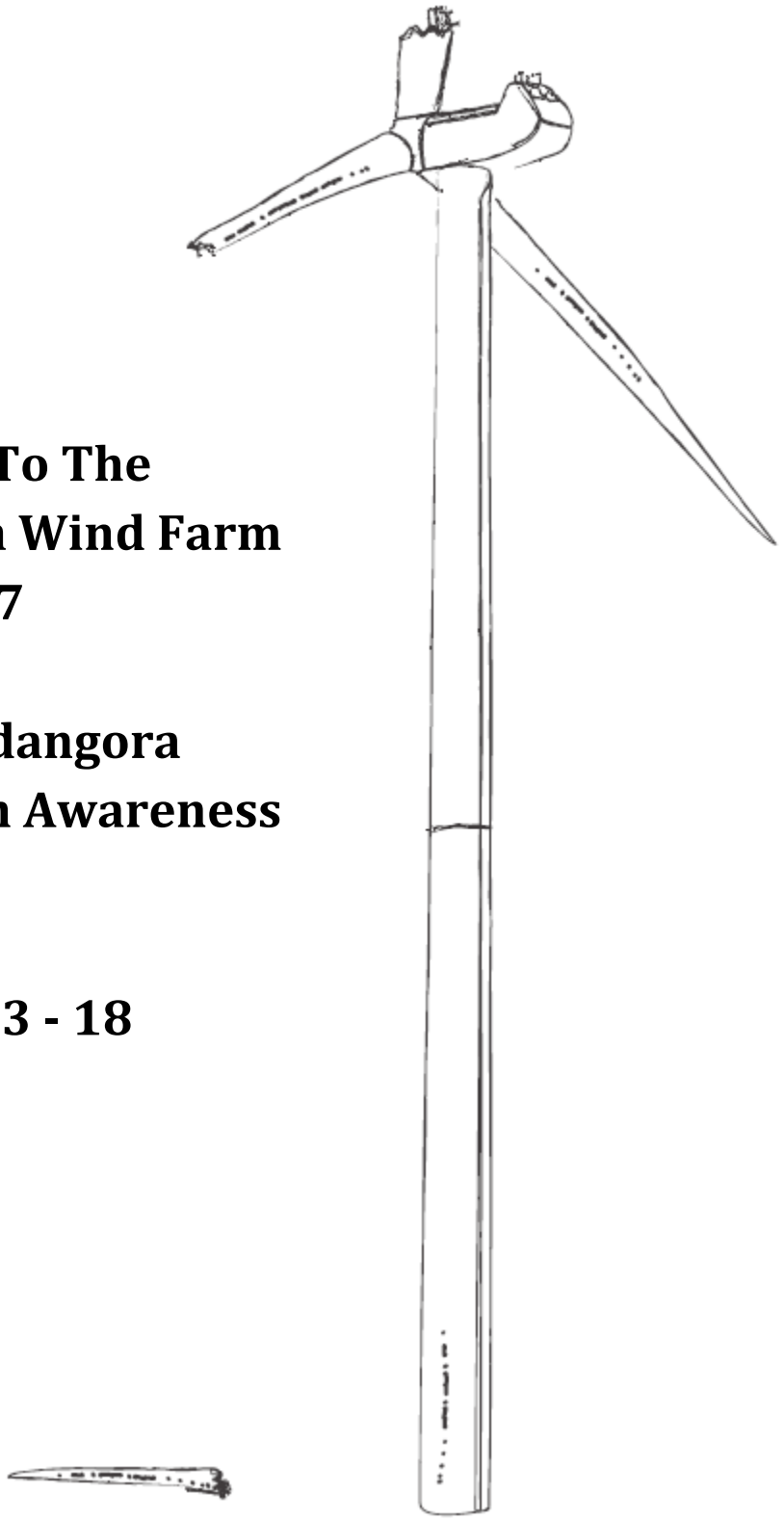


Volume 2

Objection To The Bodangora Wind Farm MP10_0157

By The Bodangora Wind Farm Awareness Group

Chapters 13 - 18

Chapter 13

Hazards, Physical Safety, Bushfires & Air Safety

CHAPTER 13 HAZARDS, PHYSICAL SAFETY, BUSH FIRES AND AIR SAFETY
DIRECTOR GENERALS REQUIREMENTS

The EA must include:

1. An assessment of the potential impacts on aviation safety, taking into account cumulative impacts from the surrounding approved or proposed wind farms in the locality, including the need for aviation hazard lighting considering nearby aerodromes and aircraft landing areas, defined air traffic routes, aircraft operating heights, radar interference, communication systems, and navigation aids.
2. Aerodromes within 30km of the turbines should be identified and impacts on obstacle limitation surfaces addressed, with particular reference to the Wellington airport.
3. In addition, the EA must assess the impact of the turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the turbine and transmission line.
4. Possible effects on telecommunications systems must be identified.
5. Potential hazards and risks associated with electric and magnetic fields (EMFs) (with reference to the Australian Radiation Protection and Nuclear Safety Agency standards) and bushfires must be assessed.
6. The EA should demonstrate, particularly in relation to grid connection transmission lines, the application of the Principles of Prudent Avoidance in relation to EMFs.
7. The EA must also detail measures to contain any hazardous substances to prevent the contamination of pastures and dams.

In addition the proponent must consider the following Hazards and risk;

Aviation safety:

1. The potential for the proposed wind farm to impact on aviation safety should be assessed. This includes aviation safety issues associated with the wind turbines, transmission lines, nearby airports, air defence facilities and private landing strips and activities such as aerial agricultural spraying / crop dusting.
2. Aerodromes or airfields within 30km of the proposed wind farm should be identified, e.g. using aerial photographs and through consultation and discussions with relevant councils, local communities and the Civil Aviation Safety Authority (CASA).
3. The proponent should consult with CASA and Air Services Australia where a wind farm is proposed within 30 kilometres of a declared aerodrome or airfield or the wind farm infringes the obstacle limitation surface around any declared aerodrome. CASA may require appropriate safeguards such as aviation safety hazard lighting or changes to turbine locations. The need for aviation hazard lighting should be considered taking into account any nearby aerodromes and aircraft landing areas, defined air traffic routes, aircraft operating heights, communication systems, and navigation aids.
4. Applicants should also consult with the Department of Defence if the wind farm is proposed in the vicinity of air force facilities.
5. Where the location of the turbines is likely to prevent or restrict aerial agricultural spraying, the impacts should be considered and an offset regime developed with the affected land owners taking into consideration any cost difference between the current aerial agricultural spraying and a reasonable alternative.
6. This may include alternative application methods or continued aerial spraying but with additional costs associated with added flight times because of the presence of the turbines.

Bushfire hazards and risks should be assessed. Relevant issues include:

1. The risk that a bushfire will damage a wind turbine if the wind farm is located in or near a bushfire prone area
2. The risk that the construction and / or operation of the wind farm will create a fire that could spread to nearby areas; the potential for the wind farm to impact on aerial fighting of bushfires fire safety for workers and visitors during the construction and operation phase, ensuring there is appropriate fire fighting equipment and water supplies on site to respond to a bush fire.
3. Proponents should consult with the NSW Rural Fire Service. The assessment should demonstrate that the proposed wind farm will be designed, constructed and operated to minimise ignition risks, provide for asset protection consistent with relevant RFS design guidelines including *Planning for Bushfire Protection 2005* and *Standards for Asset Protection* and provide for necessary emergency management. The assessment should demonstrate how a turbine fire would be managed so as prevent fire spreading to surrounding areas, such as through providing an outline emergency response plan.

Blade throw: The risk of 'blade throw':

1. Involving a wind turbines blades breaking or being ejected during operation should be considered. Relevant considerations may include (but are not limited to): whether the proposed turbines are certified against relevant standards such as *IEC 61400-23 Wind turbine generator systems – Part 23: Full-scale structural testing of rotor blades* or their equivalent standards.
2. Evidence of any such certification should be provided. Over- speed protection mechanisms including 'fail safe' mechanisms (e.g. back up (battery) power in the event of a power failure)
3. Operational management and maintenance procedures including any regular maintenance inspections provisions for blade replacement in the event a blade fault is identified (e.g. during a periodic inspection) the separation distance between turbines, neighbouring dwellings and property boundaries the probability of blade throw occurring.

13.1.0 SUMMERY OF OBJECTIONS

Bodangora Wind Turbine Awareness Group Mudgee Alliance objects to the Bodangora Wind Farm Proposal:

<u>The additional Director Generals Requirements (DRGs) have not been considered by the proponent.</u>

The Physical safety section of Chapter 15 of the EA identifies the possible risks associated with poor maintenance, environmental factors and physical damage in association with turbine failure.

According to maps provided in the EA there are 3 non-associated residence dwellings within 2kms of a wind turbine.

There is potential risk associated with physical damage occurring to public, farm employees and neighbours outside of the project zone due to debris, blade and ice

throw exceeding the project zone that has not been addressed as specified in the DGR's. **This fails the DGR's.**

The EA does not consider employee exposure to wind turbines within the 2km safety zone but outside of the project area as stated in the DGR. **This fails the DGR's.**

The EA does not specify the design and size of the turbines that will be constructed at the proposed Bodangora Wind Farm. As a result the safety features described in the EA it cannot be confirmed or identified as specified in the DGR; thus must be assumed without guarantee that the proposed safety features will be present in each turbine. Because of this it must be seen critically and that the potential of some or all "*built in*" safety features described as mitigation measures may **NOT** be precent in **ALL** turbines. **This fails the DGR's.**

The EA does not address the risks associated with increased movements along local roads. **This fails the DGR's.**

The bushfire risk assessment in the EA falls well short of covering all the necessary concerns with bushfire risk within and surrounding an Industrial Wind Turbine (IWT) project as specified in the DGR. **This fails the DGR's.**

There is no complete Bushfire Management Plan (BFMP) in the EA as specified to be completed in relation to the DGR's. **This fails the DGR's.**

There is no comment in regard to building an industrial wind turbine (IWT) in or around fire prone areas as specified in the DGR. **This fails the DGR's.**

The Bodangora and surrounding areas are all fire prone areas. The risks associated with mechanical failure, lightening strike (whether the IWT is involved or not), public safety in particular reference to fire fighters and aerial fire fighting restrictions are not covered in the hazards associated with bushfire risk. This is specified in the DGR and has not been met.

The Bodangora Wind Farm proposed by the proponent involves the construction and operation of approximately 33 wind turbines. The height of these is up to 150 m to blade tip and pose significant restrictions to aviation practices. Mt Bodangora is the highest geographical feature in the area. It is the highest point across Australia on the latitude on which it sits. A number of turbines will be located so they will be higher than Mt. Bodangora, posing a potentially serious hazard to aircraft operating in and adjacent to the development area. This has not been specified to the standard of the DGR's.

The Bodangora Wind Turbine Awareness Group to the proposal and in particular, object to the siting, the number and the design of these wind turbines, which, due to their proximity **(5km)** to Wellington Aerodrome, will interfere with the functions of this aerodrome. This has not been addressed as required in the DGR's.

It will impact upon the safety of airstrip approaches, the take off of fully loaded aircraft with water for fire fighting, air ambulance and Royal Flying Doctor Services, Defence Force manoeuvres and aerial agricultural operations, as well as other flying activities such as geophysical surveying and recreational flying.

13.2.0 TOWER FAILURE

Bodangora Wind Farm Pty Ltd, (Infigen Energy) reporting on tower failure gives an overall impression of "r*are instances*" resulting from storms, material fatigue, poor maintenance practices and lightning. In response to storms resulting in tower failure there is currently ample amount of evidence showing that storm damage is a far greater concern and occurrence than the EA portrays, with reports from Denmark, United States of America, Scotland, the United Kingdom and Australia occurring within the past 4 years alone. There is also an ample amount of evidence through media reports that there are far more incidences resulting in turbine destruction or damage as a result of storms than what has been recorded through media and publicity. The EA does not consider concerns of Physical Safety as a result from tower failure to the standards of the Director Generals Requirements including safety mechanisms and control plans for out of control towers and "fail safe" mechanisms. **This fails the DGR's.**

The EA reports rare occurrences of tower failure resulted from material fatigue. The EA does not provide enough evidence to prove or show the likely maintenance of each tower. Maintenance must be strictly observed as the potential for tower failure caused from material fatigue due to poor maintenance practices is a potential high risk factor. Tower maintenance is a potential hazard that has not been addressed in the EA at the Director generals requirements.

The risk of lightning strike briefly outlined in the EA by Bodangora Wind Farm Pty Ltd (Infigen Energy) is of a poor standard. The EA does not identify the type or size of each turbine. It must be assumed that the potential physical safety of all properties (both inside and outside) of the proposed project area are associated within a high risk level due to physical hazards being capable of exceeding the project boundaries.

Lightning strike may not directly affect neighbouring properties, but have a secondary effect. Lightning has the ability and has been shown to cause fires on turbines. In the event a turbine fire it has been documented that the turbine may pose significant risks to both the proposed project area and neighbouring properties

in facilitating the spread of fire from a localised area to larger general locations. This has been documented in the *"European Guidelines wind turbines Fire protection guideline, 3.2.1 Fire caused by lightning strike". This* document states, *"Burning parts of the blades that fell down caused a secondary fire in the nacelle"*. Fires in or on a wind turbine have the ability to throw burning or smouldering pieces causing fires away from the turbine. This has been outlined in the DGR's. The EA does not cover lightning strike and offers limited unspecified mitigation methods that are not guaranteed due to the conflicting turbines offered. **This fails the DGR's.**

The EA has not addressed the concerns of turbine pieces burning and floating pieces of turbine blades etc, into neighbouring properties outside the project area as required by the DGR's. **This fails the DGR's.**

13.3.0 BLADE THROW

The EA clearly states, *"blade throw is a rare occurrence and "Based on Infigen's global fleet of turbines and industry experience, the probability of blade throw is around 1:3000".* **This is misleading**.

A paper produced at the University of California by the California Wind Energy Collaborative, states that blade throw from either full or fragmented blades are increasing due to the increasing number of global turbines and that *"blade failure probability in the 1-in-100 to 1-in-1000."* This would indicate that the risk of blade is much higher than that claimed in the EA.

Furthermore the suggested length of "throw" that has been identified throughout the industry suggests as a guide, the length of throw is between 2.5 and 3.7 times that of the total height of the turbine. The EA requires a "worst case scenario". The distance of 3.7 times the height of the overall turbine poses significant risk to several parties including but not limited to general public and neighbours; as the EA states the height of the proposed Bodangora wind turbine farm is approximately 150 meters. Research results suggest a 150 metre turbine has a potential blade or fragment throw range of between 375 to 555 meters (2.5 – 3.7 times the overall height of the turbine respectively); this poses significant risk to persons within the proposed development area and potentially, persons outside the area. This has not been considered in the EA and **thus it fails the DGR's.**

The EA does not state the possible distance that blade throw can occur regardless of the cause. **The EA has failed the requirements of the DGR's.** According to the summary of wind turbine accidents compiled by the Caithness Windfarm Information Forum 2012, "*Pieces of blade are documented as travelling up to 1300m."* This

distance of throw could clear the project area as 23 turbines are located **within** 1.3km from the boundary of the project area.

Based on industry description of 3.7 times the overall height of the turbines there are 6 turbines under 555meters from the project zone boundary. In the event of blade throw from these turbines, it could potentially harm someone or destroy property outside the project zone. Again, **this fails the DGR's.**

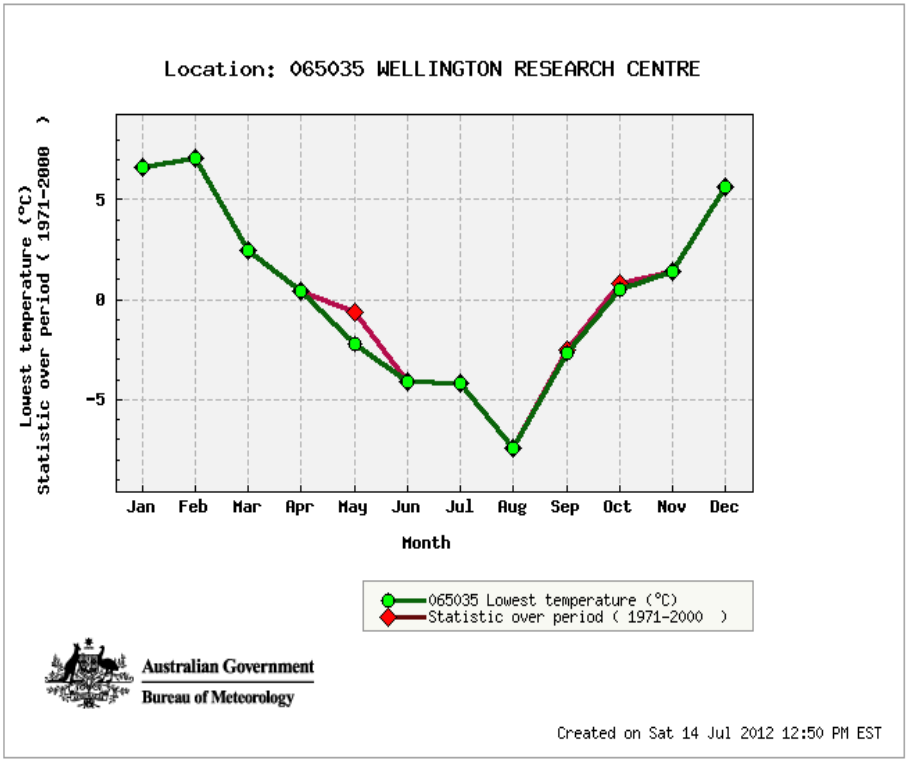
13.4.0 ICE THROW

The EA does not address the risk and potential risk of ice throw. The EA states that the level of risk associated with ice throw is "m*oderate*" with the mitigation of this problem also being "*moderate*". However, the EA shows no real mitigation methods against this hazard. The only mitigation method suggested is associated directly with landowners stating in the Risk Assessment that, "*land owners will be advised to avoid turbine locations during the few periods of below freezing temperatures".* This is inadequate.

Although the associated risks with ice throw is not as high as Northern hemisphere locations due to colder climates; the Bodangora project area is prone to below 0°C temperatures. This is most prominent at night during winter were the risk of ice forming on blades is highest. This can be seen in by the Australian Government Bureau of Meteorology, Climate statistics for Australian Locations: Wellington Research centre. The Wellington Research Centre is located 8.79km from the proposed project area and 9.93km from the closest turbine.

The Information collected from the Wellington Research Centre shows the following; Lowest temperature and statistic over period (1971-2000), Lowest temperature and statistic over period (1981-2010), Lowest temperature and statistic for the mean number of days ≤2°C and lowest temperature and statistics for the mean number of days ≤0°C.

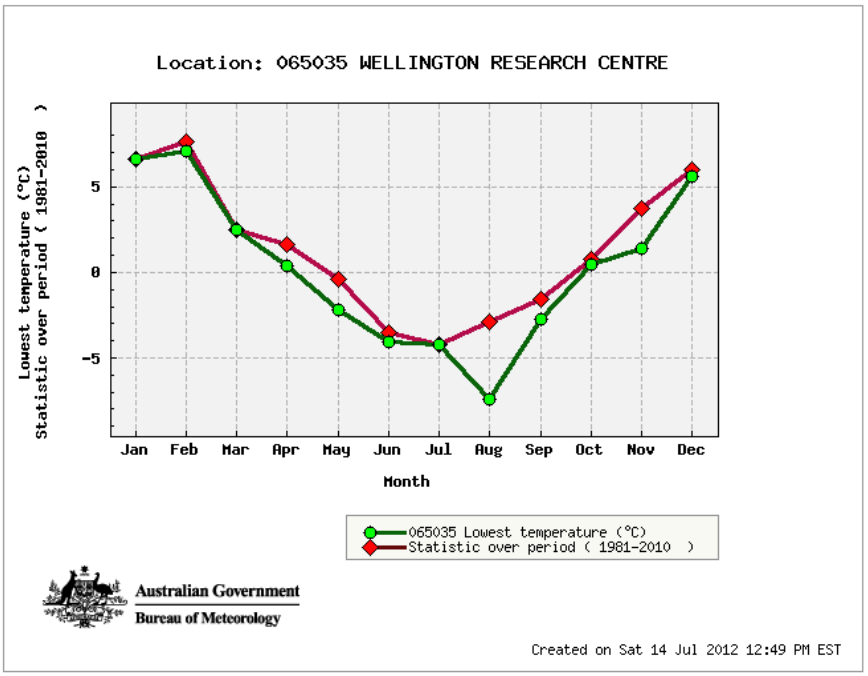
Compare with statistics for the 30 year period: 1971-2000 Redraw



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Lowest temperature (°C) for years 1965 to 2005	6.6	7.1	2.5	0.4	-2.2	-4.1	-4.2	-7.4	-2.7	0.5	1.4	5.6	-7.4	38
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Lowest temperature (°C) for years 1971 to 2000	6.6	7.1	2.5	0.4	-0.6	-4.1	-4.2	-7.4	-2.5	0.8	1.4	5.6	-7.4	28

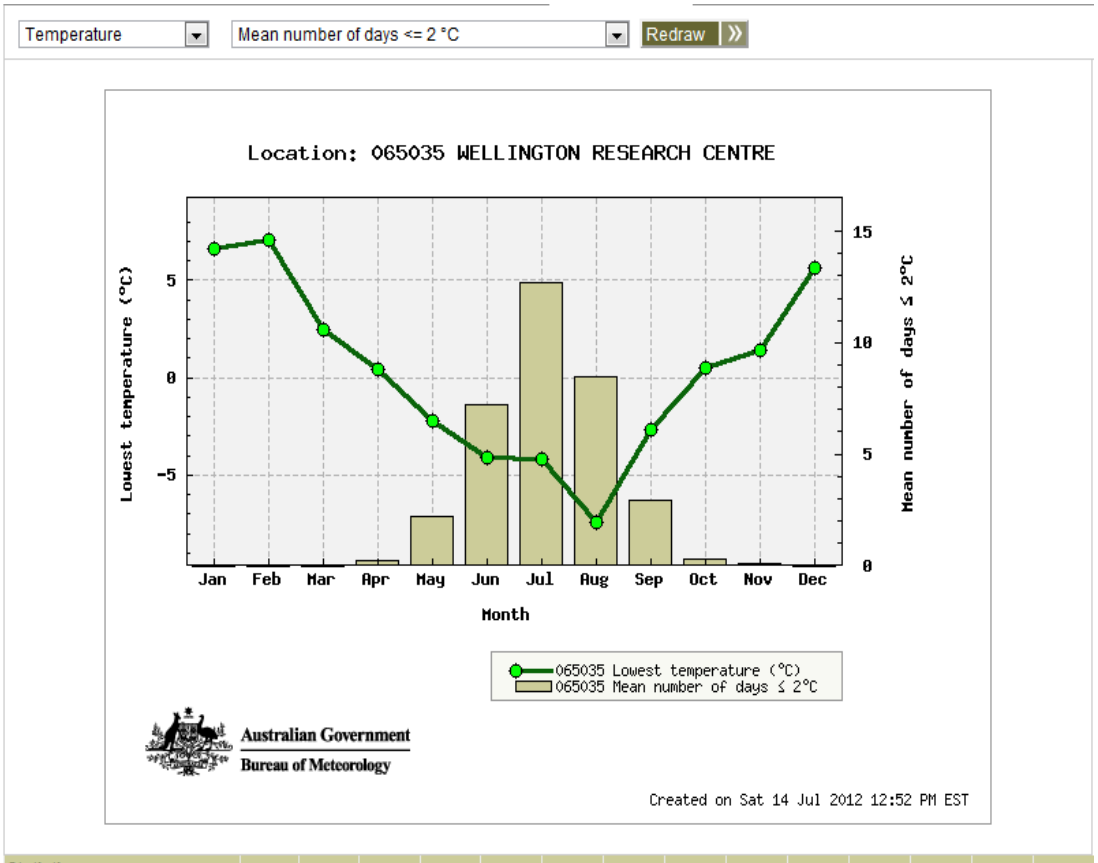
Figure 1, As can be clearly sheen by the above figure there are 5 months of the year were temperatures drop below 0°C, providing ideal conditions for Ice formation on blades.

Compare with statistics for the 30 year period: 1981-2010 Redraw



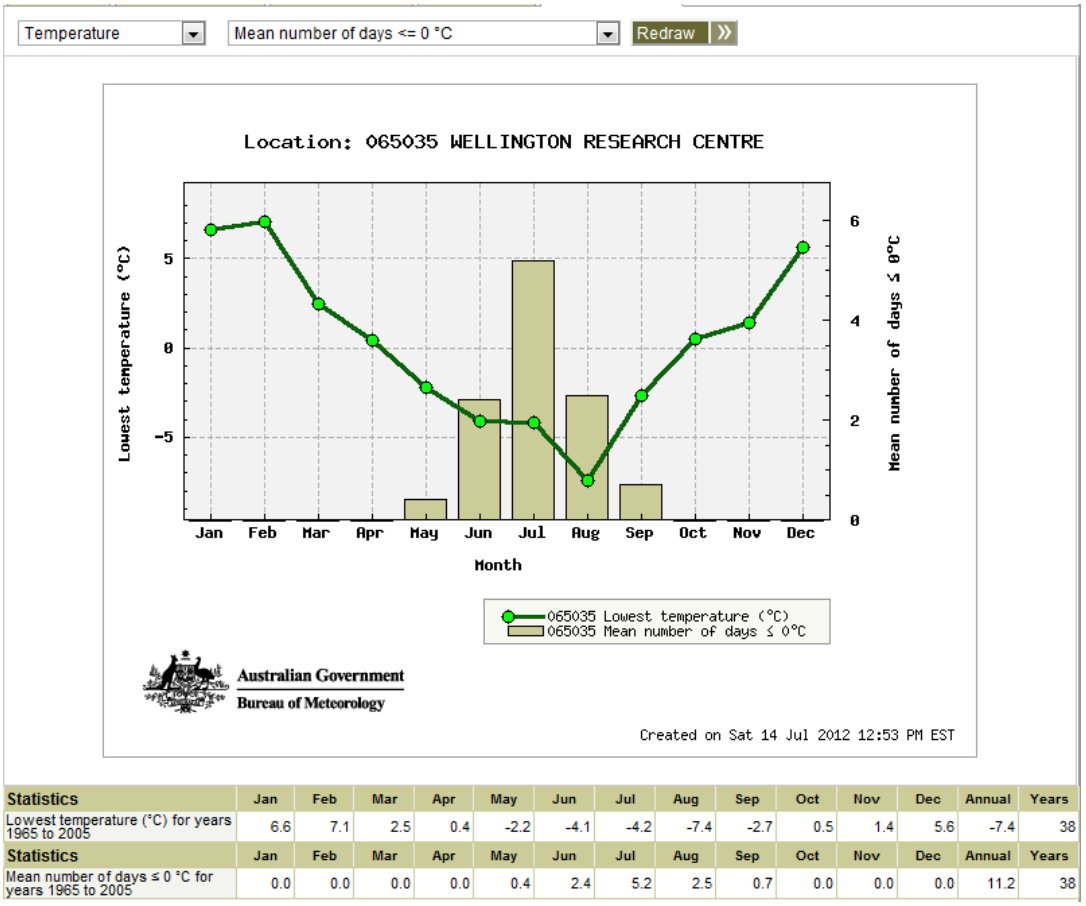
Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Lowest temperature (°C) for years 1965 to 2005	6.6	7.1	2.5	0.4	-2.2	-4.1	-4.2	-7.4	-2.7	0.5	1.4	5.6	-7.4	38
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Lowest temperature (°C) for years 1981 to 2005	6.6	7.6	2.5	1.6	-0.4	-3.5	-4.2	-2.9	-1.6	0.8	3.7	6.0	-4.2	22

Figure 2, The above figure shows statistics of an average of 4 months of the year were temperatures drop below 0°C, providing ideal conditions for Ice formation on blades.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Lowest temperature (°C) for years 1965 to 2005	6.6	7.1	2.5	0.4	-2.2	-4.1	-4.2	-7.4	-2.7	0.5	1.4	5.6	-7.4	38
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean number of days ≤ 2 °C for years 1965 to 2005	0.0	0.0	0.0	0.2	2.2	7.2	12.7	8.5	2.9	0.3	0.1	0.0	34.1	38

Figure 3, shows the mean number of days below 2°C against the lowest temperatures recorded. This provides evidence that there potentially 34.1 days below 2°C with an annual temperature averaging -7.4°C.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Lowest temperature (°C) for years 1965 to 2005	6.6	7.1	2.5	0.4	-2.2	-4.1	-4.2	-7.4	-2.7	0.5	1.4	5.6	-7.4	38
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean number of days ≤ 0 °C for years 1965 to 2005	0.0	0.0	0.0	0.0	0.4	2.4	5.2	2.5	0.7	0.0	0.0	0.0	11.2	38

Figure 4, Shows the mean number of days less than or equal to 0°C against the lowest temperature recorded. There are on average 11.2 days were the average temperature is less than or equal to 0°C. These days have the highest risk of Ice formation on blades and pose the greatest risk to persons near the project area.

There is potential risk of ice forming and falling from blades causing injury or harm to personnel close to the turbines. Although a small mitigation method of signage on property entrances may occur there is serious problems associated with property entrances from neighbouring farms were signage has not been discussed or mentioned in the EA. This causes reason for major risk associated with ice throw on unsuspecting neighbouring farm employees, owners or families retrieving strayed stock into paddocks with turbines precent during winter months and early mornings were the risk of ice throw is highest.

13.5.0 POTENTIAL RISKS

The EA does not go into depth of the general use and movements of the local roads. A risk assessment of increased movements along the road should have been done to determine the potential problems and hazards associated with local road use, including agricultural based movement along and across the roads.

The local movement of stock is known to cause stoppages in traffic movement along all roads in the development area. The EA does not attempt to show any risks that could be caused to local farm workers or stock as they are moved crossing the roads. The EA dose show that the roads are used for local farm machinery and it does not address the problems associated with oversize farm equipment and construction equipment reaching impasses, as some farm equipment cannot be reversed due to the difficulty of equipment moveability.

Neighbouring properties have not been informed by the proponent of the dangers associated with being situated near commercial scale wind turbines. This is a potential hazard as often, neighbouring farmers enter "h*ost*" properties upon invitation in order to retrieve straying livestock.

Potential hosts of commercial turbines may invite neighbouring land owners (and their associated guests and families), community members and general public to "*visit"* their homes for recreational purposes. Although the host families have signed an agreement that effectively represents the knowledge of the risks associated with living with turbines, these visiting members have not and as a result may be unlawfully and unknowingly entering a dangerous area that could potential harm individuals.

The EA fails to recognise neighbouring families and land owners' workplaces as the turbines may have a direct effect on workplace safety of adjacent land to the proposed project.

13.6.0 WIND FARM SEPARATION AND PUBLIC SAFETY

13.6.1 PUBLIC SAFETY

The EA has attempted to address the Health and Safety issues surrounding commercial scale wind turbine farms by addressing the 2010 National Health and Medical Research Council of the Australian Government by the issued statement in 15.6 Public Health.

"There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines".

This statement is from the 2010 National Health and Medical Research council "Wind Turbines and Health", *"A rapid review of the Evidence",* July 2010. This "*Rapid Review"* is **now under review** due to the concern that it was not peer reviewed. After questioning by Senator John Madigan to Prof Warwick Anderson (CEO of the National Health and Medical Research Council) The NHMRC has stated that the NHRMRC has never taken the position that there are "***no***" health problems from wind turbines. The following is an abstract from Parliament of Australia *"Community Affairs Legislation Committee"* 31/05/2012

"Senator MADDIGAN : Is the NHMRC prepared to say that there are no health problems from the wind turbines?"

"Prof. Anderson : No, we have never been prepared to say that because it is very hard to rule things out, as you would understand."

The above abstract clearly shows that the proponent's abstract from the currently revived "NHMRC rapid review" has been taken out of context. The current CEO of the NHMRC, after being asked if the NHMRC was **prepared to say that there are no health problems from wind turbines** clearly states that the NHMRC has "***never been prepared to say that***" As the Environmental Assessment exhibition began on the 08/06/2012 and the option of modification application for the project by the proponent has been accessible and able to be changed It would be expected that the latest and most up to date information would be provided. **This has not occurred resulting in the EA failing the DGR's.**

The EA has the potential to mislead the Department of Planning and Director General in an assumption to these authorities that states in the Environmental Assessment, Masterplan 15.6 Public Health, Infigen 2012 "*Accordingly, the proposed wind farm is not expected to cause any adverse human health impacts".*

In addition please refer to the Australian Environmental Foundation media release for "*Lazy Health DEPT. Must act on Wind Farm Noise".*

In addition please refer to Senator John Madigan (*Labor Party Senator for Victoria),* "Health Effects of Wind Farms", *How close is too close when protecting the health of Australians?*"

Further, refer to Dr Sarah Laurie CEO, Waubra Foundation, 28th May 2012. *Acoustic Pollution –A 'Silent Epidemic'.*

There is ample evidence suggesting that health effects are a major risk associated with the general operation of commercial scale wind turbine facilities. As the proponent uses and stresses the fact that the use of peer reviewed evidence is needed in order to answers many questions posed on its website; it is ironic that the main argument and stance the proponent uses to dismiss Public Health (15.6 of the EA) is in fact under review, due to concerns of the peer review process of the NHMRC "*A rapid review of the Evidence",* July 2010.

http://www.infigenenergy.com/renewable-energy/faq.html

13.6.2 PUBLIC SAFETY: PROPERTY ZONES

The current EA does not address concerns of public safety. This is evident in the above topics 15.3.0 "*Blade Throw"* and 15.4.0 *"Ice Throw"* as the potential for debris being thrown from a turbine onto a public road is a high risk factor due to NO mitigation in the event of such an incident.

- Number of turbines within 200m of a public road = 1
- Number of turbines within 300m of a public road = 2
- Number of turbines within 400m of a public road = 3
- Number of turbines within 500m of a public road = 5
- Number of turbines within 600m of a public road = 6
- Number of turbines within 700m of a public road = 9
- Number of turbines within 900m of a public road = 14
- Number of turbines within 1000m of a public road = 16
- Number of turbines within 1300m of a public road = 20

As stated in 15.3.0 "Blade Throw" there is the potential for a blade to be thrown up to 1300meters. There are 20 turbines within this distance to the project boundary putting neighbouring property owners, employees and family members within this "danger" zone in potential harm. This is not addressed in the EA, resulting in its **failure of the DGR's.**

Using the 3.7 times the height, blade throw distance stated by industry, there are 6 turbines within 555m throw area of the project boundary. At this distance it puts neighbouring property owners, employees and family members within this "danger" zone in potential harm.

13.6.3 PUBLIC SAFETY: PUBLIC ROADS

There are 16 turbines within 1km of a public road posing significant risk to commuters and general traffic due to possible debris thrown (see 15.3.0 "Blade Throw" & 15.4.0 "Ice Throw").

Gillinghall Road

- Number of Turbines within 500meters of Gillinghall Road = 2
- Number of Turbines within 600meters of Gillinghall Road = 4
- Number of Turbines within 700meters of Gillinghall Road = 5
- Number of Turbines within 900meters of Gillinghall Road = 7

- Number of Turbines within 1000meters of Gillinghall Road = 9

Goolma Road

There are 3 turbines within 1km of the Goolma Road including WTG18, WTG19 and WTG17 which are 652.08meters, 846.56meters and 895.85meters respectively.

13.7.0 BUSHFIRE

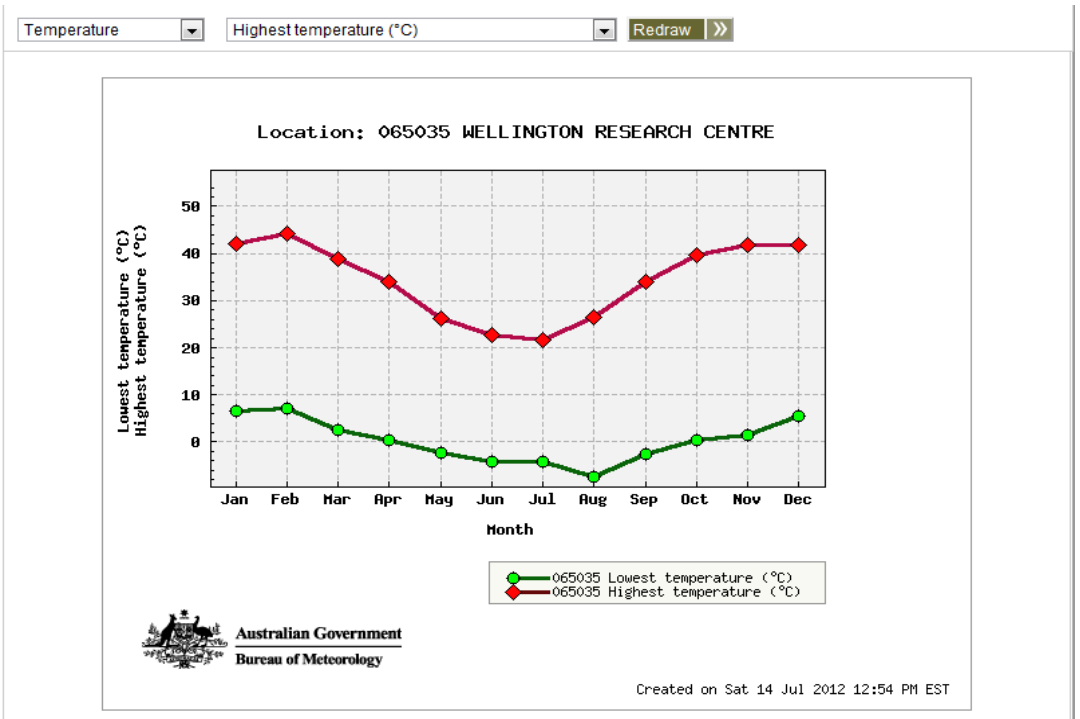
BUSHFIRE RISK: Bodangora Wind Turbine Awareness Group Mudgee Alliance objects to the Bodangora Wind Farm Proposal.

13.8.0 BUSHFIRE MANAGEMENT PLAN

The EA does not contain a BFMP except for a summary of the proponents' plans during the constructional phase and a very brief summary during the operational phase. This is a failing in the EA as management plans cannot be viewed by the public as part of the EA process and therefore comment is restricted.

13.8.1 FIRE PRONE AREA

The Bodangora and surrounding communities that neighbour the project (Spicers Creek, Comobella, Gollan, Wuuluman are all fire prone areas. The vegetation cover in the bulk of the farm land within the project area is dominated by native summer grasses. This is due to the type of grazing system the farmers use within the project. This type of farming technique is not just restricted to the project area but is popular throughout the whole region which is why it makes it such a high risk for bushfire. This has become very evident over the past few years with better summer rainfall in the region. Once seasons turn back to normal the fire risks associated with the fuel loading on the type of farms within and surrounding the project area is enormous and extremely dangerous in a bushfire situation. 'The Land' newspaper Dated July 12 2012 has a front cover story "Fuelled up and Ready to fire" which talks about the very high fuel loading from the past two good seasons and a return to an "El Nino" right across the state of NSW. A more typical summer period when the bushfire incidents are highest, it is very common to have extended periods of dry weather, which when combined with the high fuel loadings from native grass, present the NSW Rural Fire Service (RFS) with a real threat. Figures taken from the Wellington Research Centre where climate data has been collected and recorded from as far back as 1946 proves that this area has high temperatures (over 40 degrees Celsius) during four months of the year. This proves that Bodangora is a fire prone area.



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Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Highest temperature (°C) for years 1965 to 2005	42.0	44.3	38.8	34.0	26.1	22.6	21.5	26.6	34.0	39.6	41.9	41.7	44.3	38

Figure 1 Wellington Research Centre climate data.

There are also areas of timber/forest within and surrounding the project area that present even more fire risk with the associated fuel loadings and inaccessibility they present. As an example of the fire risk, the Spicers Creek Rural Fire Brigade which has country within the project area has fire incidents every year with up to five incidents per year (2009). The bulk of these incidents is caused by lightning strike either onto trees or the ground or involves power lines. All the incidents result in a bushfire being started. Be it a small grass fire or a large bushfire involving several RFS brigades the fact remains that the area in question is a fire prone area. Building an IWT farm is only going to increase the fire risk and stretch the already limited resources to control outbreaks. It is common practice on extreme fire danger days, within and surrounding the project area to recommend a ban on grain harvesting or any other risky type machinery operation to reduce the risk of a fire incident. Farmers are very good at adopting this type of practice, as it is the farmers that form the majority of the RFS volunteers. The problem with an IWT operating in this region is there is the added risk to operating a machine in a fire prone area all year round regardless of the weather conditions. A machine that is subject to mechanical and electrical failure as has been evident in Australia and around the world with IWT's

poses an unacceptable bushfire risk to the region. The EA states no restrictions on the operation of turbines on high, extreme or catastrophic fire danger days.

Although summer periods have the highest risk of fire winter periods are still prone to fire as well; this is due to the “haying off” effect where the native summer grasses that are the predominate species die and become dormant. This has a risk of, when ignited to burn quickly due to the abundance of fuel and dead grass precent throughout the area.

The Bodangora Brigade of the Rural Firs Service (RFS) attended a fire on one of the proposed host farms on the 18/07/2012 (figure 1). This is clearly within the winter months local rainfall records would show occurred shortly after large quantities of rain (figure 2).

Figure 1. shows some of the damage caused by the grass fire.

rainfall during Autumn and Winter. The area burnt was predominantly native grasses that are dominant in the areas of pasture within the development area.

Figure 2 shows a partial size of the burn and the type of pastures precent.

13.9.0 STRUCTURAL MAKEUP OF THE TURBINE AND FIRE RISK

The structural makeup of the proposed IWT poses a fire risk in itself. The nacelle which weighs 120 tonnes contains several hundred litres of oil and is situated at a height of 100 metres. This combined with an electrical or mechanical failure makes it extremely difficult (impossible) to reach with RFS equipment. The extra added risk is the hazardous compounds that would be associated with oil and electrical fires are again beyond the RFS and not covered in the EA. The diameter of the blades on the turbine is stated at 112 metres. This poses a real threat to aerial fire control due to turbulence issues as well as risk to fire fighters on the ground should a turbine be on fire. The blades are made of fibreglass weighing 20 tonnes each and 54.6 metres long. If a machine has a catastrophic failure, it would have added to the complexity of the fire as these devices cannot be extinguished, all you can do is stand back and put out the fires that are started by the flaming oil and debris. Under catastrophic failure the burning blades can travel for up to 1.3 kilometres. The EA states a perimeter of 20 metres around each turbine to be cleared of vegetation to a height of 100 millimetres. This is a little assistance in reducing bushfire risk if the turbine which is on fire, is situated 100 metres in the air. Oil and blade particles could easily be carried outside this 20 metre zone and due to the close location of some turbines to the development boundary, onto non host farms making the risk of fire totally unacceptable. Aided by high winds which are common in the high fire danger times of the year the risk of fire spreading is again unacceptable and not covered in the EA.

There are no mandatory requirements for automatic fire extinguishers to be attached to turbines, despite the technology being available. **This fails the DGR's.**

As an example of fire damage caused by machinery breakdown an extract was taken from the 'European Guidelines' written by the Confederation of Fire Protection Associations in Europe. "The nacelle of a 1.5 MW wind turbine completely burned out after the slip ring fan of the double fed induction generator had broken. Sparks that were generated by the rotating fan impeller first set the filter pad of the filter cabinet on fire and then the hood insulation. The damage to property amounted to EUR 800,000."

Fig. 2: Burnt down nacelle of a 1.5 MW wind turbine (image source: Allianz).

Figure 3. Power of a 1MW wind turbine-destroyed by fire (source Allianz)

As an example of fire damage caused by failure of electrical installations an extract was taken from the 'European Guidelines' written by the Confederation of Fire Protection Associations in Europe. "Low voltage switch gear was installed within the

nacelle of a 1 MW wind turbine. The bolted connection at one of the input contacts of the low voltage power switch was not sufficiently tightened. The high contact resistance resulted in a significant temperature increase at the junction and in the ignition of adjacent combustible material in the switch gear cabinet. The fuses situated in the front did not respond until the thermal damage by the fire was very severe. Control, inverter and switch gear cabinets that were arranged next to each other suffered a total loss. The interior of the nacelle was full of soot. The damage to the property amounted to EUR 500,000."

