

Noise and Health Threats from Bango Wind Farm

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ABSTRACT

Multiple authoritative sources, including the NHMRC, researchers and well respected acousticians, have provided overwhelming evidence and arguments why wind farm noise levels and character are unpredictable and why wind farm noise modelling is inherently unreliable.

Consequently no reliability can be placed on the noise modelling submitted in this case and therefore the project should not be approved unless:

- there is permanent 24/7, full spectrum sound monitoring;
- at sufficient locations around the wind farm to provide a comprehensive history of noise impact at all residences within at least 10 kms; and
- with the complete data permanently available to the Department **AND** to all residents who believe they may be noise affected, and to their advisors.

Further, given NHMRC advice and actions indicates the possibility of adverse health effects (including recurrent sleep deprivation) it is essential that any consent conditions:

- draw explicit attention to the developer's obligations under the *NSW Work Health and Safety Act 2011 No 10 (WH&S Act)*;
- explicitly impose health protection obligations and conditions (including for sleep) such that Investor State Dispute Resolution (ISDS) provisions under any Australian trade agreement cannot be used to block or penalise the NSW Government for any subsequent actions it may take in relation to the wind farm to protect the health of NSW citizens or their animals.

If you use an erroneous scale to weigh an object, you will get a precise weight – but the weight will be wrong. The same is true with noise measurement and even more with noise modelling.

It is common in wind farm consultants' reports to claim they are using "best practice" and that their noise modelling is "conservative". Since these claims are clearly self serving they are of no evidentiary value. Just because someone claims they are handsome does not make it so.

Even if noise modellers honestly believed their results "conservative", that belief is based on the assumptions they are using, which are *assumptions*, not demonstrable facts. As industry reports and studies make clear, there are large numbers of embedded uncertainties behind each of those assumptions. And if the assumptions are wrong, then results may be far from accurate and far from *conservative*.

The Department can give no credence to any noise modelling beyond the certainty that ***it is wrong to some degree*** and the consultants have no way of knowing or demonstrating the limits on the errors in the modelling and thus how close it will be, in practice, to actual noise to which residents are subject.

Noise from a wind farm varies substantially over space and time, and so the noise levels and character at one location in the vicinity of a wind farm may be wholly unlike the noise levels and character at another location at the same time and wholly unlike the noise levels and character at the same location at another time. Thus the noise from a wind farm impacting on individual residents cannot be determined by measurements made at one time or at restricted locations near the wind farm.

Noise modelling is inaccurate and cannot be relied upon

The simple fact is all wind farm noise modelling is inaccurate – and there is plenty of authoritative published material demonstrating that is the case and also explaining why it is so.

In an *Information Paper*¹ reviewing possible health effects of wind farms, the NHMRC stated:

"Wind farm noise is complex and highly variable in character (e.g. tonality, frequency content and impulsivity). These characteristics and the duration of exposure influence the way in which wind farm noise is perceived. Perception is also influenced by characteristics of the person perceiving the noise — people who detect and recognise wind farm noise more easily may find it more annoying and people living in quiet environments may be more sensitive to low-frequency noise."

and

"The occurrence of amplitude modulation depends on a complex range of factors, including local atmospheric conditions, topography, turbine blade design and the way in which they are controlled. A particular turbine type may exhibit the effect in one site but not in another. The effect varies greatly with distance, wind direction and over time, including whether it is day or night time (it may be more common in the evening or night).

¹ *Information Paper: Evidence on Wind Farms and Human Health*, NHMRC, February 2015, pp. 15-16.

When multiple wind turbines are producing sound, the total sound pressure level at a particular location is affected by the sequence of the arrival of the sound (referred to as coherence). For example, if each of the turbines' blades are turning at the same time and are the same distance from the location, the sound from all the turbines would arrive at the same time, increasing the "loudness" of the sound. Amplitude modulation may be enhanced when this coherence effect occurs. However, if some turbines are further away or located at 180 degrees, there will be "cancellation" of some of the sound. These effects also vary depending on meteorological conditions, distance and location."

and

"It is not yet possible to predict the complex and highly variable characteristics of wind farm noise (e.g. amplitude modulation)."

Note that last quote from the NHMRC: ***"It is not yet possible to predict the complex and highly variable characteristics of wind farm noise (e.g. amplitude modulation)."***

If it is impossible to predict "the complex and highly variable characteristics of wind farm noise" then it is logically impossible to model them. Therefore, according to the NHMRC, the modelling for this proposal (and others) cannot be relied upon.

The rest of the above quotes from the NHMRC explain why noise measurements taken at one time (e.g. after commissioning) may be quite different from noise emissions at other times.

