noise is low. It is a particular problem at night, because Infrasound persists long after the higher frequencies have been dissipated.

...... The major adverse health effects caused by wind turbines seem to be due to sleep disturbance and deprivation, with the main culprits identified as loud noise in the auditory range and low frequency noise, particularly Infrasound. This is inaudible in the
conventional sense, and is propagated over large distances and penetrates the fabric of dwellings, where it may become amplified by resonance.

..... When a noise emits more infrasound and low frequency energy than usual, the use of A-weighted thresholds and measurements is not protective.

..... Persinger makes the point that naturally occurring infrasound, including that produced within our own bodies, is random, whereas wind turbine infrasound is pulsatile; and it is this quality which causes health problems.

..... The ETSU-R-97 recommendations were based on the turbines of the mid 1990s which had a hub-height of 32 m, whereas today’s turbines are several times taller with blades that are much longer and more flexible.

..... the noise emitted by a turbine increases with size. In fact, a doubling in turbine generating capacity from 1 MW to 2 MW may result in slightly more than a doubling of the overall A-weighted sound power level, that is, an increase of more than 3 dB.

..... Moreover, it was noted that while audible sound increased with increasing turbine size, the emission of low frequency sound was disproportionally greater. Shifting the acoustic energy into the lower frequencies renders A-weighted measurements and guidelines even less applicable.

..... Long-range measurements from two different wind farms over a distance of 80 km have shown that infrasound below 6 Hz has a propagation loss approximating to 3 dB per doubling of distance.

..... It would be perfectly feasible to mount an experiment, a randomized crossover trial, in which persons impacted by wind farm noise have their biomarker levels measured after standardized periods of exposure and non-exposure to wind turbine noise. In this way, each person would act as his or her own control. A well-devised trial could be of modest size, be cheap to conduct and deliver results relatively quickly.

..... It is essential that separation distances between human habitation and wind turbines are increased. There is an international consensus emerging for a separation distance of 2 km; indeed some countries are opting for 3 km and more.

(h) Propagation thresholds and measurement of infrasound to establish separation distances from wind farm turbines to residences. Bob Thorne Noise Measurement Services Pty Ltd, Australia

..... The attenuation of noise in dB follows the slope given by 20Log(R) where R corresponds to the distance between the sound source and the distance corresponding to the attenuation. Shepherd et al. state that the attenuation at very low frequencies would not be 6dB but only 3dB per distance doubling due to atmospheric refraction and channelling of sound in the lower atmosphere.

..... (The) result ... (is) ... for the frequency range to follow a slope for sound propagation ranging from 14.3 Log(R) for a day time sound propagation to 12.4 Log(R) when a temperature inversion occurs.

..... the threshold for oppressive feeling – annoyance is reported at 80dB and the threshold for physiological effect and pain is reported at 90dB. By taking the precautionary approach it would be expected the onset of such effects to be lower for a percentage of population. Figure ... 4 therefore show(s) the onset of the effect 5dB below the reported data

..... Figure 4 shows that the onset of annoyance for the frequency range from 20Hz to 30 Hz is expected to be about 75 dB and that for the given sound power level of 120 dB at
the corresponding frequency range and the corresponding propagation slopes, the 75 dB received level at those frequencies are expected between 1300m to 4400m. Using a similar approach the received sound pressure level of 85 dB linear at frequencies ranging from 20Hz to 30 Hz would intersect the propagation slopes for those frequencies at distances ranging from 280m to 750m. The distances of 280m to 750m would correspond to the expected onset of physiological effects.

Figure 4. Distance for which the threshold of annoyance and physiological effects threshold are anticipated for one wind turbine generating a source level of 120dB in the frequencies 20Hz to 30Hz.

Note that, in this graph, the yellow horizontal line (75 dB) represents the level of onset for annoyance. The green sloping line (12.4 LOG R) shows the reduction in sound intensity over distance in temperature inversion conditions. Where they intersect indicates the distance at which the onset of annoyance would occur. The horizontal scale is logarithmic and so not easy to read – but the intersection is at 4,400m. Similarly the intersection of the yellow horizontal line and the blue sloping line (14.3 LOG R) indicates the distance at which the onset of annoyance would occur under day time conditions (1,300m).