Besides lighting strikes, failures in electrical installations of wind turbines are among the most common causes of fire. Fire is caused by overheating following overloading, earth fault/short circuit as well as arcs. Typical failures include the following:

- Technical defects of components in the power electronics (e.g., switchgear cabinet, inverter cabinet, transformer) that have the wrong dimensions
- Failure of power switches
- Failure of control electronics
- High contact resistance due to insufficient contacts with electrical connections, e.g., with bolted connections at contact bars
- Insufficient electrical protection concept with respect to the identification of insulation defects and selectivity of switch-off units
- No or no all-pole disconnection of the generator in case of failure/switch-off of the turbine
- Missing surge protection at the mean voltage side of the transformer
- Resonance within RC (resistor-capacitor) circuits (line filter, reactive power compensations)

Operating IWT's in fire prone areas are clearly are unacceptable risk to the surrounding rural community and adding unnecessary pressure to the already stretched resources of the Rural Fire Service. Operating these types of machines in this area is clearly not without risk. These risks are not addressed adequately in the EA resulting in its failure to comply with the DGR's.

13.10.0 LIGHTING STRIKE

"Lightning strike is a very common cause of fire in this region with trees and power lines being the most common cause of fire each year". Thiscomment has come from the experience of the local NSW RFS Captains who operate within and around the proposed wind farm (Consultation was made with Bodangora, Spicers Creek and Comobella RFS Captains). Adding large numbers of IWT's to the landscape only adds

to the risk of lightning strike due to the sheer size of the structures. By increasing the chance of lightning strike there is an increase in the chance of bushfire. Even though an IWT may be insulted from lightning strike there is no guarantee that a full blown lightening strike won't cause a fire. If one of the turbine blades was damaged by a lightning strike this may cause the blade to become out balance and self destruct. With several hundred litres of oil contained in the nacelle this is only adding risk to the situation.

There is an increased risk of an outbreak of fire caused by lightning strike. A large number of cases of loss have shown that lightning strikes are amongst the most frequent causes of fire at wind turbine farms. The special risk of lightning strikes arises from, but is not restricted to, the exposed locations (often located at higher altitude) and the large height of the structure.

The risk of fire increases particularly when the lightning protection system is not implemented and maintained properly. If the contact resistance of the lightning conductor path is too high, thermal damage is almost inevitable in the case of a lightning strike.

As an example of fire damage caused by a lightning strike an extract was taken from the 'European Guidelines' written by the Confederation of Fire Protection Associations in Europe. "During a heavy summer thunderstorm, the blade of a 2 MW wind turbine was struck by lightning. The turbine was shut down automatically and the blades were pitched out of the wind.

Fig 4a: Fire after lightning struck a 2 MW wind turbine in 2004 (Image source: HDI/Gerling)

Fig 4 b: Fire after lightening struck a 2 MW wind turbine in 2004 (Image source: HDI/Gerling)

The burning blade stopped at an upright position and burned off completely, little by little. Burning parts of the blades that fell down caused a secondary fire to the nacelle.

Investigation of the cause of the loss showed that the fire in the blade was caused by a bolted connection of the lightening protection system that was not correctly fixed. The electric arc between the arrester cable and the connection point led to fusion at the cable lug and to the ignition of residues of hydraulic oil in the rotor blades. The nacelle, including the rotor blades had to be referred to as a total loss. The upper part of the tower had also been destroyed due to the high temperature.

Operations were interrupted for approximately 150 days; the total loss amounted to approximately EUR 2 million. Deficient lightening arrester installations in the rotor blades of wind turbines have already caused several fires".

13.11.0 PUBLIC SAFETY

Public safety is of particular concern on several levels. Simply having IWT operating in a populated area poses risks to human life whether they are residents within the wind farm or fire fighters having to operate within the wind farm. Safety issues arise in regards to blade throw which does happen if the IWT is on fire. NSW RFS members are at risk should they simply be attending a bushfire within the wind farm boundaries. There is no mention in the EA in regards to safe distances from turbines in a bushfire. For occupational health reasons fire fighters may need to sign a waiver before they enter a wind farm due to the risks associated with blade and ice throw. The NSW RFS is based on volunteer fire fighters. The majority of its members are local farmers.

"Many wind turbine projects are having divisive impacts in rural communities. Family members are at logger-heads, club memberships are under threat and the social fabric within rural communities is being torn apart. (Opinion piece written by Senator Chris Back, Liberal Senator for Western Australia 7th of July 2012.)

Rural communities currently in dispute over proposed wind farms include Williams, Kojonup, Dandaragan, Lake Clifton and Eneabba.

In an opinion piece written by Senator Chris Back, Liberal Senator for Western Australia 7th of July 2012 he notes of reports from a "rural community in Western Australia recently in which call-outs to a bushfire failed to attract the usual response from some neighbour-brigade members due to the anger from a proposed wind farm in that community."

This is amply borne out by fact that there have been turbine fires in Australia: Starfish (2010), Lake Bonney (2006), Cathedral Rocks (2009) and Waubra (2001). At Waubra it was reported that “Local fire fighters could do little but watch the blaze from half a kilometre away as the situation was deemed too dangerous to approach, according to a local report. On arrival, WorkSafe officers then ordered fire fighters a further 500 metres away as burning tips of the blades were flying off from the structure”.

Figure 5 Lake Bonney, SA (Jan, 2006)

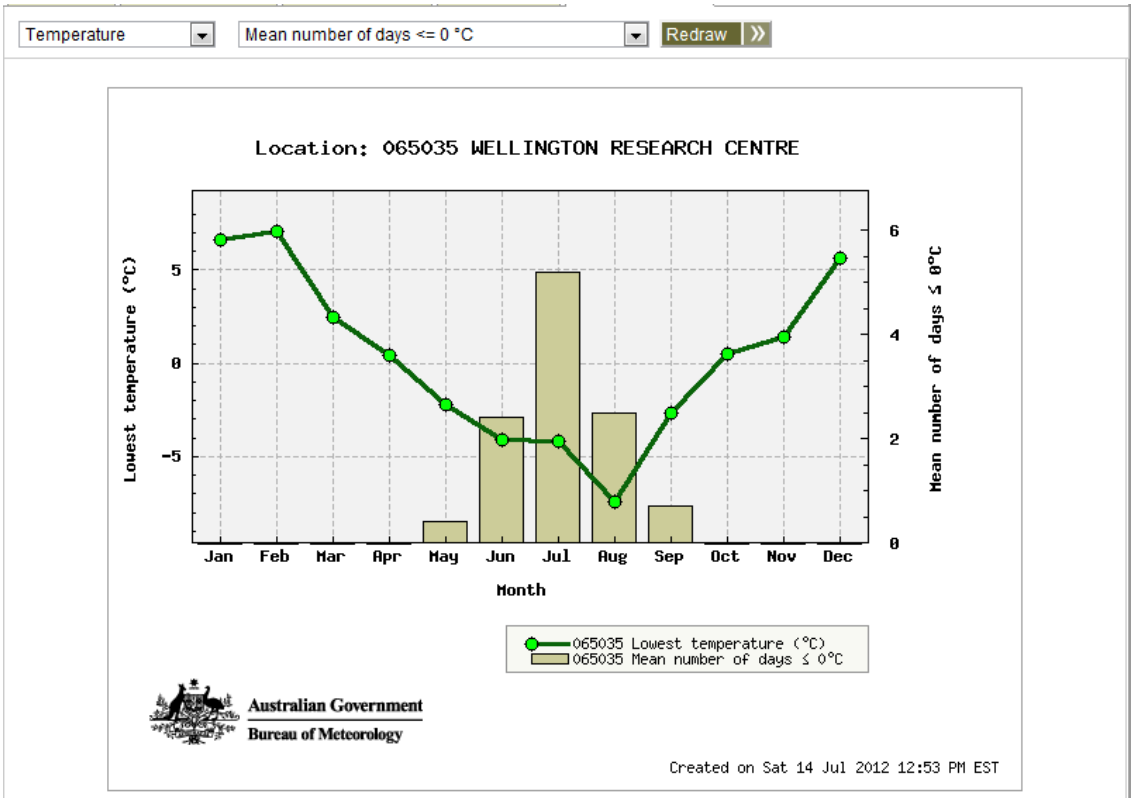
Figure 7 Cape Jervis, SA (Nov 2006)

Figure 6; Lake Bonney, SA (Jan, 2006)

If the standoff distance from a turbine fire is over one kilometre than that may put fire fighters outside the boundary of a wind farm as is the case with some of the proposed turbines.

There also poses a risk with ice throw. This has occurred in Europe so it cannot be assumed it won't occur in Australia. This is an unacceptable risk to anyone or any animal within the vicinity of an IWT. The centrifugal force at the end of the 112 metre diameter turbine 150 metres high would be great enough to throw ice quite some distance once momentum was built up.

The next graph below (Figure 8) is taken from the data supplied from the Wellington Research Centre. It shows how cold it can get in this region and the mean number of days ≤ 0 degrees Celsius which highlights the risk of ice build up on the ITW blades particularly in the months of July and August. Bushfires can occur during the winter months, (July 2012 within the proposed development area) although rarer, so this is added risk to anyone or animal with the vicinity. The IWT are generally located on ridges which gives them a distinct advantage with their already high structure to throw ice long distances. According to the EA turbines 17, 18 and 19 are located as high as 250 metres above the Mudgee Wellington main road with a distance of 660 metres from the main road. Whether this is burning blade particles or ice coming off these turbines it is clear the chance of an incident here is very much advantaged.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Lowest temperature (°C) for years 1965 to 2005	6.6	7.1	2.5	0.4	-2.2	-4.1	-4.2	-7.4	-2.7	0.5	1.4	5.6	-7.4	38
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean number of days ≤ 0 °C for years 1965 to 2005	0.0	0.0	0.0	0.0	0.4	2.4	5.2	2.5	0.7	0.0	0.0	0.0	11.2	38

Figure 8 Wellington Research Climate data

13.12.0 TERRAIN/TOPOGRAPHY

It states in the EA “the proposal will be mostly located in cleared grazing areas, with occasional scattered trees. The overall risk of bushfire to the project is low.” Where turbines are located adjacent to steep slopes and have considerable vegetation cover, the risk of bushfire is slightly higher”. This is not correct. (Refer to Fauna & Flora within this submission.) The EA doesn’t take into account the terrain or topography away from the turbine location. This is of significant importance in regard to fire fighting capability. As stated above in 15.1.2 the area within and surrounding the proposed wind farm is fire prone. Turbines are generally placed along ridge lines to capture the best wind; however fires are not restricted to just ridge lines. Generally once you move off the ridges in this proposed area and especially areas bordering the proposed area, the terrain, topography and vegetation can change dramatically making access a problem for the RFS. A burning turbine 100 -150 metres in the air has a significant advantage in spreading fire large distances very quickly if there is a hot prevailing wind blowing which is quite common in the summer months in this development area. With some of the turbines having a height advantage of 250 metres from the top of the blade to a valley below the risk of fire spreading is greatly increased. The EA states there are IWT’s proposed in forested areas and steep slopes within the wind farm project. This only adds more unnecessary risk and hazards for the NSW RFS. No IWT project should be approved in steep inaccessible fire prone country. Mount Bodangora is contained with the proposed project and access up and down this mountain is limited to one road. This makes it very dangerous to control a bushfire should it start whether from an IWT or not. Having turbines located around the mountain restricts the use of aerial fire fighting. This would be the preferred option in this case due to the terrain and accessibility around the mountain. The top of the mountain is home to several vital communication systems. Protection of these assets holds high priority.

13.13.0 AVIATION

The NSW RFS makes very good use of aircraft for fire fighting purposes especially in this region in and around this proposed wind farm. It is now standard practice to keep aircraft on standby during the fire season in this region. Fire fighting aircraft are a great asset when used in conjunction with the ground crews of the NSW RFS. Aircraft can access the steeper slopes very quickly when a fire breaks out laying out a suppression accurately onto the fire. They are also able to lay out fire breaks along ridges with the use of fire retardant. The Aerial Agricultural Association of Australia (AAAA) is the industry body that represents aerial applicators which covers agricultural aircraft used for fire fighting. The AAAA have their own policies on Wind Farms (Dated March 2011), National Aerial Fire Fighting Strategy and Powerlines policy which are located at the end of this section. When AAAA were contacted by a

local NSW RFS Captain to establish their views on wind farms in regard to the risk to agricultural aircraft, they stated they are opposed to all wind farm developments. The reply is included in this report but was not part of the EA.

AAAA is opposed to all wind farm developments – including related infrastructure such as wind monitoring towers – in agricultural areas. They represent a direct threat to aviation safety and a direct economic impact on our industry and the farmers we service.

I would appreciate you including us as an objector to any wind farms in your area. The wind farm issue is covered in some detail in our policy on wind farms that you can find at www.aerialag.com.au – under policies.

From that you will see we are opposed to all wind towers in agricultural areas and their associated infrastructure. In particular, we have identified wind monitoring towers as a safety threat to legitimate low level aviation. I also refer you to my recent evidence to the Senate Wind farm inquiry and the recent death of an agricultural pilot in the US from hitting an unmarked, un-notified tower. http://www.aph.gov.au/hansard/senate/commttee/S13670.pdf

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Professionalism = aerial agriculture
FACT: Air ag pilots have a commercial pilots licence, hold a chemical distribution licence and undertake ongoing training throughout their careers

One of the local NSW RFS Captains that has part of its brigade within and neighbouring the proposed wind farm made contact with the AAAA regarding the use of aircraft around wind turbines with reference to turbulence and safe flying distances. The reply was as follows;

"There are no guidelines – legal or otherwise - for safe distances as we have been asking the wind turbine industry association and the Federal Government to undertake studies about turbulence etc. for years. AAAA concern is that we know impermeable barriers cause turbulence up to 15 times the height of the barrier, but we are unable to find any science or research that will indicate whether this is a safety threat to aircraft.

You will have seen our policy is to flatly oppose all wind farms on agricultural or bushfire risk areas.
There has already been an air ag death from wind monitoring towers in the US – and it appears that no bureaucrat or legislator in Australia is keen to do anything."

Cheers

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Rotor wake can contain downdrafts that may exceed the performance of an aircraft, particularly at high operating weights. This hazard, combined with the undulating nature of the terrain on the wind farm site, could make aerial application of chemicals difficult on properties in the vicinity of the wind farm, particularly those within 5km downwind from the site (Rehbein Airport Consulting, Aeronautical Assessment, 2011).

Figure 9; Visible Wake Turbulence (Horns Rev, Denmark, 2010)

The EA mentions nothing about the restricted use of aerial fire fighting capabilities. As stated previously throughout this report on bushfire risks the proposed wind farm is within and neighbouring to a fire prone region. The incidence of fires especially during the summer months is high. It is common practice that the RFS brigades within and neighbouring this proposed wind farm require the use of aircraft for fire fighting purposes. Building IWT's of this size poses a direct threat to the safety and successful use of aircraft. According to AAAA' s findings on turbulence, impermeable barriers exist up to 15 times the height of the barrier which means there is unstable air from an IWT of this size out to 1680 metres. This means aircraft cannot safely manoeuvre around a wind turbine. This has consequences for safety on the ground and in the air should a pilot lose control due to turbulence. Not being able to control fires within 1.6 kilometres of a turbine is unacceptable. If ground crews are restricted to 1.0 kilometre from a burning turbine this is unacceptable. Aircraft are not allowed to fertilize or spray over the top of turbines so this also restricts the use of applying fire retardant along ridge lines should there be IWT's located there. IWT's are a direct threat to the successful safe use of aircraft for fire fighting.

In addition to the problems encountered with IWT's and aircraft there is also the problem with extra power lines required to be built to carry the power back to the sub- station and link up the IWT's where the distance for underground cabling is not an option. Extra obstacles for aircraft not only threaten the safety of aircraft but restrict the effectiveness of aerial fire fighting. In addition to this adding extra power lines in an already fire prone area is also adding to the risks associated with fire and lightening strike.

Appendix 1. Arial Agricultural association of Australia National Areal Fire Fighting Strategy

Aerial Agricultural Association of Australia
NATIONAL AERIAL FIRE FIGHTING STRATEGY

Introduction

Agricultural aircraft are ideally suited to the fire fighting role.

Similarly, agricultural pilots already hold the most senior low-level rating issued by CASA, and have thousands of hours experience of operating at very low levels delivering loads to exacting specifications.

The combination of appropriate aircraft and highly skilled pilots already available in the country in sufficient numbers is a significant resource for fire managers.

A strategic approach to the best utilisation of agricultural aircraft is essential to ensure that the States and Territories have the capacity to manage their own fire risks, have the capacity to react quickly and decisively to fires in remote and rugged terrain, and have the capacity to protect and assist ground crews in containing fires.

Importantly, the concept of aggressive initial attack and utilising fire fighting aircraft in this role is central to a strategic approach to fire fighting.

Strategic use of the available aerial agricultural fleet is far more cost-effective than purchase of a single specific role aircraft that may excel in one role but be useless in another, and which would cost taxpayers tens of millions of dollars.

There is also the benefit of not sinking all available budget into a single resource which could be lost as a result of a single accident, and which, obviously, can only be in one place at a time.

Suitable fire fighting aircraft are already available across Australia, are operated by experienced pilots, and are the most cost-effective aerial method of delivering thousands of litres of suppressant or retardant to a fire.

Background to the AAAA

The Aerial Agricultural Association of Australia (AAAA) was formed in July 1958.

The Association's Mission is to promote, foster, encourage and support a sustainable aerial agricultural industry based on the professionalism of operators, pilots and staff, and the pursuit of industry best practice.

The objectives of the Association are to :

- represent the industry to parliamentarians and appropriate government and administrative bodies
- initiate and manage programs that support and enhance the professionalism of industry members
- promote better understanding and cooperation between the industry and related industries
- promote the industry to the community to gain greater recognition of its valuable role
- initiate research that advances the industry and furthers the capability of operators
- promote a 'safety culture' within the industry.

Membership of the AAAA consists primarily of operators of agricultural aircraft. There are currently 130 active operators in Australia of which over 75% are current financial members of the Association. Our members control approximately 90% of agricultural aircraft in use and therefore AAAA feels representative of and qualified to speak on behalf of the aerial agricultural industry within Australia.

Capital investment within the industry exceeds $200 million. Agricultural aviation directly employs 2,000 personnel comprising pilots, field staff, maintenance staff and administrators. Part time positions currently number approximately 2,000.

The industry utilises nearly 300 special purpose aircraft, as well as a wide range of supporting vehicles and equipment, along with established aircraft maintenance facilities throughout the agricultural areas of Australia. The Association has its National Office based in Canberra and is governed by a Board of Directors with representation from each state and territory of Australia. The Board is in constant consultation with the Executive Officer and local agricultural operators and meets formally on a quarterly basis.

The industry has seen a period of rapid progression in all aspects of knowledge, skill and professionalism since the daredevil image of the "crop duster" existed in the 1940s. Today's agricultural pilots are highly trained and are required to be licensed under both Federal and State/Territory legislation.

Aerial fire fighting has long been a part of the industry's activities and culture, with operators considering any contribution they could make to protecting the communities they live in an important part of their ethos.

The fire fighting side of aerial agriculture has undergone considerable development over recent years with a number of operators gearing up with role-specific aircraft, adapting existing aircraft and developing a range of procedures to make fire fighting as safe and as professional as possible.

Following a discussion at the Association's Annual General Meeting in 2001, the Board of the Association agreed to member's requests for the Association to represent the interests of members involved in, or potentially involved in, fire fighting activities.

Practice in the States and Territories

A number of States maintain a strong ongoing commitment to the use of agricultural aircraft in fighting fires.

It is important to note that this commitment is based on full availability contracts for fire fighting aircraft.

Strategic Approach

A guiding principle to the issue of the use of aircraft in fire fighting must be a commitment to a strategic approach, which will result in appropriate tools being directed to appropriate tasks for the maximum effect.

This is particularly true of fires that start in rugged or remote locations, although ag aircraft's usefulness in assisting in fires in more open country has been demonstrated on many occasions.

An in-principal decision

Aircraft do not realise their potential as a fire control tool until they are integrated into the fire fighting toolbox in sufficient numbers to provide meaningful protection and support.

An in-principal decision must be made by authorities to recognise the value of aircraft in fire fighting, to offer appropriate contracts to ensure access to this resource in the fire season and to use the aircraft in an aggressive initial attack role.

Utilising an existing resource

The aerial agricultural industry invented fire bombing. The expertise of Australian aerial fire fighters has been recognised internationally, with Australian operators fulfilling overseas contracts in Italy and Indonesia.

Agricultural aircraft are specifically designed for the type of flying and product delivery involved in fire fighting.

However, investments in modern aircraft and delivery systems can cost several million dollars and operators will not invest this sort of capital on the off-chance that they will pick up a contract, or be offered an ad hoc arrangement once every few years or so.

Detection/Control of fires early - "keep fires small"

Aggressive initial attack is the key strategic principal that most fire authorities pursue.

The successful utilisation of the strengths of aircraft in fire fighting is a commitment to early intervention and to keeping fires as small as possible.

The proven ability of agricultural aircraft and pilots to accurately and quickly deliver suppressant or retardant loads onto smaller fires greatly increases their usefulness to fire authorities.

Waiting to throw aircraft into the fray when all else is lost ignores the greatest strength of the fire fighting aircraft - the ability to deliver a useful load quickly, almost regardless of terrain.

Even then, if the aircraft is used effectively when conditions make it difficult and dangerous for ground crew, it remains a very useful tool throughout the life of a fire.

Zoning of States/Territories

One method for improving the utilisation of agricultural aircraft, in addition to providing for more aircraft, would be to analyse the States and Territories in terms of fire risk, and where the need for aircraft would be greatest.

It is likely that such an approach would lead to States and Territories being categorised into areas where the terrain and fuel type could be matched to aircraft type, positioning and availability.

Once this was achieved, it would then be possible to better apply aerial resources to those parts of the State or Territory where they would be likely to do the most good during fire season.

Importantly, such an approach would enable the identification of areas of logistical shortfalls, such as key areas that may not have a suitable airstrip or readily available water. Once these issues are identified, they can be incorporated into planning and managed. For example, if a region of rugged terrain with high fuel loads was identified that did not have suitable facilities available to support aircraft, it would not be a significant cost to have an airfield suitable for ag aircraft put in, with suitable water and access available.

Aircraft set-up

Agricultural aircraft are already designed for operations that require a robust airframe, a powerful engine, good pilot protection and the ability to lift significant loads and perform dropping operations safely.

If a greater number of aircraft were included in an integrated and strategic approach to aerial fire fighting, there is little doubt that other operators would be encouraged to invest in modern equipment to be available for fire control operations.

Pilot qualifications

Agricultural pilots already hold the highest low-level qualification issued by CASA - the Agricultural Rating Grade I.

All agricultural pilots hold a commercial pilots licence. Many have accumulated thousands of hours in the air and are some of Australia's most experienced pilots.

In addition, pilots flying fire fighting aircraft have experience in 'hill' flying and the sorts of terrain and visibility issues associated with fire fighting.

All are professionals and take great pride in what they do. They have a clear commitment to identifying and pursuing best practice and to continuing their professional development throughout their career.

For example, almost all agricultural pilots are accredited under the AAAA *'Spraysafe'* program, which in turn is recognised by every State (except WA) for the issuing of a chemical distribution licence. AAAA recently launched its *'Professional Pilots Program'* to encourage pilots to maintain their commitment to professionalism and ongoing development.

Consultative committee

A key issue in any consideration of an increased use of aircraft in fire fighting is the need for expertise in the use and capabilities of aircraft generally, and ag aircraft in particular. Without first hand knowledge of the capabilities of ag aircraft and their pilots, it is very difficult to effectively manage the resource, or to arrive at an objective view of how best to utilise this resource.

AAAA would welcome the opportunity to work cooperatively with fire authorities on reviewing the protocols and procedures for the use of aircraft in fire fighting through the establishment of a National and individual State and Territory consultative committees for aerial fire fighting.

An important element in this would be to address the aircraft / fire authority interface both on the strategic level and also in terms of ensuring that there is appropriate knowledge and advice available to local fire control officers (FCOs) on the effective use of aircraft.

This would have to include training.

Equipment availability and training must also be reviewed to ensure aircraft have access to suitable support and that safety training for ground staff, who may not have ever been near an aircraft before, has been adequate.

This should include better availability of equipment to ensure aircraft can be loaded utilising equipment which most brigades would have on hand.

Recommendations

In addition to many of the comments made above, AAAA makes the following general recommendations to Government:

Governments should take an *in-principal* decision that more agricultural aircraft should be integrated into fire control activities, including their use as a tool of first defence against bush fires.

- Governments should commission a comprehensive and independent fire risk assessment project that would match aircraft to particular regions. AAAA and experienced aerial fire fighting operators should be consulted throughout the project.

- Contracted aircraft should be appropriately supported by suitable ground equipment positioned at key strategic locations across the States and Territories and the identification and, where necessary, construction of suitable landing areas for aerial fire fighting operations.

- Governments should initiate the development of suitable training for ground personnel, both management and operational personnel, in the effective use of aircraft in fire fighting. This must include significant input from AAAA and experienced aerial fire fighting operators.

- Governments should identify key positions / committees / decision-making bodies and operational structures that would benefit from input from people with experience with agricultural / fire fighting aircraft and their capabilities.

- Governments should establish a consultative committee for aerial fire fighting, where AAAA and aerial operators could work cooperatively with the relevant State/Territory fire authorities on improving the protocols and procedures for the use of aircraft in fire fighting and all related matters.

Further Information

If you require any further information, please do not hesitate to contact AAAA:

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website: www.aerialag.com.au

AERIAL AGRICULTURAL ASSOCIATION OF AUSTRALIA

13.14.0 AIR SAFETY

AIR SAFETY: Bodangora Wind Turbine Awareness Group Mudgee Alliance objects to the Bodangora Wind Farm Proposal.

13.15.0 NEARBY AERODROMES AND AIRCRAFT LANDING AREAS

13.15.1 SITING OF TURBINES

The EA states that the closest turbine to the aerodrome is 4.5km approximately from the aerodrome. **This is incorrect**. The closest turbine is **3km** from the airstrip. The runway is stated to be north –south. **This is also incorrect**.

The 05-23 runway is slightly more easterly than north east with means that aircraft using this runway would by flying through the tower area only 3km from the airstrip. This would cause extreme danger to pilots and passengers.

The other runway is 13-31 which is slightly more easterly than SE, bringing aircraft into conflict with turbines during takeoff and landing procedures.

The runway was extended in 2006 by the NSW government in order for Kingair planes to use the strip.

A water tower was constructed for bushfire use. Bushfires are very common in this area (see section on Fire hazards for exact figures)

Firebombing aircraft will have difficulty in clearing the turbines when taking off loaded, as their rate of climb to the east may be insufficient to clear those that are in the vicinity.

The Civil Aviation Safety Authority 2nd September 2011 states that *" the proposed wind farm proposal should undertake to consult with Wellington Shire Council to determine any impact on the operation of Wellington Aerodrome and to identify any other aerodromes within 30km of the boundaries of the proposed wind farm to determine any impact on the operations at such aerodromes".*

Theproponents EA stated that "no known unregistered aircraft landing strips within the immediate vicinity of the wind farm site have been identified throughout the landowner and neighbour consultation process or through a review of the aerial photography surrounding the site, however it is likely that aircraft landing strips occur in the wider locality."

There are 13 other airstrips on properties in the area used by farmers for agricultural purposes. Only a limited number of these landowners were notified of this project.

13.15.2 AVIATION HAZARD LIGHTING

No mention is made in the EA for aviation hazard lighting adjacent to the airfield. With the nearest turbine located at 3km from the airfield, standing 150m high, hazard lighting will be essential for night time use of the airport to continue. However this will also impact on the local residents of Bodangora from blade flicker.

13.15.3 WIND TURBINE NUMBERS

The large number of turbines proposed will present a hazard for any pilot, especially those pilots in training, who use Wellington Airfield for circuit practice.

13.16.0 TURBULENCE

Wake turbulence behind one single wind turbine can extend more than 16 blade diameters,

Rotor wake can contain downdrafts that may exceed the performance of an aircraft particularly those at high operating weights. This hazard, combined with the undulating terrain on the wind farm site, could make aerial application of chemicals difficult on properties near the wind farm, particularly those within 5km downwind from the site (Rehbein Airport Consulting

, Aerronautical Assessment, 2011)

The many hills and gullies in the Wellington – Bodangora area especially in the vicinity of the aerodrome, coupled with the rotor wake downdraft from the turbines would make chemical application difficult and hazardous.

Studies have shown that these impacts extend a significant distance downwind. Wind farm wake is approximately 20km, that is independent of the size of the wind farm.

"As a result of the overwhelming safety and economic impact of wind farms, AAAA opposes all wind farm developments in areas of agricultural production or elevated bush fire risk" (Aerial Agricultural Association of Australia, March 2011)

13.17.0 WEATHER

Any pilot at any time can be faced with a situation when the weather closes in, drastically reducing visibility. The presence of 33,150 m high turbines in the vicinity (3km) to the airport greatly increases the risk to the pilot and passengers.

The main airstrip's orientation means that pilots can be flying into the setting sun with reduced visibility. Again, the presence of 150 m high turbines in the vicinity greatly increases the risk to pilot and passengers.

The EA states, "The small planes that use the local airstrips will use visual rather than instrument based landings and the turbines are readily identified from long distances." This statement assumes ideal weather conditions which do not always occur when aircraft are landing and taking off.

13.18.0 RADAR INTERFERENCE

It is accepted that wind turbines can pose a risk to air traffic control and safety by the generation of two adverse effects on radar.

The tower and blades act as a reflector and present a static target to the radar system. This has the effect of swamping the receiver and making it blind to wanted targets in the immediate area beyond the turbine. This effect is constant.
The rotating blades of the turbine impart a Doppler frequency shift to the reflected radar pulse, which the radar displays as an aircraft. This effect depends on the orientation of the turbine to the radar, which varies with the wind direction.
The consequences of these effects are that in the first instance, aircraft in the vicinity of the turbines may simply "disappear" off the radar screen. In the second instance, "false targets" may be generated on the radar screen, thus appearing as aircraft that may be in conflict with other real aircraft. Both of these radar distortion effects generate significant safety concerns.
Radar is not mentioned in the EA put forward by the proponent. While radar is not a feature of Wellington Airport at this stage it is possible that in the future it will be required.

13.19.0 AVIATION BUSHFIRE FIGHTING

Wellington Council has built a water tank at Wellington Airport to supply the Rural Fire Service water bombing planes. These aircraft are fully laden on take-off and will have difficulty gaining height to clear the towers which are positioned in a direct line of the main runway.

13.20.0 AIRPORT USE

Wellington Aerodrome is not a registered airfield. CASA therefore has no jurisdiction over this airport. However the airstrip which is bitumen, and is fitted with landing lights, was recently extended by the NSW government to assist Corrective Service personnel to quickly access the gaol. The extension rapidly followed a near miss landing on the original short strip. However registered or not, it is vital that the same level of safety precautions are taken for all types of aircraft using Wellington Aerodrome. CASA states "*for registered aerodrome, wind turbines would not be allowed within 30 km."*

13.20.1 PRIVATE USE

- Ultralites
- Microlites
- Single and Twin engine

13.20.2 COMMERCIAL USE

Agricultural

Bodangora Wind Farm Pty Ltd, Infigen Energy states that *"The turbines are located on properties in which the landowner thoroughly understands the implications of the*

development and that the turbines will constrain some future aerial agricultural operations within the project area."

BWTAG does not believe that the host landowner could thoroughly understand the implications of the development. An explanation is required to have quantified the constraints on future aerial agricultural operations, which not only affect the host landowners but also those farmers adjacent to the turbine area. See Section 15.2.0.

Mining

Wellington Airport is regularly used by mining companies conducting geophysical surveys. These are low flying aircraft which will be directly affected by the turbulence created by the turbines. The location and number of the turbines will pose a serious hazard to pilots of these aircraft.

13.20.3 SERVICE AIRCRAFT USE

- RFDS

This is based in Dubbo but the Wellington Airstrip is used for the rapid retrieval of injured patients,

- Air Ambulance

The Air Ambulance is used for transport of hospital patients to major centres

- RFS

Wellington Airport is also used for the emergency retrieval of patients by air ambulance and the Royal Flying Doctor Service.

13.20.4 GOVERNMENT USE

Gaol

Wellington Airstrip has been extended to allow Corrective Service Personnel to land at the airport as it is close to the gaol.

RAAF

Wellington Airport has been used by the RAAF for training in touch and go manoeuvres using Hercules aircraft.

13.21.0 FUTURE USE OF AIRPORT

As Wellington develops with increases in mining in the area, and limestone mining at Maryvale, the need for a fully functional airport will only increase. Any threat to safety considerations in the form of wind turbines with a height of up to 180metres (equivalent to a sixty storey building) within three kilometres of the airport, must be strongly opposed, for the long term survival of this multi-purpose facility.

Wellington Airport is currently used by a diverse group of aircraft. This diversity of use requires assurances to ensure this continues with the high degree of safety that other airports (registered) enjoy where wind farms are not permitted within a 30 kilometre radius.

APPENDIX 2 ARIAL AGRICULTURAL ASSOCIATION OF AUSTRALIA WINDFARM POLICY (MARCH 2011)

Aerial Agricultural Association of Australia

Windfarm Policy

March 2011

Introduction

Windfarms and their pre-construction wind monitoring towers are a direct threat to aviation safety – and especially aerial application. They also pose an economic threat to the industry where the costs of windfarm development—including those of compensation for loss of income—are externalized onto other sectors such as aerial application.

AAAA has developed this policy so as to inform regulators, asset developers and operators alike of the need for action on their part to fulfill their duty of care to Australia's aerial applicators.

AAAA Windfarm Policy

As a result of the overwhelming safety and economic impact of windfarms and supporting infrastructure on the sector, AAAA **opposes all windfarm developments** in areas of agricultural production or elevated bushfire risk.

In other areas, AAAA is also opposed to windfarm developments unless the developer is able to clearly demonstrate they have:

1. consulted honestly and in detail with local aerial application operators
2. sought and received an independent aerial application expert opinion on the safety and economic impacts of the proposed development
3. clearly and fairly identified that there will be no short or long term impact on the aerial application industry from either safety or economic perspectives and
4. if there is an identified impact on local aerial application operators, provided a legally binding agreement for compensation over a fair period of years for loss of income to the aerial operators affected.
5. Adequately marked any wind infrastructure and advised pilots of its presence .

AAAA believes that the above processes should also apply for all windfarms that have already been approved or erected, especially the establishment of long-term (for the life of the windfarm or until it is removed, whichever is the longest) binding compensation arrangements for affected aerial application companies.

While it is not AAAA policy to provide specific comment on particular development proposals due to resource limitations, AAAA notes that windfarms can have far-reaching footprints that can remove significant amounts of land from treatment for a considerable distance from the windfarm boundary.

Operational implications of each development will vary enormously depending on the site, the positioning of the turbines, orientation of affected paddocks relative to the turbines, the type of aerial application taking place, the aircraft used, the pilot's experience, the meteorological conditions, the site elevation, the position of any airstrip relative to the turbines and a range of other variables.

However, it is clearly unacceptable that one industry can impose significant safety threats on another, longer established industry with impunity.

AAAA believes that:

- All wind monitoring towers—including guy wires—must be clearly marked to assist pilots to see them
- All wind turbines, wind monitoring towers and associated infrastructure must be required to be removed when no longer in use. A mandatory bond should be levied on all developments to ensure the site can be remediated.

Recommendations to Government

Moratorium & National Policy
AAAA recommends to all Governments the establishment of a moratorium on windfarm developments until a national COAG policy on windfarms is established that requires the following to be considered before approval:

- Competing land uses for the particular site.
- Priority for existing long-term land-uses.
- Economic and safety impacts on contracting industries such as aerial application, including the broader implications for thresholds of sustainability for contractors.
- Independent life cycle analysis of windfarms and their overall environmental impact.
- Impact on aviation safety.
- Impact on bushfire preparedness and aerial firefighting.
- Impact on visual pollution / amenity/ tourism.
- Other sources of sustainable energy.

Transparency
AAAA recommends that any 'special' or 'fast-track' planning processes established for windfarm developments be removed. All windfarm developments should be subject to the full planning processes and community consultation in each State and Territory, including appeal of decisions.

Governments should require public disclosure on a register of payments to landholders made before approval of the windfarm. This will allow other landholders and contractors to be aware of developments.

Aviation Safety
AAAA recommends that government provide better information to all windfarm developers on their responsibilities for aviation safety, including raising the duty of care requirements established under *Sheather v Country Energy* (NSW Court of Appeals) for owners of assets that pose a known threat to aviation activities to provide for suitable marking and other safety initiatives.

The Commonwealth should establish a head of power to consider and regulate windfarm developments to protect aviation safety. This should include mandatory marking and notification of wind infrastructure and the power to veto proposed developments where they interfere with aviation safety.

CASA should set a much lower than previously used height trigger for notification of tall structure developments - down to 50 feet in an area of known aerial application activity—or by using a risk assessment based approach.

CASA should work with Airservices Australia and any other relevant agencies to ensure that completed windfarms are included on suitable aviation mapping including WAC charts and topographic maps.

CASA should develop a national tall structures web database that is accessible in real time by all low-level aviation pilots and which captures all wind-monitoring towers as well as completed windfarms. The database should also capture other tall structures such as radio masts etc.

Background
CASA does not have a clear head of power or a pathway for windfarm developers to ensure the risks their developments are posing are appropriately managed so as to protect legitimate activities of low-level aviation operators.

In particular, previous CASA efforts to address this issue by requiring marking and lighting of certain towers above a certain height and within a certain distance of an airport misses the main risk to aviation and this is the wind monitoring towers as they are frequently lower than the height trigger, but still a threat to legitimate low-level aviation.

Wind monitoring towers are very tall in relation to aerial application operations, are erected within very short timeframes, are extremely difficult for any pilot to identify from the aircraft and are often not notified to aviation users because of the lack of a Government-mandated notification system and the desire of the developers to keep their positions a secret because of commercial issues.

There are two quite distinct issues arising from windfarms that affect aerial application:

- safety of the aircraft and pilot and
- economic impact on aerial applicators.

Safety Impacts
AAAA's view is that the case of *Sheather v Country Energy* (NSW Court of Appeals) clearly established that anyone with infrastructure posing a threat to aviation must consider the risks that infrastructure poses to aviation safety and respond appropriately through marking or other measures to safeguard aviation operations.

This precedent is of critical relevance to windfarm developers although not apparently widely known to them or acted upon.

Economic Impacts

Safety is not the only consideration that is imposing additional risk and consequences on the aerial application industry.

The placement of wind farms in areas of highly productive agricultural land is leading to reductions in treatment areas of aerial application companies with no compensation for this externalization of costs by wind farm developers.

For example, placement of a wind farm may affect flight lines and application height or even whether the application can be conducted at all - leading directly to either an increase in cost or a reduction in income - and sometimes both - for aerial application operators.

As windfarm developments increase in number and scale of footprints, the threshold of non-viability of aerial application in an area may be reached where it is simply not economic to base an aircraft there. In a highly seasonal industry such as aerial application, operations may already be close to this threshold and windfarm footprints may compromise the availability of a critical service.

The need to manage spray applications to ensure they are safe may mean that pest outbreaks such as locusts may not be able to be effectively controlled. Windfarms may create significant gaps in large scale treatment plans—leading to a breakdown of an overall campaign against locusts, cereal rust, noxious weeds or other pests with massive economic implications for farmers and the economy.

In particular, AAAA is concerned that not enough consideration is being given through the State planning approval processes to the impacts of windfarms on productive agricultural land and the aerial application industry, remembering that it may not only be the land footprint where the windfarm is sited, but also land surrounding that for some kilometers where aircraft may have to maneuver to conduct aerial application.

At the very least, windfarm developers should be required to pay compensation to aerial applicators where it can be reasonably established that there will be an economic impact imposed on the aerial application company by the wind farm developer.

Operational Impacts

The following potential impacts on aerial application should be considered by all windfarm developers:

- positioning of wind farms may affect local aerial application operations, depending on the particular site.
- impacts could vary from affecting flight lines to treatment height and accuracy, maneuvering areas and possibly take-off and landing splays if an airfield is nearby (see for example, CASA CAAP 92-1 for agricultural airstrips – www.casa.gov.au – search for CAAP 92-1.)
- it may not be the land or farm that the wind farm is to be situated on that will be affected. Neigbouring farms, especially any with borders close to the windfarm site, may suffer significant impacts by imposed limits on the manouvering areas of aerial application aircraft.
- a key impact may not be the turbines themselves, but the positioning of any powerline that would lead from the windfarm substation back to the grid, or any other above ground powerline that would be put in to support the development. Any sections of above ground cable should be adequately marked.
- economic impacts could include increased costs due to longer flight times required to manouver heavily laden aircraft around wind towers, a loss of accuracy due to being required to fly higher for safety reasons, an increase in liability due to the reduction in accuracy, or the complete loss of application jobs due to the landholder not wanting the area covered by windfarms to be treated.

AAAA Activities to date

AAAA has done a lot of work to make it easier to mark guy wires and powerlines – including on wind monitoring towers – through amendment of the national standard on marking of wires so as to use a marker developed by Country Energy (NSW) with the cooperation of AAAA.

There is now little practical reason why wind towers and especially wind monitoring towers should not to be clearly marked.

In addition, AAAA has attempted to provide relevant information to developers through the Wind Energy Association, but this process/ advice is voluntary and consequently will not provide coverage of all developers.

AAAA also passes on information to members that has been provided to it by wind farm developers on the physical location of wind monitoring towers. However, only a few developers provide this information and again there is little doubt that many towers are going up unmarked and unknown until hopefully spotted by pilots during pre-application inspections.

More comprehensive safeguards must include a mandatory national system of communication of the position of all wind monitoring towers and the inclusion of this on a national database accessible by low level pilots.

This is a very real issue for topdressing and firebombing operations - as wind monitoring increases, so does the threat to legal aviation activities.

AAAA Windfarm Notification Process

AAAA tries to assist aviation safety by advising those of our members on our email lists of the position of wind monitoring towers and also wind turbines when they are under construction and finally constructed, if advised by windfarm developers.

Windfarm developers are encouraged to provide these details (in lats and longs by email to AAAA) so that AAAA can pass them on to those members.

AAAA provides this facility on the basis of it being information of a general nature only and the understanding that the information, for a range of reasons (including email failure, not all members being covered by email, or non-use by members, or operational shortcomings) will not provide any guarantees of aviation safety.

AERIAL AGRICULTURAL ASSOCIATION OF AUSTRALIA

FURTHER INFORMATION

If you would like more information on the vital and responsible role the aerial application industry plays:

www.aerialag.com.au

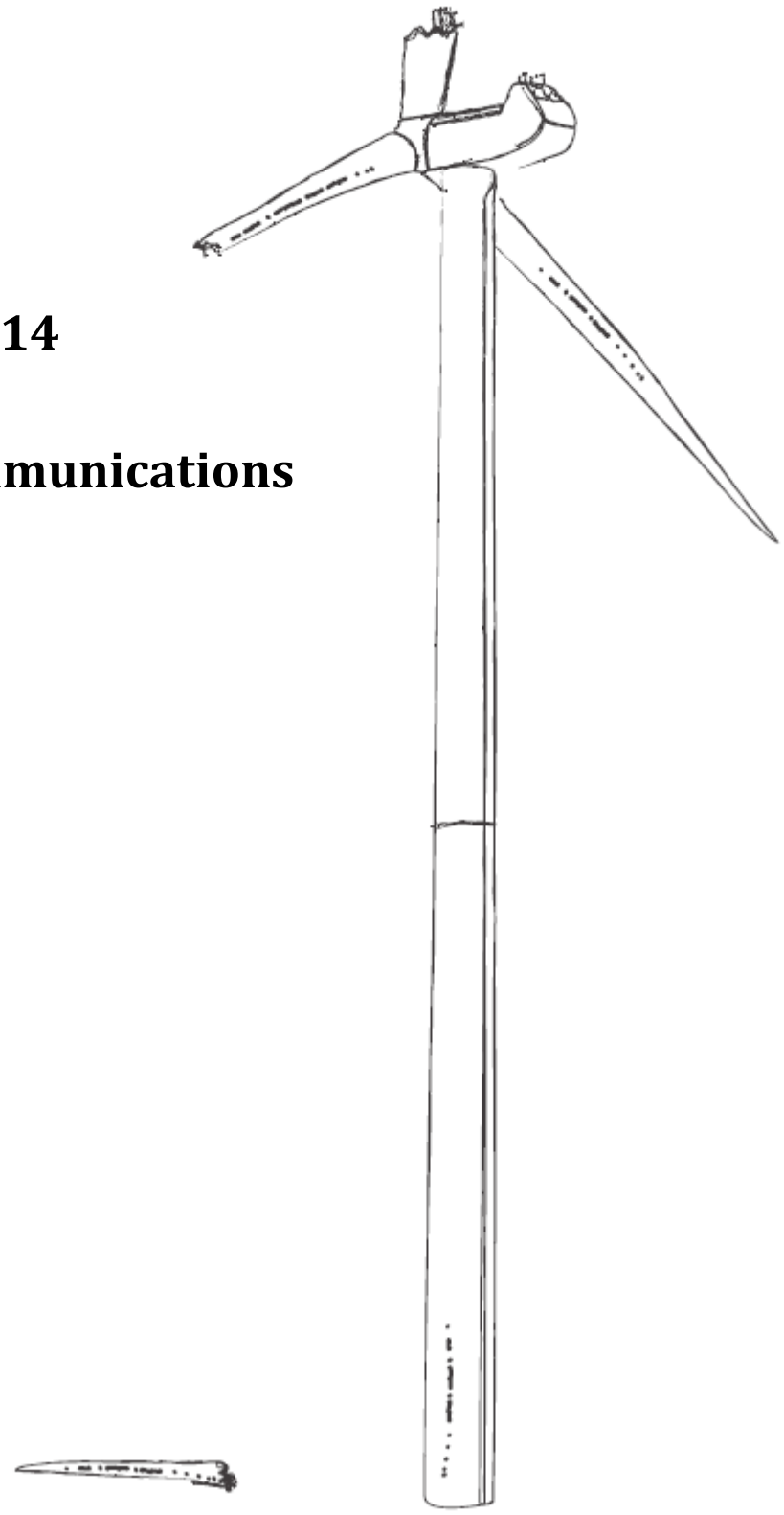
Or contact us on:
02 6241 2100 ph.

phil@aerialag.com.au

AAAA
PO BOX 353
Mitchell ACT 2911

Chapter 14

Telecommunications



CHAPTER 14 TELECOMMUNICATIONS

DIRECTOR GENERALS REQUIRMENTS

Possible effects on telecommunications systems must be identified.