These claims are not unique to the NHMRC as is made clear in many chapters of the professionally well-regarded book *Wind Turbine Noise* edited by Bowdler and Leventhall. For instance:

"changing conditions generally cause the actual sound field to vary in both time and space. Thus the output of any environmental sound model will only represent a particular 'snapshot' in time and space of the range of actual environmental sound levels that could in practice occur."²

"The standard assumption adopted for wind farm assessments is that the sound power output of a wind turbine will be of a given level for any given hub height wind speed. This assumption is usually then extended to all wind turbines seeing the same wind speed at any given moment in time. In practice this is not the case as, in a multiple wind turbine installation, the wind conditions experienced by each individual turbine will generally be different at any given moment in time. Thus the input is, in most practical cases, not a single turbine emitting a known sound power but instead a number of turbines each emitting different sound powers whose characteristics are less certain."³

"Any environmental sound modelling exercise may be encumbered by the total uncertainty arising from potential uncertainty in all elements of the calculation chain. Any such uncertainty creates the risk that the sound model may produce 'inaccurate' results that incorrectly inform the assessment decision."⁴

² Andrew Bullmore and Andrew Peplow, "Sound Propagation from Wind Turbines", in Dick Bowdler and Geoff Leventhall (eds.), *Wind Turbine Noise*, Multi-Science Publishing Co. Ltd, 2011, p. 47.

³ Bullmore and Peplow, *op cit*, p. 50.

⁴ Bullmore and Peplow, *op cit*, p. 47.

“As a consequence of the foregoing, many approaches to environmental sound modelling have developed, each of which can lead to different numerical outcomes. This, in conjunction with the challenges of objectively rating inherently variable environmental sound fields, can create a significant risk of incorrect assessment outcome when using environmental sound predictions for decision making purposes.”⁵

Empirical evidence of noise modelling error

There is clear research evidence of the fallibility of “noise modelling”. A set of very significant factors come into play when applying such tools:

- Typically they have parameters you can vary when running the “model” (so which set of parameters is the “right” one?). Changing those parameters leads to substantially different predictions. For instance predictions using Cadna A can differ by 10dBA depending on which parameter assumptions available within Cadna A are used⁶. That could easily move predictions from being well within guidelines to well outside them. Indeed another comparison of a number of models for estimating the propagation of wind turbine noise found a differences ranging from 20dB at 500m to 30dB at 5000m⁷.
- The input data on noise output from each turbine, parameterised terrain details, assumptions about wind and other atmospheric characteristics, assumptions about where sound is produced by an individual wind turbine (they are not point sources), assumptions about interaction between turbines in the process of generating sound.

Modelling depends on simplifying abstractions. And simplifying abstractions, even if done with honest intentions, produce results different from reality.

The variations allowed in the modelling software together with the ability to adjust all the other input parameters in favourable ways allows enormous latitude to get the “right” results.

This combination of possibilities is why every sound model, and its forecasts, served up to justify a wind farm is something of a fiction. It is a complex mathematical fiction with a lot of computer computation behind it. But GIGO always prevails.

That is an explanation why you would expect wind farm sound models to be unreliable. The ultimate test is what happens in reality. What do we find when *independent*⁸ tests are done on operating wind farms?

Invariably we find that noise pollution occurs in excess of what the “modelling” claimed would be the case. In general, where “modelling” claimed each wind farm would comply with guidelines, independent monitoring shows they don’t⁹.

⁵ Bullmore and Peplow, *op cit*, p. 50.

⁶ “Propagation Modelling Parameters for Wind Power Projects”, Kenneth Kaliski and Eddie Duncan, *Sound & Vibration*, December 2008, pp 12-15 (see Figure 5).

⁷ Tickell, C.E., Ellis, J.T. and Bastasch, M., “Wind Turbine Generator Noise Prediction – Comparison of Computer Models”, *Proceedings of Acoustics*, 3-5 November 2004, pp 45-50.

⁸ Note, studies done by or for government agencies involved in wind farm approval are not independent. Those agencies are complicit in the creation of health problems from wind farm noise and will normally attempt to conceal their culpability.

Errors in data

These problems are exacerbated with errors in the data fed into modelling software. For instance, in its submission on the Crookwell 3 Wind Farm, the NSW EPA¹⁰ identified multiple substantial errors in the reported geo-positioning of sensitive receiver locations with many being in error by hundreds of metres and, in one case, by 1,500 metres. That erroneous data was apparently used to predict the noise at identified residences and may have been used to input background noise values. Many, if not all, of the assertions by the developer's consultants may have been rendered void as a consequence.

How many other noise modelling errors have gone undetected? What undetected errors exist in relation to the Bango proposal?

Another important error source is consultant discretion. When measuring background and operational noise for wind farms, recording periods materially affected by extraneous noise (e.g. machinery or noisy livestock near the recording microphone, or the noise of rain falling on the equipment) are to be excluded. But there is no standardised way of determining such occasions. That inevitably creates opportunity for developers' consultants, who decide which periods to exclude, to make choices that happen to favour their clients, without anyone else being able to check (e.g. allowing periods with extraneous noise to remain in the dataset raises the reported level of background noise).

The idea that no noise consultant has ever influenced the data in this way is as preposterous as the claim that no politician has ever lied. Perhaps only a few of them do it, or perhaps they all do it. The fact is the Department has no way to tell – and is thus confronted with a noise modelling output of unavoidably indeterminate veracity.