(i) www.masenv.co.uk/Den_Brook_AM_Condition

..... Following the discussion of the potential noise impact from amplitude modulation and excess amplitude noise at the proposed Den Brook Wind Farm, MAS sought to draft a condition which would allow approval of wind development whilst maintaining protection of residents’ amenity. Since its inception the Den Brook condition has been revised ..... 

..... The wind turbine shall not emit greater than expected amplitude modulation. Amplitude modulation is modulation of the level of broadband noise emitted by a turbine
at blade passing frequency. These will be deemed greater than expected if the following characteristics apply:

(1) A change in the measured LAeq 100 milliseconds turbine noise level of more than 3dB (represented as a rise and fall in sound energy levels each of more than 3dB) occurring within a 2 second period.

(2) The change identified in (a) above shall not occur less than 5 times in any one minute period provided that the LAeq, 1 minute turbine sound energy level for that minute is not below 28dB.

(3) The changes identified in (a) and (b) above shall not occur for fewer than 6 minutes in any hour. ..... 

(j) www.heaton harris.com/node/290
...... I am sponsoring the independent Noise Monitoring Group (INWG) to produce a Wind Turbine Amplitude Modulation (AM) & Planning Control Study.
...... DECC has appointed an external consultant to review the available evidence on AM, with a view to recommending how excessive AM might be controlled through a planning condition.
...... Excessive Amplitude Modulation (EAM) is a Significant Factor.
...... These noise components are not covered by the ETSU (Energy Technology Support Group from the Department for Environment Food and Rural Affairs) guidelines and we know of only one wind farm planning decision in the UK where a planning condition has been imposed for AM noise (Den Brook, Devon).
...... Wind Turbine Noise Adversely Affects Sleep and Health. It is abundantly clear from the evidence examined by a world renowned expert in sleep medicine working with the INWG that wind turbine noise adversely affects sleep and health at the setback distances and noise levels permitted by ETSU.
...... we recommend an effective AM planning condition should be part of every wind turbine planning approval unless there is clear evidence it is not needed.

(k) Wind Turbine Syndrome: The Impact of Wind Farms on Suicide - Eric Zou October 2017
...... Wind farm data are obtained from the U.S. Energy Information Administration’s form 860 (EIA-860). EIA-860 provides annual census of existing power generators larger than one megawatt (MW) in generation capacity, and it contains information on plant location, nameplate capacity, and month and year in which the new capacity came online. I define wind turbine installation events as entries of new capacities whose primary energy source is specified as wind. My baseline event study estimation includes a total of 828 installation events spanning 39 states in the United States from 2001 to 2013.

My primary outcome variable is the suicide rate at the county × month level from 2001 to 2013. This data come from the National Center for Health Statistics’ Vital Statistics Multiple Cause of Death Data File. Suicide rate is defined as the fraction of individuals in the county who died due to suicide (ICD 10 =X60-X84, Y87.0) relative to the county’s total population in the year. I also construct age-specific suicide rates using Vital Statistics data’s information on descendants’ age of death. Population estimates at both the county × year level and the county × year × age level are obtained from the National
Cancer Institute's Surveillance, Epidemiology, and End Results Program (SEER).
I derive wind data from the North American Regional Reanalysis (NARR) produced by the National Centers for Environmental Prediction, which contains information on wind conditions at a spatial resolution of 32km × 32 km grid cell. For each grid cell × day, NARR reports the horizontal (u-wind) and vertical (v-wind) components of the wind vector. I link each wind farm to the corresponding grid cell, and convert u- and v-wind into wind vectors (direction and speed) using trigonometry.

..... I find no significant changes in the suicide rate over the two years (which likely covers the entire construction period) before the turbines’ installation, followed by a prompt increase by about 2 percent in the month when new turbines began generating power. This effect stays relatively stable for the following year.