In addition the proponent must consider the following NSW Draft Guidelines

1. Electromagnetic interference

The potential for a proposed wind farm to cause electromagnetic interference (EMI) with communication signals and services, such as microwave, television, radar and radio transmission signals, should be assessed. Where communication facilities are located in the vicinity of the wind.

farm, the applicant should:

- identify any signals and services which may be affected
- assess the potential for the proposed wind farm to impact on the signals and services
- consult with the relevant parties
- outline proposed measures to avoid or mitigate against electromagnetic interference impacts.

Potential electromagnetic interference effects can be calculated from information from affected telecommunications transmitting or receiving stations, local conditions, turbine design and location.

The potential for electromagnetic interference from a proposed wind farm should be minimised, if not eliminated, through appropriate turbine design, siting and mitigation. A design measure to reduce EMI is to minimising the use of turbines with metal blades or those with metallic cores. A siting measure is to avoid siting turbines in the 'line of sight' between transmitters and receivers.

If a Development Application is approved, detailed conditions of consent will be specified that aim to protect landowners in the area against electromagnetic interference and ensure that any impacts are rectified at the proponent's cost.

2. Electromagnetic fields

The assessment should consider the potential for the proposed wind farm and associated

transmission line network to generate electro magnetic fields (EMFs).

Wherever electrical equipment operates, electric and magnetic fields (EMFs) are created in the surrounding environment. The main sources of EMFs typically associated with a proposed wind farm is the electrical equipment within the turbine structures, the substation and the interconnecting underground and overhead wiring. The fields associated with these are typically localised.

Despite extensive research and numerous public inquiries, adverse health effects have not been established, but the possibility has not been ruled out. A prudent approach should be applied in designing and siting wind farm facilities. All equipment should be constructed according to industry accepted practices. Provided this occurs, the EMFs associated with the proposed wind farm will typically be well within the relevant health standards (including ARPANSA standards) and, in many cases, will be localised to areas not often frequented by people.

14.1.0 SUMMARY OF OBJECTIONS

The proponent has not considered the additional Draft guidelines in regards to telecommunications.

Telecommunications is based on studies of S-88 wind turbines and not the Vesta 112 wind turbine as outlined in the EA.

The EA is brief in general, and while some highly relevant issues such as repeater stations and the importance of UHF to land holders are barely discussed, other irrelevant topics are discussed at length.

The effect the turbines may have on the Triple Zero emergency radio communications is not even mentioned. The risk of interference to the '000' Emergency phone communication
Ch6 UHF (Emergency Channel) Open CB Radio that uses repeater stations on Mt Bodangora has not been discussed

VHF Interference for the Air Field on Mt Bodangora has not been discussed
VHF 121.5 MHz Civil Aeronautical Calling and Distress Frequency has not been discussed

VHF 243 MHz Military Aeronautical Calling and Distress Frequency has not been discussed

The effects on landholder communication is not discussed.
The document *Director General's Requirements* has no section outlining Telecommunication requirements or the expected impacts, other than **identifying possible effects on telecommunication systems.**

14.1.1 INTRODUCTION INTO TELECOMMUNICATIONS

Chapter 13 outlines the telecommunication systems in the area and states that according to their study there will be no adverse effects. However the study used to make these assertions does not actually look at the proposed model for the wind farm (Vesta 112), instead using the smaller and less powerful S-88 wind turbines. The proponent should have been required to submit evidence and data that was based on the larger turbines as this would give a "worst case" scenario which would have more accurately reflected the likely impact of the turbines.

14.2.0 MISREPRESENTATION OF INFORMATION/ IRRELEVANT INFORMATION

1. Data supplied in Chapter 13 of the EA relating to the impacts of wind turbines on telecommunications is based on studies of S-88 wind turbines; this model is smaller than the Vesta 112 wind turbine which is the intended model for the farm project. It is not made clear whether or not the results of this study (Laurence Derrick and Ass) are relevant to the impacts of the larger Vesta 112 wind turbine model. This may lead to inaccuracies and a false picture of how the turbines will affect the surrounding telecommunications systems

2. The EA is brief in general, and while some highly relevant issues such as repeater stations and the importance of UHF to land holders are barely discussed, other irrelevant topics are discussed at length. An example of this is the 13.2.1, Analogue Television, which takes up a whole section of 10 paragraphs when the report itself acknowledges analogue TV will be phased out by June 30, 2012. By the time the closing date for public exhibition of the EA has arrived, the Analogue television system will have been shut down.

   Conversely, the effect the turbines may have on the Triple Zero emergency radio communications is not even mentioned. This reflects a poorly prepared report in the assessment as it would appear that vital research has not been carried out.

3. In regards to section 13.3 *Additional consultation with telecommunication aspects,* the outcomes of the consultations between mobile coverage providers, Murray regional telecommunications, CTS and Broadcast Australia should be made available to the landholders.

14.3.0 ISSUES NOT DISCUSSED.

Inadequate information discussing the impacts of proposed wind turbines on transmission repeaters in the area. If radio repeaters are affected, interference with the following services could be expected;

14.3.1 THE RISK OF INTERFERENCE TO THE '000' EMERGENCY PHONE COMMUNICATION

No mitigation or management measures have been proposed to be put in place to ensure that relay and transmission of communication between emergency vehicles, respondents and callers will not be compromised. NSW Ambulance and the Rural Fire Service both have established communications aerials on Mt. Bodangora. No research has been carried out to determine the risk of interference from the wind turbines between emergency bases and responding vehicles (NSW Ambulance or Rural Fire Service) if attending an emergency on one of the land owner's properties in and around the immediate area of the development. The construction of the turbines will require a large number of personnel and heavy machinery. The associated risks of an accident happening, whilst unwanted, is also very real.

14.3.2 CHANNEL 6 UHF (EMERGENCY CHANNEL) OPEN CB RADIO THAT USES REPEATER STATIONS ON MT BODANGORA.

If an emergency situation has occurred, it might not always be easy or advisable to move to an area (as suggested by Chapter 13) that will receive sufficient coverage for Emergency calls. Car accidents or workplace accidents can hardly be moved 100m or so just to get radio reception. Further information should have been provided on the areas that will be affected by interrupted or decreased coverage.

14.3.3 VHF INTERFERENCE FOR THE AIR FIELD ON MT BODANGORA

If an emergency landing (e.g. Westpac helicopter) is needed to be performed on the air strip on 'Mt Bodangora', any one of the surrounding properties or on any of the roads in and around the development area then aeronautical VHF channels may be compromised. No information is contained in the EA regarding the effects the turbines may have on this communication.

Other frequencies that may be affected include:

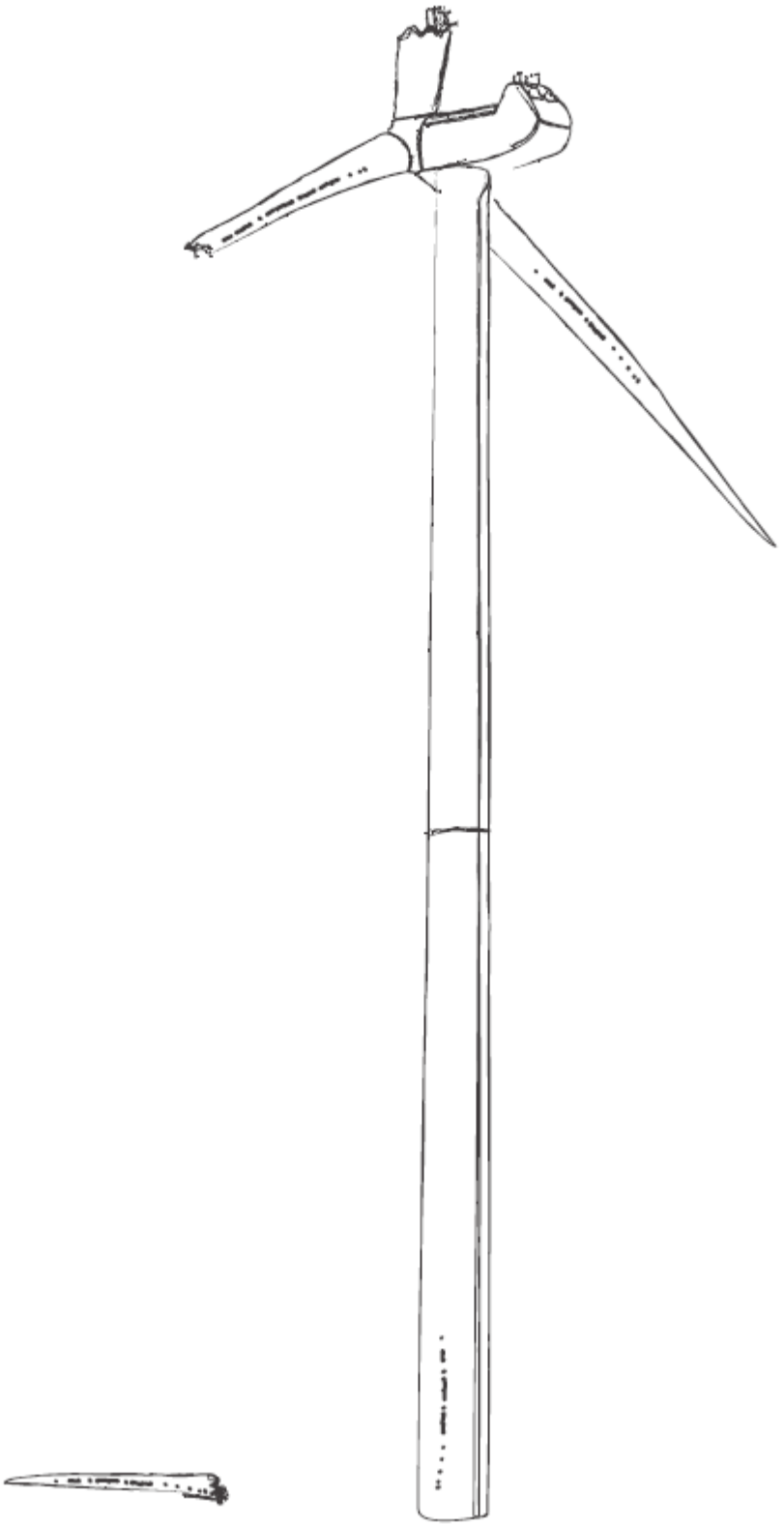
VHF 121.5 MHz Civil Aeronautical Calling and Distress Frequency

VHF 243 MHz Military Aeronautical Calling and Distress Frequency

Again, no information is contained in the EA as to how the development may affect aircraft communications on these frequencies operating in close proximity to the development area.

Chapter 15

Noise



DIRECTOR GENERAL REQUIREMENTS

The EA must

1. include a comprehensive noise assessment of all phases and components of the project including, but not limited to, turbine operation, the operation of the electrical substation, corona and/or aeolian noise from the transmission line, construction noise (focusing on high noise-generating activities and any works proposed outside of standard construction hours), traffic noise during construction and operation, and vibration generating activities (including blasting) during construction and/ or operation. The assessment must identify noise/vibration sensitive locations (including approved but not yet developed dwellings), baseline conditions based on monitoring results, the levels and character of noise (eg. tonality, impulsiveness etc.) generated by noise sources, noise/vibration criteria, modelling assumptions and worst case and representative noise/vibration impacts;

2. in relation to wind turbine operation, determine the noise impacts under operating meteorological conditions (i.e. wind speeds from cut in to rated power), including impacts under meteorological conditions that exacerbate impacts (including varying atmospheric stability classes and the van den Berg effect for wind turbines). The probability of such occurrences must be quantified;

3. include monitoring to ensure that there is adequate wind speed/profile data and ambient background noise data that is representative for all sensitive receptors;
4. provide justification for the nominated average background noise level used in the assessment process, considering any significant difference between daytime and night time background noise levels;
5. identify any risks with respect to low frequency or infra-noise;
6. if any noise agreements with residents are proposed for areas where noise criteria cannot be met, provide sufficient information to enable a clear understanding of what has been agreed and what criteria have been used to frame any such agreements;
7. clearly outline the noise mitigation, monitoring and management measures that would be applied to the project. This must include an assessment of the feasibility, effectiveness and reliability of proposed measures and any residual impacts after these measures have been incorporated; and
8. include a contingency strategy that provides for additional noise attenuation should higher noise levels than those predicted result following commissioning and/or noise agreements with landowners not eventuate.

The assessment must be undertaken consistent with the following guidelines:

- Wind Turbines - the South Australian Environment Protection Authority's *Wind Farms- Environmental Noise Guidelines* (2003);
- Substation- *NSW Industrial Noise Policy* (EPA, 2000);
- Site Establishment and Construction – *Interim Construction Noise Guidelines* (DECC, 009);
- Traffic Noise – *Environmental Criteria for Road Traffic Noise* (NSW EPA,1999);
- Vibration- *Assessing Vibration: A Technical Guideline* (DECC, 2006); and Blasting – *Technical Basis for Guidelines to Minimise Annoyance Due to*
- *Blasting Overpressure and Ground Vibration* (ANZECC 1990).

In addition the proponent must take into consideration the following NSW Draft Guidelines

(d) Noise

It is recognised by developed countries and all Australian states that wind farms need specific guidelines because wind turbines have unique noise generating characteristics including noise output that varies with wind speed and their location, which is often a quiet rural setting.

Specific *NSW Wind Farm Noise Guidelines* have been developed to provide practical guidance to proponents, planners, regulatory authorities, acousticians and the broader community on how to measure and assess environmental noise impacts from wind farms. The *NSW Wind Farm Noise Guidelines* are included as **Appendix C** to these guidelines.

The Noise Guidelines have been developed to provide greater clarity and rigour regarding the assessment and ongoing regulation of wind farm noise including:

- low frequency noise
- tonality
- excessive amplitude modulation (including the van den Berg effect)
- auditing and compliance issues

In NSW, endeavours are made to retain an acoustic amenity commensurate with the objectives of the surrounding land uses. Excluding areas affected by noise from transport corridors, these noise goals are given in Table 1.

Table 1: Noise Amenity Goals for Residential Receivers

Noise amenity

Potential sources of noise from a wind farm include:

- wind turbines
- substation

- construction
- traffic noise
- vibration

An operational wind farm can emit noise due to mechanical noise (produced by the wind turbine generators) and aerodynamic noise (produced by movement of the rotor blades through the air). The level of noise impact depends on the sensitivity of the surrounding land uses, the existing background noise levels, topography, the wind speed and its direction. Noise is also a consideration during construction. The impact of wind turbine noise should be assessed consistent with *NSW wind farm noise guidelines* provided at

Appendix C.

If agreements with landowners are proposed for areas where noise criteria cannot be met (i.e. associated landowners), sufficient information should be provided on what has been agreed and what criteria have been used to frame any such agreements. This should be undertaken with reference to sleep disturbance criteria in World Health Organisation (2009) *Night noise guidelines for Europe*.

The impacts of other noise sources from a wind farm should be assessed with reference to the following:

- *Substation* – NSW Industrial Noise Policy (EPA 2000)
- *Construction* – Interim Construction Noise Guidelines (DECC, 2009)
- *Traffic noise* – NSW Road Noise Policy (OEH, 2011)
- *Vibration* – Assessing Vibration: A Technical Guideline (DECC, 2006).

Cumulative impacts

Potential cumulative impacts should be assessed. Cumulative impacts may occur where other existing or future activities have impacts similar to the development proposed. It includes wind farms, but is not limited to wind farms, and could include other types of development. The area that needs to be considered will vary depending on the issue, and the spatial extent of the associated impact.

Cumulative impacts that should be considered where relevant include (but are not limited to)

- landscape values issues,
- noise issues
- ecological issues, including birds and bats
- aviation safety
- electromagnetic interference

Proposed mitigation and management measures (and their likely effectiveness) should be described.

Appendix B: NSW wind farm noise guidelines

Introduction

The objective of this document is to provide practical guidance to proponents, planners, regulatory authorities, acousticians and the broader community on how to measure and assess environmental noise impacts from wind farms. It is recognised by developed countries and all Australian states that wind farms need specific guidelines because wind turbines have unique noise generating characteristics including noise output that varies with wind speed and their location, which is often a quiet rural setting.

In developing this guideline, consideration has been given to guidelines developed for overseas jurisdictions as well as those used regularly in Australia including the New Zealand and South Australian guidelines. In particular this document closely follows methodologies and practices presented in the 2009 South Australian document *Wind farms - environmental noise guidelines* and Australian Standard AS4959 – 2010 *Acoustics – Measurement, prediction and assessment of noise from wind turbine generators*. This document also draws on experience gained in the assessment and operation of wind farms in NSW and from community input.

Applicability of guideline

It is proposed to strengthen the regulation of noise from wind farms under the *Protection of the Environment Operations Act 1997* with the Environment Protection Authority (EPA) having a regulatory r ole in relation to wind farms that are State Significant Development as well as existing major projects.

The standards in the guideline are intended to be used in the assessment and approval of the operational noise associated with wind farms applications under the EP&A Act. Ancillary operations such as sub stations are most appropriately assessed in accordance with the NSW Industrial Noise Policy. Assessment of construction noise from infrastructure developments such as wind farms should be undertaken in accordance with the NSW Interim Construction Noise Guideline.

Criteria in this guideline have been developed with the fundamental characteristics of wind turbine noise taken into consideration and have been established for sensitive receivers such as residences located in quiet rural noise environments. Goals for other less sensitive receivers should be developed on a case by case basis. This guideline is not intended to apply to small wind turbines, but aspects of the guideline may be adapted as appropriate.

Noise criteria

A unique characteristic of wind farms is that the noise level from each wind turbine rises as the wind speed at the site increases. This is typically accompanied by an equal or greater increase in the background noise which may completely or substantially mask the wind turbine noise.

Wind turbines typically start generating electricity at around 4 m/s (14 km/h) and reach maximum or 'rated' capacity at wind speeds of around 11 m/s (40 km/h) at the turbine's hub height. For a new wind farm development the predicted equivalent noise level (Leq, 10 minute), adjusted for any excessive levels of tonality, amplitude modulation or low frequency, but including all other normal wind farm characteristics, should not exceed:
35dB(A) or the background noise (L90) by more than 5dB(A), whichever is the greater, at all relevant receivers not associated with the wind farm, for wind speed from cut-in to rated power of the WTG and each integer wind speed in between. The noise criteria must be established on the basis of separate daytime (7am to 10pm) and night-time (10pm to 7am) periods. As shown in a typical example of a noise criteria curve presented in **Figure 1** the criteria increases with wind speed as the background noise floor increases with wind speed.

Figure 1 – Typical noise criteria curve

Wind farm noise criteria relative to NSW Amenity Noise Goals

In NSW, endeavours are made to retain an acoustic amenity commensurate with the objectives of the surrounding land uses. Excluding areas affected by noise from transport corridors, these noise goals are given in Table 1.

Table 1: Noise Amenity Goals for Residential Receivers

To ensure that the amenity of an area is not compromised, criteria have been set to restrict noise generated by wind turbines to 5dB(A) below the lowest acceptable noise criteria for a suburban or rural amenity area (which is 40dB(A) at night) unless the area experiences background noise levels higher than the average 30dB(A)1 in which case the noise criteria can be up to 5dB(A) above the L90 background noise level. These criteria apply to all periods of the day regardless of whether the acceptable amenity is higher during the day or night.
1 Average background level for an area with negligible transportation noise set by *AS 1055.2.Acoustics – Description and measurement of environmental noise*

Wind farm criteria adopted in other states and internationally

As shown in **Figure 2**, the criteria established in this document are stringent by both Australian and world standards being approximately 10dB(A) lower than most European countries which have significant experience in the management of wind farm noise. In addition, conservative estimates of where these noise levels may begin to be measured (subject to site specific topography and meteorological conditions) are shown.

Figure 2 – Comparison of NSW baseline A-weighted noise criteria with other jurisdictions

Note 1. Noise setback distances are indicative only and do not account for site specific conditions which may increase or decrease the noise level. In NSW noise setback distances typically vary between 0.8 – 1.5 km due to project and site-specific factors such as turbine configuration, design, intervening topography and vegetation.
Note 2. Both the SA and NZ guidelines also set lower levels for areas of high amenity which attract a criteria of 35 dB(A). The SA guidelines apply 35 dB(A) in land use zones where the focus of the zoning is on "rural living" rather than primary production. In NSW, most wind farm applications have tended to be in areas where the focus of the land use zoning has been on primary production (e.g. RU1 Primary Production) rather than rural living (e.g. R5 Large Lot Residential).

Negotiated agreements

Wind farm proponents commonly negotiate agreements with the owners of private land suitable for hosting wind turbines. Such agreements provide the wind farm proponent with the appropriate siting while offering the landowner a level of compensation and diversity in their income stream.

Criteria in this guideline have been developed to minimise the impact on the amenity of neighbouring properties that do not have an agreement with wind farm proponent (typically referred to as non-host or non-associated landowners).

Staged development and cumulative impacts

The procedure and criteria presented in these guidelines are for greenfield sites where no wind turbines have been installed. It is recognised that a single wind farm may be developed over a number of stages and / or that there may be a subsequent separate wind farm developed in close proximity.

To avoid any 'background creep' of the L90 noise level that may occur as a result of previous wind farm developments influencing the noise catchment, any existing wind turbine noise shall be excluded from the calculation of background noise levels. All combined (cumulative and staged) wind farm noise should meet the criteria set in these guidelines.

Undertaking measurements

The overall objective of the measurement process is to collect:

- baseline data that will assist in setting criteria;
- background noise data at intermediate locations that may ultimately assist in demonstrating compliance (these may be non-associated receivers); and
- compliance data that can be compared against criteria and previous noise measurements.

There are two important noise indices to be measured as part of establishing existing and future noise levels.

1. The measurement of background noise as defined by the 90 per cent exceeded noise level (L90) which should be measured both in the absence of any wind farm noise prior to construction and again for compliance in the presence of the operational wind farm. This allows for the assessment of impacts on the background noise levels and assists with determination of the Leq.
2. The equivalent noise level (Leq) of wind farm noise, which is mainly used for demonstrating compliance, can also be used as a screening tool to exclude data contaminated with extraneous noise due to strong relationships with the L90. To improve the collection of uncontaminated data, the criteria set in this guideline include an allowance for inter-changeability of L90 based on a relationship for wind turbine noise proposed in AS 4959 of Leq = L90 + 1.5dB(A) when measured at receiver locations. It is therefore appropriate to collect both L90 and Leq information at the same time. Additionally, detailed spectral data may also be collected to examine certain noise characteristics of the wind farm.

Measurement locations

Noise measurements should be carried out at locations that are relevant for assessing the 'worst case' impact of wind turbine noise on relevant receivers and at any intermediate locations being used to provide supplementary data. In general, any outdoor area within 30 metres of a sensitive nonassociated receiver (such as a primary residence) and in the direction of the wind farm would be a valid measuring position.

Care should be taken to ensure that selected measurement locations are not shielded from the wind farm and will be suitable as a location for any future repeat monitoring (such as during compliance). Where tall trees are present which may compromise the collection of valid noise data, then it may be justified to undertake measurements at an upwind location (the wind farm side of the trees) provided that a similar offset to the trees is adopted. The microphone should be positioned 1.2−1.5 metres above the ground and at least 5 metres from any reflecting surface (other

than the ground) and remote from any significant extraneous noise sources. Site information should be recorded and the area photographed.

Wind Monitoring Location

The same location should be used for measuring wind speed and direction for the following procedures:

- background noise measurements;
- noise predictions;
- compliance checking.

Wind speed measurement locations at the wind farm site should be representative of the wind speed at all proposed wind turbines in the noise catchment of the receiver under investigation. Careful consideration should be given to the long term suitability of these locations to ensure that any future wind turbine towers do not cause undue wind turbulence. If during compliance / complaints investigation it is not possible to obtain measurements at the same location as was used for the background noise monitoring, wind speed measurements may be measured at a nearby wind turbine site provided it is demonstrated it will return similar wind data.

Supplementary noise measurement locations

During typical operating conditions wind farm noise may be completely or substantially masked by wind or other extraneous noises. Measurement of actual wind farm noise in these conditions is often difficult and in some cases not possible. To improve the ability to undertake compliance measurements alternative techniques may be employed. Such alternate methods will need to be assessed individually and on their merits. Methods may include the use of supplementary intermediate locations between the wind farm and the relevant receiver where the signal to noise ratio is much higher, and for which there are well established theoretical and empirical relationships to the relevant receivers. Data from such sites may be used to supplement and support conclusions obtained at the receiver locations In most cases, it is expected that intermediate locations will be chosen from predicted noise contour maps and that these intermediate locations would return Leq levels of around 45 – 55dB(A) under down wind conditions or be at around 400m from the nearest turbines.

Noise data collection

The need for representative valid data is critical to the operation and on-going compliance of a wind farm. Therefore a high level of diligence is expected in the collection and analysis of noise data.

Equipment

Background noise levels should be collected for continuous 10 minute intervals using sound level meters or loggers of at least Class 2 certification in accordance with Standard AS IEC−61672 *Electroacoustics – Sound level meters*. Sound level meters used for frequency analysis must be capable of collecting data between 20 Hz and 4000 Hz and have an inherent noise floor of no greater than 20dB(A). The meters or loggers must be suitably calibrated.

Rain

If rain was recorded in the vicinity during the collection period it must be either excluded from the data set or the rain noise be shown to be at least 10dB(A) below the L90.

Wind Induced Noise

Data affected by wind across the microphone inducing 'instrumentation noise' that affects the measured noise level by more than 1dB(A) should be excluded from the data set (also refer to Section 5).

Extraneous noise

Data that is affected by extraneous noise should be excluded from the final data set. Screening tools which develop a relationship between Leq and L90 such as a difference of greater than 5dB(A) can be useful in identifying potentially contaminated data. Audio recordings can be used to subjectively analyse data for extraneous noise.

Measurement duration

Long term monitoring

It is advisable to reference historical meteorological data and forecasts to schedule the collection of noise data for when there is a high probability that worst case scenarios will be captured. This could include source-to-receiver wind vectors, stable atmospheric conditions and the like.

Data collected in both the pre and post operational monitoring phases follow a similar methodology in that both the Leq and L90 are measured over continuous 10 minute intervals and over at least the range of wind speeds from the cut-in speed to that of the maximum 'rated' power of the wind turbines. Sufficient data is considered to be approximately 2,000 valid measurement intervals (or the equivalent of two weeks' worth of data) where at least 500 of these points should be from the worst-case wind direction. Wind speed is measured in accordance with these guidelines in intervals that correlate with the ambient noise measurements.

Endeavours should be made to collect a substantial amount of data associated with the worst case wind direction from the wind farm to the relevant receiver and for speeds generally experienced at the site. A wind direction spread of 45° either side of the direct line between the nearest actual or proposed wind turbine and the relevant receiver is considered acceptable. If it appears to be impractical to collect 500 valid data points under the worstcase wind direction conditions then data collection should continue for up to 6 weeks and the

valid data collected in this period shall be deemed to be an acceptable quantity. Natural variations in background noise may occur throughout the seasons of the year due to prevailing wind direction, changes in the density of foliage or the like. Whilst these natural variations should be accounted for, data measured during known extraneous noise events should not be included in the analysis.

Attended monitoring

Data collected whilst an acoustician is present to validate or identify extraneous noise can be used for compliance measurements at a single receiver. The monitored noise is to be accurately recorded and extraneous noise should be excluded from the data analysis either during the data acquisition or post-acquisition data processing. Attended monitoring should include at least four site visits with each visit including eight hours of monitoring or more and equally including day and night time periods. Measurements should be taken when the wind direction corresponds to the worst case scenario. It will usually require periodical shut down of wind turbines to enable a determination of the noise contribution associated with operation of the wind farm.

If an alternative technique enables reliable monitoring of the wind farm noise using Leq descriptor, it should be measured and reported as such. Comparison of the noise criteria with the wind farm noise should also be performed using the Leq indices or equivalent.

Wind data collection

Microphones should be protected with windshields, and the accuracy of the wind speed measurements at the microphone should be ±0.5m/s or better. Wind speed must be made in 10-minute intervals that correlate/synchronise with the background noise data collection.

Microphone height

For measurements made at receiver or intermediate points the anemometer must be placed at the same height as the noise microphone (i.e. between 1.2 - 1.5m above the ground).

Hub height

Wind speeds (in m/s) should be measured at the proposed wind turbine hub and relevant intermediate heights for the range of meteorological conditions expected. The noise level data at hub height for each wind turbine is used to predict the total noise level from a wind farm. Wind speed at the wind farm site and background noise at the relevant receiver must be correlated so that background noise and wind farm noise can be compared.

Wind speed measurements at other heights must be obtained to allow wind shear calculations to be made. Final wind turbine design may result in different heights to those originally proposed. In these cases the measured data can be extrapolated to the final design hub height using the equation below. In all cases atmospheric stability conditions should be taken into account to ensure accurate conversion of the data.

Wind shear factor

$\alpha = \log(V1/V2)/\log(H1/H2)$

where α = wind shear factor

Extrapolated wind speed V1 = wind velocity at originally proposed hub height in m/s

VFHH = $V1/(H1/HFHH)\alpha$ V2 = wind velocity at comparison height in m/s

H1 = originally proposed hub height in m

H2 = comparison height of V2 in m/s (to be within 30m of the original proposed hub height)

HFHH = final hub height in m

VFHH = wind velocity at final hub height in m/s

Data analysis

A best fit regression analysis should be carried out on the data. The polynomial order (from linear up to third order) providing the best correlation coefficient should be used to present the fitted regression line to calculate the background noise level (*Lb*). The correlation coefficient should be specified for each polynomial order. If a higher order of polynomial is used, its use should be justified. Background noise typically demonstrates an incremental trend if the wind speed increases.

The graph for each relevant receiver showing the plotted points, the fitted regression line, the polynomial describing that line and the correlation coefficient should all be

reported. A table clearly showing the results for each integer wind speed from cut-in speed to the rated power should be prepared. A typical graph is shown below.

Figure 3 – Background noise at the receiver vs wind speed at wind farm
Wind speed m/s
Management of specific noise characteristics

These guidelines have been developed with the fundamental characteristics of wind turbine n
presence of excessive levels of specific noise characteristics.

Tonality

It is recognised that the emergence of discrete frequency bands in the broader frequency spectrum can increase adverse reaction to a particular noise. These tonal characteristics typically do not occur in well designed and well maintained wind turbines. If present, they are typically caused by a maintenance issue.
Y = 0.0024x2 + 2.2189x + 22.379
R2 = 0.6398
For the purposes of this guideline, the presence of excessive tonality is defined as when the level of one-third octave band measured in the equivalent noise level Leq(10 minute) exceeds the level of the adjacent bands on both sides by:

- **5 dB or more** if the centre frequency of the band containing the tone is above 400Hz
- **8 dB or more** if the centre frequency of the band containing the tone is 160 to 400Hz inclusive
- **15 dB or more** if the centre frequency of the band containing the tone is below 160Hz

If tonality is found to be a repeated characteristic of the wind turbine noise, 5dB(A) should be added to the predicted or measured noise level from the wind farm. If tonality is only identified for certain wind directions and speeds, the penalty shall only be applied to measurements made under those meteorological conditions.

The tonal characteristic penalty applies only if the tone from the wind turbine is audible at the relevant receiver. Absence of tone in noise emissions measured at an intermediate location is sufficient proof that the tone at the receiver is not associated with the wind farm's operation.

Amplitude Modulation

Amplitude modulation (AM) refers to aerodynamic noise from a wind turbine's blades, and is sometimes referred to as 'swish' or 'thump'. Noise from a wind turbine typically includes an inherent level of reasonable amplitude modulation. The criteria in these guidelines have been determined with the inherent characteristics of wind

turbine noise – including reasonable levels of amplitude modulation – taken into consideration.

An excessive level of modulation is taken to be a variation of greater than 4dB(A) at the blade passing frequency. If excessive modulation is found to be a repeated characteristic of the wind turbine noise, 5dB(A) should be added to the predicted or measured noise level from the wind farm. If modulation is only identified for certain wind directions and speeds, the penalty shall only be applied to measurements made under those meteorological conditions.

The modulation characteristic penalty applies only if the modulation from the wind turbine is audible at the relevant receiver. Absence of excessive modulation in noise emissions measured at an intermediate location is sufficient proof that the modulation is not a feature of the wind farm.

Low frequency noise

Low frequency noise is present in all types of environmental noise and is particularly difficult to measure when in the presence of wind. Analysis of wind turbine spectra shows that low frequency noise is typically not a significant feature of modern wind turbine noise and is generally less than that of other industrial and environmental sources.

If it is shown that the C-weighted noise (measured from 20Hz upwards) from a wind farm (excluding any wind induced or extraneous C-weighted noise) is repeatedly greater than 65dB(C) during the daytime or 60dB(C) during the night-time a more detailed low frequency noise assessment should be undertaken.

Should a detailed assessment confirm that excessive levels of low frequency noise above the human threshold of hearing are occurring internally at non-associated residences (as described in the UK Department for Environment, Food and Rural Affairs document *Proposed criteria for the assessment of low frequency noise disturbance*), then a 5dB(A) penalty should be applied to the predicted or measured noise level from the wind farm for the periods and meteorological conditions under which the low frequency noise has been identified.

It should be noted that the low frequency characteristic penalty applies only if excessive low
frequency noise is present, or predicted to be experienced at the relevant receiver. If C-weighted measurements at intermediate location(s) extrapolated to non associated receivers using relevant geometric spreading techniques demonstrate

that C-weighted noise levels are less than the trigger levels, this is considered sufficient to demonstrate an absence of excessive low frequency noise impacts.

Definitions and additional management of noise characteristics

Definitions and additional management of specific noise characteristics are listed below:

- ***A single exceedance***
- A single exceedance occurs when wind farm noise displays a characteristic described in Section 6.1.1 to 6.1.3 for a 10 minute averaged period. Where this occurs, a penalty shall be applied to the identified equivalent noise level Leq (10 minute) data point and this point is to be included in the data set.
- ***A repeated exceedance***
- A repeated exceedance occurs when single exceedance events occur for more than 10% of an assessment period. An assessment period is defined as day (7am – 10pm) or night (10pm – 7am).
- ***A sustained exceedance***
- A sustained exceedance occurs when a repeated exceedance is shown to occur for greater than 30% of a season. A season is defined as either Spring, Summer, Autumn or Winter.

Should a sustained exceedance be identified then operation of the wind farm should be modified to ensure that those wind speeds and directions that cause exceedances of noise
characteristic goals are minimised.

The above definitions refer to valid wind farm noise only.

Application of Penalties

Should penalties be applicable for specific noise characteristics then a maximum penalty of 5dB(A) shall be added to the relevant time period.

Noise predictions

The noise level associated with the wind farm should be predicted at all locations identified as relevant receivers under these guidelines, for wind speeds from cut-in speed to the speed of the rated power and each integer speed in between. Where wind farms are shown to comply with the noise level criteria in these guidelines up to the turbine's maximum rated power, it is unlikely that adverse impacts will occur at higher wind speeds and the wind farm is considered to be in compliance at these higher wind speeds.

Noise propagation model

A suitable model must be selected (or developed) to predict the 'worst-case' noise level at all relevant receivers and at any proposed intermediate points. There is no standard procedure directly applicable to sound propagation from wind farms although ISO9613−2: 1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* or the CONCAWE noise propagation model is commonly used.

The noise level at the relevant receiver locations should be predicted, allowing for the propagating effect of wind in the direction from the wind farm to the receiver at each reportable wind speed.

The intent, is to predict a worst- case scenario whilst recognising that in practice there will be different wind directions and speeds between each WTG on a wind farm site and the relevant receiver which will reduce the actual noise level when compared to that predicted under worst-case conditions.

A conservative approach should be used for predicting wind farm noise by calculating noise levels in relative octave bands to determine an overall predicted level.

The details of the model should be clearly stated and the approach documented.

The following information should be provided as part of the noise impact assessment:

- the propagation model, and any variation of the model, used for the prediction;
- an estimate of the model accuracy in dB(A) referenced and peer reviewed papers;
- the assumptions used as input to the model, including allowances for noise absorption due to air, ground, topographical and wind effects.

Noise levels should be predicted by an appropriately qualified and experienced acoustician. Details of the acoustician's qualifications and experience should be included in the assessment report.

Micro-siting of turbines

Micro-siting of turbines up to 100m from each turbine's nominated location will generally be permitted. Noise levels at receivers must be based on the 'worst case' turbine layout / configuration having regard to any micro-siting.

Noise model calibration

The results of compliance noise monitoring should be used to further calibrate the noise model developed for the project and to identify any areas of concern or additional testing requirements.

Noise assessment report

The applicant must prepare a report detailing the noise assessment undertaken and include this as part of the applicant's Environmental Impact Statement (EIS). As a minimum, the noise assessment report must include the following information:

- background noise measurement locations;
- time and duration of the background noise monitoring regime;
- wind speed monitoring locations and heights above ground;
- graphical correlation plot of the wind speed versus background noise level data;
- a summary of the environmental noise criteria for the project at each integer wind speed based on the correlation;
- the make and model of the representative wind turbine(s);
- the positions of the wind turbines;
- the model used to predict the wind farm noise levels;
- the input assumptions and factors used in the model;
- the predicted noise levels at the closest dwellings to the wind farm at each integer wind speed;
- a comparison of the predicted noise levels against the criterion at each integer wind speed for the closest dwellings to the wind farm;
- the modifications or operating strategy that would be employed to address any unforseen noncompliances.

Equipment, methodologies and documentation used and prepared in the prediction of wind farm noise and subsequent compliance should be outlined in the Noise Management Plan and be of a standard that will allow completion of an independent review if required and shall be commensurate with the risk and size of the proposal. The Department of Planning and Infrastructure shall determine whether an acceptable standard has been met.

Assessing compliance

The 'worst-case' noise propagation conditions predicted using the procedure in these guidelines typically won't occur during the operation of the wind farm or will only occur a minority of the time.

The actual impacts will therefore typically be less than the predicted worst case impacts.

Notwithstanding this, the prediction process in these guidelines relies on assumptions about a range of inputs. The compliance procedure outlined below is a means of confirming that the actual noise levels comply with the criteria and predicted impact.

Conditions of consent

If a Development Application for a wind farm classed as State Significant Development is granted consent, conditions of consent will require the applicant to undertake noise compliance monitoring.

This includes a requirement for the applicant to prepare and submit a Noise Compliance Report within 12 months of the commencement of operation of the wind farm. Noise monitoring must be undertaking during period(s) commensurate with the 'worst case' operational and meteorological factors (including temperature inversions). Any relevant special audible characteristics including tonality and modulation-related noise from the wind turbines and any cumulative noise impacts from the operation of the turbines and substation must also be considered. The applicant must make the Noise Compliance Report publicly available including to the community consultation committee and on the proponent's website.

Independent review

A condition of consent will also be included so that a neighbour may ask the Director-General in writing for an independent review of the impacts of the wind farm project on his/her land. If the Director-General is satisfied that an independent review is warranted, then the Director-General may require the proponent to commission a suitably qualified, independent expert, whose appointment has been approved by the Director-General, to consult with the landowner to determine his/her concerns, and conduct monitoring to determine whether the project is complying with the relevant impact assessment criteria.

If the project is not complying with these criteria then measures to ensure compliance with the relevant criteria must be identified and implemented in consultation with the affected neighbour. Alternatively, the proponent may seek to secure a written agreement with the neighbour to allow exceedances of the relevant criteria to occur. A copy of the independent review must be provided to the Director-General and the affected neighbour.

Compliance data

Where background data needs to be collected or confirmed after operation of the wind farm has commenced then this may be achieved with the wind turbines parked / offline or with the wind turbine rotor revolutions below 2 revolutions / minute. Alternative methods may also be proposed. The data to be analysed should be representative of all wind speeds above the cut-in speed of the wind turbines.

This guideline recommends that noise compliance monitoring be repeated at different seasons of the year where warranted by community concerns. If data adjusted for special noise characteristics (if needed) is below the criteria it should be

reported as such and no further data analysis or additional noise measurements are required.

As per the methodology described in Section 3 operational wind farm valid Leq and L90 data delineated into day (7am – 10pm) and night (10pm – 7am) periods is collected at relevant non-associated receiver locations and any proposed intermediate monitoring locations. Where collection of valid Leq data at the relevant receivers (not at any intermediate monitoring locations) proves difficult to distinguish above the ambient background noise level, then the Leq is taken to be equivalent to the L90 + 1.5dB.

Analysis of wind farm noise measurements

Regression analysis of both the pre and post wind farm data should be compared and the results compiled.

Calculation of wind farm equivalent noise level (Leq)

To identify the contribution of the wind farm to the total noise level and hence the wind farm's equivalent noise level (Leq), the Leq (or adjusted L90) noise level before the wind farm is installed needs to be logarithmically subtracted from the Leq (or adjusted L90) after the wind farm is installed. The resultant noise level can then be compared against the criterion for the relevant integer wind speed.

Additional management

In the event that an exceedance is identified through compliance monitoring, the proponent must identify the meteorological conditions under which the exceedance occurs and take all reasonable and feasible measures to resolve the non-compliance including a timetable for their implementation.

Measures may include, but are not limited to, sector management to eliminate the occurrence of exceedances under the identified problematic meteorological conditions and/or negotiation with the affected resident. If a compliance issue is not resolved, the regulator may restrict operation of the wind farm until satisfied that acceptable operation of the wind farm can be demonstrated.

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23 July 2012

L345

Let1

Lyn Jarvis

Bodangora Wind Turbine Awareness Group

L Huson & Associates has been commissioned by the Bodangora Wind Turbine Awareness Group
to review an Environmental Noise Assessment for the Bodangora Wind Farm prepared by Sonus Pty
Ltd dated May 2012 (Report).

Review
The Report is required to be prepared in accordance with Director General"s Requirements (DGR) for
the Bodangora Wind Farm and it is stated in the Report that it has been.

The main parts of DGR relating to noise follows:

Noise Impacts – the EA must:

Include a comprehensive noise assessment of all phases and components of the project

including, but not limited to, turbine operation, the operation of the electrical substation, corona
and/or Aeolian noise from the transmission line, construction noise (focusing on high noise- generating activities and any works proposed outside of standard construction hours), traffic noise during construction and operation, and vibration generating activities (including blasting) during construction and/ or operation. The assessment must identify noise/vibration sensitive locations (including approved but not yet developed dwellings), baseline conditions based on monitoring results, the levels and character of noise (eg. Tonality, impulsiveness etc.) generated by noise sources, noise/vibration criteria, modelling assumptions and worst case and representative noise/vibration impacts;

In relation to wind turbine operation, determine the noise impacts under operating meteorological conditions (i.e. wind speeds from cut in to rated power), including impacts under
meteorological conditions that exacerbate impacts (including varying atmospheric stability classes and the van den Berg effect for wind turbines). The probability of such occurrences must be quantified;

Include monitoring to ensure that there is adequate wind speed/profile data and ambient background noise data that is representative for all sensitive receptors;

Provide justification for the nominated average background noise level used in the assessment process, considering any significant difference between daytime and night time background noise levels;

Identify any risks with respect to low frequency or infra-noise;

If any noise agreements with residents are proposed for areas where criteria cannot be met, provide sufficient information to enable a clear understanding of what has been agreed and what criteria have been used to frame any such agreements;

Clearly outline the noise mitigation, monitoring and management measures that would be applied to the project. This must include an assessment of the feasibility, effectiveness and reliability of proposed measures and any residual impacts after these measures have been incorporated; and

Include a contingency strategy that provides for additional noise attenuation should higher noise levels than those predicted result following commissioning and/or noise agreements with landowners not eventuate.