Cumulative effects with other wind farms

The submission purports to provide noise modelling with Rye Park but it appears to be cursory at best. It should be obvious that if there are great uncertainties associated with noise modelling for a single wind farm, the uncertainties are still greater for multiple wind farms.

Cumulative effects may occur in various ways. Note that the NHMRC has referred to coherence, where the wave phase from multiple turbines arrives at a location simultaneously (coherence) and thereby greatly increases the SPL. This effect can occur with audible and low frequency noise and, given the greater transmissibility of low frequency noise, the problem may occur long distances away for the latter.

In addition, there is the cumulative potential impact on people where changing wind directions make them exposed to noise from one wind farm at one time and then noise from another, so they are perpetually affected.

The cumulative noise modelling for this proposal has no reliability.

⁹ See for instance “Noise Monitoring in the Vicinity of the Waterloo Wind Farm”, by Kristy Hansen, Branko Zajamsek and Colin Hansen, from the University of Adelaide School of Mechanical Engineering, May 26, 2014. About half the 8 residences monitored, each for about one week, had breaches of various guidelines (SA EPA (2009) plus European guidelines).

¹⁰ Letter from NSW EPA to Department of Planning and Environment, EPA Reference: DOC16/504288-02; EF16/308, dated 17 November 2016.

Consent implications of indeterminate errors in and unrepresentativeness of noise modelling

The evidence is clear that noise levels and character is unpredictable and cannot be accurately represented by measurements at one time. It is also clear that noise modelling is inherently unreliable and the problem is exacerbated by data errors, whether inadvertent or intentional.

Consequently no reliability can be placed on the noise modelling submitted in this case, unless the Department has strong evidence to demonstrate that:

- the causes of time and space wind farm noise variability identified by the NHMRC and professionals such as Bullmore and Peplow have somehow ceased to apply; and
- the variability in noise modelling algorithms and the dependence of results on input assumptions has disappeared; and
- there are absolutely no errors, intentional or inadvertent, in the data used for the noise modelling in this case

and therefore the project should not be approved unless:

- there is permanent 24/7, full spectrum sound monitoring;
- at sufficient locations around the wind farm to provide a comprehensive history of noise impact at all residences within at least 10 kms; and
- with the complete data permanently available to the Department **AND** to all residents who believe they may be noise affected, and to their advisors.

This is particularly important given that the person responsible for the wind farm EIS has declined to unequivocally certify, in the manner required by Schedule 2, Part 3, s 6(f) of the *Environmental Planning and Assessment Regulation 2000*, that “the information contained in the statement is neither false nor misleading”¹¹.

Health

The NHMRC has commissioned a number of studies into the potential health effects of wind farm noise, including recurrent sleep deprivation. The Department is presumably aware of this. If not I can provide references.

This means that based on NHMRC advice and actions, the possibility exists of adverse health effects (including recurrent sleep deprivation) from Bango wind farm, either alone or cumulatively with other wind farms in the area.

On that basis it is essential that any approval conditions:

- draw explicit attention to the developer’s obligations under the *NSW Work Health and Safety Act 2011 No 10 (WH&S Act)*;
- explicitly impose health protection obligations and conditions (including for sleep) such that Investor State Dispute Resolution (ISDS) provisions under any Australian trade agreement cannot be used to block or penalise the NSW Government for any subsequent actions it may take in relation to the wind farm to protect the health of

¹¹ See *Bango Wind Farm EIS Does Not Comply with the Regulations*, Dr Michael Crawford, 27th November 2016.

NSW citizens or their animals. [If the Department is unaware of the ISDS issues, identified by the Chief Justice of the Australian High Court, I can provide relevant information.]

In relation to health, the *NSW Work Health and Safety Act 2011 No 10 (WH&S Act)*, imposes duty of care obligations on anyone conducting a business in NSW, which obligations extend beyond their employees to include “other persons”. Thus, s 19 (2) says:

A person conducting a business or undertaking must ensure, so far as is reasonably practicable, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.

Note that the Act does not simply preclude harm to employees and other persons but ***precludes putting them at risk***. The Act also forbids attempts to “contract out” of such obligations, e.g. in relation to hosts or residents on other associated properties.

Approval of the proposal by the NSW Government, under a set of conditions which do not explicitly confirm to the developer that the WH&S Act also applies, could reasonably give rise to the understanding that all the developer has to comply with are the conditions stated in the consent.

This risk is especially pertinent in the context of ISDS and the ability of ISDS tribunals, without any control by Australian courts, to make their own interpretations of approval conditions and impose penalties on the NSW Government for subsequent actions by the NSW Government which the tribunal believes reduce the value of a foreign owned investment.

History has shown the ease of transferring wind farm ownership to foreign parties. Failure to protect the NSW Government up front by explicit statement of these conditions would in fact amount to corrupt negligence on the part of the government officials involved, since the only rationale for creating such as exposure for the NSW Government is to advantage the developer.