..... the suicide effect is explained mainly by days when residents spend downwind or upwind wind farms, while crosswind days are not predictive of the suicide effects. This is consistent with the “acoustic dipole” property that low-frequency noise typically exhibits: measured noise levels are higher at upwind and downwind locations while suppressed at crosswind locations (e.g., Hubbard and Shepherd, 1990; Oerlemands and Schepers, 2009).

2. “Amenity” considerations for rural dwellers

Isolated rural dwellings should have a higher level of visual amenity rights and setback distances from wind turbines than town dwellers.

(a) Town dwellers have elected for a higher “amenity” values with regard to –
- access to public transport
- the service of sealed roads
- proximity to health professionals and facilities
- proximity to educational institutions
- proximity to major cultural, entertainment and sporting facilities

(b) Isolated rural dwellers have foregone these “amenity” advantages in favour of –
- A quieter environment
- A longer horizon

Because there is less sound, any introduced sound causes more disturbance for isolated rural dwellers. Because wind turbines are generally situated on higher ground they will have a bigger impact on isolated rural dwellers (whose horizons are greater).

3. “Envisaged” & “supported” wind turbines

We believe the words “envisaged” and “supported”, with regard to wind turbines in the settled areas of the Rural Zone for Phase Two (Regional) and Phase Three (Urban), high value Agricultural areas, important biodiversity areas, and areas accommodating important environment features outside of zones aimed at conservation outcomes, should be removed. Each project should be assessed on its merits rather than a one size fits all, rubber stamped approach.
4. **Enforceable assessments versus informal advice from the EPA**

It seems that EPA assessments will provide enforceable “direction” rather than informal advice. Perhaps their assessments should have the same weight as those of other Governmental advisory bodies such as -

- the Department of Environment and Water
- Native Vegetation Council (NVC)/ Native Vegetation Assessment Panel (NVAP)
- Regional Landscape Boards
- Civil Aviation Safety Authority (CASA)
- Bureau of Meteorology (BOM)
- Department of Defence

Our observation would be that the EPA’s track record wouldn’t justify them having a greater weighting.

The Luke Pickering v. Christchurch City Council case (May, 2017) may also be relevant to this consideration. The court said that

i. “The experts advising the City Council and Windflow have assumed the adverse effect of noise is acceptable provided that the wind turbine complies with the guideline noise limits in the New Zealand Standard 6808. We disagreed. Whether the effect of noise below the guideline limits is adverse is sensitive to the receiving environment in which …. the noise is experienced.”

ii. “The Council did not appreciate that the New Zealand Standard is a guideline and instead relied on its expert’s advice that the effect of noise below the guideline levels in the Standard is always acceptable.”

iii. “restrictions on the hours of operation and ceasing operation of the turbine if verification measurements identified penalizable levels of amplitude modulation or tonality were an appropriate response”.

This seems to imply that it is the body or panel authorizing approval for a development which will be held responsible for any adverse consequences. Thus such a body should not be accepting “direction” from any advisory agency.

5. **Northern Mount Lofty Ranges**

We are particularly familiar with the ranges in the St Kitts area. According to the SA Department of Environment and Water these contain the largest contiguous areas of important native grasslands and Pygmy Blue Tongue Lizard populations in the State. Hence we consider them to be of conservation significance although not covered in the conservation overlays/zones. We seek their protection.

When the viticultural regions of the world were being specified and delineated in the 1980’s it became necessary to draw a line on a map which would be the northern boundary of the Barossa Valley. This was hastily drawn so that it was immediately to the north of the vineyards established at that time (significant vineyards now exist north of this line). Then in 2013, when legislation to establish the Barossa Conservation area was being drafted, this same norther boundary was hastily adopted. This meant that the St Kitts area, although culturally, historically and geographically part of the Barossa, was left out. This omission needs rectification.

Thank you for your consideration.

Miles & Andrea White