Noise (DRG dated 18/4/2012 regarding Draft NSW Wind Farm Planning Guidelines)

- Undertake assessment based on separate daytime (7am to 10pm) and night-time periods (10pm to 7am).
- Predict noise levels at all dwellings within 2km of a proposed turbine.
- Consider special audible characteristics, including tonality, amplitude modulation, and low frequency noise (apply penalties where relevant).
- Outline measures to avoid, minimize, manage and monitor impacts.
- Outline program to monitor environmental performance to ensure compliance including mechanisms for reporting outcomes and procedures to rectify non-compliance – including any provision for independent reviews.

The assessment must be undertaken consistent with the following guidelines:

Wind Turbines – the South Australian Environment Protection Authority's *Wind Farms –*
Environmental Noise Guidelines (2003);
Substation – *NSW Industrial Nose Policy* (EPA, 2000);
Site Establishment and Construction – *Interim Construction Noise Guidelines* (DECC, 2009);
Vibration – *Assessing Vibration: A Technical Guideline* (DECC, 2006); and

Blasting – *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure*
and Ground Vibration (ANZECC 1990).

Upon reviewing the report we find that the following issues have not been addressed at all or have been addressed only in part or inadequately:

corona and/or Aeolian noise from the transmission line (Not addressed at all);

any approved but not yet developed dwellings (Not addressed at all);

impacts under meteorological conditions that exacerbate impacts (including varying atmospheric stability classes and the van den Berg effect for wind turbines). The probability of such occurrences must be quantified. (Probability not addressed at all, van den Berg effects not fully addressed)

adequate wind speed/profile data and ambient background noise data that is representative for all sensitive receptors. (The SA Guideline recommends 2000 data points and the DRG require assessment at night. It would logically follow that a robust data set would need 2000 data points at night and the monitoring period fails to attain the number of data points at night. Wind speed / profile data is often referred to as wind shear and this data is not presented)

risks with respect to low frequency or infra-noise (only cursory anecdotal data is presented for infrasound that is misleading)

a clear understanding of what has been agreed and what criteria have been used to frame any such agreements. (It would be useful to examine the type of Agreement that would be offered)

a contingency strategy that provides for additional noise attenuation should higher noise levels than those predicted result following commissioning and/or noise agreements with landowners not eventuate. (Not addressed at all)

Draft NSW Wind Farm Planning Guidelines. (Addressed in part)

Noise monitoring and compliance program (Not addressed at all in the Report although Infigen state that they will conduct noise compliance monitoring as per its other wind farm developments in NSW – Attachment C. We suggest that the noise monitoring program proposed be submitted for review as required by the Draft NSW Wind Farm Planning Guidelines.)

Specific comments on the Report

Amplitude modulation is suggested in the Report to be a normal characteristic of wind farm noise emissions, however, the Draft NSW Wind Farm Planning Guidelines suggests a test where "An excessive level of modulation is taken to be a variation of greater than 4dB(A) at the blade passing frequency." It is highly likely that the wind farm hosts experiencing up to 45 dB(A) noise exposure would

experience such modulation that would warrant a 5 dB(A) penalty and so exceed the noise criteria.

The problem with NSW referencing a guideline from another state (SA) is in the relationship with other legislation. For example, the SA Wind Farm Guideline 2003, when dealing with less stringent noise limits for hosts of the turbines, states

"Notwithstanding this, the EPA cannot ignore noise impacts on the basis that an agreement has been made between the developer and the landowner. Developers cannot absolve themselves of their obligations under the Act by entering into an agreement with a landowner.

If it is shown that a development is having an „adverse effect on an amenity value of an area that unreasonably interferes with the enjoyment of the area" then appropriate action can be taken under the Act. "

The Draft NSW Wind Farm Planning Guidelines and the SA Wind Farm Guideline requires an assessment of the uncertainty of the prediction model used to be included in a noise assessment report. This has not been done. Uncertainty in the sound power input to the model should also be considered in separate addition to the stated limitations of the model used. The equations used in ISO9613 have limitations which increase uncertainty above +/-3 dB for receiver distances over 1000m and for sound sources above 30m high. The model is also limited to wind speeds below about 5m/s.

Wind speed at each receiver location considered appropriate for background surveys has not been taken, contrary to the requirements of the SA Guideline 2003: "Affected data can be identified by monitoring the wind speed at the noise measurement position (1200 -1500 mm above ground level at the relevant receiver) over 10-minute intervals that correspond with the noise level measurement intervals. " We have similar concerns regarding correct removal of rain affected data since only one of the monitored sites had a rain gauge.

The noise model used for the Report is ISO 9613 and parameters used have been listed. One of the major parameters that affect sound propagation results is the ground absorption factor G. A value of G=0.5 has been used for 50% intervening absorptive ground. However, although the 2003 version of the SA Wind Farm Guidelines is mute on the subject the 2009 version states that a ground absorption of G=0 should be used. This will increase sound propagation by some 2 dB and we question the use of G=0.5 in Australia. The Report references advice from a group of acoustic consultants in the UK where a G=0.5 may indeed be appropriate. We recommend that the predictions should use G=0.

With regard to noise modeling it is instructive to read the abstract to one of the van den Berg papers[1] regarding night time wind profile:

"Since the start of the operation of a 30MW, 17 turbine wind park, residents living 500m and more from the park have reacted strongly to the noise; residents up to 1900m distance expressed annoyance. To assess actual sound immission, long term measurements (a total of over 400 night hours in 4 months) have been performed at 400 and 1500m from the park. In the original sound assessment a fixed relation between wind speed at reference height (10 m) and hub height (98 m) had been used. However, measurements show that the wind speed at hub height at night is up to 2.6 times higher than expected, causing a higher rotational speed of the wind turbines and consequentially up to 15 dB higher sound levels, relative to the same reference wind speed in daytime. Moreover, especially at high rotational speeds the turbines produce a 'thumping', impulsive sound, increasing annoyance further. It is concluded that prediction of noise immission at night from (tall) wind turbines is underestimated when measurement data are used (implicitly) assuming a wind profile valid in daytime."

The Report has not addressed this issue adequately in our opinion and should provide wind shear data for the site over an extended period to justify why such conditions will not prevail at the Bodangora wind farm site, rather than reference court proceedings that deal with another site.

Statements referenced in the Report regarding cumulative effects are misleading. When put in context with other required reference documents it is clear that cumulative effects are not ignored by the use of a 35 dB(A) base noise level. This issue was clarified in the 2009 version of the SA Guideline and in the Draft NSW Wind Farm Planning Guidelines.

Emphasis has been made throughout the Reports that the target noise limits are „significantly more stringent" than other wind farm guideline limits. This is not true. The NZS6808:2010 standard has a 35 dB(A) noise level for high amenity areas, which we believe would be applicable to the Bodangora dwellings. Furthermore, the general assumption that the attenuation of noise from outside to inside a dwelling with windows open is not 15 dB, but often much less at around 5 dB for particular properties.[2] It is not clear from the data presented in this particular reference if the outside sound levels outside were free field, as predicted in the Report. If a free field correction is applied then the sound reductions quoted would be some 2.5 dB lower.

This would then make a 35 dB(A) base outside noise level target perfectly reasonable to attain the generally recommended internal noise level of 30 dB(A), Leq to protect sleep.

An example is shown in the following chart of actual outside and inside dB(A) sound levels measured simultaneously for a dwelling in Victoria with one window partially open that clearly show attenuation of between 2 dB and 8 dB. The peaks and troughs match the blade pass of the wind turbines.

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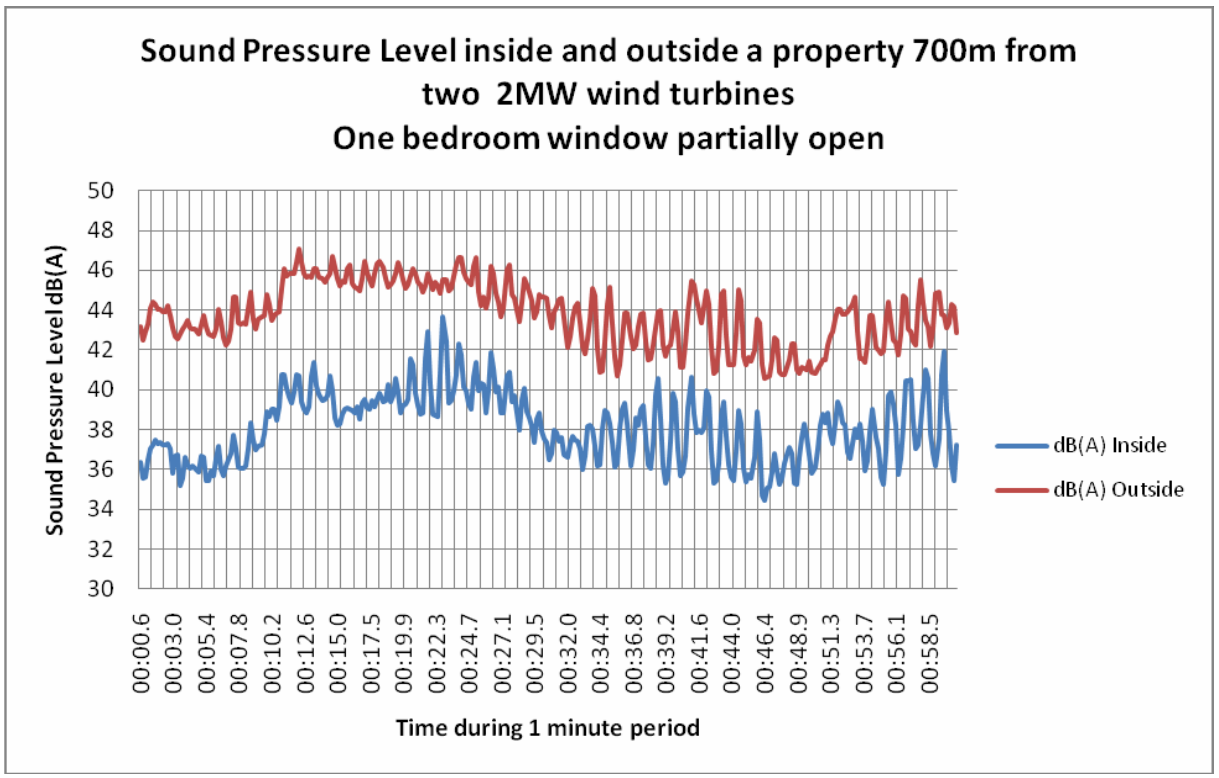
[1] van den Berg, G.P.. Effects of the wind profile at night on wind turbine sound. Journal of Sound and Vibration 2003

[2] Ryan, M. et al Noise Reduction through Facades with Open Windows. Acoustics 2011, Gold Coast

The amplitude modulation shown in this example is often higher inside than outside the dwelling.



The part of the Report dealing with low frequency noise on page 18 suggests that masking will occur due to local wind in foliage and the like. However, it is not uncommon for wind to be high on a ridge at the turbines but to be still at the dwelling, as pointed out in the Report on page 16, 2nd paragraph. Under these conditions little or no masking will occur.

The contingency strategy on page 20 of the Report describes how low noise operating modes may be implemented for the example wind turbine (Vestas V112). However, this particular wind turbine is only an example and another turbine option may not have this function available. In the event that another turbine is chosen that does not have low noise operating modes there is no contingency offered.

Page 20 of the Report presents misleading information regarding infrasound. DEFRA research showed at 360m levels up to 80 dB(G) from a modern wind farm. The following chart is an extract from a UK DTI report prepared by Hayes Mckensie Partnership in their report on low frequency noise in 2006. It shows that a significant amount of infrasound energy can be generated from a wind farm (in this case up to 80 dB(G) at higher wind speeds).

The commonly used statement that „infrasound is not a significant feature of modern wind farms „(e.g. SA wind farm guidelines and in the Report) is clearly not true.

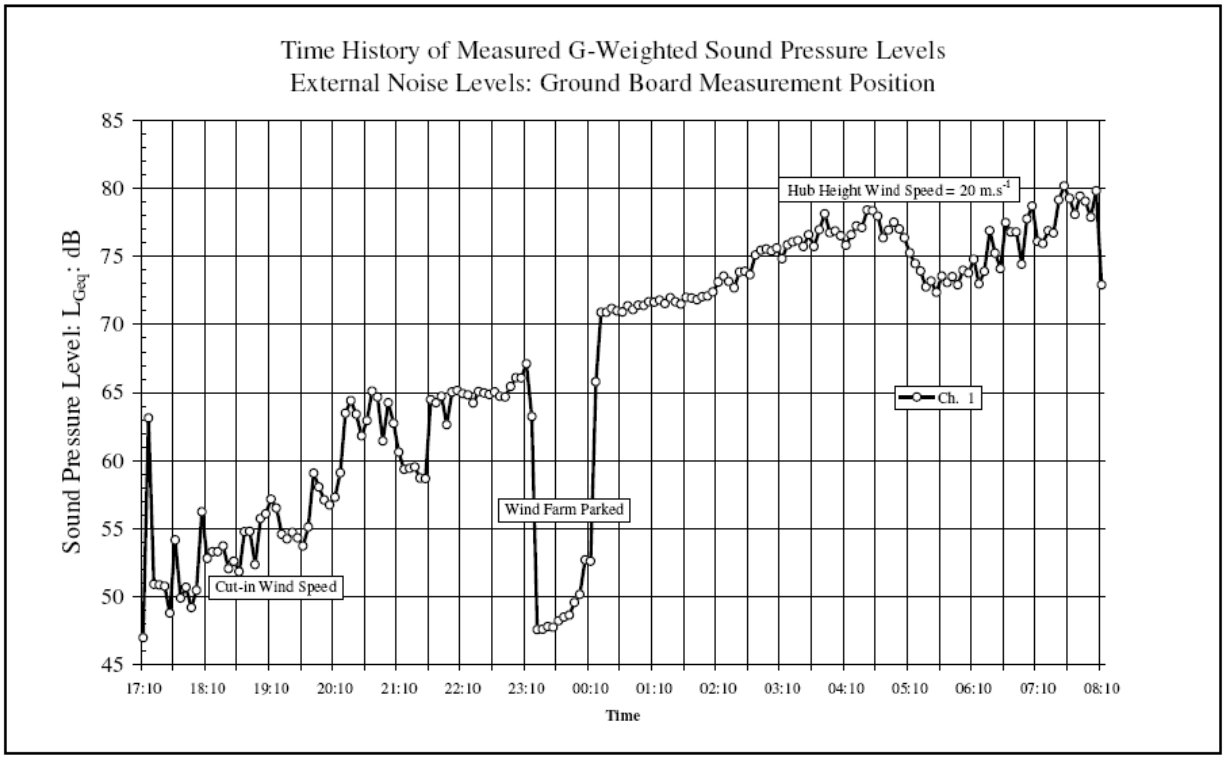
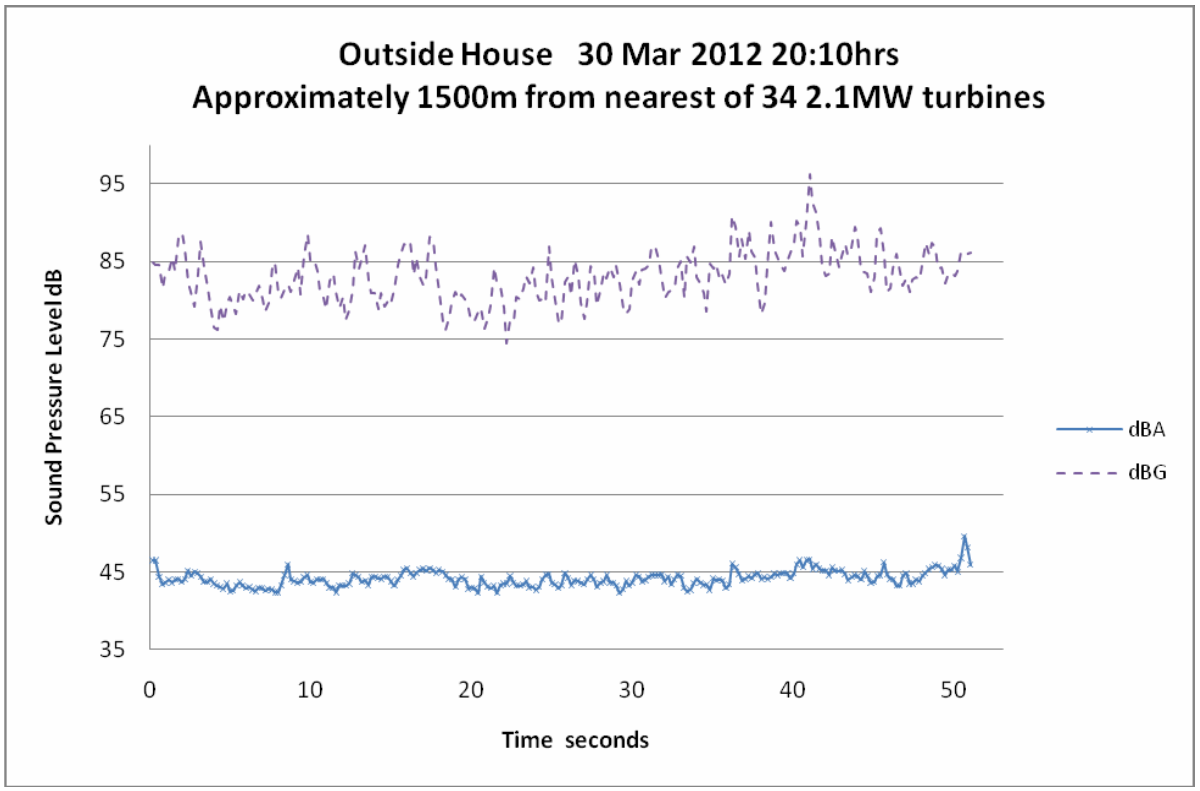


Figure 12: Time History Figure of G-Weighted Sound Pressure Levels for a Wind Farm

Extract from UK DTI Low Frequency Noise Report by Hayes Mckensie 2006

The levels in the above figure were averaged rms levels. This type of analysis hides the actual peaks that occur in dB(G) levels. An example of a time chart for a dwelling in SA show higher levels of blade pass pulses up to 95 dB(G) with average peaks around 85 dB(G), see below.



In summary, we find that the Report fails to address key requirements of the DGR and errs on the positive side in all instances where there could be cause for concern regarding infrasound, tonality, amplitude modulation and noise modelling, for example.

The parameters used in noise prediction modelling are inappropriate for Australia and the lack of a comprehensive uncertainty section with sensitivity analysis for the model parameters is a major omission.

We do not believe that the Report presents a balanced unbiased assessment with regard to wind turbine noise. Construction noise impacts are addressed but demonstrate non-compliance at times that require management. No suggestions are given to ensure construction noise compliance.

Yours sincerely

W L Huson

THE ACOUSTIC GROUP PTY LTD

CONSULTING ACOUSTICAL & VIBRATION ENGINEERS

PEER REVIEW OF NOISE IMPACT

ASSESSMENT STONY GAP WIND FARM

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Prepared for: *Regional Council of Goyder*

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BURRA SA 5417

CONTENTS

APPENDICES

1.0 INTRODUCTION

An application has been submitted to the Regional Council of Goyder by Roaring 40s Renewable Energy Pty Ltd for the proposed Stony Gap Wind Farm to be located near the township of Burra, north of Adelaide, South Australia.

Accompanying the application is a report from Marshall Day Acoustics: "Stony Gap Wind Farm, Noise Impact Assessment" dated 2 March 2011 (report ref 002 R07 2008241). This report is on the TRUenergy website.

Subsequent advice is that there is a different acoustic report from Marshall Day Acoustics being: "Stony Gap Wind Farm, Noise Impact Assessment" dated 20 July 2011 (report ref 002 R08 2008241). This report is **NOT** on the TRUenergy website.

Examination of the two reports reveals the primary difference is the removal of references to ''Roaring 40s", changes to the regression curves and identification of the noise floor of the unattended noise loggers.

The Council has received objections in relation to approval of the proposed wind farm, one of the grounds of objection being noise disturbance. Objectors have cited impacts from existing wind farms in the region as evidence of potential impacts arising from the proposed wind farm.

The objections are expressed in layman's terms with the exception of a report from Professor Colin Hansen of Adelaide University: "Stony Gap Wind Farm Noise Impact Assessment" dated 22nd February 2012.

In view of the Council not having staff with expertise in acoustics for assessing the objector's claims and complaints from residents concerning operational wind farms in the region, the Council requested a peer review of the above two noise reports.

In addition to the above two reports the peer review was extended to consider a response document (dated 24th April 2012) from TRUenergy Development Pty Ltd. The response is to the "eligible representations received to the Stony Gap wind farm development application (422/115111) **(Stony Gap DA)** during the public notification periods" in January, February and March 2012.

The above documents refer to noise guidelines for wind farms issued by the South Australia EPA (2003 and 2009), the Goyder Council Development Plan (dated February 2011 and consolidated in February 2012), and the Mid North Regional Land Use Framework (adopted in May 2011 as part ofthe Planning Strategy of SA).

2.0 QUALIFICATIONS OF REVIEWER

The nature of actual or perceived noise impacts associated with wind farms is the subject of wide debate throughout communities in proximity to wind farms.

To date there are conflicting arguments or claims as to noise and resultant health impacts due to wind farm operations.

In conducting a peer review it is appropriate to identify the reviewer's technical expertise to undertake such an exercise and to identifY any potential conflicts.

I Steven Edwin Cooper am the principal of The Acoustic Group Pty Ltd, Consulting Acoustical and Vibration Engineers.

I have been in practice as an Acoustical Consulting Engineer for 34 years. I hold a Bachelor of Science (Engineering) degree from the University of New South Wales and a Master of Science (Architecture) degree from the University of Sydney and am a Chartered Professional Engineer. I am a Fellow of the Institution of Engineers Australia, a Member of the Australian Acoustical Society and a Member of the Institute ofNoise Control Engineering (USA).

In the course of my acoustical consulting practice I have been involved in numerous projects for private, commercial and government organisations requiring expertise in acoustics, noise and vibration issues.

Furthermore as a practising Acoustical Consulting Engineer I am or have been a member of the Standards Association of Australia Committees AV4, AV/10, AV/10/4 and EV/11 dealing with Architectural Acoustics, Whole-Body Vibration, Rail Traffic Noise, and Aircraft Noise respectively. I was a member of the Australian Acoustical Society NSW Membership Grading Committee from 1979 to 1997 and was a member of the Australian Acoustical Society Federal Grading Committee in 1998. My Curriculum Vitae is set out in Annexure A.

It is noted that in the course of my professional career I have been involved in projects where I have appeared for Applicants, Objectors, Councils, Government Departments (State and Federal) and as a Court Appointed Expert. I am not a member of any political party and have not been retained or approached by any wind farm proponents to undertake an assessment of wind farm noise.

I have extensive experience in the measurement and assessment of large industrial premises where there is a requirement to maintain compliance with specified noise limits under all weather scenarios. I have also conducted research into various acoustic issues concerning the propagation of aircraft noise and sound dispersion in enclosed spaces that has questioned the status quo of various Standards or acoustic texts leading to modification/amendments to Australian Standards and International guidelines.

Whilst I have not been engaged by any wind farm applicant to undertake an acoustic assessment or compliance testing of planned or operational wind farms, I was requested last year by a community group opposing a proposed wind farm at Flyers Creek (in NSW) to review an application.

I prepared a desk top review of the acoustic assessment that had been prepared for the Flyers Creek Wind Farm. My desk top audit was contained in a submission from the Flyers Creek Wind Turbine Awareness Group ("FCWTAG") in relation to the proposed Flyers Creek Wind Farm. The desk top review raised issues as to the ambient background levels, the predicted noise emission levels and the absence of an assessment of the noise impact ofthe proposed wind farm.

The desk top review was supplemented by preliminary noise testing in proximity to the Capital Wind Farm (in NSW) to experience first-hand wind farm operations and conduct sound level measurements. The preliminary testing highlighted a number of issues with respect to the assessment and evaluation of wind farm noise where currently the predominant acoustic descriptor is the dB(A) level.

I found at times there to be no audible noise inside or outside residential dwellings, whilst on other occasions I was able to detect wind farm noise both outside and inside dwellings.

My testing identified the possibility that noise originating from the wind farm could affect individuals and that further testing/investigations were required as set out in my review of the Flyers Creek Wind Farm application (available on the NSW Department of Planning website).

The NSW Department of Planning issued in late 2011 a draft set of wind farm guidelines for public comment. The NSW guidelines are more stringent than the SA wind farm noise guidelines.

As part of my review of the draft NSW guidelines I undertook further measurements and analysis of wind farm noise (Capital, Cullerin and Woodlawn Wind Farms) to research wind farm noise and assess the practicality of compliance testing as set out in the draft NSW guidelines.

I prepared a submission on the draft guidelines. I was not engaged by any party to prepare my submission, but as it relied upon previous material prepared for the Flyers Creek submission, my review of the draft NSW guidelines was added to the Flyers Creek community submissions (available on the NSW Department of Planning website).

As part of my on-going investigations into wind farm noise I have attended residential properties and public roads in proximity to Waterloo and Hallett wind farms in order to place in context claims of excessive noise/impacts from those wind farms. As for the NSW wind farms I have attended, at some sites there was clearly audible noise from the wind farm, at other sites some noise was audible, whilst at other sites there was no audible noise.

In the reporting of wind farm noise, there are claims and counter claims as to bias in the presentation of data which is a fundamental issue to be addressed prior to this peer review.

As a Member of the Australian Acoustical Society (the "AAS") and a Fellow of the Institution of Engineers Australia I am required to abide by the Code of Ethics for those two organisations.

Annexure B provides a copy of the Code of Ethics of the Australian Acoustical Society.

If there is potential for an industry to jeopardise the welfare, health or safety of the public, or affect the well-being of the community I am duty bound to identifY those issues under the Code of Ethics of the Australian Acoustical Society.

The AAS Code of Ethics requires that the acoustical assessment in relation to a wind farm is accurate and contains all the relevant material. This is the obligation placed on the acoustician. The acoustician has a heavy professional obligation and should be neither pro nor anti wind farm in approach.

I approach all my work in accordance with my professional Code of Ethics. I make the specific statement that I am not anti-wind farm.

Any project, be it an industrial application or a wind farm, should operate without giving rise to disturbance, health effects or adverse impacts on the community. If it can do so then, from a noise point of view, it may be permitted.

In relation to my knowledge of the authors of the reports which I am peer reviewing, I am aware of some of the Marshall Day staff and their professional qualifications. I am unable to find the Associate whose signature appears on the cover page of the report currently listed as a Member of the Australian Acoustical Society. If however the author(s) of the report are not members of the Australian Acoustical Society then the report is required to accord with the Code of Conduct from the Association of Australian Acoustical Consultants of which Marshall Day Acoustics (Melbourne) is identified as a member firm. As a professional working in the area of acoustics, I have known Professor Hanson in a limited professional capacity over quite a few years. I have not discussed with him the contents of his assessment of the proposed wind farm.

3.0 THE MARSHALL DAY ASSESSMENT

3.1 Outline

The document status table indicates that the assessment has been undertaken over some 18 months and subject to a number of revisions.

The overview of the document indicates the assessment was undertaken in accordance with the 2009 version of the South Australian EPA wind farm noise guidelines where the base level for noise assessment has been set at 40 dBA.

The assessment has assumed forty one (41) Vestas V90-3MW wind turbines with a nominal hub height of 80 m. There is an acknowledgement that if the turbine model is altered or changed then a review of the noise predictions and compliance will need to be undertaken.

The overview indicates eleven (11) assessable residential properties had been identified in the vicinity ofthe proposed wind farm with background noise monitoring being carried out at seven residential properties.

The overview identifies that noise emissions from the proposed wind farm, including substation noise, comply with the guidelines noise limits at all 11 assessed properties.

The overview also identifies that noise emission from the substation will comply with the Environment Protection (Noise) Policy 2007.

The report indicates that the noise source level used for the turbines has been supplied by the manufacturer and that the noise data used in the assessment has been identified as Mode 0, which is reported as not including any noise management. The report appears to indicate that the audibility of tones is based on International Standard ISO 1996-2:2004. The report indicates at a distance of approximately 150 m an audibility assessment of prevalent tones for the wind speed of 6 – 10 m at 10 m above ground for Mode 0 operation is -1.7 dB, leading to the MDA opinion tonal correction is not necessary for any of the assessed wind speeds.

However the EPA have used IEC Standard 61400-11 :2006 for describing tonality where the Standard nominates -3 dB as the lower limit of inaudibility. This would appear to be different to the +4 dB limit nominated by MDA be reference to ISO 1996.2:2004.

The report identifies that noise guidelines were issued by the EPA in 2003 and were revised in 2009. The assessment is based on the 2009 version of the Guidelines.

Section 3.1 of the report refers to extracts from the SA EPA Guidelines to identifY 40 dBA as the base level noise criteria which would apply at non-host residential receivers or background noise + 5 dBA whichever is the greater. In relation to infrasound, reference is made to Section 4.7 of the Guidelines to quote that the EPA "is not aware of infrasound sound being present at any modem wind farm site".

Section 3.2 identifies that the Environment Protection (Noise) Policy 2007 covers other noise sources associated with wind farms and identifies transformer stations as a typical noise source. The design target for the substation has been set at 35 dBA at the nearest affected residential property.

Section 4 identifies the methodology used in the assessment with Section 4.2 referring to International Standards for the determination of the sound data and also the propagation of noise from wind turbines.

Section 4 identifies the background noise monitoring as utilising at least 2000 data points. These data points are correlated with local weather conditions and hub height wind strength to develop regression analyses upon which the background noise levels are derived in order to determine the noise limits.

Table 2 in Section 5 identifies residential sites that are to be assessed and indicates the location of the nearest turbine to the house. Table 2 shows eleven houses of which seven are stakeholder properties, which do not have to achieve the noise limits obtained from the EPA Guidelines.

Table 3 identifies the background noise monitoring periods at the various houses followed by identification of the equipment used for noise monitoring with the qualification that the noise loggers were placed at least 5 m from the nearest dwellings in positions that were representative of the general ambient noise environment. Reference is made to Appendix F to show photographs of the logger locations.

I note that Appendix F does not provide any plans to indicate the relative position of the loggers with respect to the residential dwellings. Due to the proximity of foliage, and in particular large trees in a number of the sites, the ambient background level for times at which wind is present at the site could influence the results.
Page 12 refers to weather stations installed at houses 19 & 23 for limited periods in 2009. There is a claim that wind speeds of greater than 5 m/s (at the residential monitoring stations) has resulted in those data points being removed from the regression analysis.

The report does not indicate the model or type of weather stations used at residential dwellings. Nor does it appear there is any material contained in the assessment report to indicate the ambient background level at the receiver locations versus the wind that was occurring at the equipment used for monitoring the ambient background noise level.

Section 6 provides a series of regression analysis curves that indicate for each site the number of data points that have been excluded from the analysis due to either rain, out-of-range wind speeds, or high wind speed at the microphone position. There are noticeable differences in the regression curves between report R7 (on the applicant's website) and R8.

Section 7 refers to predicted noise levels and refers to appendices at the rear of the report which provide a summary of the computer noise predictions. The report concludes that there is compliance with the criteria derived from the Guidelines.

Section 8 refers to the transformer station assessment to indicate that noise from the substation would be insignificant at the nearest residential property.

Section 9 concludes that noise emission from the proposed wind farm will be less than 40 dBA at non-stakeholder properties and not exceed 45 dBA at stakeholder properties.

3.2 **Analysis**

The Marshall Day noise impact assessment report is similar to that provided by that organisation for other wind farms and would appear to fall into a generic type of report. There are a number of issues arising from this. Further, in relation to the Stony Gap Wind Farm, there are specific requirements arising from Council's Development Plan which also need to be addressed but I will deal with these in a separate section below.

One issue of concern in relation to the generic type of noise assessment prepared for the subject wind farm is that there is a conflict between the title of the report and the contents of the report.

The report is titled "Stony Gap Wind Farm Noise Impact Assessment" yet the report has not actually identified the noise impact that will be generated by the proposed wind farm. This would appear to be a fundamental failure in the obligations of the author(s) of the acoustic assessment i.e. a failure of the obligation to provide a meaningful document in relation to actual noise impacts that the community can understand.

The acoustic assessment has not explained to the community the impact that the proposed wind farm will have upon the existing acoustic environment of the area nor whether the operation of the wind farm will affect their daily activities or their night time sleeping patterns.

The ambient data reveals the existing acoustic environment of the area is significantly less than 40 dBA. This automatically raises the question of "What is an acceptable noise impact from the proposed wind farm?" This is not an exercise that has been carried out in the subject assessment.

It would appear that the acoustic report considers that the description of the acoustic impact is satisfied by identifying compliance with a noise target set out in the Guidelines. However, any experienced acoustic engineer would be aware that generating a noise which is significantly greater than the existing ambient background level of an area can create an impact which should be assessed.

The regression analysis curves reveal a significant degree of variation in background noise levels at individual wind speeds referenced to 80 m above ground level at the wind farm.

The regression analysis as presented in the report does not differentiate between the background levels that occur at night versus the background levels that occur in the day. One typically expects night time background levels to be lower than in the day.

Therefore if one was seeking to conduct an assessment of the impact of the wind farm on the community, it would be appropriate to differentiate between the acoustic environment that exists in the day versus that in the night. The document has not identified that position.

The regression analysis does not continue below the cut-out speed to indicate the natural ambient background level of the environment. Nor do the graphs show the full extent of the ambient noise in the area. For example houses 10, 16, 23, 24 and 29 all appear to have a threshold limit above 20 dBA, whereas house 20 and 21 show a lower ambient floor which suggests different instrumentation from the other houses.

If one assumes that the ambient background level of the area from the regression analysis is around 25 dB at the cut-out speed, then it is an undeniable fact that a noise limit of 40 dBA, obtained from the Guidelines, would be clearly audible both inside and outside residential dwellings and would represent a significant impact in terms of the existing environment.

If the regression lines are extrapolated to identify the background level prior to the cut in speed then one would expect a lower background level to prevail.

If one was to identify to the community there would be no impact/an impact /an adverse impact or severe impact from the proposed wind farm it would be appropriate for the report to discuss the relevance of the predicted noise levels versus the regression curve and/or the minimum background levels that relate to the various wind speeds.

In addition to the above, in seeking to inform the community as to the noise impact of the proposed wind farm it would be appropriate to identify whether the assessment of noise is conservative and/or the extent of variation that may occur in such noise propagation.

For example, one can have the turbines operating whilst at residential receivers there is absolutely no wind.

The MDA report has not identified the relationship between the wind speed at the hub height versus the wind speed at receiver locations. There is therefore no correlation with the predicted noise levels under the wind scenarios that have been assessed, nor consideration of the difference in propagation for different wind directions. Nor is there consideration of the occurrence of adverse meteorological effects which could be identified in a generic term as temperature inversions, separately to the more detailed and complex analysis attributed to the van den Berg effect (referred to in Appendix E).

It is quite likely that such an analysis could show a range of noise levels and identify to the community that for a certain percentage of the time the wind farm would be inaudible/barely audible/clearly audible. Such an analysis could show there is no issue in the day, but an issue at night that could be resolved by not operating the turbines at night.

The assessment report has failed to identify the potential audibility of turbine noise inside residential dwellings. Documents otherwise in the public domain establish that Marshal Day Acoustics are intimately aware of the significance of this issue for wind farms.

There would appear to be an assumption that the noise from the wind farm would not exhibit modulation at residential receivers thereby requiring an adjustment to the predicted noise levels.

There is no discussion or consideration of whether the subject wind farm will generate any low frequency, tonal or infrasound energy at residential receivers. One would expect a "Noise Impact Assessment" to provide an appropriate consideration of this issue in relation to these specific characteristics.

4.0 GOYDER COUNCIL DEVELOPMENT PLAN

The application was lodged with the Council November 2011. The relevant Development Plan is the Goyder Council Development Plan dated 17 February 20 II and the Statewide Wind Farms Development Plan dated 19 October 2011. The Goyder Council Development Plan was consolidated on 23 February 2012. The provisions of the Development Plan relevant to the assessment of the application, which was lodged in November 2011 thereby includes the now consolidated provisions of the Statewide Wind Farms Development Plan, i.e. one must consider both the Council's Development Plan and the Statewide Wind Farms Development Plan.

The TRUenergy response document acknowledges the Development Plan and the relevant sections in the plan which the subject wind farm is required to satisfy/address. With respect to noise issues, commencing on page 40 of the document is a section titled *"Interface between Land Uses"*. It is as follows:

OBJECTIVES

Development located and designed to prevent adverse impact and conflict between land uses.

2 Protect community health and amenity and support the operation of all desired land uses.

3 Accepting that wind farms and ancillary development may need to be sited in visually prominent locations, then the visual impact of the development needs to be managed.

PRINCIPLES OF DEVELOPMENT CONTROL

Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through any of the following:

(a) the emission of effluent, odour, smoke, fumes, dust or other airborne pollutants
(b) noise
(c) vibration
(d) electrical interference
(e) light spill

(f) glare
(g) hours of operation
(h) traffic impacts.

2 Development should be designed and sited to minimise negative impact on existing and potential future land uses considered appropriate in the locality.

3 The visual impact of wind farms and ancillary development should be managed in accordance with the policies contained within the General Section headed Renewable Energy Facilities.

4 Development adjacent to a Residential Zone or residential area within a Township Zone should be designed to minimise overlooking and overshadowing of nearby residential properties.

s Residential development adjacent to non-residential zones and land uses should be located, designed and/or sited to protect residents from potential adverse impacts from non-residential activities.

6 Sensitive uses likely to conflict with the continuation of lawfully existing developments and land uses considered appropriate for the zone should not be developed or should be designed to minimise negative impacts.

Noise

7 Development should be designed, constructed and sited to minimise negative impacts of noise and to avoid unreasonable interference.

a Development should be consistent with the relevant provisions each of the following documents:

(a) AS 2107 Acoustics- Recommended Design Sound Levels and Reverberation Times for Building Interiors

(b) AS 3671 Acoustics- Road Traffic Noise Intrusion, Building Siting and Construction

(c) the current Environment Protection (Noise) Policy

The Objectives of the Interface between Land Uses section have not been addressed in the Marshall Day acoustic assessment for the proposed wind farm.

In relation to the first objective, the matter of adverse impact and conflict between land uses is not addressed on a noise basis. The Marshall Day report considers simply complying with the criteria derived from the EPA wind farm noise guideline.

As identified above, the Marshall Day report does not adequately address the actual noise impact of the proposed wind farm at all. It is silent therefore on what would constitute a negative or adverse impact for the purposes of the Development Plan. The Development Plan itself does not appear to quantify adverse impact.

From an acoustic perspective one may consider an adverse impact to occur at a noise level of greater than what may be considered a significant impact, which on A-weighted value may be assigned background+ 5 dB(A) on the following basis. Under previous versions of Australian Standard AS 1055, noise level that exceeds the background may be considered to be annoying. Noise levels up to 5 dBA above the background were considered to be of marginal significance.

The second objective requires the protection of community health and amenity and to support the operation of all desired land uses. Whilst at the present point in time the community health impacts of wind farms have not been identified on a purely noise basis and have been the subject of recommendations for further research, the protection ofthe amenity of the community and the ongoing operation ofthe existing land uses is required by the second objective. There accordingly needs to be an examination of whether there is compliance with the DP or whether there may be a conflict between noise impacts and the second objective. Interference with sleep for example, would be a clear conflict.

On proceeding to principles six (6) and seven (7) under the subheading "Noise," there is a requirement for development to minimise negative impacts of noise and to avoid unreasonable interference. The noise levels contained in the Marshall Day report as outlined above (without taking into account any of the factors raised by Professor Hansen - see below) raise the potential for both negative impacts and unreasonable interference when one considers the true ambient background level of the area.

Principal 7 refers to two Australian Standards which have not been considered in the acoustic assessment. If AS21 07 is to be considered, as directed by the Development Plan, then from Table I of that Standard for houses in areas with negligible transportation the recommended satisfactory design internal sound level for sleeping areas is 25 dBA. This internal level has not been assessed by Marshall Day.

The second Standard relates to road traffic noise and therefore would be irrelevant with respect to the operation of the wind farm.

The third document referred to is the current Environment Protection (Noise) Policy. However the Environment Protection (Noise) Policy reference contained in the *Interface Between Uses* section of the Development Plan does not appear to apply to wind farms, other than providing a mechanism to utilise the guidance document issued by the SA EPA being the wind farm noise guidelines. [1]

In addition to the above, the Development Plan (Page 62) contains a separate section with specific sections for Renewable Energy Facilities:

OBJECTIVES

1 **The development of renewable energy facilities, such as wind and biomass energy facilities, in appropriate locations.**

[1] In Part one, subsection 5, Table 2 identifies that the indicative noise factor for rural living at night is 40 dBA. Under the subclause preceding the table there is an identification that if a measurement place is within a habitable room that cannot be located an open window the indicative noise level for the noise source is the satisfactory level set out in Australian Standard AS 2107 or 20 dB(A) less than the indicative noise level.

By reference to the comments above the indicative noise level inside a habitable room in a rural living use is 40 -20 = 20 dBA under the indicative method or 25 dB(A) under the AS 2107 method.

Clause 6 identifies the policy does not apply to a noise of a class set out in Schedule 1. Wind farms are not identified in Schedule **1.**

Clause 9 identifies the object of the Policy under subsection (b) is to fix goals for most noise sources compliance with which will satisfy the general environmental duty under section 25 of the Act in relation to noise from those noise sources. However there is a note that Part 4 does not apply to noise is of the kinds to which Part 6 and Part 7 apply. Part 7 is headed "Guidance documents" and identifies in clause 34 wind farms and refers to 2003 version of the guidelines.

It would therefore appear that the Environment Protection (Noise) Policy reference contained in the Interface between Uses section of the Development Plan does not apply to wind farms, other than the providing a mechanism to utilise the guidance document issued by the SA EPA being the wind farm noise guidelines.

2 Location, siting, design and operation of renewable energy facilities to avoid or minimise adverse impacts and maximise positive impacts on the environment, the local community and the State.

PRINCIPLES OF DEVELOPMENT CONTROL

Renewable energy facilities, including wind farms and ancillary developments, should be located in areas that maximise efficient generation and supply of electricity.

2 Wind farms and ancillary development such as substations, maintenance sheds, access roads and connecting power-lines, should be sited, designed and operated in a manner that:

(a) avoids or minimises negative impacts on the character, landscape quality, visual significance or amenity of the area

(b) uses elements of the landscape and appropriate materials and finishes to minimise visual impact

(c) avoids or minimises the potential for adverse impact on areas of native vegetation, conservation, environmental, geological, tourism or built or natural heritage significance

(d) does not impact on the safety of water or air transport and the operation of ports, airfields and designated landing strips

(e) avoids or minimises nuisance or hazard to nearby property owners and/or occupiers, road users and wildlife by not:

(i) causing shadowing, flickering, reflection or blade glint impacts

(ii) creating excessive noise

(iii) interfering with television and radio signals

(iii) modifying vegetation, soils and habitats

(iv) striking birds or bats.

The Development Plan requires wind energy facilities to be developed in appropriate locations and to avoid or minimise adverse impacts. Under principal 2(e) the wind farm and ancillary development is required to avoid or minimise nuisance to nearby property owners by not creating excessive noise or interfering with television and radio signals.

The Development Plan does not define "excessive noise" which to some people could be any noise that is audible and gives rise to disturbance.

The previous version of the Statewide Wind Farm Policy specified for Renewable Energy Facilities the same Objectives and Principles as set out in the Council's Development Plan.

The updated (current) version of the Statewide Wind Farm Policy alters the visual aspect of wind farms. Under Renewable Energy Facilities the policy states:

Renewable Energy Facilities

Objective 1 **Location, siting, design and operation of renewable energy facilities as essential infrastructure that benefits the environment, the local community and the State.**

Objective 2 **The development of renewable energy facilities, such as wind farms and ancillary development, in areas that provide the opportunity to harvest natural resources for the efficient generation of electricity, accepting that such facilities will often need to be sited in visually prominent locations.**

Objective 3 **Location, siting, design and operation of renewable energy facilities to avoid or minimise adverse impacts on the natural environment.**

PDC 1 **Renewable energy facilities, including wind farms and ancillary developments, should be located in areas that maximise efficient generation and supply of electricity.**

PDC 2 **Wind farms and ancillary development such as substations, maintenance sheds, access roads, wind monitoring masts and connecting power-lines (including to the National Electricity Grid), should be sited, designed and operated to:**

(a) **manage the visual impact of the development by achieving the following:**

(i) a setback of at least 1kilometre of a wind turbine from a dwelling that is not associated with the development
(ii) vegetated buffers to mitigate short to medium range visual impacts
(iii) regular spacing of wind turbines in open/flat landscapes where vegetation is orderly
(iv) irregular spacing in hilly/rugged landscapes where vegetation is varied
(v) ensure that blades on wind turbines rotate in the same direction
(vi) ensure that all wind turbines have uniformity in terms of colour, size and shape

(b) avoid or minimise the potential for adverse impact on areas of native vegetation, conservation, the natural environment, geological, tourism or built or natural heritage significance

(c) avoid or minimise the following impacts on nearby property owners and/or occupiers, road users and wildlife:
(i) shadowing, flickering, reflection or blade glint impacts
(ii) excessive noise
(iii) interference with television and radio signals
(iv) modification of vegetation, soils and habitats
(v) striking of birds or bats.

PDC 3 Renewable energy facilities, including wind farms and ancillary development, should be designed and sited so as not to impact on the safety of water or air transport and the operation of ports, airfields and designated landing strips.

In terms of noise impacts there is no difference between the Council's Development Plan and the Statewide Wind Farm Policy. The wind farm is to avoid or minimise excessive noise.

In any event the Marshall Day report has not addressed the objectives or principles specifically identified for Renewable Energy Facilities in the Development Plan.

It is noted that during the course of monitoring at various residential dwellings in proximity to Waterloo or Hallett wind farms residents identified the existing wind farms had given rise to interference with radio and television reception with a number of houses having been supplied satellite receivers because they could no longer get television signals from Adelaide. A criticism of a number of the residents concerning the satellite receivers is that they were watching television programs in the Northern Territory and could not get local or state news.

5.0 PROFESSOR HANSEN'S ASSESSMENT

The document prepared by Professor Hanson is dated 22nd February 2012. Each page has a header identifying "the assessment was prepared by Professor Hansen at the request of Stony Gap residents including Dunn, Mitchell and Coffey families".

The matters raised by Professor Hansen may be said to fall into two categories. The first are those which outline technical matters in the Marshal Day report such that Professor Hansen suggests there is likely to be an exceedance of the South Australian EPA guidelines if the wind farm is approved. Secondly, Professor Hansen questions the adequacy of the existing guidelines (for technical reasons which he outlines) and provides an alternative assessment of the expected noise impact from the proposed wind farm. These areas overlap at times.

The comments concerning the assessment of existing background noise levels identifY that there is no correlation between the wind speed data at the wind farm location versus the noise levels measured at residential locations. They raise concerns as to differences in timing between the two assessment items.

There are concerns raised as to the absence of identifYing the true background level of the area and disagreement with the regression analysis that has been provided, with specific reference to the noise floor of the various types of instrumentation which would not give rise to the correct levels being measured and therefore leads to an over estimate of the regression line so derived.

With respect to the establishment of acceptable noise criteria, Professor Hansen raises questions as to the validity of noise levels nominated as acceptable by the EPA. He lists a number of relevant factors/reasons to query the acceptable noise criteria nominated in the assessment.

Those factors include:

- The absence of an assessment of low frequency dominance in the noise spectrum which will dramatically be enhanced when considered inside a residence by way of the transmission loss properties of typical building elements at low frequencies versus high frequencies.

- The suggestion of 30 dBA as an acceptable internal level based on a World Health Organisation document is inappropriate for remote rural areas.
- There are issues with correlating background noise levels versus wind speed at the wind farm. There is a significant degree of variation in background noise levels (without identifying the source of those variations) that is considered to overestimate the background noise determined by the regression line at quiet times during the night.
- The EPA guidelines make no distinction between night and day when establishing background levels and if the data was separated into day and night then the spread of results for the regression lines would be likely to be less, but more importantly the background levels attributed to the night time period would be expected to be lower than the regression lines that have been provided.

Professor Hansen questions the appropriateness of nominating 40 dBA for residences in the vicinity of wind farms.

He also questions the assumption of absence of tones in relation to Stony Gap when noise radiated by existing turbines near Mount Bryan has been identified as having a tonality characteristic.

With respect to the noise level predictions specifically, questions are raised as to the appropriateness of the noise prediction model and the source data where such data may have been obtained in flat terrain and smooth air which is not representative of the subject site. Questions are raised as to the use of 6 dB per doubling of distance attenuation. Professor Hansen identifies that the actual decay rate after 200 to 400 m is more like 3 to 4 dB per doubling of distance. The modelling assumes 50% soft ground would not apply to low frequencies thereby suggesting that with respect to low frequency noise the model will underestimate the resultant noise.

Professor Hansen identifies that the computer modelling results have been presented as A-weighted values and not in octave bands. The evaluation of potential low frequency noise problems has not been provided nor can those predictions be quantified.

Professor Hansen criticises the adequacy of treatment and consideration of adverse weather conditions that can give an enhancement of sound and thereby result in noise from the wind farm exceeding the nominated criteria even if one was to consider such a level to be acceptable.

Professor Hansen forms the view that the predicted noise levels provided by the applicant are highly likely to exceed the maximum level allowed by the South Australian EPA guidelines. Notwithstanding the nominated level he considers that the appropriate target under the guideline should be 35dBA. On the basis of that level then there is an issue in respect to the subject application.

Professor Hansen identifies that the Marshall Day report has not considered annoying modulation effects or low frequency content of wind farm noise which would further exacerbate the impact on the community.

He raises the point that as the turbine size and type has not been finalised at this point in time then there are further concerns of a greater degree of noise impact to residential receivers.

Professor Hansen concludes that the application should not be approved until such time as the above matters of the final turbine size and layout decided upon, and by reason of the other components in the conclusion there are additional noise impacts to be considered.

6.0 EPA GUIDELINES, NOISE IMPACTS

The Marshall Day report presents data which it asserts is sufficient to establish compliance with EPA guidelines. It then relies upon the concept that the EPA guidelines have determined comprehensively an acceptable noise level for rural environments that will apply to the assessment of wind farms. On this basis, the EPA guidelines "cover the field" and no further examination of noise impacts is undertaken, either generally or specifically in relation to the Development Plan. The report does not identity for the community the actual noise impact which will occur.

The alternative assessment report provided by Professor Hansen suggests, for the technical reasons outlined above, that sufficient data has not been presented to conclude that the wind farm will be compliant with existing guidelines. However, Professor Hansen is also critical of the basis of acceptable noise levels set out in the EPA guidelines and in particular the assessment utilising A-weighted levels only, the regression line approach for determining the background noise level, and the absence of identifYing sleep disturbance impacts inside residential properties. One view of Professor Hansen's position is that the actual noise impact of the proposed development is not and cannot be properly assessed under the EPA guidelines for the reasons he sets out.

I have outlined at Section 3 above, a variety of concerns which I believe should be addressed in relation to the Marshall Day report. It is not necessary for this peer review to comment further on the fundamental difference in approach between the two reports concerning the guidelines. It is my view that the Development Plan alone specifically requires actual noise impacts for the community to be addressed and this has not occurred.

However, given the obligations under the Development Plan and given the matters raised in the Hansen assessment, I propose for Council's assistance to give some consideration to the adequacy of the Guidelines in relation to Council's obligations and responsibilities to residents of the Goyder region (both in terms of its Development Plan and generally).

The Guidelines introduce two "core" principles - protecting the amenity of the community from adverse noise impacts and taking all reasonable and practicable measures to prevent or minimise environmental harm. These are contained in the Introduction section and its explanatory content:

> The core objective of the guidelines is to balance the advantage of developing wind energy projects in South Australia with protecting the amenity of the surrounding community from adverse noise impacts.

Guidelines

The *Environ1719nt Protection Act 1993* (EP Act) requires a ltlty of care for the environment. This Is specified under section 25 of the Act and states:

> A person must not undertake an actiVIty that pollutes. or mlgllt pollute, tne envronment unless tile person taKes all reasonable and practicable measures to prevent or minimise any resulting environmental narm.

Guidelines published by the EPA Inclcate tile standard of care tllat Is liKely to be required to secure compliance with the general environmental duty. They have the advantage of fle)(iblity and can be adapted to a range of circumstances.

Neither the body of the document nor the glossary defines "adverse impacts". As such the Guidelines do not assist the Council by defining "adverse noise" for the purposes of the Development Plan. Similarly whilst Section 4.8 of the Guidelines is headed "Excessive noise," there is no definition of excessive noise.

If one assumes the EPA has a responsibility to protect the community from unreasonable disturbance and to prevent or minimise any resulting environmental harm then it is not unreasonable to expect the noise criteria to reflect that situation.

Section 2 identifies that the concept is to set a base noise level typically 5 dB(A) lower than the level considered to reflect the amenity of the receiving environment. The Guidelines correctly identify that as the wind increases so can the noise in the environment such that a varying noise limit (dependent upon the wind strength) must apply.

Reliance is placed on the *Environment Protection (Noise) Policy* 2007 as the basis of an Indicative Level of 40 dB(A) at night.

In the 2003 version of the Guidelines the noise criteria for a new wind farm development was:

> T11e predicted equivalent noise le\'el tL to) adjusted f01 tonality in accordance \lith these guidelmes. shouht not exceed:
>
> - 35 LiB(A). o1"
> - the backgro,md noise (L4.90,1o) by mot·e than 5 l1B(A)
>
> whichever is the gt·eater, at all relev.utt receivers- for each i.ntege£,,-ind speed hom cut-n1 to rated power of the lVTG.
>
> T11e ba.:kgrottnd noise shoulLi be as dNemtine-d b,- the ctata colle-ction J.i\d regression analysi5 procedure 1ecouU11ended LUtdec these gtUdehnes tSe<hon 3). [t should l"lt' u•ad fmm the 1·esultant graph at the re-levant i:ntege1· wind speed.

Whilst the above criteria may prevail for existing wind farms, the 2009 version of the Guidelines sets different noise criteria:

2.2 Noise criteria-new wind farm development

The predicted eoul'lalerrt noise level (LA"'"). adjusted for tonality In accordance with these guidelines. should not exceed:

35dB(Al ot relevont receivers In locolities [1] which -: re prlmorily intended for rural living',or

40dB(Al at relevant receivers In localities' in other zores or

lhe background noise ($L_{.,.10}$) by more than 5dB(A).

whichever is the greater. at all relevant receivers for wird sp;,ed from cut-in tc rated power of the *WTG* and each intEger wind speed in between.

The background noise should be as determined by the data collection and regression analysis procedure recommended under these guidelines (Section 3). It should be read from the resultant graph at the relevant integer wind speed.

Compliance wilh !he noise criteria should also be demonstrated for lhe approved developments in the zone adjacent to the wind farm.

'Rural living

A ·rural living' zone Is 8 rur81-resldenl1111 'lifestyle' 11re111ntended to h11ve 11 rel!!tlvely quiet emenlty The 8re!!l should not be used for prlmafY production other than to produce food, crops or keep animals *for* the occupiers' own use. consumption and/or enjoyment The noise amenity should be quieter than In an urban-restdentlalarea.

If there is uncertainty about the zone and whether the rural living criter1a stlould be applied. the question Is to oe determined. for tile purposes of tllese Guidelines. by tile EPA in consultation witlllhe council for tile area concerned.

The Marshall Day report sets out that the proposed wind farm is located in a Primary Production zone thereby utilising 40 dB(A) as the base limit. This means that where the Council has received complaints in relation to existing wind farms where the criteria is 35 dBA or background + 5 dBA (whichever is the greater), the proposed noise limit for the subject wind farm is less stringent.

In a general acoustic sense, one has difficulty accepting that persons living on a farm in a Primary Production zone automatically experience a higher ambient noise than those in a rural living zone. In fact ifthere are large properties (as frequently found in Primary Production zones) there can be a significant distance from adjacent dwellings and therefore lower ambient noise levels. This is because there is no impact from adjacent dwellings.

If a rural living zone is intended to have a relatively quiet amenity and background levels in the day and night can be around 20- 25 dBA (or lower), then there would appear to be a conflict between the noise criteria set by the Guidelines and what residents who reside in such zones would consider is an acceptable acoustic amenity level.

There is a fundamental problem with the selection of the base criteria ifthey are meant to ensure there are no adverse noise impacts. What constitutes an acceptable acoustic amenity for residents in a rural area has not been established.

There is no material in either the 2003 or the 2009 versions of the Guidelines identifying the basis of the base level of 40 dB(A) for a rural area. The bibliography towards the end of the Guidelines does not reference any reports or studies as to the acoustic amenity of rural areas in Australia (or in fact anywhere) nor any evaluation of acceptable amenity levels for rural areas.

There is a reference to World Health Organisation *Guidelines for Community Noise*.

The WHO Guidelines appear in an explanatory note in Section 2.3 "Agreements with wind farm developers".

> A risk associated with relying on such agreements $till remains where the criteria In these guidelines are exceeded. This Is because an Interpretation of 'unreasonable' is required In any future assessment of the impact of wind farm noise initialed by a complaint from the landowner (or future landowners).
>
> Wod Health Organization Guidelines for Community Noise recommend 30dB(A) Indoor limit to prevent negative effects on sleep. The Working Group on Noise from Wind Turbines (Final Report. ETSU for DTI. 1996) recommends the outdoor noise Imlt of 45d8(A) (efter eny adjustment for tonality) for landowners having financial involvement In the wind farm. If the Wind farm noise does not exceed 30dB(A) Indoors and 45dB(A) outdoors at the loc8lltles belongln:to the financial stakeholders It Is considered acceptable. In particular situations the expected noise Impact can be above the recommended limits. In this case the landowner has to agree In wri ng with the higher lave; of exposure and the developer should discuss the Issue With the EPA.

However, examination of the WHO 1999 Guidelines reveals the 30 dBA indoor limit is associated with urban areas impacted by road traffic. There is no mention of wind farms or criteria for sleep disturbance in rural areas in the WHO Guidelines.

The second sentence in the second paragraph of the above explanatory note could be taken as an implication that the World Health Organisation is nominating a 30 dBA indoor level as acceptable, which is not the case. The explanatory note appears in the section covering stakeholders, i.e. residents who receive a financial interest from the wind farm.

If as identified in the Guidelines the stake holder dwelling is permitted a higher level of noise then does it not mean that for non-stake holders where the external limit for rural living is reduced from 45 to 35 dBA, the corresponding internal limit should be 20 dBA so as to ensure there is no adverse health impact?

Addressing Stony Gap specifically, if, as identified in the Marshall Day acoustic assessment, external background levels at rural dwellings in proximity to the proposed wind farm are below 30 dBA then it must follow that background levels inside dwellings will be lower.

Further, if as identified in the Marshall Day Acoustic report there are background levels at say cut in speed significantly less than 30 dB(A), then it is an undeniable fact that a wind farm generating say 38 dB(A) will be clearly audible at a dwelling. This noise will be significantly greater than the general concept for an annoyance of marginal significance being background+ 5 dB(A). The EPA Guidelines are silent on the actual acoustic impact of wind farms because they utilise noise limits significantly greater than background+ 5 dB(A).

The Guidelines do identify sleep disturbance as an adverse impact. The Guidelines, for example, identify on page 4 that if stakeholders experience sleep disturbance then that must be an adverse health impact:

However, the existence of an agreement will affect the consideration of whether the interference is unreasonable in a given situation. It Is unlikely that there will be unreasonable Interference if:

- a formal agreement Is documented between the parties.
- the agreement clearly outlines to the landowner the expected Impact of the noise from the wind farm and Its effect upon the landowner's amenity, and
- the likely impact or exposure will not result In adverse health Impacts (eg the level does not result in sleep disturbance).

As the Guidelines do not specifically define or quantify excessive noise or adverse impact in terms of any measurable impact, the identification of sleep disturbance as an adverse impact provides a mechanism for quantifYing the second objective in the Renewable Energy Facilities section of the Goyder Council's Development Plan. It is also relevant to the core objective of the Guidelines themselves.

The issue of sleep disturbance as an adverse health impact in the Guidelines must lead to an examination of what noise causes sleep disturbance and to the use of dBA as the assessment parameter. Whilst identifYing the sleep disturbance as an adverse health impact the Guidelines do not identify what level of noise from wind farms generates sleep disturbance. Noise generated from wind turbines covers the entire audio spectrum and includes infrasound. Where monitoring reveals compliance with the nominated dBA noise criteria residents still hear the wind farm noise and complain about sleep disturbance.

The A-weighted filter curve significantly attenuates low frequencies (see Appendix C) and cannot provide a true indication of potential low frequency noise issues, which is a common source of complaint concerning wind farms. Furthermore if one considers noise that is below the frequency range of human hearing (i.e. less than 20 Hz which is normally referred to as lnfrasound) the A-weighted value for such frequencies is insignificant.

H. G. Leventhall published a paper in Noise & Health 6.23 (April 2004) "Low frequency noise and annoyance" where the abstract states:

> *Low frequency noise, the frequency range from about 1OHz to 200Hz, has been recognised as a special environmental noise problem, particularly to sensitive people in their homes. Conventional methods of assessing annoyance, typically based on A-weighted equivalent level, are inadequate for low frequency noise and lead to incorrect decisions by regulatory authorities. There have been a large number of laboratory measurements of annoyance by low frequency noise, each*

> *with different spectra and levels, making comparisons difficult, but the main conclusions are that annoyance of low frequencies increases rapidly with level. Additionally the A-weighted level underestimates the effects of low frequency noises. There is a possibility of learned aversion to low frequency noise, leading to annoyance and stress which may receive unsympathetic treatment from regulatory authorities. In particular, problems of the Hum often remain unresolved. An approximate estimate is that about 2.5% of the population may have a low frequency threshold which is at least 12dB more sensitive than the average threshold, corresponding to nearly 1,000,000 persons in the 50-59 year old age group in the EU-15 countries. This is the group which generates many complaints. Low frequency noise specific criteria have been introduced in some countries, but do not deal adequately with fluctuations. Validation of the criteria has been for a limited range of noises and subjects.*

In the paper Leventhall specifically cites the World Health Organization as recognising low frequency noise as an environmental problem. He references the WHO publication on Community Noise and provides the following in relation to rest, sleep and adverse effects:

> *"It should be noted that low frequency noise, for example, from ventilation systems can disturb rest and sleep even at low sound levels"*
> *"When prominent low frequency components are present, noise measures based on A-weighting are inappropriate"*
> *"Since A-weighting underestimates the sound pressure level of noise with low frequency components, a better assessment of health effects would be to use C-weighting"*
> *"It should be noted that a large proportion of low frequency components in a noise may increase considerably the adverse effects on health"*
> *"The evidence on low frequency noise is sufficiently strong to warrant immediate concern"*
> *"For noise with a large proportion of low frequency sounds a still/ower guideline (than 30dBA) is recommended"*

In 2009 Leventhal! provided another paper in the Journal of Low Frequency Noise, Vibration and Active Control Low Frequency Noise, "What we know, what we do not know, and what we would like to know". He defines low frequency noise as in the range of l0 Hz to lOOHz, but could be extended an octave each end to give 5 Hz to 200Hz.

Whilst the 2009 paper contains the majority of the 2004 information he highlights significant issues concerning low frequency noise that cannot be detected using A-weighting.

> *Although we know a great deal about low frequency noise, there are aspects which we cannot yet explain. We know about how people hear low frequency noise and that some have a low tolerance to it. We believe that low frequency noise may, in general, be more annoying than higher frequency noise, but do not know why this is so. We do not know why some people complain of a low frequency noise which cannot be measured separately from the background noise.*
>
> *It is also possible that there are subtle effects of low frequency noise on the body, which we do not yet understand.*

Leventhall provides standardised threshold levels over a frequency range assigned for human hearing, including levels for part of the range described as Infrasound. He provides a series of questions that are clearly relevant to the proposed wind farm if it is shown that low frequency noise is likely to be produced:

> ***SOME FINAL QUESTIONS***
>
> *This review of low frequency noise and its effects leaves some unanswered questions, towards which future work might be directed.*
>
> - *Is the ear the most sensitive receptor to low frequency sound in the body?*
> - *Alternatively, is there a receptor mechanism in the body which is more sensitive than the ear at low frequencies? If so, what is the mechanism?*
> - *Are levels of infrasound below hearing threshold potentially harmful? If this is true, are there safe levels?*
> - *When people complain about noise which cannot be measured, is it because they are disturbed by fluctuations in the background noise?*
> - *Can fluctuations in the background noise level turn a noise, which has an average level below the hearing threshold of a listener, into a nuisance?*
> - *If fluctuations are combined with the lowest sensitivity of the hearing threshold (e.g. three standard deviations below the median) can people hear noises which have a measured average value so far below the hearing threshold that we might consider them inaudible?*
> - *Does the way in which we measure low frequency noise hide some of its disturbing characteristics?*

- *Considering the normal distribution of the hearing threshold, why are there not more complaints of low frequency noise?*

Barbara Griefahn (Institute of Occupational Physiology at the University of Dortmund, Germany) is a well-known researcher on sleep disturbance due to noise. In Noise & Health Vol 4, 15 (2002) the abstract to "Sleep disturbance related to environmental noise" identifies that the ear still hears even when asleep:

The permanently open auditory channel and the ability of the brain to process incoming acoustical stimuli even while asleep and to respond adequately is the essential precondition for noise-induced sleep disturbances which are regarded as the most deleterious effects of noise. In the past, research was mainly focused on the detection and description of the various effects of noise, on the influence of personal and environmental factors, on the determination of dose response relations and the definition of critical noise loads, above which noise becomes intolerable. These limits are, however, as yet only tentative or applicable for a very few situations and need to be verified or revised

This material was available prior to the 2003 Guidelines and gives an explanation as to potential sleep disturbance impacts from wind farms that may operate continuously or intermittently at night.

The Guidelines recommend computer prediction methods in accordance with IS09613-2 or CONCA WE. These models are designed to deal with general noise sources not wind farms with low frequency noise.

In a submission on the Draft NSW Wind Farm Guideline document issued for public comment last year, Vestas Australian Wind Technology Pty Ltd (available on NSW Department of Planning Website) states:

Low frequency noise

The Draft Guidelines state that *"Analysis of wind turbine spectra shows that low frequency noise is typically not a significant feature of modern wind turbine noise and is generally less than that of other industrial and environmental sources."*

It is therefore unnecessary to require the prediction and monitoring of low frequency noise emissions from wind turbines. This is especially so, given the absence of regulation or limits upon the low frequency noise from "other industrial and environmental sources" as mentioned in the above statement from the Draft Guidelines. This is a further example of the way in which the Draft Guidelines discriminate against wind farms.

In addition, the existing and well validated industry standard models for acoustic propagation are not designed to deal with frequencies at the low end of the audible spectrum, specifically because noise emissions in this band are not considered to pose issues likely to affect the surrounding environment. Accordingly, Vestas suggests the removal of the requirement to measure low frequency noise from the Draft Guidelines.

The above comment on low frequency noise from a local subsidiary of Vestas Wind Systems A/S (the world's largest manufacturer of wind turbines and being supplier of the turbines currently proposed) confirms the models are not designed to deal with the low frequencies.

Use of the A-weighting as an assessment criterion overcomes the inadequacy of the computer models (because it ignores low frequency) and does not deal with the presence and impact of low frequency noise received at dwellings from wind farms.

One result of considering the potential adverse impact of sleep disturbance is that as there is an assumption people sleep at night, the assessment should differentiate between day and night. This would enable consideration of whether approval conditions requiring that turbines not operate at night could satisfY the obligations imposed by the Development Plan.

In addition to low frequency noise, the operation of wind farms produces noise characteristics that do not get picked up in an average A-weighted measurement. For example there are modulations in the noise signature, tonal characteristics and infrasound.

Section 4.7 of the Guideline under "Annoying characteristics" states:

> These guidelines have been developed with the fundamental characteristics of noise from a wind farm taken into accoo.ml. These Include the aerodynamic noise from the passing blades (commonly termed 'swish') and the infrequent and short-term braking noise.
>
> Howe ··><. annoying characteristics that are not fundamental to a typical well-maintained wind farm should be rectified Such characteristics may include Infrasound (low frequency noise below the audible frequency range that manifests as a rattle In lightweight materials such as glass) or adverse mechanical noise (perhaps generated as a failure of a component).

> Infrasound was a characteristic of some wind turbine models that has been allnbuted to early designs In Which turbine blades were downwind of the main tower. The effect was generated as the blades cut through the turbulence generated around the downwind side of the tower.
>
> Modem designs generally have the blades upwind of the tower. Wind conditions around the blades and Improved blade design minimise the generation of the etrect. The EPA has consulted the working group and completed an extensive l erature search but is not aware of Infrasound being present et any modern wind fanm site.

Notwithstanding the above, noise data in relation to wind farms in the Goyder region are discussed in the following section and show amplitude modulation, tones and infrasound exist for wind farms in proximity to the proposed wind farm. These characteristics, when present, can also be said to be adverse noise impacts from which the surrounding community is required to be protected.

Finally, there are those matters (outlined in preceding sections) in relation to which clear identification of the range of expected higher noise levels and the frequency of occurrence of the same needs to be made in order to comply with the objectives of the Guidelines and the requirements of the Development Plan.

The predicted noise levels for a wind farm will be expected to vary as a result of different weather conditions. When there is no wind in the area, the wind farm will not create an acoustic impact.

However different wind strengths (at the wind farm turbine height) will generate different noise levels. Similarly different wind direction will also change the level of noise.

Similarly temperature inversions can alter the propagation of noise that can significantly increase the noise levels.

The community will experience a range of noise levels over time depending upon the prevailing weather conditions. It would seem appropriate for the Guidelines (and reports prepared in accordance with the Guideline) to clearly identify the range of noise levels and the frequency of occurrence of the higher noise levels.

7.0 TESTING OF WINDFARM NOISE -WATERLOO AND HALLETT

Any appropriately qualified and experienced acoustic engineer will be aware that when there are vigorous complaints from residents as to noise disturbance then there is likely to be some form of noise impact occurring with respect to the relevant noise source. There may very well be a heightened sensitivity of residents who are continuously exposed to the subject noise and who can become "tuned into" the noise.

As part of my ongoing research into the actual or perceived impacts associated with wind farms, when the opportunity arises it is appropriate to undertake sound level measurements.

This section provides the results of measurements taken by the author near turbines in the Goyder region to identify noise levels associated with the source and noise measurements at residential receivers. The results assist in placing the perceived noise impact in the existing environment and are relevant to the acceptability concept identified in the Guidelines. This material provides context to the subject application with respect to the topography and acoustic environment of the area.

These measurements may also provide an opportunity for residential receivers potentially impacted by the proposed Stony Gap Wind Farm to attend various locations in proximity to the Waterloo Wind Farm, or the group of wind farms that generically go under the name of Hallett, and ascertain for themselves the external acoustic environment that they could receive as a result of the subject proposal.

By use of noise contour graphs that identify the A-weighted level to be emitted from the Wind Farm, residents can find locations that would approximate their residence with respect to the proposed development to gauge first-hand the impact. For example, such a practical method permits residents who may be subject to a major road upgrade to experience the predicted noise levels as a result of that upgrade and thereby ascertain the likely impact.

Some caution should be applied to this suggestion as noise levels will depend on weather conditions and the perceived noise will relate to external noise, and not the noise levels obtained inside a dwelling.

Attendance at a number of residential dwellings found that residents related having experienced varying degrees of disturbance/impacts when the turbines are operating compared to the situation prior to the construction of the relevant wind farm. Measurements were conducted both external to various dwellings, and in some cases simultaneous measurements both external to an inside the dwelling were undertaken.

During the course of attending various residences where either complaints have been registered with the Council, or compliance monitoring has been conducted by the wind farm operators, an opportunity was also presented to conduct measurements on public roads in proximity to turbines in situations where noise was not influenced by either vehicular activity (i.e. no vehicles) or activities associated with rural properties. On attending a number of residences noise from the wind farms varied ranging from barely audible, clearly audible or not audible outside the residence. Measurements inside residences found differing degrees of audibility.

Some residents near Mt Bryan advised of sleep disturbance, whilst for periods when the turbines were not operating at night, they experienced no disturbance.

Some residents did not want their property specifically identified and therefore have been excluded from the material contained in this peer review. Residences referred to in this peer review are identified by a house code (house 5 – 12 are in the vicinity of Hallett and Waterloo Wind Farms).

As set out in a previous section of this review, the Guidelines indicate that there is no issue in terms of low frequency noise and that infrasound is only generated in poorly maintained wind farms.

Towards the northern end of the Waterloo Wind Farm there is one public road that passes through the Wind Farm (Quinns Gap Road) and another that runs along the northern side of the current Wind Farm (Moilers Gap Road). These public roads permit access to positions relatively close to the turbines from which measurements may be undertaken.

One set of measurements were conducted on the top of Quinns Gap Road where one microphone was located directly in front of the turbine at a position 142 m from the base, or 168m slant distance to the hub. A second microphone was located at a similar distance but perpendicular to the side of the hub so as to be in line with the rotating plane of the turbine blades.

A second set of measurements were conducted on the top and eastern side of Mollers Gap Road where one microphone was located at to the side turbine at a position 152 m from the base or 172 m slant distance to the rear housing.

The response curves in Appendix C show the response of the ear is non-linear across the frequency bands. The general community assessment uses the A-weighted curve (the blue curve in the lower graph of Appendix C) and as identified previously attenuates the low frequency components.

Typically wind turbine noise spectra are also presented in A-weighting curves that show the maxima to be in the mid frequencies.

The upper graph in Appendix D presents the turbine power levels measured for a distance of 800 metres for Capital Wind Farm (NSW) and Waterloo Wind Farm (slant distances noted above) on the assumption of hemispherical radiation and 6 dB per doubling of distance. Included in the graph are sound power levels for VestasV90 turbine from the Marshal Day report. These results are Linear results (without the A-weighting filter).

The lower graph in Appendix D reproduces the Linear results and also the same results when presented as A-weighted levels. The difference in the identification of low frequency becomes obvious.

Appendix E present the 1/3 octave band results of the Quinns Gap Road measurements over the Guideline standard I0 minute sample. The results show the spectrum information on a statistical basis in a linear format (not A-weighted) and show the statistical variation in the noise level.

There were no other intrusive noises at the site. only turbine noise. The results clearly identify frequency peaks rather than a broadband noise.

The measurement results show different frequency characteristics for noise off the front of the turbines versus to the side.

The A-weighted level was not constant and exhibited a variation in level which as nominated in the Guideline is identified as modulation. The modulation occurs over the entire audio spectrum. Whilst not showing a significant variation in the statistical analyses in Appendix E the modulation is most obvious in the upper frequency bands as shown by comparison of the A-weighted level versus the 2500 Hz 1/3 octave band in Appendix F.

Appendix G presents a number of FFT analyses that show the sound spectrum in a linear format (rather than constant percentage bandwidth- 1/3 octave bands) to permit identification of narrowband tones. Appendix G1 shows the statistical variation in the frequency display with the remaining graphs being the energy average (Leq) of each 2 minute sample.

The FFT analyses progressively reduce the bandwidth of each analysis to permit identification of specific tones that occur in the frequency area nominated as covering low-frequency sound and infrasound. The bottom axes are frequencies in Hz (i.e. Appendix G I and G2 show **O– I** kHz, Appendix G3 0 – 100Hz and Appendix G4 **O–** 12.5 Hz).

The frequency graphs clearly show that there are low frequency and infrasound components generated by the turbine.

The results set out in Appendices D – G for the measurements of the turbine reveal modulation, low frequency noise and infrasound components.

The Marshall Day Acoustics report identifies ambient background levels below 40 dBA for residential receivers in proximity to the Stony Gap Wind Farm.

Appendix H provides measurements using a SVAN 957 Sound Level Meter at a location approximately 2km south of the proposed Hallett 3. The location is well removed from any main roads.

The background levels (shown in Appendix H) during the day are below 20 dB(A) – except for 40 minutes in the day whilst the evening and night time background level are below 15 dB(A). How much below 15 dB(A) cannot be ascertained as the background is less than the electrical noise floor of the sound level meter.

The daytime (7am – 6pm) Leq, is 31 whilst the Leq for the entire 23 hour period shown in Appendix H is 28 dB(A). The ambient noise in the rural environment as such is significantly lower than "Indicative" level of 40 dB(A).

Appendix I provides a series of measurements conducted at House 10 which is approximately 1300 metres from the northern end of the Waterloo Wind Farm. The measurements include simultaneous inside and outside measurements where the internal location was in the centre of the master bedroom and the external location was located at 15 metres in front of the dwelling towards the wind farm.

The measurements in Appendix I were recorded during the night time period. The turbines were audible both outside and inside the dwelling. The external background level was found to be 27 dB(A) and the background in the bedroom (windows closed) was 16 dB(A).

The modulation of the turbine noise external to the dwelling becomes obvious in the 2 minute sample of the A-weighted level over time. However the attenuation of the building eliminates the high frequency modulation inside the building, which becomes obvious in comparing the results.

Similarly the presence of both low-frequency sound and infrasound inside the dwelling and outside the dwelling is shown in the frequency spectra.

Moller (for Maastricht City Council) identifies the use of A-weighted measurements and in relation to audibility states:

The levEl of the infrasoLWd produced by modern wind turbines is so low that the sound annot be perceive<! by humans evEn close to the turbines". Much higher levEls occur elsewhere in our daily emlironme-11t, e.g- in mmspon:a tion.

ow-fr;:que-ncy wind turbine noise is usuaJiv described as hum n ing o r rumbling. It ma have a more or less pronounceif tonal ch;uaeter, e..g. · t.::rms of tone.s that fluctuate and vaJ)ı in leve l and/or pitch, or of tone-like pues excited with regtJiar or random inte rvals. The feeling of pressu re at the eardl\lms is also reported. It is characteristic that the noise wrie.s a lot in time and with wind and other- abllo.spheric cooditions.

The rare of modu ion of tM! low-frequen<v noise from wind turbines (and higher frequendes as well) is ofttm · he Infrasonic frequency range, e.g.. the ade passage frequency, and the noise may thus be mistaken as Infrasound, eve-n o,hen th ere i:s littl e or virtua lly no infrasound present.

The measurements in proximity to the Waterloo turbines identifies the blade pass frequency of the turbines and the harmonics of that frequency to be present and those frequencies are also present outside and inside houses. The turbine measurements reveal the presence of infrasound components.

The measurement of infrasound inside houses is similar to that obtained in Falmouth by Rand and Ambrose.

It is noted that the difference from outside to inside with respect to the low frequency sound and infrasound components is relatively small, and in some cases there is a negative difference in that there are higher levels inside the dwelling than outside.

When one is dealing with low frequency or infrasound noise associated with gas fired power stations it has been found that the energy emitted from the power station can excite the building elements into resonant modes or physical vibration that leads to the internal surfaces of the room in question vibrating and radiating noise.

The fact that there are discrete frequencies detected inside the dwelling that fall into the frequencies typically associated with different levels of sleep states is a matter that should be noted. The assessment of sleep disturbance is outside my field of expertise but the material provided in Appendix I is informative.

It is noted that in viewing the frequency graphs contained in this report, the measurement results are those obtained directly from the Bruel & Kjaer Pulse system with a low pass filter of 7 Hz (rather than the standard 22 Hz) and utilising Bruel & Kjaer Type 4189 microphones that have a frequency response that falls off below 10Hz.

If one is looking to accurately define the sound levels occurring in the infrasound region then one needs to adjust the measurement results appended to this review which will result in higher sound pressure levels for frequencies below 7Hz.

Similarly, in view of the low ambient noise levels recorded both inside and outside the dwellings the measurement results are approaching the electrical noise floor of the microphones. More detailed investigations require specialised microphones to accurately record such levels.

During the course of monitoring at house H10, the occupants related that on the night upon which the measurement results appended to this review were obtained, they experienced disturbed sleep.

Residents at houses I0 and 12 advised the author that testing has been conducted by independent consultants to reveal that both of these properties comply with the Guidelines. Yet the occupants of both ofthese properties experience sleep disturbance and at times complained of excessive noise intrusion. I was advised that at house H10 monitoring conducted by one set of independent consultants placed the microphone approximately 1.5 m from the bedroom window of that residence. This would not comply with the requirements of the Guidelines.

Attendance at House H12 also suggested that monitoring which had been conducted by independent consultants was not in accordance with the Guidelines. The occupant identified that the monitoring position was to the side of the residence in relatively close proximity to large trees, rather than the complying with the requirement to be between the residence and the wind farm which would have placed the monitor in an open paddock.

Residents indicated that there are significant differences in noise received at their property dependent upon the weather conditions and cited both light and strong winds giving rise to different noise effects. Cloud cover was also cited as altering the noise propagation.

Appendix J provides a series of photos from house H8 obtained in the morning. The photos indicate wind occurring across the valley yet there is cloud on the lee side of the hill completely covering a residence. A close up of the photo shows at one point in time an operating turbine poking through the cloud cover.

For the purposes of this peer review, the attached Appendices are sufficiently detailed to reveal that even when wind farms in the Goyder area are apparently able to comply with the Guidelines, they are still generating adverse impacts at residential properties. These impacts can be detected and measured when one looks to the use of non-A-weighted measurement results. The measurement data appended to this review identifies that there are both low frequency and infrasound components generated by the turbines that are currently located in the region.

8.0 CONCLUSIONS

Marshall Day Acoustics has relied solely upon the EPA Guidelines and has ignored the acoustic characteristics that residents will actually receive as a result of the Stony Gap Wind Farm. They have not addressed the actual acoustic impact of the wind fann on the community.

The Marshall Day acoustic assessment provides a set of predicted noise levels in terms of the A-weighted values set out in the Guidelines and concludes that there are no tonal or modulation characteristics requiring modification to the predicted noise levels.

The assessment does not specifically address the influence or effect of winds and temperature inversions which have the potential to result in higher noise levels than have been predicted.

Professor Hansen has raised the issue that the acoustic assessment has under predicted the noise that residents will receive and taking into account the above matters, there is the distinct possibility that at times noise generated by the proposed wind farm will be greater than that set out in the acoustic assessment.

In relation to background levels, the attached measurement results confirm (as expected) that ambient background levels inside rural properties in the subject region are significantly lower than 30 dB(A) and that external noise levels are lower than the nominated Environment Protection (Noise) Policy 2007 night time Indicative Level of 40 dB(A) for rural areas. As such, the noise generated by the wind farm is likely to be significantly greater than background +SdB(A) and therefore to have an impact significantly greater than for an "annoyance."

The issue of low frequency noise and infrasound has been raised and discussed above. Documentation from the world's leading supplier of turbines has identified that computer models are inadequate for low-frequency noise propagation. As high frequencies are rapidly attenuated over distance (when compared to low frequencies) audible characteristics of the turbines may be reduced to a low frequency hum and can also include frequencies below the normal range of human hearing.

The Guidelines identify that infrasound is not generated on a well maintained wind farm yet the measurement results obtained for the purposes of this report prove otherwise. The measurement data appended to this review identifies that there are both low frequency and infrasound components generated by the turbines that are currently located in the region.

A proper assessment of community impact (either pursuant to the Development Plan or generally) cannot ignore low frequency noise and "infrasound." To the extent that it does, when these have been issues of specific complaint with other wind farms, the Marshall Day report falls short of its responsibility to the community.

The Guidelines identify that for host stakeholders, sleep disturbance is an adverse health effect. It is not unreasonable for Council and the community to assume that if sleep disturbance gives rise to an adverse health effect for persons who are obtaining a financial gain from hosting turbines, then sleep disturbance that impacts upon the general community (i.e. non-host stakeholders) must also give rise to an adverse health effect.

This peer-review has identified two eminent acousticians who, in 2002/2004, identified that there are issues with low frequency and infrasound and that the ear still continues to work and receive signals even when people are asleep. The mechanism causing sleep disturbance (for example, whether individuals are able to detect the infrasound components) is an issue outside my expertise.

But it is clear that use of the A-weighted value for assessment or compliance purposes does not address all of the noise impact issues associated with wind farms.

The Council's Development Plan requires certain objectives to be met for the subject wind farm. These objectives have been outlined above. The current application has not satisfactorily addressed these objectives, and has not actually assessed the noise or the impact of the subject development.

Inadequacies of the EPA Guidelines in meeting their own core objects have been raised. Council may consider raising these difficulties which the Guidelines are causing the Council with the EPA to address the concerns of the community.

As a result of the various matters raised and outlined above, there can be no confidence that the community will not be adversely impacted by the proposed Stony Gap Wind Farm. It is recommended that Council should request further particulars from the Applicant to address the individual matters raised above with particular reference to the Development Plan and with a view to identifying the actual noise impact that will be generated by the proposed wind farm.

Yours faithfully,

THE ACOUSTIC GROUP PTY LTO

STEVEN E. COOPER

References:

- Marshall Day Acoustics: "Stony Gap Wind Farm, Noise Impact Assessment" dated 2 March 2011 (report ref 002 R07 2008241)
- Professor Colin Hansen of Adelaide University: "Stony Gap Wind Farm Noise Impact Assessment" dated 22nd February 2012
- TRUenergy Development Pty Ltd., Letter response to the eligible representations received to the Stony Gap wind farm development application (422/115/11) (Stony Gap DA) during the public notification periods in January, February and March 2012, dated 24th April 2012
- SA EPA, "Wind Farms, Environmental Noise Guidelines" July 2009
- SA EPA, "Wind Farms, Environmental Noise Guidelines" February 2003
- SA Government, "Environment Protection (Noise) Policy 2007" Version 31.3.2008
- Cooper S, Peer Review of Acoustic Assessment, Flyers Creek Wind Farm" ref 41.4963.R 1A, 15th December 2011
- NSW Planning & Infrastructure, "Draft NSW Planning Guidelines Wind Farms", December 2011

- CooperS, "Review of Draft Wind Farm Guidelines" refer 42.4963.R2, dated l4[1] h March 2012
- Australian Acoustical Society, "Code of Ethics"
- Goyder Council, "Development Plan", 17 February 2011
- Marshall Day Acoustics "Waubra Wind Farm, Post – Construction Noise Compliance Assessment", ref 001 2009107 October 2010
- Standards Australia, "AS 1055.1-1997 Acoustics Description and measurement of environmental noise, Part I: General procedures", 1997

- Standards Australia, "AS/NZS 2107:2000 Acoustics- recommended design sound levels and reverberation times for building interiors", 2000
- Standards Australia, "AS 3671-1989, Acoustics – Road traffic noise intrusion – Building siting and construction", 1989
- Leventhal! G, Low Frequency Noise, "What we know, what we do not know, and what we would like to know", Journal of Low Frequency Noise, Vibration and Active Control, Vol 28, No 2, 2009
- Leventhall GH "Low Frequency Noise and Annoyance" Noise & Health 6, 23 (2004).
- Griefahn B, "Sleep disturbance related to environmental noise" Noise & Health Vol 4, 15 (2002)
- Vestas Australia Wind Technology Pty Ltd, "Draft NSW Planning Guidelines: Wind Farms", 14 March 2012
- Van de Berg GP, "The sound of high winds: the effect of atmospheric stability on wind turbine sound and microphone noise" 2006
- Moller H, Pedersen JK, Strunstrap JK and Pedersen CS, "Assessment of low-frequency noise from wind turbines in Maastricht", April 2012
- Ambrose S, Rand R, The Bruce McPherson ILFN Study Report, December 14, 2011
- Shepherd D, McBride D, Welch D, Dirks K, Hill E, Evaluating the impact of wind turbine noise on health- related quality of life, Noise & Health, September-October 20 II, vol 13.

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CONSULTING ACOUSTICAL & VIBRATION ENGINEERS

PEER REVIEW OF NOISE IMPACT

ASSESSMENT STONY GAP WIND FARM

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Prepared for: *Regional Council of Goyder*

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BURRA SA 5417

CONTENTS

APPENDICES

1.0 INTRODUCTION

An application has been submitted to the Regional Council of Goyder by Roaring 40s Renewable Energy Pty Ltd for the proposed Stony Gap Wind Farm to be located near the township of Burra, north of Adelaide, South Australia.

Accompanying the application is a report from Marshall Day Acoustics: "Stony Gap Wind Farm, Noise Impact Assessment" dated 2 March 2011 (report ref 002 R07 2008241). This report is on the TRUenergy website.

Subsequent advice is that there is a different acoustic report from Marshall Day Acoustics being: "Stony Gap Wind Farm, Noise Impact Assessment" dated 20 July 2011 (report ref 002 R08 2008241). This report is **NOT** on the TRUenergy website.

Examination of the two reports reveals the primary difference is the removal of references to ''Roaring 40s", changes to the regression curves and identification of the noise floor of the unattended noise loggers.

The Council has received objections in relation to approval of the proposed wind farm, one of the grounds of objection being noise disturbance. Objectors have cited impacts from existing wind farms in the region as evidence of potential impacts arising from the proposed wind farm.

The objections are expressed in layman's terms with the exception of a report from Professor Colin Hansen of Adelaide University: "Stony Gap Wind Farm Noise Impact Assessment" dated 22nd February 2012.

In view of the Council not having staff with expertise in acoustics for assessing the objector's claims and complaints from residents concerning operational wind farms in the region, the Council requested a peer review of the above two noise reports.

In addition to the above two reports the peer review was extended to consider a response document (dated 24th April 2012) from TRUenergy Development Pty Ltd. The response is to the "eligible representations received to the Stony Gap wind farm development application (422/115111) **(Stony Gap DA)** during the public notification periods" in January, February and March 2012.

The above documents refer to noise guidelines for wind farms issued by the South Australia EPA (2003 and 2009), the Goyder Council Development Plan (dated February 2011 and consolidated in February 2012), and the Mid North Regional Land Use Framework (adopted in May 2011 as part ofthe Planning Strategy of SA).

2.0 QUALIFICATIONS OF REVIEWER

The nature of actual or perceived noise impacts associated with wind farms is the subject of wide debate throughout communities in proximity to wind farms.

To date there are conflicting arguments or claims as to noise and resultant health impacts due to wind farm operations.

In conducting a peer review it is appropriate to identify the reviewer's technical expertise to undertake such an exercise and to identifY any potential conflicts.

I Steven Edwin Cooper am the principal of The Acoustic Group Pty Ltd, Consulting Acoustical and Vibration Engineers.

I have been in practice as an Acoustical Consulting Engineer for 34 years. I hold a Bachelor of Science (Engineering) degree from the University of New South Wales and a Master of Science (Architecture) degree from the University of Sydney and am a Chartered Professional Engineer. I am a Fellow of the Institution of Engineers Australia, a Member of the Australian Acoustical Society and a Member of the Institute ofNoise Control Engineering (USA).

In the course of my acoustical consulting practice I have been involved in numerous projects for private, commercial and government organisations requiring expertise in acoustics, noise and vibration issues.

Furthermore as a practising Acoustical Consulting Engineer I am or have been a member of the Standards Association of Australia Committees AV4, AV/10, AV/10/4 and EV/11 dealing with Architectural Acoustics, Whole-Body Vibration, Rail Traffic Noise, and Aircraft Noise respectively. I was a member of the Australian Acoustical Society NSW Membership Grading Committee from 1979 to 1997 and was a member of the Australian Acoustical Society Federal Grading Committee in 1998. My Curriculum Vitae is set out in Annexure A.

It is noted that in the course of my professional career I have been involved in projects where I have appeared for Applicants, Objectors, Councils, Government Departments (State and Federal) and as a Court Appointed Expert. I am not a member of any political party and have not been retained or approached by any wind farm proponents to undertake an assessment of wind farm noise.

I have extensive experience in the measurement and assessment of large industrial premises where there is a requirement to maintain compliance with specified noise limits under all weather scenarios. I have also conducted research into various acoustic issues concerning the propagation of aircraft noise and sound dispersion in enclosed spaces that has questioned the status quo of various Standards or acoustic texts leading to modification/amendments to Australian Standards and International guidelines.

Whilst I have not been engaged by any wind farm applicant to undertake an acoustic assessment or compliance testing of planned or operational wind farms, I was requested last year by a community group opposing a proposed wind farm at Flyers Creek (in NSW) to review an application.

I prepared a desk top review of the acoustic assessment that had been prepared for the Flyers Creek Wind Farm. My desk top audit was contained in a submission from the Flyers Creek Wind Turbine Awareness Group ("FCWTAG") in relation to the proposed Flyers Creek Wind Farm. The desk top review raised issues as to the ambient background levels, the predicted noise emission levels and the absence of an assessment of the noise impact ofthe proposed wind farm.

The desk top review was supplemented by preliminary noise testing in proximity to the Capital Wind Farm (in NSW) to experience first-hand wind farm operations and conduct sound level measurements. The preliminary testing highlighted a number of issues with respect to the assessment and evaluation of wind farm noise where currently the predominant acoustic descriptor is the dB(A) level.

I found at times there to be no audible noise inside or outside residential dwellings, whilst on other occasions I was able to detect wind farm noise both outside and inside dwellings.

My testing identified the possibility that noise originating from the wind farm could affect individuals and that further testing/investigations were required as set out in my review of the Flyers Creek Wind Farm application (available on the NSW Department of Planning website).

The NSW Department of Planning issued in late 2011 a draft set of wind farm guidelines for public comment. The NSW guidelines are more stringent than the SA wind farm noise guidelines.

As part of my review of the draft NSW guidelines I undertook further measurements and analysis of wind farm noise (Capital, Cullerin and Woodlawn Wind Farms) to research wind farm noise and assess the practicality of compliance testing as set out in the draft NSW guidelines.

I prepared a submission on the draft guidelines. I was not engaged by any party to prepare my submission, but as it relied upon previous material prepared for the Flyers Creek submission, my review of the draft NSW guidelines was added to the Flyers Creek community submissions (available on the NSW Department of Planning website).

As part of my on-going investigations into wind farm noise I have attended residential properties and public roads in proximity to Waterloo and Hallett wind farms in order to place in context claims of excessive noise/impacts from those wind farms. As for the NSW wind farms I have attended, at some sites there was clearly audible noise from the wind farm, at other sites some noise was audible, whilst at other sites there was no audible noise.

In the reporting of wind farm noise, there are claims and counter claims as to bias in the presentation of data which is a fundamental issue to be addressed prior to this peer review.

As a Member of the Australian Acoustical Society (the "AAS") and a Fellow of the Institution of Engineers Australia I am required to abide by the Code of Ethics for those two organisations.

Annexure B provides a copy of the Code of Ethics of the Australian Acoustical Society.

If there is potential for an industry to jeopardise the welfare, health or safety of the public, or affect the well-being of the community I am duty bound to identifY those issues under the Code of Ethics of the Australian Acoustical Society.

The AAS Code of Ethics requires that the acoustical assessment in relation to a wind farm is accurate and contains all the relevant material. This is the obligation placed on the acoustician. The acoustician has a heavy professional obligation and should be neither pro nor anti wind farm in approach.

I approach all my work in accordance with my professional Code of Ethics. I make the specific statement that I am not anti-wind farm.

Any project, be it an industrial application or a wind farm, should operate without giving rise to disturbance, health effects or adverse impacts on the community. If it can do so then, from a noise point of view, it may be permitted.

In relation to my knowledge of the authors of the reports which I am peer reviewing, I am aware of some of the Marshall Day staff and their professional qualifications. I am unable to find the Associate whose signature appears on the cover page of the report currently listed as a Member of the Australian Acoustical Society. If however the author(s) of the report are not members of the Australian Acoustical Society then the report is required to accord with the Code of Conduct from the Association of Australian Acoustical Consultants of which Marshall Day Acoustics (Melbourne) is identified as a member firm. As a professional working in the area of acoustics, I have known Professor Hanson in a limited professional capacity over quite a few years. I have not discussed with him the contents of his assessment of the proposed wind farm.

3.0 THE MARSHALL DAY ASSESSMENT

3.1 Outline

The document status table indicates that the assessment has been undertaken over some 18 months and subject to a number of revisions.

The overview of the document indicates the assessment was undertaken in accordance with the 2009 version of the South Australian EPA wind farm noise guidelines where the base level for noise assessment has been set at 40 dBA.

The assessment has assumed forty one (41) Vestas V90-3MW wind turbines with a nominal hub height of 80 m. There is an acknowledgement that if the turbine model is altered or changed then a review of the noise predictions and compliance will need to be undertaken.

The overview indicates eleven (11) assessable residential properties had been identified in the vicinity ofthe proposed wind farm with background noise monitoring being carried out at seven residential properties.

The overview identifies that noise emissions from the proposed wind farm, including substation noise, comply with the guidelines noise limits at all 11 assessed properties.

The overview also identifies that noise emission from the substation will comply with the Environment Protection (Noise) Policy 2007.

The report indicates that the noise source level used for the turbines has been supplied by the manufacturer and that the noise data used in the assessment has been identified as Mode 0, which is reported as not including any noise management. The report appears to indicate that the audibility of tones is based on International Standard ISO 1996-2:2004. The report indicates at a distance of approximately 150 m an audibility assessment of prevalent tones for the wind speed of 6 – 10 m at 10 m above ground for Mode 0 operation is -1.7 dB, leading to the MDA opinion tonal correction is not necessary for any of the assessed wind speeds.

However the EPA have used IEC Standard 61400-11 :2006 for describing tonality where the Standard nominates -3 dB as the lower limit of inaudibility. This would appear to be different to the +4 dB limit nominated by MDA be reference to ISO 1996.2:2004.

The report identifies that noise guidelines were issued by the EPA in 2003 and were revised in 2009. The assessment is based on the 2009 version of the Guidelines.

Section 3.1 of the report refers to extracts from the SA EPA Guidelines to identifY 40 dBA as the base level noise criteria which would apply at non-host residential receivers or background noise + 5 dBA whichever is the greater. In relation to infrasound, reference is made to Section 4.7 of the Guidelines to quote that the EPA "is not aware of infrasound sound being present at any modem wind farm site".

Section 3.2 identifies that the Environment Protection (Noise) Policy 2007 covers other noise sources associated with wind farms and identifies transformer stations as a typical noise source. The design target for the substation has been set at 35 dBA at the nearest affected residential property.

Section 4 identifies the methodology used in the assessment with Section 4.2 referring to International Standards for the determination of the sound data and also the propagation of noise from wind turbines.

Section 4 identifies the background noise monitoring as utilising at least 2000 data points. These data points are correlated with local weather conditions and hub height wind strength to develop regression analyses upon which the background noise levels are derived in order to determine the noise limits.

Table 2 in Section 5 identifies residential sites that are to be assessed and indicates the location of the nearest turbine to the house. Table 2 shows eleven houses of which seven are stakeholder properties, which do not have to achieve the noise limits obtained from the EPA Guidelines.

Table 3 identifies the background noise monitoring periods at the various houses followed by identification of the equipment used for noise monitoring with the qualification that the noise loggers were placed at least 5 m from the nearest dwellings in positions that were representative of the general ambient noise environment. Reference is made to Appendix F to show photographs of the logger locations.

I note that Appendix F does not provide any plans to indicate the relative position of the loggers with respect to the residential dwellings. Due to the proximity of foliage, and in particular large trees in a number of the sites, the ambient background level for times at which wind is present at the site could influence the results.
Page 12 refers to weather stations installed at houses 19 & 23 for limited periods in 2009. There is a claim that wind speeds of greater than 5 m/s (at the residential monitoring stations) has resulted in those data points being removed from the regression analysis.

The report does not indicate the model or type of weather stations used at residential dwellings. Nor does it appear there is any material contained in the assessment report to indicate the ambient background level at the receiver locations versus the wind that was occurring at the equipment used for monitoring the ambient background noise level.

Section 6 provides a series of regression analysis curves that indicate for each site the number of data points that have been excluded from the analysis due to either rain, out-of-range wind speeds, or high wind speed at the microphone position. There are noticeable differences in the regression curves between report R7 (on the applicant's website) and R8.

Section 7 refers to predicted noise levels and refers to appendices at the rear of the report which provide a summary of the computer noise predictions. The report concludes that there is compliance with the criteria derived from the Guidelines.

Section 8 refers to the transformer station assessment to indicate that noise from the substation would be insignificant at the nearest residential property.

Section 9 concludes that noise emission from the proposed wind farm will be less than 40 dBA at non-stakeholder properties and not exceed 45 dBA at stakeholder properties.

3.2 **Analysis**

The Marshall Day noise impact assessment report is similar to that provided by that organisation for other wind farms and would appear to fall into a generic type of report. There are a number of issues arising from this. Further, in relation to the Stony Gap Wind Farm, there are specific requirements arising from Council's Development Plan which also need to be addressed but I will deal with these in a separate section below.

One issue of concern in relation to the generic type of noise assessment prepared for the subject wind farm is that there is a conflict between the title of the report and the contents of the report.

The report is titled "Stony Gap Wind Farm Noise Impact Assessment" yet the report has not actually identified the noise impact that will be generated by the proposed wind farm. This would appear to be a fundamental failure in the obligations of the author(s) of the acoustic assessment i.e. a failure of the obligation to provide a meaningful document in relation to actual noise impacts that the community can understand.

The acoustic assessment has not explained to the community the impact that the proposed wind farm will have upon the existing acoustic environment of the area nor whether the operation of the wind farm will affect their daily activities or their night time sleeping patterns.

The ambient data reveals the existing acoustic environment of the area is significantly less than 40 dBA. This automatically raises the question of "What is an acceptable noise impact from the proposed wind farm?" This is not an exercise that has been carried out in the subject assessment.

It would appear that the acoustic report considers that the description of the acoustic impact is satisfied by identifying compliance with a noise target set out in the Guidelines. However, any experienced acoustic engineer would be aware that generating a noise which is significantly greater than the existing ambient background level of an area can create an impact which should be assessed.

The regression analysis curves reveal a significant degree of variation in background noise levels at individual wind speeds referenced to 80 m above ground level at the wind farm.

The regression analysis as presented in the report does not differentiate between the background levels that occur at night versus the background levels that occur in the day. One typically expects night time background levels to be lower than in the day.

Therefore if one was seeking to conduct an assessment of the impact of the wind farm on the community, it would be appropriate to differentiate between the acoustic environment that exists in the day versus that in the night. The document has not identified that position.

The regression analysis does not continue below the cut-out speed to indicate the natural ambient background level of the environment. Nor do the graphs show the full extent of the ambient noise in the area. For example houses 10, 16, 23, 24 and 29 all appear to have a threshold limit above 20 dBA, whereas house 20 and 21 show a lower ambient floor which suggests different instrumentation from the other houses.

If one assumes that the ambient background level of the area from the regression analysis is around 25 dB at the cut-out speed, then it is an undeniable fact that a noise limit of 40 dBA, obtained from the Guidelines, would be clearly audible both inside and outside residential dwellings and would represent a significant impact in terms of the existing environment.

If the regression lines are extrapolated to identify the background level prior to the cut in speed then one would expect a lower background level to prevail.

If one was to identify to the community there would be no impact/an impact /an adverse impact or severe impact from the proposed wind farm it would be appropriate for the report to discuss the relevance of the predicted noise levels versus the regression curve and/or the minimum background levels that relate to the various wind speeds.

In addition to the above, in seeking to inform the community as to the noise impact of the proposed wind farm it would be appropriate to identify whether the assessment of noise is conservative and/or the extent of variation that may occur in such noise propagation.

For example, one can have the turbines operating whilst at residential receivers there is absolutely no wind.

The MDA report has not identified the relationship between the wind speed at the hub height versus the wind speed at receiver locations. There is therefore no correlation with the predicted noise levels under the wind scenarios that have been assessed, nor consideration of the difference in propagation for different wind directions. Nor is there consideration of the occurrence of adverse meteorological effects which could be identified in a generic term as temperature inversions, separately to the more detailed and complex analysis attributed to the van den Berg effect (referred to in Appendix E).

It is quite likely that such an analysis could show a range of noise levels and identify to the community that for a certain percentage of the time the wind farm would be inaudible/barely audible/clearly audible. Such an analysis could show there is no issue in the day, but an issue at night that could be resolved by not operating the turbines at night.

The assessment report has failed to identify the potential audibility of turbine noise inside residential dwellings. Documents otherwise in the public domain establish that Marshal Day Acoustics are intimately aware of the significance of this issue for wind farms.

There would appear to be an assumption that the noise from the wind farm would not exhibit modulation at residential receivers thereby requiring an adjustment to the predicted noise levels.

There is no discussion or consideration of whether the subject wind farm will generate any low frequency, tonal or infrasound energy at residential receivers. One would expect a "Noise Impact Assessment" to provide an appropriate consideration of this issue in relation to these specific characteristics.

4.0 GOYDER COUNCIL DEVELOPMENT PLAN

The application was lodged with the Council November 2011. The relevant Development Plan is the Goyder Council Development Plan dated 17 February 20 II and the Statewide Wind Farms Development Plan dated 19 October 2011. The Goyder Council Development Plan was consolidated on 23 February 2012. The provisions of the Development Plan relevant to the assessment of the application, which was lodged in November 2011 thereby includes the now consolidated provisions of the Statewide Wind Farms Development Plan, i.e. one must consider both the Council's Development Plan and the Statewide Wind Farms Development Plan.

The TRUenergy response document acknowledges the Development Plan and the relevant sections in the plan which the subject wind farm is required to satisfy/address. With respect to noise issues, commencing on page 40 of the document is a section titled *"Interface between Land Uses"*. It is as follows:

OBJECTIVES

Development located and designed to prevent adverse impact and conflict between land uses.

2 Protect community health and amenity and support the operation of all desired land uses.

3 Accepting that wind farms and ancillary development may need to be sited in visually prominent locations, then the visual impact of the development needs to be managed.

PRINCIPLES OF DEVELOPMENT CONTROL

Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through any of the following:

(a) the emission of effluent, odour, smoke, fumes, dust or other airborne pollutants
(b) noise
(c) vibration
(d) electrical interference
(e) light spill

(f) glare
(g) hours of operation
(h) traffic impacts.

2 Development should be designed and sited to minimise negative impact on existing and potential future land uses considered appropriate in the locality.

3 The visual impact of wind farms and ancillary development should be managed in accordance with the policies contained within the General Section headed Renewable Energy Facilities.

4 Development adjacent to a Residential Zone or residential area within a Township Zone should be designed to minimise overlooking and overshadowing of nearby residential properties.

s Residential development adjacent to non-residential zones and land uses should be located, designed and/or sited to protect residents from potential adverse impacts from non-residential activities.

6 Sensitive uses likely to conflict with the continuation of lawfully existing developments and land uses considered appropriate for the zone should not be developed or should be designed to minimise negative impacts.

Noise

7 Development should be designed, constructed and sited to minimise negative impacts of noise and to avoid unreasonable interference.

a Development should be consistent with the relevant provisions each of the following documents:

(a) AS 2107 Acoustics- Recommended Design Sound Levels and Reverberation Times for Building Interiors

(b) AS 3671 Acoustics- Road Traffic Noise Intrusion, Building Siting and Construction

(c) the current Environment Protection (Noise) Policy

The Objectives of the Interface between Land Uses section have not been addressed in the Marshall Day acoustic assessment for the proposed wind farm.

In relation to the first objective, the matter of adverse impact and conflict between land uses is not addressed on a noise basis. The Marshall Day report considers simply complying with the criteria derived from the EPA wind farm noise guideline.

As identified above, the Marshall Day report does not adequately address the actual noise impact of the proposed wind farm at all. It is silent therefore on what would constitute a negative or adverse impact for the purposes of the Development Plan. The Development Plan itself does not appear to quantify adverse impact.

From an acoustic perspective one may consider an adverse impact to occur at a noise level of greater than what may be considered a significant impact, which on A-weighted value may be assigned background+ 5 dB(A) on the following basis. Under previous versions of Australian Standard AS 1055, noise level that exceeds the background may be considered to be annoying. Noise levels up to 5 dBA above the background were considered to be of marginal significance.

The second objective requires the protection of community health and amenity and to support the operation of all desired land uses. Whilst at the present point in time the community health impacts of wind farms have not been identified on a purely noise basis and have been the subject of recommendations for further research, the protection ofthe amenity of the community and the ongoing operation ofthe existing land uses is required by the second objective. There accordingly needs to be an examination of whether there is compliance with the DP or whether there may be a conflict between noise impacts and the second objective. Interference with sleep for example, would be a clear conflict.

On proceeding to principles six (6) and seven (7) under the subheading "Noise," there is a requirement for development to minimise negative impacts of noise and to avoid unreasonable interference. The noise levels contained in the Marshall Day report as outlined above (without taking into account any of the factors raised by Professor Hansen - see below) raise the potential for both negative impacts and unreasonable interference when one considers the true ambient background level of the area.

Principal 7 refers to two Australian Standards which have not been considered in the acoustic assessment. If AS21 07 is to be considered, as directed by the Development Plan, then from Table I of that Standard for houses in areas with negligible transportation the recommended satisfactory design internal sound level for sleeping areas is 25 dBA. This internal level has not been assessed by Marshall Day.

The second Standard relates to road traffic noise and therefore would be irrelevant with respect to the operation of the wind farm.

The third document referred to is the current Environment Protection (Noise) Policy. However the Environment Protection (Noise) Policy reference contained in the *Interface Between Uses* section of the Development Plan does not appear to apply to wind farms, other than providing a mechanism to utilise the guidance document issued by the SA EPA being the wind farm noise guidelines. [1]

In addition to the above, the Development Plan (Page 62) contains a separate section with specific sections for Renewable Energy Facilities:

OBJECTIVES

1 **The development of renewable energy facilities, such as wind and biomass energy facilities, in appropriate locations.**

[1] In Part one, subsection 5, Table 2 identifies that the indicative noise factor for rural living at night is 40 dBA. Under the subclause preceding the table there is an identification that if a measurement place is within a habitable room that cannot be located an open window the indicative noise level for the noise source is the satisfactory level set out in Australian Standard AS 2107 or 20 dB(A) less than the indicative noise level.

By reference to the comments above the indicative noise level inside a habitable room in a rural living use is 40 -20 = 20 dBA under the indicative method or 25 dB(A) under the AS 2107 method.

Clause 6 identifies the policy does not apply to a noise of a class set out in Schedule 1. Wind farms are not identified in Schedule **1.**

Clause 9 identifies the object of the Policy under subsection (b) is to fix goals for most noise sources compliance with which will satisfy the general environmental duty under section 25 of the Act in relation to noise from those noise sources. However there is a note that Part 4 does not apply to noise is of the kinds to which Part 6 and Part 7 apply. Part 7 is headed "Guidance documents" and identifies in clause 34 wind farms and refers to 2003 version of the guidelines.

It would therefore appear that the Environment Protection (Noise) Policy reference contained in the Interface between Uses section of the Development Plan does not apply to wind farms, other than the providing a mechanism to utilise the guidance document issued by the SA EPA being the wind farm noise guidelines.

2 Location, siting, design and operation of renewable energy facilities to avoid or minimise adverse impacts and maximise positive impacts on the environment, the local community and the State.

PRINCIPLES OF DEVELOPMENT CONTROL

Renewable energy facilities, including wind farms and ancillary developments, should be located in areas that maximise efficient generation and supply of electricity.

2 Wind farms and ancillary development such as substations, maintenance sheds, access roads and connecting power-lines, should be sited, designed and operated in a manner that:

(a) avoids or minimises negative impacts on the character, landscape quality, visual significance or amenity of the area

(b) uses elements of the landscape and appropriate materials and finishes to minimise visual impact

(c) avoids or minimises the potential for adverse impact on areas of native vegetation, conservation, environmental, geological, tourism or built or natural heritage significance

(d) does not impact on the safety of water or air transport and the operation of ports, airfields and designated landing strips

(e) avoids or minimises nuisance or hazard to nearby property owners and/or occupiers, road users and wildlife by not:

(i) causing shadowing, flickering, reflection or blade glint impacts

(ii) creating excessive noise

(iii) interfering with television and radio signals

(iii) modifying vegetation, soils and habitats

(iv) striking birds or bats.

The Development Plan requires wind energy facilities to be developed in appropriate locations and to avoid or minimise adverse impacts. Under principal 2(e) the wind farm and ancillary development is required to avoid or minimise nuisance to nearby property owners by not creating excessive noise or interfering with television and radio signals.

The Development Plan does not define "excessive noise" which to some people could be any noise that is audible and gives rise to disturbance.

The previous version of the Statewide Wind Farm Policy specified for Renewable Energy Facilities the same Objectives and Principles as set out in the Council's Development Plan.

The updated (current) version of the Statewide Wind Farm Policy alters the visual aspect of wind farms. Under Renewable Energy Facilities the policy states:

Renewable Energy Facilities

Objective 1 **Location, siting, design and operation of renewable energy facilities as essential infrastructure that benefits the environment, the local community and the State.**

Objective 2 **The development of renewable energy facilities, such as wind farms and ancillary development, in areas that provide the opportunity to harvest natural resources for the efficient generation of electricity, accepting that such facilities will often need to be sited in visually prominent locations.**

Objective 3 **Location, siting, design and operation of renewable energy facilities to avoid or minimise adverse impacts on the natural environment.**

PDC 1 **Renewable energy facilities, including wind farms and ancillary developments, should be located in areas that maximise efficient generation and supply of electricity.**

PDC 2 **Wind farms and ancillary development such as substations, maintenance sheds, access roads, wind monitoring masts and connecting power-lines (including to the National Electricity Grid), should be sited, designed and operated to:**

(a) **manage the visual impact of the development by achieving the following:**

(i) a setback of at least 1kilometre of a wind turbine from a dwelling that is not associated with the development
(ii) vegetated buffers to mitigate short to medium range visual impacts
(iii) regular spacing of wind turbines in open/flat landscapes where vegetation is orderly
(iv) irregular spacing in hilly/rugged landscapes where vegetation is varied
(v) ensure that blades on wind turbines rotate in the same direction
(vi) ensure that all wind turbines have uniformity in terms of colour, size and shape

(b) avoid or minimise the potential for adverse impact on areas of native vegetation, conservation, the natural environment, geological, tourism or built or natural heritage significance

(c) avoid or minimise the following impacts on nearby property owners and/or occupiers, road users and wildlife:
(i) shadowing, flickering, reflection or blade glint impacts
(ii) excessive noise
(iii) interference with television and radio signals
(iv) modification of vegetation, soils and habitats
(v) striking of birds or bats.

PDC 3 Renewable energy facilities, including wind farms and ancillary development, should be designed and sited so as not to impact on the safety of water or air transport and the operation of ports, airfields and designated landing strips.

In terms of noise impacts there is no difference between the Council's Development Plan and the Statewide Wind Farm Policy. The wind farm is to avoid or minimise excessive noise.

In any event the Marshall Day report has not addressed the objectives or principles specifically identified for Renewable Energy Facilities in the Development Plan.

It is noted that during the course of monitoring at various residential dwellings in proximity to Waterloo or Hallett wind farms residents identified the existing wind farms had given rise to interference with radio and television reception with a number of houses having been supplied satellite receivers because they could no longer get television signals from Adelaide. A criticism of a number of the residents concerning the satellite receivers is that they were watching television programs in the Northern Territory and could not get local or state news.

5.0 PROFESSOR HANSEN'S ASSESSMENT

The document prepared by Professor Hanson is dated 22nd February 2012. Each page has a header identifying "the assessment was prepared by Professor Hansen at the request of Stony Gap residents including Dunn, Mitchell and Coffey families".

The matters raised by Professor Hansen may be said to fall into two categories. The first are those which outline technical matters in the Marshal Day report such that Professor Hansen suggests there is likely to be an exceedance of the South Australian EPA guidelines if the wind farm is approved. Secondly, Professor Hansen questions the adequacy of the existing guidelines (for technical reasons which he outlines) and provides an alternative assessment of the expected noise impact from the proposed wind farm. These areas overlap at times.

The comments concerning the assessment of existing background noise levels identifY that there is no correlation between the wind speed data at the wind farm location versus the noise levels measured at residential locations. They raise concerns as to differences in timing between the two assessment items.

There are concerns raised as to the absence of identifYing the true background level of the area and disagreement with the regression analysis that has been provided, with specific reference to the noise floor of the various types of instrumentation which would not give rise to the correct levels being measured and therefore leads to an over estimate of the regression line so derived.

With respect to the establishment of acceptable noise criteria, Professor Hansen raises questions as to the validity of noise levels nominated as acceptable by the EPA. He lists a number of relevant factors/reasons to query the acceptable noise criteria nominated in the assessment.

Those factors include:

- The absence of an assessment of low frequency dominance in the noise spectrum which will dramatically be enhanced when considered inside a residence by way of the transmission loss properties of typical building elements at low frequencies versus high frequencies.

- The suggestion of 30 dBA as an acceptable internal level based on a World Health Organisation document is inappropriate for remote rural areas.
- There are issues with correlating background noise levels versus wind speed at the wind farm. There is a significant degree of variation in background noise levels (without identifying the source of those variations) that is considered to overestimate the background noise determined by the regression line at quiet times during the night.
- The EPA guidelines make no distinction between night and day when establishing background levels and if the data was separated into day and night then the spread of results for the regression lines would be likely to be less, but more importantly the background levels attributed to the night time period would be expected to be lower than the regression lines that have been provided.

Professor Hansen questions the appropriateness of nominating 40 dBA for residences in the vicinity of wind farms.

He also questions the assumption of absence of tones in relation to Stony Gap when noise radiated by existing turbines near Mount Bryan has been identified as having a tonality characteristic.

With respect to the noise level predictions specifically, questions are raised as to the appropriateness of the noise prediction model and the source data where such data may have been obtained in flat terrain and smooth air which is not representative of the subject site. Questions are raised as to the use of 6 dB per doubling of distance attenuation. Professor Hansen identifies that the actual decay rate after 200 to 400 m is more like 3 to 4 dB per doubling of distance. The modelling assumes 50% soft ground would not apply to low frequencies thereby suggesting that with respect to low frequency noise the model will underestimate the resultant noise.

Professor Hansen identifies that the computer modelling results have been presented as A-weighted values and not in octave bands. The evaluation of potential low frequency noise problems has not been provided nor can those predictions be quantified.

Professor Hansen criticises the adequacy of treatment and consideration of adverse weather conditions that can give an enhancement of sound and thereby result in noise from the wind farm exceeding the nominated criteria even if one was to consider such a level to be acceptable.

Professor Hansen forms the view that the predicted noise levels provided by the applicant are highly likely to exceed the maximum level allowed by the South Australian EPA guidelines. Notwithstanding the nominated level he considers that the appropriate target under the guideline should be 35dBA. On the basis of that level then there is an issue in respect to the subject application.

Professor Hansen identifies that the Marshall Day report has not considered annoying modulation effects or low frequency content of wind farm noise which would further exacerbate the impact on the community.

He raises the point that as the turbine size and type has not been finalised at this point in time then there are further concerns of a greater degree of noise impact to residential receivers.

Professor Hansen concludes that the application should not be approved until such time as the above matters of the final turbine size and layout decided upon, and by reason of the other components in the conclusion there are additional noise impacts to be considered.

6.0 EPA GUIDELINES, NOISE IMPACTS

The Marshall Day report presents data which it asserts is sufficient to establish compliance with EPA guidelines. It then relies upon the concept that the EPA guidelines have determined comprehensively an acceptable noise level for rural environments that will apply to the assessment of wind farms. On this basis, the EPA guidelines "cover the field" and no further examination of noise impacts is undertaken, either generally or specifically in relation to the Development Plan. The report does not identity for the community the actual noise impact which will occur.

The alternative assessment report provided by Professor Hansen suggests, for the technical reasons outlined above, that sufficient data has not been presented to conclude that the wind farm will be compliant with existing guidelines. However, Professor Hansen is also critical of the basis of acceptable noise levels set out in the EPA guidelines and in particular the assessment utilising A-weighted levels only, the regression line approach for determining the background noise level, and the absence of identifYing sleep disturbance impacts inside residential properties. One view of Professor Hansen's position is that the actual noise impact of the proposed development is not and cannot be properly assessed under the EPA guidelines for the reasons he sets out.

I have outlined at Section 3 above, a variety of concerns which I believe should be addressed in relation to the Marshall Day report. It is not necessary for this peer review to comment further on the fundamental difference in approach between the two reports concerning the guidelines. It is my view that the Development Plan alone specifically requires actual noise impacts for the community to be addressed and this has not occurred.

However, given the obligations under the Development Plan and given the matters raised in the Hansen assessment, I propose for Council's assistance to give some consideration to the adequacy of the Guidelines in relation to Council's obligations and responsibilities to residents of the Goyder region (both in terms of its Development Plan and generally).

The Guidelines introduce two "core" principles - protecting the amenity of the community from adverse noise impacts and taking all reasonable and practicable measures to prevent or minimise environmental harm. These are contained in the Introduction section and its explanatory content:

> The core objective of the guidelines is to balance the advantage of developing wind energy projects in South Australia with protecting the amenity of the surrounding community from adverse noise impacts.

Guidelines

The *Environ1719nt Protection Act 1993* (EP Act) requires a ltlty of care for the environment. This Is specified under section 25 of the Act and states:

> A person must not undertake an actiVIty that pollutes. or mlgllt pollute, tne envronment unless tile person taKes all reasonable and practicable measures to prevent or minimise any resulting environmental narm.

Guidelines published by the EPA Inclcate tile standard of care tllat Is liKely to be required to secure compliance with the general environmental duty. They have the advantage of fle)(iblity and can be adapted to a range of circumstances.

Neither the body of the document nor the glossary defines "adverse impacts". As such the Guidelines do not assist the Council by defining "adverse noise" for the purposes of the Development Plan. Similarly whilst Section 4.8 of the Guidelines is headed "Excessive noise," there is no definition of excessive noise.

If one assumes the EPA has a responsibility to protect the community from unreasonable disturbance and to prevent or minimise any resulting environmental harm then it is not unreasonable to expect the noise criteria to reflect that situation.

Section 2 identifies that the concept is to set a base noise level typically 5 dB(A) lower than the level considered to reflect the amenity of the receiving environment. The Guidelines correctly identify that as the wind increases so can the noise in the environment such that a varying noise limit (dependent upon the wind strength) must apply.

Reliance is placed on the *Environment Protection (Noise) Policy* 2007 as the basis of an Indicative Level of 40 dB(A) at night.

In the 2003 version of the Guidelines the noise criteria for a new wind farm development was:

> T11e predicted equivalent noise le\'el tL to) adjusted f01 tonality in accordance \lith these guidelmes. shouht not exceed:
>
> - 35 LiB(A). o1"
> - the backgro,md noise (L4.90,1o) by mot·e than 5 l1B(A)
>
> whichever is the gt·eater, at all relev.utt receivers- for each i.ntege£,,-ind speed hom cut-n1 to rated power of the lVTG.
>
> T11e ba.:kgrottnd noise shoulLi be as dNemtine-d b,- the ctata colle-ction J.i\d regression analysi5 procedure 1ecouU11ended LUtdec these gtUdehnes tSe<hon 3). [t should l"lt' u•ad fmm the 1·esultant graph at the re-levant i:ntege1· wind speed.

Whilst the above criteria may prevail for existing wind farms, the 2009 version of the Guidelines sets different noise criteria:

2.2 Noise criteria-new wind farm development

The predicted eoul'lalerrt noise level (LA"'"). adjusted for tonality In accordance with these guidelines. should not exceed:

35dB(Al ot relevont receivers In locolities [1] which -: re prlmorily intended for rural living',or

40dB(Al at relevant receivers In localities' in other zores or

lhe background noise ($L_{.,.10}$) by more than 5dB(A).

whichever is the greater. at all relevant receivers for wird sp;,ed from cut-in tc rated power of the *WTG* and each intEger wind speed in between.

The background noise should be as determined by the data collection and regression analysis procedure recommended under these guidelines (Section 3). It should be read from the resultant graph at the relevant integer wind speed.

Compliance wilh !he noise criteria should also be demonstrated for lhe approved developments in the zone adjacent to the wind farm.

'Rural living

A ·rural living' zone Is 8 rur81-resldenl1111 'lifestyle' 11re111ntended to h11ve 11 rel!!tlvely quiet emenlty The 8re!!l should not be used for prlmafY production other than to produce food, crops or keep animals *for* the occupiers' own use. consumption and/or enjoyment The noise amenity should be quieter than In an urban-restdentlalarea.

If there is uncertainty about the zone and whether the rural living criter1a stlould be applied. the question Is to oe determined. for tile purposes of tllese Guidelines. by tile EPA in consultation witlllhe council for tile area concerned.

The Marshall Day report sets out that the proposed wind farm is located in a Primary Production zone thereby utilising 40 dB(A) as the base limit. This means that where the Council has received complaints in relation to existing wind farms where the criteria is 35 dBA or background + 5 dBA (whichever is the greater), the proposed noise limit for the subject wind farm is less stringent.

In a general acoustic sense, one has difficulty accepting that persons living on a farm in a Primary Production zone automatically experience a higher ambient noise than those in a rural living zone. In fact ifthere are large properties (as frequently found in Primary Production zones) there can be a significant distance from adjacent dwellings and therefore lower ambient noise levels. This is because there is no impact from adjacent dwellings.

If a rural living zone is intended to have a relatively quiet amenity and background levels in the day and night can be around 20- 25 dBA (or lower), then there would appear to be a conflict between the noise criteria set by the Guidelines and what residents who reside in such zones would consider is an acceptable acoustic amenity level.

There is a fundamental problem with the selection of the base criteria ifthey are meant to ensure there are no adverse noise impacts. What constitutes an acceptable acoustic amenity for residents in a rural area has not been established.

There is no material in either the 2003 or the 2009 versions of the Guidelines identifying the basis of the base level of 40 dB(A) for a rural area. The bibliography towards the end of the Guidelines does not reference any reports or studies as to the acoustic amenity of rural areas in Australia (or in fact anywhere) nor any evaluation of acceptable amenity levels for rural areas.

There is a reference to World Health Organisation *Guidelines for Community Noise*.

The WHO Guidelines appear in an explanatory note in Section 2.3 "Agreements with wind farm developers".

> A risk associated with relying on such agreements $till remains where the criteria In these guidelines are exceeded. This Is because an Interpretation of 'unreasonable' is required In any future assessment of the impact of wind farm noise initialed by a complaint from the landowner (or future landowners).
>
> Wod Health Organization Guidelines for Community Noise recommend 30dB(A) Indoor limit to prevent negative effects on sleep. The Working Group on Noise from Wind Turbines (Final Report. ETSU for DTI. 1996) recommends the outdoor noise Imlt of 45d8(A) (efter eny adjustment for tonality) for landowners having financial involvement In the wind farm. If the Wind farm noise does not exceed 30dB(A) Indoors and 45dB(A) outdoors at the loc8lltles belongln:to the financial stakeholders It Is considered acceptable. In particular situations the expected noise Impact can be above the recommended limits. In this case the landowner has to agree In wri ng with the higher lave; of exposure and the developer should discuss the Issue With the EPA.

However, examination of the WHO 1999 Guidelines reveals the 30 dBA indoor limit is associated with urban areas impacted by road traffic. There is no mention of wind farms or criteria for sleep disturbance in rural areas in the WHO Guidelines.

The second sentence in the second paragraph of the above explanatory note could be taken as an implication that the World Health Organisation is nominating a 30 dBA indoor level as acceptable, which is not the case. The explanatory note appears in the section covering stakeholders, i.e. residents who receive a financial interest from the wind farm.

If as identified in the Guidelines the stake holder dwelling is permitted a higher level of noise then does it not mean that for non-stake holders where the external limit for rural living is reduced from 45 to 35 dBA, the corresponding internal limit should be 20 dBA so as to ensure there is no adverse health impact?

Addressing Stony Gap specifically, if, as identified in the Marshall Day acoustic assessment, external background levels at rural dwellings in proximity to the proposed wind farm are below 30 dBA then it must follow that background levels inside dwellings will be lower.

Further, if as identified in the Marshall Day Acoustic report there are background levels at say cut in speed significantly less than 30 dB(A), then it is an undeniable fact that a wind farm generating say 38 dB(A) will be clearly audible at a dwelling. This noise will be significantly greater than the general concept for an annoyance of marginal significance being background+ 5 dB(A). The EPA Guidelines are silent on the actual acoustic impact of wind farms because they utilise noise limits significantly greater than background+ 5 dB(A).

The Guidelines do identify sleep disturbance as an adverse impact. The Guidelines, for example, identify on page 4 that if stakeholders experience sleep disturbance then that must be an adverse health impact:

However, the existence of an agreement will affect the consideration of whether the interference is unreasonable in a given situation. It Is unlikely that there will be unreasonable Interference if:

- a formal agreement Is documented between the parties.
- the agreement clearly outlines to the landowner the expected Impact of the noise from the wind farm and Its effect upon the landowner's amenity, and
- the likely impact or exposure will not result In adverse health Impacts (eg the level does not result in sleep disturbance).

As the Guidelines do not specifically define or quantify excessive noise or adverse impact in terms of any measurable impact, the identification of sleep disturbance as an adverse impact provides a mechanism for quantifYing the second objective in the Renewable Energy Facilities section of the Goyder Council's Development Plan. It is also relevant to the core objective of the Guidelines themselves.

The issue of sleep disturbance as an adverse health impact in the Guidelines must lead to an examination of what noise causes sleep disturbance and to the use of dBA as the assessment parameter. Whilst identifYing the sleep disturbance as an adverse health impact the Guidelines do not identify what level of noise from wind farms generates sleep disturbance. Noise generated from wind turbines covers the entire audio spectrum and includes infrasound. Where monitoring reveals compliance with the nominated dBA noise criteria residents still hear the wind farm noise and complain about sleep disturbance.

The A-weighted filter curve significantly attenuates low frequencies (see Appendix C) and cannot provide a true indication of potential low frequency noise issues, which is a common source of complaint concerning wind farms. Furthermore if one considers noise that is below the frequency range of human hearing (i.e. less than 20 Hz which is normally referred to as lnfrasound) the A-weighted value for such frequencies is insignificant.

H. G. Leventhall published a paper in Noise & Health 6.23 (April 2004) "Low frequency noise and annoyance" where the abstract states:

> *Low frequency noise, the frequency range from about 1OHz to 200Hz, has been recognised as a special environmental noise problem, particularly to sensitive people in their homes. Conventional methods of assessing annoyance, typically based on A-weighted equivalent level, are inadequate for low frequency noise and lead to incorrect decisions by regulatory authorities. There have been a large number of laboratory measurements of annoyance by low frequency noise, each*

> *with different spectra and levels, making comparisons difficult, but the main conclusions are that annoyance of low frequencies increases rapidly with level. Additionally the A-weighted level underestimates the effects of low frequency noises. There is a possibility of learned aversion to low frequency noise, leading to annoyance and stress which may receive unsympathetic treatment from regulatory authorities. In particular, problems of the Hum often remain unresolved. An approximate estimate is that about 2.5% of the population may have a low frequency threshold which is at least 12dB more sensitive than the average threshold, corresponding to nearly 1,000,000 persons in the 50-59 year old age group in the EU-15 countries. This is the group which generates many complaints. Low frequency noise specific criteria have been introduced in some countries, but do not deal adequately with fluctuations. Validation of the criteria has been for a limited range of noises and subjects.*

In the paper Leventhall specifically cites the World Health Organization as recognising low frequency noise as an environmental problem. He references the WHO publication on Community Noise and provides the following in relation to rest, sleep and adverse effects:

> *"It should be noted that low frequency noise, for example, from ventilation systems can disturb rest and sleep even at low sound levels"*
> *"When prominent low frequency components are present, noise measures based on A-weighting are inappropriate"*
> *"Since A-weighting underestimates the sound pressure level of noise with low frequency components, a better assessment of health effects would be to use C-weighting"*
> *"It should be noted that a large proportion of low frequency components in a noise may increase considerably the adverse effects on health"*
> *"The evidence on low frequency noise is sufficiently strong to warrant immediate concern"*
> *"For noise with a large proportion of low frequency sounds a still/ower guideline (than 30dBA) is recommended"*

In 2009 Leventhal! provided another paper in the Journal of Low Frequency Noise, Vibration and Active Control Low Frequency Noise, "What we know, what we do not know, and what we would like to know". He defines low frequency noise as in the range of l0 Hz to lOOHz, but could be extended an octave each end to give 5 Hz to 200Hz.

Whilst the 2009 paper contains the majority of the 2004 information he highlights significant issues concerning low frequency noise that cannot be detected using A-weighting.

> *Although we know a great deal about low frequency noise, there are aspects which we cannot yet explain. We know about how people hear low frequency noise and that some have a low tolerance to it. We believe that low frequency noise may, in general, be more annoying than higher frequency noise, but do not know why this is so. We do not know why some people complain of a low frequency noise which cannot be measured separately from the background noise.*
>
> *It is also possible that there are subtle effects of low frequency noise on the body, which we do not yet understand.*

Leventhall provides standardised threshold levels over a frequency range assigned for human hearing, including levels for part of the range described as Infrasound. He provides a series of questions that are clearly relevant to the proposed wind farm if it is shown that low frequency noise is likely to be produced:

> ***SOME FINAL QUESTIONS***
>
> *This review of low frequency noise and its effects leaves some unanswered questions, towards which future work might be directed.*
>
> - *Is the ear the most sensitive receptor to low frequency sound in the body?*
> - *Alternatively, is there a receptor mechanism in the body which is more sensitive than the ear at low frequencies? If so, what is the mechanism?*
> - *Are levels of infrasound below hearing threshold potentially harmful? If this is true, are there safe levels?*
> - *When people complain about noise which cannot be measured, is it because they are disturbed by fluctuations in the background noise?*
> - *Can fluctuations in the background noise level turn a noise, which has an average level below the hearing threshold of a listener, into a nuisance?*
> - *If fluctuations are combined with the lowest sensitivity of the hearing threshold (e.g. three standard deviations below the median) can people hear noises which have a measured average value so far below the hearing threshold that we might consider them inaudible?*
> - *Does the way in which we measure low frequency noise hide some of its disturbing characteristics?*

- *Considering the normal distribution of the hearing threshold, why are there not more complaints of low frequency noise?*

Barbara Griefahn (Institute of Occupational Physiology at the University of Dortmund, Germany) is a well-known researcher on sleep disturbance due to noise. In Noise & Health Vol 4, 15 (2002) the abstract to "Sleep disturbance related to environmental noise" identifies that the ear still hears even when asleep:

The permanently open auditory channel and the ability of the brain to process incoming acoustical stimuli even while asleep and to respond adequately is the essential precondition for noise-induced sleep disturbances which are regarded as the most deleterious effects of noise. In the past, research was mainly focused on the detection and description of the various effects of noise, on the influence of personal and environmental factors, on the determination of dose response relations and the definition of critical noise loads, above which noise becomes intolerable. These limits are, however, as yet only tentative or applicable for a very few situations and need to be verified or revised

This material was available prior to the 2003 Guidelines and gives an explanation as to potential sleep disturbance impacts from wind farms that may operate continuously or intermittently at night.

The Guidelines recommend computer prediction methods in accordance with IS09613-2 or CONCA WE. These models are designed to deal with general noise sources not wind farms with low frequency noise.

In a submission on the Draft NSW Wind Farm Guideline document issued for public comment last year, Vestas Australian Wind Technology Pty Ltd (available on NSW Department of Planning Website) states:

Low frequency noise

The Draft Guidelines state that *"Analysis of wind turbine spectra shows that low frequency noise is typically not a significant feature of modern wind turbine noise and is generally less than that of other industrial and environmental sources."*

It is therefore unnecessary to require the prediction and monitoring of low frequency noise emissions from wind turbines. This is especially so, given the absence of regulation or limits upon the low frequency noise from "other industrial and environmental sources" as mentioned in the above statement from the Draft Guidelines. This is a further example of the way in which the Draft Guidelines discriminate against wind farms.

In addition, the existing and well validated industry standard models for acoustic propagation are not designed to deal with frequencies at the low end of the audible spectrum, specifically because noise emissions in this band are not considered to pose issues likely to affect the surrounding environment. Accordingly, Vestas suggests the removal of the requirement to measure low frequency noise from the Draft Guidelines.

The above comment on low frequency noise from a local subsidiary of Vestas Wind Systems A/S (the world's largest manufacturer of wind turbines and being supplier of the turbines currently proposed) confirms the models are not designed to deal with the low frequencies.

Use of the A-weighting as an assessment criterion overcomes the inadequacy of the computer models (because it ignores low frequency) and does not deal with the presence and impact of low frequency noise received at dwellings from wind farms.

One result of considering the potential adverse impact of sleep disturbance is that as there is an assumption people sleep at night, the assessment should differentiate between day and night. This would enable consideration of whether approval conditions requiring that turbines not operate at night could satisfY the obligations imposed by the Development Plan.

In addition to low frequency noise, the operation of wind farms produces noise characteristics that do not get picked up in an average A-weighted measurement. For example there are modulations in the noise signature, tonal characteristics and infrasound.

Section 4.7 of the Guideline under "Annoying characteristics" states:

> These guidelines have been developed with the fundamental characteristics of noise from a wind farm taken into accoo.ml. These Include the aerodynamic noise from the passing blades (commonly termed 'swish') and the infrequent and short-term braking noise.
>
> Howe ··><. annoying characteristics that are not fundamental to a typical well-maintained wind farm should be rectified Such characteristics may include Infrasound (low frequency noise below the audible frequency range that manifests as a rattle In lightweight materials such as glass) or adverse mechanical noise (perhaps generated as a failure of a component).

> Infrasound was a characteristic of some wind turbine models that has been allnbuted to early designs In Which turbine blades were downwind of the main tower. The effect was generated as the blades cut through the turbulence generated around the downwind side of the tower.
>
> Modem designs generally have the blades upwind of the tower. Wind conditions around the blades and Improved blade design minimise the generation of the etrect. The EPA has consulted the working group and completed an extensive l erature search but is not aware of Infrasound being present et any modern wind fanm site.

Notwithstanding the above, noise data in relation to wind farms in the Goyder region are discussed in the following section and show amplitude modulation, tones and infrasound exist for wind farms in proximity to the proposed wind farm. These characteristics, when present, can also be said to be adverse noise impacts from which the surrounding community is required to be protected.

Finally, there are those matters (outlined in preceding sections) in relation to which clear identification of the range of expected higher noise levels and the frequency of occurrence of the same needs to be made in order to comply with the objectives of the Guidelines and the requirements of the Development Plan.

The predicted noise levels for a wind farm will be expected to vary as a result of different weather conditions. When there is no wind in the area, the wind farm will not create an acoustic impact.

However different wind strengths (at the wind farm turbine height) will generate different noise levels. Similarly different wind direction will also change the level of noise.

Similarly temperature inversions can alter the propagation of noise that can significantly increase the noise levels.

The community will experience a range of noise levels over time depending upon the prevailing weather conditions. It would seem appropriate for the Guidelines (and reports prepared in accordance with the Guideline) to clearly identify the range of noise levels and the frequency of occurrence of the higher noise levels.

7.0 TESTING OF WINDFARM NOISE -WATERLOO AND HALLETT

Any appropriately qualified and experienced acoustic engineer will be aware that when there are vigorous complaints from residents as to noise disturbance then there is likely to be some form of noise impact occurring with respect to the relevant noise source. There may very well be a heightened sensitivity of residents who are continuously exposed to the subject noise and who can become "tuned into" the noise.

As part of my ongoing research into the actual or perceived impacts associated with wind farms, when the opportunity arises it is appropriate to undertake sound level measurements.

This section provides the results of measurements taken by the author near turbines in the Goyder region to identify noise levels associated with the source and noise measurements at residential receivers. The results assist in placing the perceived noise impact in the existing environment and are relevant to the acceptability concept identified in the Guidelines. This material provides context to the subject application with respect to the topography and acoustic environment of the area.

These measurements may also provide an opportunity for residential receivers potentially impacted by the proposed Stony Gap Wind Farm to attend various locations in proximity to the Waterloo Wind Farm, or the group of wind farms that generically go under the name of Hallett, and ascertain for themselves the external acoustic environment that they could receive as a result of the subject proposal.

By use of noise contour graphs that identify the A-weighted level to be emitted from the Wind Farm, residents can find locations that would approximate their residence with respect to the proposed development to gauge first-hand the impact. For example, such a practical method permits residents who may be subject to a major road upgrade to experience the predicted noise levels as a result of that upgrade and thereby ascertain the likely impact.

Some caution should be applied to this suggestion as noise levels will depend on weather conditions and the perceived noise will relate to external noise, and not the noise levels obtained inside a dwelling.

Attendance at a number of residential dwellings found that residents related having experienced varying degrees of disturbance/impacts when the turbines are operating compared to the situation prior to the construction of the relevant wind farm. Measurements were conducted both external to various dwellings, and in some cases simultaneous measurements both external to an inside the dwelling were undertaken.

During the course of attending various residences where either complaints have been registered with the Council, or compliance monitoring has been conducted by the wind farm operators, an opportunity was also presented to conduct measurements on public roads in proximity to turbines in situations where noise was not influenced by either vehicular activity (i.e. no vehicles) or activities associated with rural properties. On attending a number of residences noise from the wind farms varied ranging from barely audible, clearly audible or not audible outside the residence. Measurements inside residences found differing degrees of audibility.

Some residents near Mt Bryan advised of sleep disturbance, whilst for periods when the turbines were not operating at night, they experienced no disturbance.

Some residents did not want their property specifically identified and therefore have been excluded from the material contained in this peer review. Residences referred to in this peer review are identified by a house code (house 5 – 12 are in the vicinity of Hallett and Waterloo Wind Farms).

As set out in a previous section of this review, the Guidelines indicate that there is no issue in terms of low frequency noise and that infrasound is only generated in poorly maintained wind farms.

Towards the northern end of the Waterloo Wind Farm there is one public road that passes through the Wind Farm (Quinns Gap Road) and another that runs along the northern side of the current Wind Farm (Moilers Gap Road). These public roads permit access to positions relatively close to the turbines from which measurements may be undertaken.

One set of measurements were conducted on the top of Quinns Gap Road where one microphone was located directly in front of the turbine at a position 142 m from the base, or 168m slant distance to the hub. A second microphone was located at a similar distance but perpendicular to the side of the hub so as to be in line with the rotating plane of the turbine blades.

A second set of measurements were conducted on the top and eastern side of Mollers Gap Road where one microphone was located at to the side turbine at a position 152 m from the base or 172 m slant distance to the rear housing.

The response curves in Appendix C show the response of the ear is non-linear across the frequency bands. The general community assessment uses the A-weighted curve (the blue curve in the lower graph of Appendix C) and as identified previously attenuates the low frequency components.

Typically wind turbine noise spectra are also presented in A-weighting curves that show the maxima to be in the mid frequencies.

The upper graph in Appendix D presents the turbine power levels measured for a distance of 800 metres for Capital Wind Farm (NSW) and Waterloo Wind Farm (slant distances noted above) on the assumption of hemispherical radiation and 6 dB per doubling of distance. Included in the graph are sound power levels for VestasV90 turbine from the Marshal Day report. These results are Linear results (without the A-weighting filter).

The lower graph in Appendix D reproduces the Linear results and also the same results when presented as A-weighted levels. The difference in the identification of low frequency becomes obvious.

Appendix E present the 1/3 octave band results of the Quinns Gap Road measurements over the Guideline standard I0 minute sample. The results show the spectrum information on a statistical basis in a linear format (not A-weighted) and show the statistical variation in the noise level.

There were no other intrusive noises at the site. only turbine noise. The results clearly identify frequency peaks rather than a broadband noise.

The measurement results show different frequency characteristics for noise off the front of the turbines versus to the side.

The A-weighted level was not constant and exhibited a variation in level which as nominated in the Guideline is identified as modulation. The modulation occurs over the entire audio spectrum. Whilst not showing a significant variation in the statistical analyses in Appendix E the modulation is most obvious in the upper frequency bands as shown by comparison of the A-weighted level versus the 2500 Hz 1/3 octave band in Appendix F.

Appendix G presents a number of FFT analyses that show the sound spectrum in a linear format (rather than constant percentage bandwidth- 1/3 octave bands) to permit identification of narrowband tones. Appendix G1 shows the statistical variation in the frequency display with the remaining graphs being the energy average (Leq) of each 2 minute sample.

The FFT analyses progressively reduce the bandwidth of each analysis to permit identification of specific tones that occur in the frequency area nominated as covering low-frequency sound and infrasound. The bottom axes are frequencies in Hz (i.e. Appendix G I and G2 show **O– I** kHz, Appendix G3 0 – 100Hz and Appendix G4 **O–** 12.5 Hz).

The frequency graphs clearly show that there are low frequency and infrasound components generated by the turbine.

The results set out in Appendices D – G for the measurements of the turbine reveal modulation, low frequency noise and infrasound components.

The Marshall Day Acoustics report identifies ambient background levels below 40 dBA for residential receivers in proximity to the Stony Gap Wind Farm.

Appendix H provides measurements using a SVAN 957 Sound Level Meter at a location approximately 2km south of the proposed Hallett 3. The location is well removed from any main roads.

The background levels (shown in Appendix H) during the day are below 20 dB(A) – except for 40 minutes in the day whilst the evening and night time background level are below 15 dB(A). How much below 15 dB(A) cannot be ascertained as the background is less than the electrical noise floor of the sound level meter.

The daytime (7am – 6pm) Leq, is 31 whilst the Leq for the entire 23 hour period shown in Appendix H is 28 dB(A). The ambient noise in the rural environment as such is significantly lower than "Indicative" level of 40 dB(A).

Appendix I provides a series of measurements conducted at House 10 which is approximately 1300 metres from the northern end of the Waterloo Wind Farm. The measurements include simultaneous inside and outside measurements where the internal location was in the centre of the master bedroom and the external location was located at 15 metres in front of the dwelling towards the wind farm.

The measurements in Appendix I were recorded during the night time period. The turbines were audible both outside and inside the dwelling. The external background level was found to be 27 dB(A) and the background in the bedroom (windows closed) was 16 dB(A).

The modulation of the turbine noise external to the dwelling becomes obvious in the 2 minute sample of the A-weighted level over time. However the attenuation of the building eliminates the high frequency modulation inside the building, which becomes obvious in comparing the results.

Similarly the presence of both low-frequency sound and infrasound inside the dwelling and outside the dwelling is shown in the frequency spectra.

Moller (for Maastricht City Council) identifies the use of A-weighted measurements and in relation to audibility states:

The levEl of the infrasoLWd produced by modern wind turbines is so low that the sound annot be perceive<! by humans evEn close to the turbines". Much higher levEls occur elsewhere in our daily emlironme-11t, e.g- in mmspon:a tion.

ow-fr;:que-ncy wind turbine noise is usuaJiv described as hum n ing o r rumbling. It ma have a more or less pronounceif tonal ch;uaeter, e..g. · t.::rms of tone.s that fluctuate and vaJ)ı in leve l and/or pitch, or of tone-like pues excited with regtJiar or random inte rvals. The feeling of pressu re at the eardl\lms is also reported. It is characteristic that the noise wrie.s a lot in time and with wind and other- abllo.spheric cooditions.

The rare of modu ion of tM! low-frequen<v noise from wind turbines (and higher frequendes as well) is ofttm · he Infrasonic frequency range, e.g.. the ade passage frequency, and the noise may thus be mistaken as Infrasound, eve-n o,hen th ere i:s littl e or virtua lly no infrasound present.

The measurements in proximity to the Waterloo turbines identifies the blade pass frequency of the turbines and the harmonics of that frequency to be present and those frequencies are also present outside and inside houses. The turbine measurements reveal the presence of infrasound components.

The measurement of infrasound inside houses is similar to that obtained in Falmouth by Rand and Ambrose.

It is noted that the difference from outside to inside with respect to the low frequency sound and infrasound components is relatively small, and in some cases there is a negative difference in that there are higher levels inside the dwelling than outside.

When one is dealing with low frequency or infrasound noise associated with gas fired power stations it has been found that the energy emitted from the power station can excite the building elements into resonant modes or physical vibration that leads to the internal surfaces of the room in question vibrating and radiating noise.

The fact that there are discrete frequencies detected inside the dwelling that fall into the frequencies typically associated with different levels of sleep states is a matter that should be noted. The assessment of sleep disturbance is outside my field of expertise but the material provided in Appendix I is informative.

It is noted that in viewing the frequency graphs contained in this report, the measurement results are those obtained directly from the Bruel & Kjaer Pulse system with a low pass filter of 7 Hz (rather than the standard 22 Hz) and utilising Bruel & Kjaer Type 4189 microphones that have a frequency response that falls off below 10Hz.

If one is looking to accurately define the sound levels occurring in the infrasound region then one needs to adjust the measurement results appended to this review which will result in higher sound pressure levels for frequencies below 7Hz.

Similarly, in view of the low ambient noise levels recorded both inside and outside the dwellings the measurement results are approaching the electrical noise floor of the microphones. More detailed investigations require specialised microphones to accurately record such levels.

During the course of monitoring at house H10, the occupants related that on the night upon which the measurement results appended to this review were obtained, they experienced disturbed sleep.

Residents at houses I0 and 12 advised the author that testing has been conducted by independent consultants to reveal that both of these properties comply with the Guidelines. Yet the occupants of both ofthese properties experience sleep disturbance and at times complained of excessive noise intrusion. I was advised that at house H10 monitoring conducted by one set of independent consultants placed the microphone approximately 1.5 m from the bedroom window of that residence. This would not comply with the requirements of the Guidelines.

Attendance at House H12 also suggested that monitoring which had been conducted by independent consultants was not in accordance with the Guidelines. The occupant identified that the monitoring position was to the side of the residence in relatively close proximity to large trees, rather than the complying with the requirement to be between the residence and the wind farm which would have placed the monitor in an open paddock.

Residents indicated that there are significant differences in noise received at their property dependent upon the weather conditions and cited both light and strong winds giving rise to different noise effects. Cloud cover was also cited as altering the noise propagation.

Appendix J provides a series of photos from house H8 obtained in the morning. The photos indicate wind occurring across the valley yet there is cloud on the lee side of the hill completely covering a residence. A close up of the photo shows at one point in time an operating turbine poking through the cloud cover.

For the purposes of this peer review, the attached Appendices are sufficiently detailed to reveal that even when wind farms in the Goyder area are apparently able to comply with the Guidelines, they are still generating adverse impacts at residential properties. These impacts can be detected and measured when one looks to the use of non-A-weighted measurement results. The measurement data appended to this review identifies that there are both low frequency and infrasound components generated by the turbines that are currently located in the region.

8.0 CONCLUSIONS

Marshall Day Acoustics has relied solely upon the EPA Guidelines and has ignored the acoustic characteristics that residents will actually receive as a result of the Stony Gap Wind Farm. They have not addressed the actual acoustic impact of the wind fann on the community.

The Marshall Day acoustic assessment provides a set of predicted noise levels in terms of the A-weighted values set out in the Guidelines and concludes that there are no tonal or modulation characteristics requiring modification to the predicted noise levels.

The assessment does not specifically address the influence or effect of winds and temperature inversions which have the potential to result in higher noise levels than have been predicted.

Professor Hansen has raised the issue that the acoustic assessment has under predicted the noise that residents will receive and taking into account the above matters, there is the distinct possibility that at times noise generated by the proposed wind farm will be greater than that set out in the acoustic assessment.

In relation to background levels, the attached measurement results confirm (as expected) that ambient background levels inside rural properties in the subject region are significantly lower than 30 dB(A) and that external noise levels are lower than the nominated Environment Protection (Noise) Policy 2007 night time Indicative Level of 40 dB(A) for rural areas. As such, the noise generated by the wind farm is likely to be significantly greater than background +SdB(A) and therefore to have an impact significantly greater than for an "annoyance."

The issue of low frequency noise and infrasound has been raised and discussed above. Documentation from the world's leading supplier of turbines has identified that computer models are inadequate for low-frequency noise propagation. As high frequencies are rapidly attenuated over distance (when compared to low frequencies) audible characteristics of the turbines may be reduced to a low frequency hum and can also include frequencies below the normal range of human hearing.

The Guidelines identify that infrasound is not generated on a well maintained wind farm yet the measurement results obtained for the purposes of this report prove otherwise. The measurement data appended to this review identifies that there are both low frequency and infrasound components generated by the turbines that are currently located in the region.

A proper assessment of community impact (either pursuant to the Development Plan or generally) cannot ignore low frequency noise and "infrasound." To the extent that it does, when these have been issues of specific complaint with other wind farms, the Marshall Day report falls short of its responsibility to the community.

The Guidelines identify that for host stakeholders, sleep disturbance is an adverse health effect. It is not unreasonable for Council and the community to assume that if sleep disturbance gives rise to an adverse health effect for persons who are obtaining a financial gain from hosting turbines, then sleep disturbance that impacts upon the general community (i.e. non-host stakeholders) must also give rise to an adverse health effect.

This peer-review has identified two eminent acousticians who, in 2002/2004, identified that there are issues with low frequency and infrasound and that the ear still continues to work and receive signals even when people are asleep. The mechanism causing sleep disturbance (for example, whether individuals are able to detect the infrasound components) is an issue outside my expertise.

But it is clear that use of the A-weighted value for assessment or compliance purposes does not address all of the noise impact issues associated with wind farms.

The Council's Development Plan requires certain objectives to be met for the subject wind farm. These objectives have been outlined above. The current application has not satisfactorily addressed these objectives, and has not actually assessed the noise or the impact of the subject development.

Inadequacies of the EPA Guidelines in meeting their own core objects have been raised. Council may consider raising these difficulties which the Guidelines are causing the Council with the EPA to address the concerns of the community.

As a result of the various matters raised and outlined above, there can be no confidence that the community will not be adversely impacted by the proposed Stony Gap Wind Farm. It is recommended that Council should request further particulars from the Applicant to address the individual matters raised above with particular reference to the Development Plan and with a view to identifying the actual noise impact that will be generated by the proposed wind farm.

Yours faithfully,

THE ACOUSTIC GROUP PTY LTO

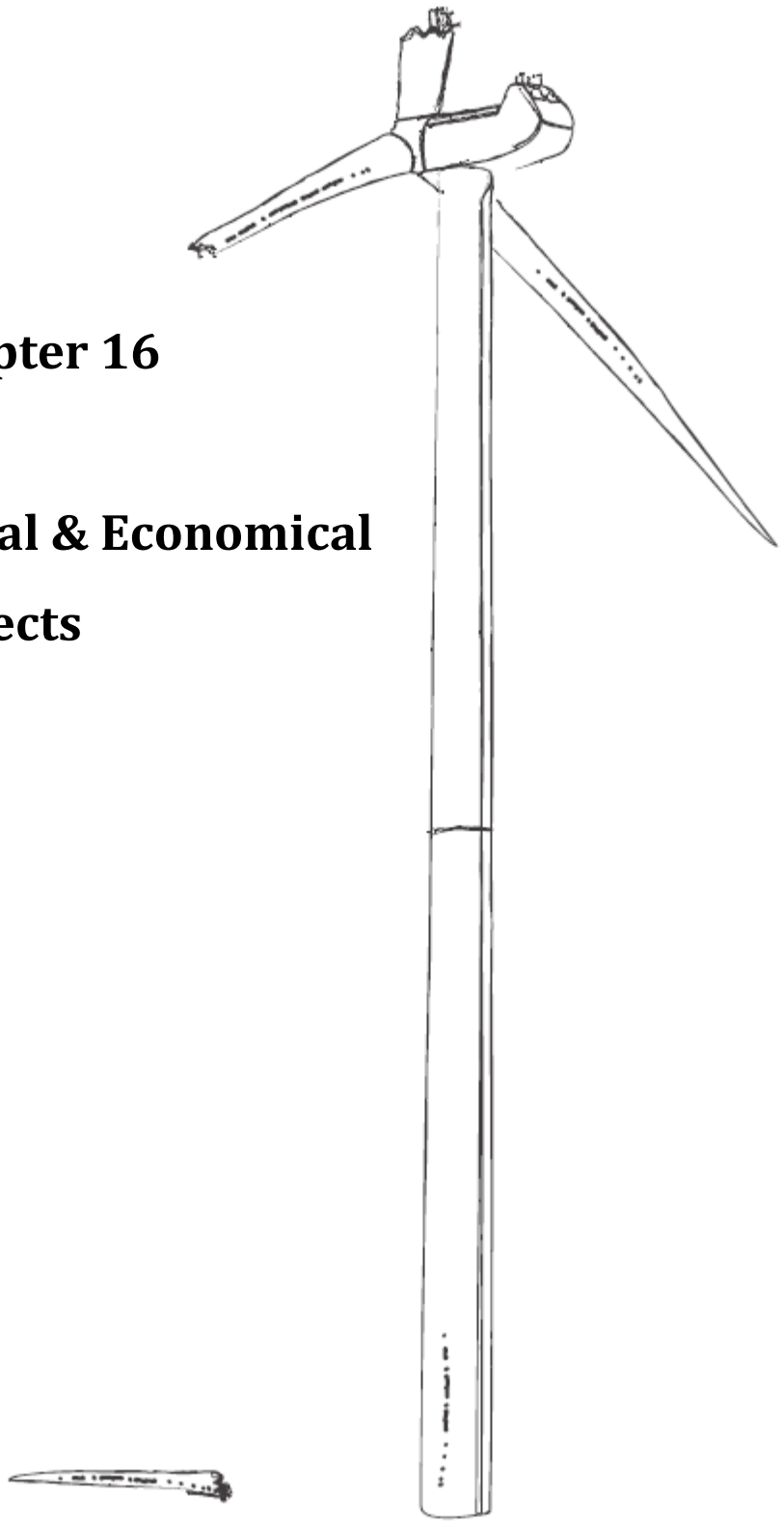
STEVEN E. COOPER

References:

- Marshall Day Acoustics: "Stony Gap Wind Farm, Noise Impact Assessment" dated 2 March 2011 (report ref 002 R07 2008241)
- Professor Colin Hansen of Adelaide University: "Stony Gap Wind Farm Noise Impact Assessment" dated 22nd February 2012
- TRUenergy Development Pty Ltd., Letter response to the eligible representations received to the Stony Gap wind farm development application (422/115/11) (Stony Gap DA) during the public notification periods in January, February and March 2012, dated 24th April 2012
- SA EPA, "Wind Farms, Environmental Noise Guidelines" July 2009
- SA EPA, "Wind Farms, Environmental Noise Guidelines" February 2003
- SA Government, "Environment Protection (Noise) Policy 2007" Version 31.3.2008
- Cooper S, Peer Review of Acoustic Assessment, Flyers Creek Wind Farm" ref 41.4963.R 1A, 15th December 2011
- NSW Planning & Infrastructure, "Draft NSW Planning Guidelines Wind Farms", December 2011

- CooperS, "Review of Draft Wind Farm Guidelines" refer 42.4963.R2, dated l4[1] h March 2012
- Australian Acoustical Society, "Code of Ethics"
- Goyder Council, "Development Plan", 17 February 2011
- Marshall Day Acoustics "Waubra Wind Farm, Post – Construction Noise Compliance Assessment", ref 001 2009107 October 2010
- Standards Australia, "AS 1055.1-1997 Acoustics Description and measurement of environmental noise, Part I: General procedures", 1997

- Standards Australia, "AS/NZS 2107:2000 Acoustics- recommended design sound levels and reverberation times for building interiors", 2000
- Standards Australia, "AS 3671-1989, Acoustics – Road traffic noise intrusion – Building siting and construction", 1989
- Leventhal! G, Low Frequency Noise, "What we know, what we do not know, and what we would like to know", Journal of Low Frequency Noise, Vibration and Active Control, Vol 28, No 2, 2009
- Leventhall GH "Low Frequency Noise and Annoyance" Noise & Health 6, 23 (2004).
- Griefahn B, "Sleep disturbance related to environmental noise" Noise & Health Vol 4, 15 (2002)
- Vestas Australia Wind Technology Pty Ltd, "Draft NSW Planning Guidelines: Wind Farms", 14 March 2012
- Van de Berg GP, "The sound of high winds: the effect of atmospheric stability on wind turbine sound and microphone noise" 2006
- Moller H, Pedersen JK, Strunstrap JK and Pedersen CS, "Assessment of low-frequency noise from wind turbines in Maastricht", April 2012
- Ambrose S, Rand R, The Bruce McPherson ILFN Study Report, December 14, 2011
- Shepherd D, McBride D, Welch D, Dirks K, Hill E, Evaluating the impact of wind turbine noise on health- related quality of life, Noise & Health, September-October 20 II, vol 13.



Chapter 16

Social & Economical Aspects

CHAPTER 16 SOCIAL AND ECONOMIC ASPECTS

DIRECTOR-GENERAL'S REQUIREMENTS:

Taking into consideration the…social and economic impact of the project

The proponent must consider the following additional NSW Draft Guidelines:

Social issues including noise, blade glint, shadow flicker, electromagnetic interference, night lighting, electromagnetic fields and potential health issues

Economic issues likely impacts of the development, including environmental impacts on both the natural and built environments, and social and economic impacts of the locality the public interest property values measures to avoid, manage or mitigate relevant impacts from the wind farm including:

social issues, including noise, flicker, glint, night lighting, electromagnetic interference

Social issues

Social issues include:

- noise (from wind turbines, substation, construction, traffic and vibration)
- blade glint
- shadow flicker
- electromagnetic interference
- night lighting
- electromagnetic fields
- other health issues

Noise amenity

Potential sources of noise from a wind farm include:

- wind turbines
- substation
- construction
- traffic noise
- vibration

Existing and future land uses

Demonstration should be provided that the project is consistent with existing and future surrounding land uses (including urban communities, land of high agricultural value, land of significant scenic or visual value, rural residential development, mineral reserves, forestry, conservation areas and crown land), taking into account relevant local and regional strategic land use plans and including consistency with agricultural land use objectives. Potential cumulative social and economic impacts on the local community should also be addressed.

Consider the likely impacts of the development;

including environmental impacts on both the natural and built environments, and social and economic impacts of the locality

Identifying relevant assessment issues

Landscape and visual amenity

Social issues

Economic issues

Property values

The potential for a proposed wind farm to impact on the value of surrounding properties that do not host the wind farm facility, including properties within 2 km of a proposed wind turbine should be considered.

Relevant considerations may include (but are not limited to):

- the types of development that are permitted in the land use zone(s) in which the wind farm is proposed
- whether the wind farm is consistent with the local and regional strategic land use planning context for the area including whether the area has been identified for future subdivision
- relevant studies and credible research on wind farms and property values
- whether other impacts such as noise and visual impacts are considered to be within acceptable Limits

Description of the surrounding area

the provisions of any relevant strategic plan by council(s) or government authorities applying to the site or area (land use, economic development, vegetation, biodiversity, electricity distribution, etc)

Existing and future land uses

Demonstration should be provided that the project is consistent with existing and future surrounding land uses (including urban communities, land of high agricultural value, land of significant scenic or visual value, rural residential development, mineral reserves, forestry, conservation areas and crown land), taking into account relevant local and regional strategic land use plans and including consistency with agricultural land use objectives. Potential cumulative social and economic impacts on the local community should also be addressed.

16.1.0 SUMMARY OF OBJECTIONS

Social and Economic Aspects: The Bodangora Wind Turbine Awareness Group, Mudgee Alliance objects to the Proposed Bodangora Wind Farm.

The destruction of the social and economic fabric of this small rural community has already begun, because of the secretive way in which the wind farm proposal was initiated.
The EA has not addressed any of the DGRs relating to social and community dynamics.

The EA has not addressed economic aspects of the proposal in any quantified or scientific detentions.

The proponent has directly caused a rift in the community dynamics of the local area causing long time friends and neighbours to be in dispute and conflict.

The proponent has convinced proposed hosts of the proposed project that they are at no fault by not notifying their immediate neighbours of their intentions despite the immediate and non immediate impacts of their action on neighbouring properties.

The proponent has not contacted or informed immediate or extended neighbours of the proposed Bodangora wind farm beyond an inquiry of the willingness to host turbines.

The proponent has not followed up on "*promises"* to visit immediate neighbours of the proposed project.

The proponent has accused immediate neighbours of "*refusing to meet with the project manager"* (ABC local radio 2012). This statement is not true and is identified as such further within this document.

The proponent has offended immediate neighbours with misconstrued conceptions and given several conflicting stories to differing neighbours and the community consultation meeting. (involved land holder, community consultation committee and cons).

The proponent has identified that any concerns with the proposed Bodangora Wind Farm may not be acted upon but simply noted (*community consultation meeting*).

The proponent has not correctly informed the local communities or local villages directly surrounding the proposed wind farm; in addition it has not correctly or informatively identified the project within the township of Wellington. This is evident in the poor attendance and location of the "community open information days" provided by the proponent.

16.2.0 COMMUNITY CONSULTATION

The majority of neighbours surrounding the proposed wind farm have **not** indicated support for the Bodangora Wind Farm.

Immediate neighbours were **not** advised by the proponent, by phone or mail, of either the proposal, or of turbine sites, in the early stages of development. A small number of neighbouring farmers were consulted about placement of towers on their properties. They refused and have received no further communication from the proponent.

The majority of residents in the Bodangora Village have received no information regarding the Wind Farm proposal and no ongoing information for development. Several homes in the Village are within a range of 2 to 3 kilometres 3 to 4 kilometres and 4 to 5 kilometres from and in full view of turbines.

The results of this lack of communication are annoyance, confusion and anxiety.

The consultation program has **not** extended to the neighbouring farmers and wider local community. Some neighbours received letters notifying them of The Bodangora Wind Farm

Community Information Days on Friday September 2, 2011 – 1.00pm to 6.00pm and Saturday September 3, 2011 – 8.00am to 2.00pm. No other consultation was established.

The Environmental Assessment document was supposedly released on Friday June 8 and was not made available to the public by Wellington Council until Tuesday June 12. The document is available for reading at the Wellington Library and chained to a table in the foyer of the Wellington Council Chambers. Additional hard copies are not available to the public. CD copies are available, but only of use to those who have home computers; the majority of farmers within the immediate vicinity have no access or are computer illiterate. To sit in the library or Council foyer and read this large 800 plus page document impossible for the whole community to view. There is very limited access.

It is also noted that the first meeting of the Community Consultation Committee (CCC) organised by Mr Frank Boland on behalf of the proponent, was held on Wednesday June 20, (**after** the release of the EA). Of the members of this Committee, only one, Mrs Lyn Jarvis, followed the proper application process. Of the other nine members, seven were personally invited by the proponent, one was invited as part of a local organisation and one Mr Michael Lyons, initiated his own membership at a later date. Mr Robert Jarvis was denied membership of the Committee after following the proper application process through the advertisement by the proponent in the local paper. This is not a true representation of the affected members of the community and shows a clear lack of information provided to the general public.

At this first meeting of the CCC one member, Mr Bob Sewell, behaved most inappropriately by slamming his hand several times upon the table and demanding to know the names of people who had met with the local Mayor, to discuss their concerns about wind farms on the basis that he wanted to contact them. This is not community consultation, it is community bullying.

Please note the letter to Mr David Griffin from the Director-General Sam Haddad, 16.08.2011, stating 4 points of community consultation requirements. (Attachment A of EA).

1. "a comprehensive, detailed and genuine community consultation and engagement process must be undertaken. This process must ensure that the community is both informed of the proposal and is actively engaged in
   issues of concern to them, and is given ample opportunity to provide its views on the proposal. Sufficient information must be provided to the community so that it has a good understanding of what is being proposed and of the impacts. There should be a particular focus on those non wind farm associated community members who live in proximity to the site;"

1. "The Environmental Assessment must clearly document and provide details and evidence of the consultation process and who was consulted with;"

2. "All issues raised during the consultation process must be clearly identified and tabulated in the Environmental Assessment;" and

3. "The Environmental Assessment must state how the identified issues have been addressed, and how they have informed the proposal as presented in the Environmental Assessment. In particular, the Environmental Assessment must state how the community's issues have been responded to."

A comprehensive, detailed and genuine community consultation and engagement process **did not happen thus leaving the community ill informed and unaware of problems or issues they may have.**

These Supplementary Director-General's Requirements for Bodangora Wind Farm MP10_0157, have clearly **not** been addressed or **considered**.

The following issues are of great concern to the social wellbeing of adjoining landowners, broader community and villagers of Bodangora. **Noise pollution both audible and infrasound. "**Given what we do know already about infrasound exposure, it would seem imperative to immediately adopt the precautionary approach, and not site turbines within distances where people are currently experiencing symptoms (10Km), until such detailed infrasound studies are done"

(Submission to the Australian Federal Senate Enquiry on Rural Wind Farms, 10th February 2011. Dr Sarah Laurie BMBS (Flinders 1995). Awarded FRACGP 1999. Awarded FACCRM 2000)

"The infrasonic impact of an operational wind farm, may therefore be far greater than that which the audible noise of the wind farm would indicate, may produce its effects at a far greater distance from the wind farm than the audible noise level would suggest, may be impossible to mitigate in situ by either enclosure, shielding or absorption, and may be subliminal, and therefore not consciously attributable to its source" (Three Windfarm Studies and an Assessment of Infrasound: Executive Summary. Author: Tharpaland International Retreat Centre.)

16.3.0 CONTRACTUAL SECRECY

Hosts are reluctant to discuss details of their contracts, including but not limited to lease payments, and contract format because of confidentiality clauses. Hosts were signed up before neighbours and wider community were made aware by the proponent, of any details of the wind farm proposal. This secrecy suggests that hosts were encouraged (with small financial incentives), to sign contracts before they could learn / research adverse effects of wind farms. This shows that proponent used pressure in order to obtain signed contracts by the now potential hosts.

Furthermore after a meeting with Mr. Grant Christopherson who despite his active promotion of wind farms on behalf of the Government, said, "***he would not sign a wind***

farm contract in its usual form" (appendix 1). The Bodangora Wind Farm Awareness Group is currently aware of several potential hosts that did not read or change the contracts.

16.4.0 BUSHFIRES AND SOCIAL IMPACTS ON THE COMMUNITY

"Turbines can and do catch fire." At least three have done so in South Australia in the last few years - Cathedral Rocks, Lake Bonney and Starfish Hill. Turbines have significant quantities of highly flammable oil in their gear box.

There are significant impediments to fighting wind turbine fires – both the fire authorities and wind turbine developers admit there is little that can be done in the event of a fire except just watch it burn, and try and put out any spot fires. There are further restrictions if the turbine blades are on fire and spinning, as happened recently at Starfish Hill, requiring the CFS to move back to at least one kilometre from the burning, spinning turbine blades. Preliminary discussions with people interstate have revealed the same issues and restrictions. There are currently turbines within 1km of public roads and pose a significant risk to the general public, neighbours and property.

The social fabric of the community has been disturbed and in some cases unrepairable to date as a direct result of the proponent's action and handling of the proposed Bodangora wind farm. This has caused serious problems when communities are in danger and under threat by bushfires; as the community makes up the fire fighting force of the local and surrounding Rural Fire Service (RFS) Brigades. There is evidence within Australia suggesting that during a fire on the property of a host supporting wind farms that the community has not rallied together to protect and help each other, and with attendance of fires significantly dropping due to the close proximity of host and neighbours during these stressful events. The same has been recorded in the reverse with "*host*" members not attending fires of their immediate or extended neighbours.

This cohesion of the community has already been significantly damaged as a **direct** result of the presence of the proponent.
This proposal of a wind farm should be immediately abandoned in order to preserve what relations are still intact between and within the community. During a meeting with Mr Grant Christopherson he was quoted as saying "*for every major works there are casualties"* (Appendix 1). This should not be the case and shows that a member acting on behalf of the Government clearly believes that casualties cannot be avoided: this is unacceptable. To have neighbouring property owners and their families who have been farming and taking the responsibility as custodians of the land for generations, those who had plans of future generations willingly taking over this responsibility are simply road kill for a short sighted proposal and nil social and economic gain.

16.5.0 DIVISION OF RURAL COMMUNITES

Division of Rural Communities, Alienation within Families and the Destruction of Rural Social Infrastructure has already occurred. There are many tensions obvious where host families are reluctant to, or simply cannot (because of contractual agreements), speak about the wind farm development with neighbours and other members of the community. This has been evident when community members and neighbours have inquired about the project with little response or recognition of the project by the hosts. There has been no prior notification by hosts to neighbours of any impending wind turbine construction; this has resulted in creating anxiety, unrest, confusion and division within our formerly very harmonious community.

The question is posed, asking the motives behind the secrecy of engaging and signing up hosts. This is evident in the reasons for rushing the EA through before the NSW Draft Guidelines have been set and before the National Medical Health and Research Council has documented its findings. This is apparent in the clear objections both community-based and individual based that have been submitted. In addition this document has clearly identified the immense short-fallings of the proponent.

16.6.0 HEALTH RISK

Infigen Energy has suggested that there is no health effects associated with wind turbines. This has been shown by the proponent with the use of council records from operational wind farms. However one must be concerned on the accuracy of and appropriateness of the source of information as most sick people would see their doctor or local GP rather than informing their local council. There are in fact documented cases of deteriorating health effects associated with individuals living amongst wind farms. These individuals have been documented through health authorities and doctors.

The direct health consequence associated with turbines has not been described in the EA. Secondary health effects have not been described in the EA. In addition the EA does not address the significant mental health problems that may be an occurrence with turbines. This is occurring in people already living adjacent to the turbines, but they are also occurring in significant numbers in those populations who are confronted with a proposed development in their "backyard"." *(Submission to the Australian Federal Senate Enquiry on Rural Wind Farms, 10th February 2011. Dr Sarah Laurie BMBS (Flinders 1995). Awarded FRACGP 1999. Awarded FACCRM 2000).*

Extreme anxiety is already evident in a number of individuals within this district. Sourcing medical help is difficult and requires travelling large distances, as mental health counselling services are not readily available in Wellington.

A Randomised Survey by the Wellington Times, resulted in 75%, being against or doubtful of the benefits of a wind farm in Wellington. (Wellington Times, Page 4, Wednesday June 13, 2021)

The cumulative effect of proposed neighbouring wind farm projects at Bodangora and Uungula, (including up to 900 turbines), on villagers, lifestyle land holders or commercial farmers has not been addressed in the EA. This has failed the DGR .

16.7.0 VISUAL IMPACTS

The turbines are proposed for hill tops and will be standing 150 metres into our skyline. **They will be obvious**, cannot be screened by vegetation which has not yet been planted and such vegetation will take the life expectancy of a turbine to mature. This will definitely create an **unnatural visual impact.**

"The visual impact of turbines, even at considerable distances of up to
8.6kms, was found to be highly disturbing. Amongst other visual factors reported to be disturbing at all three windfarms studied were (1) the constant rotation of the turbine blades (2) the lack of synchronicity of blades within clusters of turbines (3) the view of partial blades 'flicking' on a horizon (4) the strobe effect of shadow-flicker and (5) the dominating presence of the turbine structures.

These findings indicate that 'visual impact' is not merely in the 'eye' of the beholder and related to visual amenity alone, but is related to deep physiological and psychological processes within that beholder." (Three Windfarm Studies and an Assessment of Infrasound: Executive Summary. Author: Tharpaland International Retreat Centre.)

The development **will** affect the ongoing rural use of land within the project area, the rural use of immediate neighbouring and a wide radius of adjacent land.

Creation of a Microclimate and Posing the Question "Do Industrial Wind Turbines Save the Environment?"

"Peer reviewed research has identified **significant local climate effects** of large scale wind farms, the most recent paper titled: Simulating impacts of wind farms on local hydrometeorology", Somnath Baidya (Department of Atmospheric Sciences, University of Illinois), Journal of Wind Engineering and Industrial Aerodynamics, 2011. This research found **significant effects on local hydro-meteorology up to 18 to 23km from wind farms.**

This is of particular concern to the local farming community. Roy says, "It's something like the wake from the propeller of a boat. Now this added turbulence mixes air, up and down, and creates a warming and drying effect near the ground." He says "the effects can be felt for miles". The researchers found that in the predawn hours, when atmosphere is less turbulent, a large windmill array could influence the local climate, raising temperatures by about 2 degrees Celsius for several hours. The rotating blades could also redirect high-speed

winds down to the Earth's surface, boosting evaporation of soil moisture." ("Wind Energy" Boorowa District Landscape Guardians)

16.8.0 EMPLOYMENT OPPORTUNITIES

The construction stage of the wind farm it is stated, will take approximately 18 months. (3.7). Services such as accommodation, vehicle maintenance, refuelling and fuel are likely to benefit from additional construction staff. The 70-100 construction staff, (no mention of the local community being included in these numbers), will be in the region for an estimated 18 months which is a very small window of time when one considers that the turbines have a life expectancy of 20 to 25 years. "The services are likely to be spread within the region including Wellington, Mudgee, Gulgong and Dubbo". This would suggest that the Wellington business houses would benefit from a small percentage of economic growth from the wind farm. It is also stated that four employees will be permanently working on the wind farm once it is in service.

There is no guarantee these people will be living in Wellington and therefore no guarantee of great increases of income to the Wellington business houses.

"A viewing area for the Bodangora Wind Farm is proposed to be developed at a later stage." There is reference to neither the proposed site of this viewing platform nor the safety provisions of the general public and parking arrangements. The statement that "This viewing platform will assist visitors to safely view the wind farm…." suggests that viewing from any other vantage point is unsafe.

Farmers in the local area are **not** adverse to changes and are insulted by this implication. It must be pointed out that members of the local farming community have continuously changed and adapted to such innovative farming techniques as conservation farming and time control grazing methods, in an effort to conserve and improve their soils and to regenerate natural flora and fauna. All of this occurs with the confidence that property values will continue to improve.

The NSW Department of Land published document of 2009, "Preliminary Assessment of the Impact of Wind Farms on Surrounding Land Values in Australia", is now three years outdated. In 2012 property agents are finding that Wind Farms certainly do have a negative effect on property values.

"The National Manager of Elders (Rural Services), Shane McIntyre has stated, "A proliferation of wind towers adjacent to a property **has the same effect as high voltage power lines, rubbish tips, piggeries, hatcheries and sewerage treatment plants,** in that, if buyers are given a choice, they choose not to be near any of these impediments to value.

The ultimate effect is that the number of buyers willing to endure these structures is significantly less than if the structures were not there. This logically has a detrimental effect on the final price of the adjoining lands.

Experts assess the loss of the value to be in excess of 30% and sometimes up to half.

My personal experience is that when an enquiry (potential buyer) becomes aware of the presence of wind towers, or the possibility of wind towers in the immediate district of a property advertised for sale, the "fall out" of buyers is major. Very few go on to inspect the property, and even fewer consider a purchase. On the remote chance they wish to purchase, they seek a significant reduction in the price."
("Wind Energy" Boorowa District Landscape Guardians)

"**ABSTRACT:** The siting of wind facilities is extremely controversial. This paper uses data on 11,331 property transactions over 9 years in Northern New York to explore the effects of new wind facilities on property values. We used a fixed effects framework to control for omitted variables and endogeneity biases. We find that nearby wind facilities significantly reduce property values in two of the three counties studied. These results indicate that local homeowners / communities may not be being fully compensated for allowing wind development within their communities.

Hans-Joachim Mengel a Professor of Political Science at the Free University, Berlin, has likened Wind Turbines to "the worst desecration of our countryside since it was laid waste in the 30 Years War nearly 400 years ago." If wind turbines are perceived to have this manner of impact on local areas, they would have a strong negative impact on local property values.

Property values are an important component in any cost-benefit analysis and should be accounted for as new projects are proposed and go through the approval process. (Values in the Wind: A Hedonic Analysis of Wind Power Facilities Martin D. Heintzelman Carrie M. Tuttle May 23, 2011)

Overall it is expected that the Bodangora Wind Farm **will have major social impacts** on the rural communities of Bodangora, Comobella and Spicer's Creek. The proposal will provide minimal stimulus to the local economy with no employment opportunities to members of the local farming community and very little opportunity for the members of the wider Wellington community.

16.9.0 ECONOMIC ASPECTS

"To the nearest whole number, the percentage of the world's energy that comes from wind turbines today is: zero. Despite the regressive subsidy (pushing pensioners into fuel poverty while improving the wine cellars of grand estates), despite tearing rural communities apart, killing jobs, despoiling views, erecting pylons, felling forests, killing bats and eagles, causing

industrial accidents, clogging motorways, polluting lakes in Inner Mongolia with the toxic and radioactive tailings from refining neodymium, a ton of which is in an average turbine – despite all this, the total energy generated each day by wind has yet to reach half a percent worldwide.
If wind power was going to work, it would have done so by now." (The Winds of Change, Matt Ridley, THE SPECTATOR, 3 March, 2012)

The project **will not provide increased employment opportunities** for local trades people. After consultation with a builder in Wellington, it was found that there are not enough trades persons, in particular electricians, in the town of Wellington to complete building construction work which is currently available. Sub-contractors are sourced from other towns. This builder is adamant there will be no work for him with the wind farm company and furthermore, other contractors have no need of an increase in work load, as they are already fully employed. Wellington has experienced the construction of the Correctional Centre on the Goolma Rd. Very few local tradespeople were employed by the major contractor.

As stated in 16.1, the construction stage will take approximately 18 months which is a very small window of time when considering the turbines have a life expectancy of 20-25 years. The business houses of Wellington will benefit from a very small percentage of economic growth.

16.10.0 IMPROVEMENTS TO LOCAL INFRASTRUCTURE.

It must be noted that numerous extremely heavy wide loads, (20 tonnes to 120 tonnes, plus the weight of the transporting vehicle), will be traversing many of NSW, South Australian, Victorian and Queensland roads.
The proponent must accept full financial responsibility for all structural damage, reconstruction and maintenance of these roads, resulting from the transportation of these enormously heavy weights. Furthermore, there must be no financial burden to local councils and taxpayers.

There are no specific routes planned for transportation from Port Kembla or the Victorian suppliers to Bodangora. Routes of deliveries from South Australia and Queensland are named as "could be" and "may be" and this is not a definite plan. The route from Port of Newcastle is defined, with three areas of concern being Denman Rd / Golden Highway, Denman, Palace St. / Golden Highway, Denman and Goolma Rd. / Gillinghall Rd., Bodangora.

The proponent has not documented consultation with any local Councils in these far reaching areas. Mention is made of consultation with Wellington Council. **No specific details of costing of road construction, repair and maintenance have been included in the EA.**
These costs must be exposed and borne by the proponent.

Owners of properties will be faced with new and ever increasing costs created by the heating and drying soil and air conditions of turbulence as mentioned previously, 16.1. There could also be the added expenses of reimbursing neighbours for loss of production and devaluation of land. To "drought proof" a property a farmer must change his grazing management, cropping practices and develop marketing skills. Financial agreements between hosts and the proponent simply create an additional source of income.

Subdivision within the Bodangora Village and for neighbouring land owners is indeed a significant issue.

"Property values fall – the removal of subdivision approvals within 2kms. of a turbine takes away the capital appreciation factor--- the main economic reason for owning a rural holding --- for both the owner AND HIS UNCOMPENSATED NEIGHBOURS." (The Social and Economic Effect of Rural Wind farms. Submission by John Carter)

The brevity of this chapter of the EA exposes the callous manner, indifference and disdain in which the concerns of the Community have been held by the proponent.

The destruction of the social and economic fabric of this small rural community has already begun. This has been most evident during the community public meeting held by the BWTAG, where host families arrived in groups with Infigen Energy. Following this they had a "host" meeting on the other side of the road while the rest of the community enjoyed a light lunch with one another. The "host" families did not move to the public meeting until it had almost started effectively avoiding their neighbours.

Figure 1 and 2 show the clear division in the community caused by the proponent by segregating host families.

Figure 1. Shows host families segregated from the rest of the community

Figure 2. Shows host families in a meeting with Infigen Energy and Sonus representatives

Appendix 1

Industrial Wind Turbine Awareness
Mudgee Alliance

P.O. Box 659 Mudgee NSW. 2850 ℘ Mobile: 0447139706 ℘ Email: iwetama@y7mail.com

To: Hon. Barry O'Farrell Date: 4th July 2012
Premier of New South Wales

Copies: The Hon. Andrew Gee, Paul Toole, Chris Hartcher, Andrew Stoner, Brad Hazzard

Re: Government Policy on 'Casualties of Wind Farms'

I am writing to you as President of the abovementioned Alliance. Yesterday the Secretary/Public Officer of the Alliance, Ann Walker, and I met with Grant Christopherson, Regional Coordinator Renewable Energy Precincts, Office of Environment & Heritage, Department of Premier and Cabinet. The meeting took place at Mr. Christopherson's request.

The first point which I wish to raise is that during our two hour discussion Mr. Christopherson repeatedly referred to the neighbours of hosts of wind turbines as ***"casualties of major works."*** We raised concerns about people we represent who include those who are:

- in their 70's;
- depressed about the major intrusion neighbouring turbines will have on their lives;
- unable to fulfill future retirement plans (which are often to sell and move into a close town) because their land is now unsaleable;
- unable to run their properties because of boundary proximity to turbines and restricted weed and bushfire control, and
- worried about health care as they age as they are too far out of town for a district nurse to visit.

Mr. Christopherson shrugged and repeated ***"For every major works there are casualties"***. When asked what help, as a representative of the State Government, he

could offer these people, he offered to "talk to them." That was all; he couldn't do anything else. When asked where this talk might lead, he replied, "Talking's good".

We raised with Mr. Christopherson the inequities and community divisions created by wind farms. We mentioned that host landholders have been reported as saying that if there were problems with turbines they would "buy a house in town" and that they would be able to "buy cheap neighbouring land".

Mr. Christopherson's response did not vary. He shrugged and repeated ***"For every major works there are casualties"***.

Is this our state government's policy on neighbours of wind farms? Is it to simply refer to them as 'casualties' and offer no help for any of their concerns?

This State Significant Development has, at the stroke of a pen, polarized rural communities into 'haves' and 'have-nots', has left one group with imposed constraints on their lives and livelihood with no power to do anything about remedying their situation. What can an individual do when local councils have no say?

The second acknowledgement of serious concern by Mr. Christopherson was that, despite his active promotion of wind farms on behalf of the government, ***he would not sign a wind farm contract in its usual form.*** During our discussion I mentioned I had decided not to sign a wind farm contract when I discovered that when we signed we would not know the size, number or location of turbines on our property. Mr. Christopherson volunteered the information that ***he would not sign one either.*** Later in our conversation I asked him if he had seen a contract and he replied in the affirmative.

Is the State Government, via its Regional Coordinators encouraging or promoting host landholders to sign contracts that they themselves would not? Are Regional Coordinators telling host landholders the full story covering all the pitfalls of such contracts, or is their role to promote wind turbines at any cost?

Thirdly, I question the role of Regional Coordinators Renewable Energy Precincts, Office of Environment & Heritage. Mr. Christopherson is actively involving himself in individual projects with an apparent view to ensuring projects succeed. I am not suggesting that he is acting outside the scope of his authority. To the contrary, I assume he is simply doing what he has been told to do. In so doing, he crosses the line from public servant to agent of the developer. His actions demonstrate that the public service of this State is embroiled with wind farm developers to ensure renewable energy policy is effected at all cost. I question whether this is a breach of public service ethics and principles and a misuse of public position.

To date, NSW government departments have consistently denied any adverse impact from wind farms. Mr. Christopherson's repeated acknowledgement of the "casualties" associated with wind farms is a clear

admission by his Department and hence the government to the contrary. As he shrugged, what are a few casualties in the interest of policy?

I repeat, is it State Government policy to inhumanely treat neighbours of wind farms as casualties of major works and offer them no help whatsoever other than to “talk to them”? Is it State Government policy to hoodwink host landholders into signing up to deals that are not in their favour, by the use of rhetoric and generalisations that cannot be supported by evidence?

Before we explain to our members this government’s position, we seek your response.

Yours sincerely, Stephanie

Newman Interim President
Industrial Wind Turbine Awareness Mudgee Alliance

Appendix 2

RESPONSE TO BODANGORA WIND FARM ENVIRONMENTAL ASSESSMENT REPORT: SOCIAL AND ECONOMIC ASPECTS.

Prepared by Philip Rackall, Urban Economist.

Introduction

Chapter 16 of the EA, which purports to examine the Social and Economic Aspects of the proposed development is an extremely inadequate and disappointing section that covers a sum of only 3 pages and whose content is merely a set of assertions without any substantiating or corroborating evidence. Moreover many elements fail to receive any consideration in assessing the effects of the development on adjacent business properties, residents or the broader community or economy. There is no mention of potential effects on human and animal health, or risks associated with safety on farm management, and subsequent economic effects on farm income of the development. No mention is made of the potential negative impact on the districts substantial tourism income and businesses, nor possible effects from potential telecommunications difficulties particularly in respect of emergencies. The EA makes virtually no reference to the social impact of the development, preferring to concentrate purely on unsubstantiated economic matters.

No evidence or analysis is provided to substantiate any of the claims made in the document, even remarkably to quantify the potential benefits of the development., other than to claim that the development is "unlikely" to affect neighbouring land and that the project will provide for an unquantified "increased employment opportunities during the construction phase".

There is no way that such a set of unsupported claims based on no evidence can be considered as an adequate assessment of the economic and social impacts of the proposed development.

Even the qualitative assertions made are misleading, with selective quotes from studies which in reality are heavily qualified (no mention of these qualifications is made) and based on flawed and minimally small sample sizes in locations far removed from the project area. And no qualification to the conclusive assertions made including even recognising the existence of contradictory evidence.

Lack of Social Impact Analysis

By ignoring social impact, no consideration is paid to important criteria relating to community functioning, including:

- Community cohesion/relationships

- Feelings of well-being/amenity
- Perceptions of safety
- Lifestyle impacts
- Aspirations/expectations of the future
- Values and valued places, and, most importantly,
- Dislocations/disruption from the project

In consequence no reference or consideration is then made to impacts on community infrastructure, including:

- Health services
- Recreational services
- Housing availability/affordability
- Traffic and road safety issues
- Community services (commerce/other), and
- Community organisations.

The only social aspect referred to is an 'optional survey' of 26 individuals which was 'available' on one information day. (See pp 6-7 to 6-9 of EA). What is not pointed out in this section is that only 13 of the 26 who responded to such a limited survey supported the project (either 'supported' or 'strongly supported' the proposal) and that the great majority (9) of these were financially associated with the proposal. That is not 'majority support' as claimed in the document, but a bare 50% support. Such a result possibly explains the lack of quantitative evidence to support the claim. In view of the unwillingness to assess any of these social impacts, one must wonder at the quality of the information presented to those who agreed to be financially linked to the proposal. Already because of the paucity of information to affected land-holders and the broader community and the inadequacy of the consultation process undertaken, the community cohesion has been severely dented as the community has divided. It is understood that every neighbour surrounding the project is opposed to it.

Particularly disturbing has been the lack of any discussion or assessment of the potential health effects – from low-frequency noise, light-flicker, vibrations, stress and quality-of-life aspects stemming from the visual impact of the proposed development. This may be an area of medical uncertainty, but was a significant component of the Senate Inquiry into Wind Farms conducted last year.

One witness to the Senate Inquiry Hearing gave the following description of the noise:

> *The types of noise that we experience depend on wind direction. The noises range from a doof-doof noise, like you would hear from a subwoofer at a party down the street, to a constant jet rumble. We can also hear the generator noise, like a fridge when it fires up – that electrical sound – and a times a whooshing sound, like a stick being swung through the air quickly. These noises are not just for a minute or two but can go on all night, not to mention the day. On average, we would say that we have interrupted sleep at least three to four nights a week and on some occasions up to five…..This continuous*

interruption to and lack of sleep has enormous impact on our lives, our business and our future. [Committee Hansard, 28 March 2011, p. CA 46]

Overseas people who have lived in close proximity to wind farms have reported symptoms of sleep disturbance, headache, visceral vibratory vestibular disturbance, dizziness, vertigo, unsteadiness, memory and concentration deficits, irritability, anger, fatigue and loss of motivation.

Given the potential of these adverse impacts on the surrounding community, it is indeed surprising that they are not addressed or assessed in the social impact.

This is all the more so because contrary to the claim in the EA that there are no neighbouring residences within 2 kilometres of any wind turbine, in fact there are 3 houses within 2 kilometres and indeed within 1 km which are not part of any agreement to host a turbine. Another 2 house is a mere 70 and 90 metres outside this arbitrary 2 km measure – and has not even been directly consulted on the potential impact.

In other EAs for Wind Farms development proponents have relied on a 'rapid review' survey of the literature published by the National Health and Medical Research Council (NHMRC) that concluded, among other things that 'there is currently no published scientific evidence to positively link wind turbines with adverse health effects'.

However, Prof Anderson, the Chief Executive Officer of NHMRC, informed the Senate Inquiry that:

I do want to make a point to anyone who is relying on this.
We regard this as a work in progress. We certainly do not believe that this question has been settled. That is why we are keeping it under constant review. That is why we said in our review that we believe authorities must take a precautionary approach to this. That is what we do say in medicine anyhow, but this is very important here because of the very early stage of the scientific literature……We cannot be responsible for the use that others make of the literature..." [Committee Hansard, Perth, 31 March 2011, p. CA87]

It is notable that subsequent to the Senate Inquiry that this year, 2012, a "growing body of evidence" that wind farm noise could have health effects has prompted Queensland Health to call for caution when approving wind farm developments.

Overseas the prestigious British Medical Journal in response to an increasing number of peer-reviewed research has recently published an editorial: "A large body of evidence now exists to suggest that wind turbines disturb sleep and impair healthy at distances and external noise levels that are permitted in most jurisdictions. When seeking to generate renewable energy through wind, governments must ensure that the public will not suffer harm from additional ambient noise "[British Medical Journal 2012; 344 doi:10.1136/bmj.e1527 – published 8 March 2012].

The medical research boundaries are beginning to emerge in a manner reminiscent of the early research into asbestos. For risk-management and liability reasons it behoves assessment authorities to consider these social l aspects seriously.

An independent study partly funded by the Danish government (the home of wind farms) and published in the peer-reviewed Acoustical Society of America Journal June 2011 confirms "*beyond any doubt that the low frequency part of the spectrum plays an important role in the noise at neighbours and that the low-frequency sound must be treated seriously in the assessment of noise from large turbines."* Moreover, it went on that "results confirm the hypothesis that the spectrum of wind turbine noise moves down in frequency with increasing turbine size. The relative amount of emitted low frequency noise is higher for large turbines than for small turbines… Large turbines affect the same area – or possibly even larger areas – with noise when compared to small turbines with the same total installed electric power." [Henrik Moller and Christian Sejer Pedersen, "Low-frequency noise from large wind turbines, H Journal of the Acoustical Society of America, June 2011, 129 (6), p.3735

However, this EA report didn't even see the need to assess this potential social and economic impact. The simple conclusion is that we simply do not know enough about the health effects on individuals and communities that find themselves adjacent to these developments. One wonders if this would occur if the developer were required to indemnify neighbours and the community against realised health issues resulting from the proposed development.

As it stands the so-called Social Impact aspect of the assessment is fundamentally flawed by its failure to consider significant relevant social impact.

Inadequate Economic Impact Analysis

Unfortunately the Economic Aspects of the assessment are little better. Little is quantified, there is no evidence provided to support unsubstantiated claims. Again, as in the Social aspects significant economic aspects are ignored.

As a member of the 'Wind' Industry, it might have been expected that the developers and their consultant might have been aware of and utilised the economic framework analysis developed by Dr Robert Passey for the Australian Wind Energy Association in March 2003. This at least set out a framework for analysis and some approximate parameters to quantify some of the benefits. The work seems to have underpinned adequate evidenced-based economic assessments such as that undertaken by Parsons Brinkerhoff for the Stockyard Hill Wind Farm, Sinclair Knight Merz for the Hallett Wind Farms in South Australia, and SGS for the Silverton Wind Farm in the Far West of NSW. All of these studies looked at the impact

within the context of the total development benefits and costs to the state and nation as well as within the context of the local economy.

In comparison to the analytic nature of these studies, the current EA for the propoasal provides no quantifiable evidence, instead resorting to unsubstantiated claims about employment and economic benefits , as well as ignoring (or at best dismissing) any assessment of economic costs to adjoining neighbours, the surrounding community.

On the one issue (impact on land values) for which supporting evidence is provided – it is selective and ignores important qualifications made in the cited report.

The best way to demonstrate the inadequacy of the economic assessment is to examine the paucity of evidence presented on a point-by-point basis as outlined in the so-called Social and Economic Assessment.

Local Context (P.16-5, paragraphs 1 and 2)

According to data provided by the NSW and Australian Government through RDA Central West web-site (www.rdacentralwest.org.au/investdata), the Wellington Shire Council area economy, with a population of nearly 9000 residents, has a total of 880 businesses, employs over 4000 employees and has a Gross regional Product of approximately $200m annually. Many of these employees and residents will be impacted by the proposed development both directly and indirectly as a result of the proposal. Very few of these impacts have been addressed with adequate evidence in the EA Assessment.

For instance, no quantifiable evidence is provided of the impact of the development on the recreational and tourist regional economy estimated from the 63,000 overnight visitors per year over the last six years (rdacentralwest website). 44% of these visitors are coming to the area for holiday or leisure entertainment (including accommodation, cafes and restaurants) – much of this is in the form of life-style/nature-based holidays, recreational walking and visits to attractions such as Wellington Caves.

No evidence is presented on the deleterious impact of the development on this significant visitor economy arising from the visual impact, reduction in local natural amenity, wildlife impact or the perception of adverse health effects from the operation.

Similarly no quantifiable assessment is made of the impact of the development on the 20% of the local economy dependent upon the agricultural activity. This is worth well over $30 million annually in the Wellington Council area (rdacentralwest website). There is no evidence provided of the impact on crop disease mitigation, lambing and animal health of the proposal.

Visual Landscape (p 16-5, paragraph 2)

No evidence is provided to support the claim that the "visual landscape of the region has the capacity to absorb the proposed development". At the very least, these could have included sight-line drawings, photo-montages, etc. The suggestion that "screening vegetation" can be planted to mitigate the visual impact of 150 metre tall structures is almost laughable, as is the claim that the development would "retain the existing landscape character". No mention is made of who would pay for such 'visual mitigation' (if such a plan was developed) on neighbouring properties or other publicly-owned land.

Whilst the argument can be made that the visual impact of wind turbines is a subjective thing – there are some people who might be attracted by the curiosity value, whilst others would be appalled by the intrusion of such artificial structures in a natural and rural landscape. The fact that stems from this is that the value of affected properties subject to visual impact would find that, conceptually, the value of their properties would decline as the pool of people interested in purchasing such affected properties now and into the future would be decreased. In simple terms demand would fall and so would market price.

This could affect the potential value of such properties to raise additional operating capital via loans to maintain or upgrade their business.

On-going rural use of neighbouring land (p 16-5, paragraph 3)

The EA claims that the "development is 'unlikely' to affect on-going rural use within the project area or the rural use of neighbouring land." No assessment is made of these affects and no evidence at all is provided to support the claim.

The EA concedes that "there will be some disruptions during the construction phase of the project to associated land-owners" but again makes no assessment of these or any evidence of the magnitude of such. No reference is made to adjoining and neighbouring properties.

Aside from the economic costs of upgrading roads to cater for the extremely heavy loads of materials to construct the towers, and resultant on-going maintenance costs associated with the traffic, other construction-related impacts not addressed include:

- Road safety issues for farm workers and children crossing roads that transverse properties, and similar from stock crossing such roads
- Disruption to farm management in moving oversize farm machinery
- Potential disruption to aerial spraying for effective farm management

Economic employment effects of the proposal (p16-5, paragraph 3)

The EA makes the unqualified and unevidenced assertion that the project will have "employment and associated economic benefits particularly during the construction phase oft the project." The number of direct employment effects in equivalent effective full-time employment is not even presented. Thankfully some estimate of this can be made from other more robust EAs for Wind Farms that have been referred to earlier (SKM, SGS, Parsons Brinkerhoff).

Based on these studies the construction phase for 47 wind turbines might employ a direct total of 100 jobs and the on-going job count is likely to be about 6 people. Indeed, the Hallett 1 development reported by Sinclair Knight Merz was for 45 turbines and so provides a check of estimates. This recorded an annual actual construction FTE employment of 66 , which if spread over the estimated 18 months of construction suggests a total of 99 jobs. In addition, there are indirect multiplier effects of approximately 0.5 depending on the local content of the spend. In total, some 150 direct and indirect jobs may be created in the construction phase. However, these are only one-year equivalent jobs.

In the on-going operation of the turbines, largely for maintenance, monitoring and repair, employment is much reduced. For instance, at Hallett 1 on-going operational employment was 9 persons (although this might have been in part preparing for other phases of the project). At the Senate Committee Inquiry, Origin Energy submitted that a general rule of thumb is that for every 25 turbines three on-site jobs are generated. (Submission 591, p12). On that basis, a reasonable estimate is 6 on-going jobs generated.

Thus over a 25 year operating period the employment benefits are not substantial - totally over 25 years the total of 300 full-time full-year jobs or an average of 12 continuous jobs per year. The Wellington economy has a workforce of approximately 4000 currently, so the development may raise the long-term employment level by 0.3%. And this assumes that all labour and employment effects are able to be localised.

The realisation of this to the local economy depends upon how much is able to be supplied locally and how much is imported from other regions or even from overseas.

However, this maximum potential benefit can also have costs associated. For instance, depending on the state of the local labour market and the skill/occupational mix of the local workforce, the demand for skilled labour is unlikely to be met through local supply. The undersupply of local labour can result in flow-on effects to Wellington's small business sector and the capacity to meet demands for services through local supply. This can mean higher costs. The local economy's capacity to retain skilled labour beyond the period of their initial contract is a further- supply-side constraint to on-going economic expansion of the local economy.

Conversely, no estimate is made of the possible job losses arising from any deleterious impact on surrounding rural activities arising from the adverse operation of the wind turbines.

Tourism Viewing Area (p. 16-5, final paragraph)

No evidence is presented that wind farms are a long-standing tourist attraction. There may be a novelty value at present when only about 1000 turbines have been approved on about a dozen wind farms in NSW since 2005. However, as they become more prevalent (in accords with the Australian Government's targets for renewable energy), then the curiosity of novelty may well dissipate and the employment effect may be very temporary. All the more so when this is described as a later stage development in the EA.

Conversely, no assessment is made of potential deleterious effect on tourism related to life-style visitation based on the traditional historical activity of the area/ natural walking trails/ Caves which may be impacted by the development.

Of the 68,000 annual visitors to Wellington, even if as little as 10% are deterred by the wind turbine visual display and do not visit, or are put off by perceptions of health effects, then the impact on employment in the local economy could be sufficient to make the economic contribution of the development negative as far as employment is in the local community is concerned.

Surrounding Land Value Impact (p. 16-6)

The EA believes that there is "limited evidence' that wind farm developments lead to reduced property values. Much is made of a selective extract of from the Executive Summary of a NSW Department of Land report prepared by the NSW Valuer-General, three years ago.

However, perusal of the full report reveals that its conclusions are heavily-qualified. It relies on data from a total of just 45 sales drawn from wind-farm developments around Australia. Only two of these wind-farms were in NSW. Given the potential effects on property prices, this is an extremely small sample, hence little value cane be placed on the conclusion. Conversely, the Senate Committee Inquiry heard contrary evidence from an experienced Elders estate agent that stated that land adjacent to wind farms could lose 30% -50% of its value. A Report by Access Economics submitted to the Senate Inquiry that the use of land (agricultural or amenity) is important in considering the impact of wind farms on land values.

A reasonable person would be forced to agree with the conclusion of the Senate Committee that:

> *Although there were conflicting views expressed, there were sufficient indications in the evidence to suggest that the value of rural lifestyle properties in close proximity to wind farms may be adversely affected by the establishment of the wind farms. Agricultural*

properties near wind farms which do not host turbines may not be similarly affected, although there could be some diminution of values if dwellings on the properties are situated very close to turbines. There might also be some negative effects on agricultural property values if those properties could not utilise aerial applications of fertiliser, seeds and pesticides' (The Senate Community Affairs Committee, Report on The Social and Economic Impact of Rural Wind Farms, Parliament House, June 2011; paragraph 4.19 p.57).

Unfortunately, as this review of the EA report has indicated, whilst the Senate Committee recognised these factors as having impact on surrounding property land values, none of these issues formed part of the development proposal EA.

Economic Impacts of Social Impacts

It is difficult to understand how on such limited presented evidence, the EA report was able to claim that the proposed wind farm "will have minimal negative social effect to the region." This is yet another unsubstantiated claim with no evidence presented to support the assertion. As examined earlier in this paper, many of these social impacts can have important subsidiary economic effects.

Whilst the social impacts discussed above may affect neighbours' and the community quality-of-life, these social impacts can also have an economic consequence which needs to be assessed as part of the EA.

For instance, if a health effect from prolonged exposure to the deleterious noise of wind turbines induces sleeplessness, anxiety, fatigue, nausea, then this will in turn have an impact on labour productivity and the ability to maximise production in the on-going businesses that people form as part of the workforce. An unhealthy worker is an unproductive one. There may be very real Occupational Safety and Health cost issues.

None of these economic costs of social impacts have been examined by the EA. Potentially, the economic assessment should include the economic impact of the affected health of animals through for example lambing, or the impact of the inability or cost associated with reduced capacity to control crop diseases through aerial spraying.

Reiterated Economic Claims (p.16 – 7)

The final part of the social and economic section of the EA is a reiteration of the unquantified and unsubstantiated statements made earlier in the chapter.

The critique holds that while the social impact analysis is substantially missing, the economic analysis is totally inadequate. Until a proper assessment is undertaken, in a comprehensive

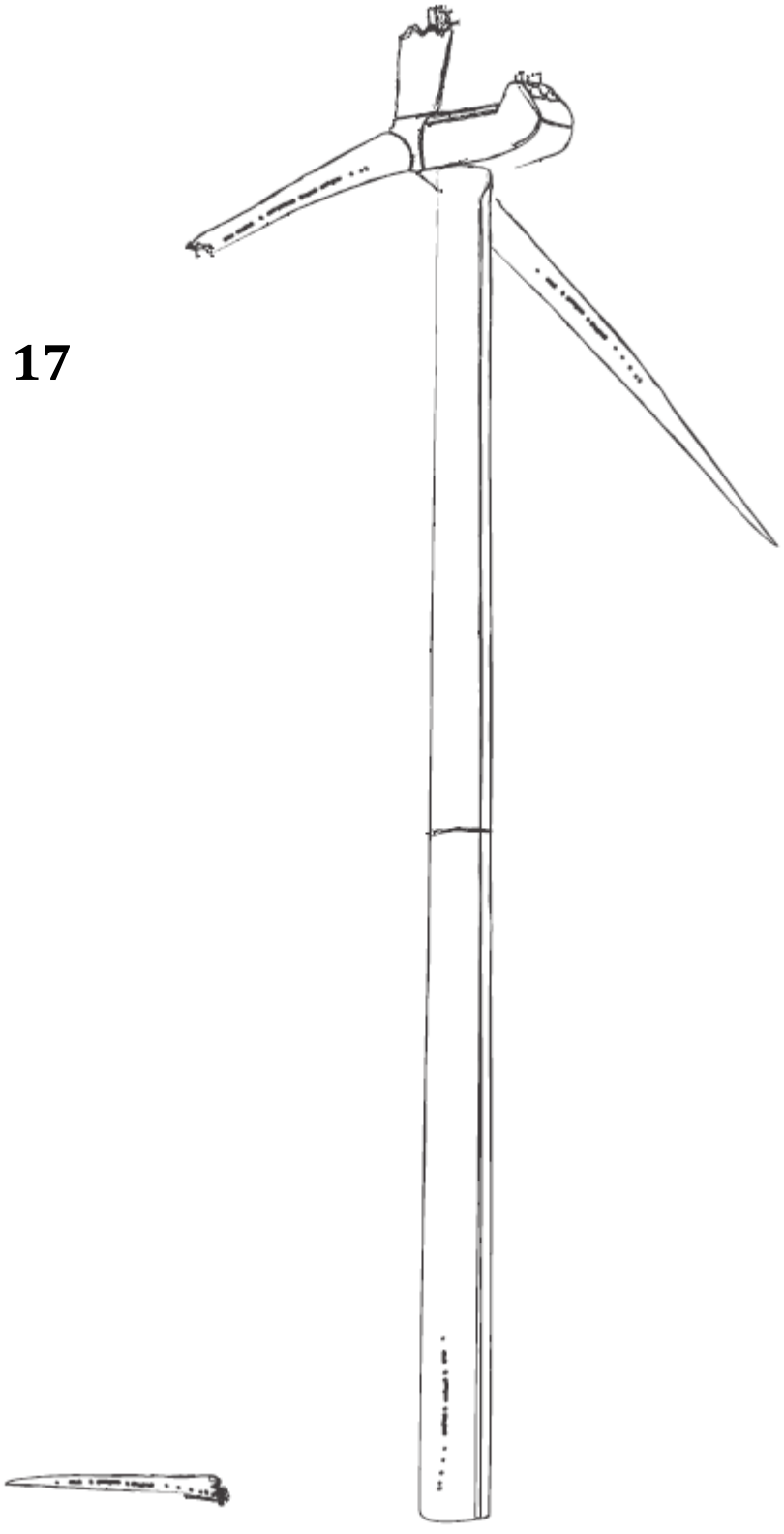
fashion with evidence-based local research and specified transparent assumptions outlined , the economic analysis as presented cannot be said to fulfil the requirements of the Act or those of the Director-General.

Most people are generally supportive of the development of renewable energy resources to address the issues we and our children face in respect of greenhouse emissions. However, that pursuit for cleaner energy cannot be a carte blanche to ride roughshod over the legitimate concerns that many Australians have about the impacts on physical and mental health of too adjacent wind turbines. As Access Economics made the point in a report cited in the Senate Inquiry Report into Rural Wind Farms: “From a policy perspective, it is debatable whether paying for what is a genuine public good – greenhouse gas abatement – should fall so disproportionately on so few.”

It would be a sad day for planning and the people of the state if merely claiming a benefit without analysing the outcomes became the basis of successful assessment. Given the unfolding public health concerns with wind turbine farms, the people on surrounding properties to this development would be the ultimate victims of this lack of accountability.

Chapter 17

Health



CHAPTER 17 HEALTH

THE DRAFT DGRS REQUIRE CONSIDERATION OF HEALTH

The approach to health issues in these guidelines have been developed in consultation with the NSW Ministry of Health. The guidelines adopt a precautionary approach for the consideration of health issues. This includes requiring proponents to explicitly consider health issues as well as comply with stringent operational performance criteria including stringent noise criteria. Applications may also be referred to the Ministry of Health as part of the assessment process.

Further, the Draft DGRs go on to say, *"Where a turbine is proposed within 2 km of a neighbour's house, proponents should consult with affected neighbours on specific issues including landscape and visual amenity issues, noise, health, property values, blade glint, and shadow flicker. Proponents should also consult with occupiers in the cases of rented premises."*

Health issues

The potential for the proposed wind farm to impact on human health should be considered, focusing on neighbours' houses within 2 km of any proposed wind turbine. This may be undertaken with reference to the following:

- up to date evidence-based research
- statements from relevant health bodies, such as the National Health and Medical Research Council's (2010) *Public Statement: Wind Turbines and Health*.
- the predicted level of impact from the wind farms including impacts from noise, shadow flicker, blade glint, night lighting, electric and magnetic fields
- consultation undertaken regarding health issues and concerns

The Department of Planning and Infrastructure may refer applications to the NSW Department of Health (NSW Health) as part of the assessment.

The DGRs require the proponent to:

….."*identify any risks with respect to low frequency or infra-noise;*

describe the issues raised during consultation and how and where these have been addressed in the EA".

17.1.0 SUMMARY OF OBJECTIONS

Health: the bodangora wind tubine awearness group objects to the proposed bodangora wind farm.

One of the major issues relating to the development is the continued health of the residents in and surrounding the development area. This has not been addressed in the EA submitted by the proponent.
Instead, the EA launches into varying reports that support its claims that operational performances of the turbines is within acceptable ranges as stated. What is not explained is why the "up to date evidence based research" as required by the Director General Draft Guidelines is either missing or has been slanted in favour of the proponent.

17.2.0 ORGANIZATION, RESEARCH AND EVIDENCE OF HEALTH EFFECTS.

The EA quotes several sources as stating there are no adverse physiological effects from the noise emanating from wind turbines. But research and legal opinion has moved on. For instance, the EA makes reference to the National Health and Medical Research Council (NHMRC) which published a *"Wind Turbines and Health: A Rapid Review of the Evidence"* in July 2010 stating in part that there was no direct pathological effects from wind farms36. This has been convincingly rebutted by – see for instance, Dr. Carl Phillips in his submission (No.897) to the Australian Senate Enquiry into Rural Wind Farms.

Nevertheless the NHMRC also clearly says:
1. a precautionary approach should be taken
2. research outcomes should continue to be monitored;
3. wind turbine design standards should be complied with;
4. site evaluation should occur to minimise potential impacts; and
5. people who believe they are experiencing health problems should consult their doctor promptly.

By omitting the recommendations contained in this Public Statement, the EA completely **distorts the Public Statement and by its omission is dishonest**.

Since that time, there have been the following developments. In March 2011, the CEO of the NHMRC Professor Warwick Anderson gave evidence to the Federal Senate Inquiry into Rural Wind Farms. In his oral testimony, he said the following;

On p 86 of Hansard for 31st March, 2011
"As I said in my opening statement, **we are very aware that the high-quality scientific literature in this area is very thin**. That is why we were at pains to point out that we believe that **a precautionary approach should be taken** to this, because, as you would understand, **the absence of evidence does not mean that there might not be evidence in the future"**

On p 87
"**We are encouraging scientists—epidemiologists and others—to think about this area and use the information that the anecdotes and individual patients have provided to better design epidemiological approaches to investigate**

the issues. Anecdotes are very valuable ways of honing the questions to be asked.

On p 87
"**….but I do want to make a point to anybody who is relying on this (Rapid Review). We regard this as a work in progress. We certainly do not believe that this question has been settled**. That is why we are keeping it under constant review. **That is why we said in our review that we believe authorities must take a precautionary approach to this**. That is what we do say in medicine anyhow, but **this is very important here because of the very early stage of the scientific literature….**

On p 88 an exchange between Senator Steve Fielding and Professor Anderson
Senator FIELDING—
"…you are making some, I think, rightly qualified statements that we have to take a precautionary approach. It seems to me that that precaution may not be being taken because everyone is putting a very large weight on the NHMRC's rapid review statement and saying that there are no adverse health impacts from living near wind turbines and everyone is just approving them on that basis. That is of huge concern to me. "

Prof Anderson—
"I know that the headline on that public statement says that, but the document does not say that. It did say that there was no published scientific evidence at that stage to positively link the two. **That is a very different thing to saying that there are no ill effects and we do not say that there are no ill effects**. We definitely do not say it that way…."

This testimony indicates that the CEO of the NHMRC was concerned about the health problems being reported by residents and their treating doctors, was aware of the fact the existing research data was limited, and that the absence of peer reviewed published research does not mean there is not a problem.

Since this time, the NHMRC have held a workshop (June 2011) after which they have announced a new Panel which will reexamine the literature – some of which was omitted with the first review, and some of which is new.

Then in late June 2011, the Australian Federal Senate Inquiry handed down its recommendations, which included urgent research, measurement of the low frequency noise emissions inside homes, studying infrasound, updating the NHMRC and various other initiatives. To date, nothing has been done in the way of research, with the exception of field research being conducted by the acousticians (see later). The NHMRC are updating their review.

In July 2011, in a landmark decision in Ontario, in which acknowledged acoustics and health experts from around the world gave evidence, the court found that

"While the Appellants were not successful in their appeals, the Tribunal notes that their involvement and that of the Respondents, has served to advance the state of the debate about wind turbines and human health. **This case has successfully shown that the debate should not be simplified to one about whether wind turbines can cause harm to humans.** ***The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents****. The debate has now evolved to one of degree."* (p. 207) (*Emphasis added*)

Environmental Review Tribunal, Case Nos.: 10-121/10-122 Erickson v. Director, Ministry of the Environment, Dated this 18th day of July, 2011 by Jerry V. DeMarco, Panel Chair and Paul Muldoon, Vice chair, http://www.ert.gov.on.ca/english/decisions/index.htm

IN the same month, a paper was published from Danish Acousticians Moller and Pedesen which showed that the larger the wind turbine and its power generating capacity, the greater the amount and proportion of low frequency noise emitted, and therefore the greater the "annoyance" for the neighbours. This document is accessible from http://www.wind-watch.org/documents/low-frequency-noise-from-large-wind-turbines-2/ This is particularly relevant, because there is very little information about the impact on the local community of larger wind turbines.

However the Waterloo wind development in South Australia has been studied, and has had a lot of adverse publicity because of the effects of noise and vibration on the neighbours. These turbines are the largest operating wind turbines in Australia at the moment. A survey by an Adelaide University Masters student "Frank" Zhenhua Wang found that 50% of people surveyed (total population out to 5km from the 37 3MW VESTAS V90 turbines, 64% response rate) were moderately to severely impacted by the noise. (see http://www.wind-watch.org/documents/evaluation-of-wind-farm-noise-policies-in-south-australia/)

As Adelaide University staff refused to allow Mr Wang to release a briefing summary with these results to participants in the study and has also refused to allow access to the masters dissertation, a local resident at Waterloo, Mary Morris, decided to repeat the Wang survey, in order to verify its findings, but increased the distance out to 10km because she knew people who were having problems out to that distance. Her survey confirmed the impact of the turbines reached out to 10km (see http://www.wind-watch.org/news/2012/07/18/open-letter-to-the-premier-of-south-australia-re-new-survey-at-waterloo-wind-farm/)

One critical reference omitted from the first 2010 NHMRC Rapid Review was a document of which the lead author was Professor Geoffrey Leventhall, a British acoustician, who was also one of the two undisclosed peer reviewers of the NHMRC Rapid Review. The document was prepared for the UK government department DEFRA in 2003 and can be downloaded from http://www.wind-watch.org/documents/review-of-published-research-on-low-frequency-noise-and-its-effects/ .

This literature review is a key summary of the then known evidence linking low frequency noise with adverse health impacts and was cited in suggested Australian noise guidelines subsequently. (see for example http://www.wind-watch.org/documents/ecoaccess-guideline-for-the-assessment-of-low-frequency-noise/ . Inexplicably, Professor Leventhall failed to make this 2003 DEFRA document known to the NHMRC authors of the Rapid Review, despite his knowledge that wind turbines were a source of low frequency noise (confirmed in that document). It appears that he may not have disclosed his financial connections to the wind industry to the NHMRC at the time either.

In the DEFRA document there is reference to a case control study which clearly showed that people exposed to low frequency noise (from a source other than wind turbines) could develop the characteristic symptoms and pattern of occurrence, identical to "wind turbine syndrome", were known to acousticians. (see p 49 for table reproduced below)

17.3.0 Effects on health.

In an epidemiological survey of low frequency noise from plant and appliances in or near domestic buildings, the focus was on health effects (Mirowska and Mroz, 2000). … A control group of dwellings had comparable conditions to the test group, with similar A-weighted levels, except that there was no low frequency noise. There were 27 individuals in the test group and 22 in the control group. The test group suffered more from their noise than the control group did, particularly in terms of annoyance and sleep disturbance. They were also less happy, less confident and more inclined to depression. The comparison of the symptoms between the tested group and the control group show clear differences, as in Table 5.

Table 5. Health comparison of exposed and control group.

Symptom	Test group %	Control group %
Chronic fatigue	59	38
Heart ailments anxiety, stitch, beating palpitation	81	54
Chronic insomnia	41	9
Repeated headaches	89	59
Repeated ear pulsation, pains in neck, backache	70	40
Frequent ear vibration, eye ball and other pressure	55	5
Shortness of breath, shallow breathing, chest trembling	58	10
Frequent irritation, nervousness, anxiety	93	59

Frustration, depression, indecision	85	19
Depression	30	5

These results are extremely interesting as an epidemiological survey of an affected and a control group.

Professor Leventhall has since publicly admitted that the symptoms of "wind turbine syndrome" have been known to him for some years. The first occasion was at the NHMRC workshop in June 2011 (see video of his presentation at http://www.nhmrc.gov.au/your-health/wind-farms-and-human-health).

On another occasion giving evidence in 2009 in Wisconsin, (Testimony before the Public Service Commission of Wisconsin (PSC Ref#121877 20), (2009, October) Leventhall had the following to say:

"Pierpont defined the symptoms of the Wind Turbine Syndrome as:"….*sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal pulsation or quivering when awake or asleep* … **I am happy to accept these symptoms, as they have been known to me for many years** as the symptoms of **extreme** psychological **stress from environmental noise, particularly low frequency noise**"

So, acousticians are well aware of symptoms identical to "wind turbine syndrome" occurring with exposure to low frequency noise, **and have been since at least 2003 when this document was published**. Almost all medical practitioners remain ignorant of these problems, and their connection with infrasound and low frequency noise. This is partly because the engineers use the word "annoyance" which medical practitioners who treat these sick residents are realizing covers a lot of serious pathology which the engineers do not always pick up on, not being doctors. (personal communication, Dr Laurie, Waubra Foundation).

The other important point from Leventhall's 2003 work is the discussion of the research relating to the causal connection between low frequency noise and physiological stress (as distinct from psychological stress, which Leventhall now claims). There is clear evidence in Section 10 of the DEFRA document, for a physiological stress response in response to low frequency noise exposure. The example Leventhall gives is that of children exposed to truck low frequency noise showing **physiological stress when they are asleep, clearly confirming that there is a physiological stress reaction to LFN**. Leventhall now states that it is a psychological stress reaction to noise "annoyance", seemingly having forgotten this earlier research work.

Recent acoustic survey work in Australia and in the USA has confirmed the presence of wind turbine acoustic emissions, which contain a characteristic sound signature which includes significant amounts of infrasound and low frequency noise, which can be further amplified inside a building. The presence of infrasound has been denied by the wind industry and also by noise guidelines used by government, for example the SA EPA windfarm noise guidelines claim that there is no infrasound at a well maintained wind farm.

Yet acousticians such as Robert Rand and Steven Ambrose are measuring infrasound from wind turbines in the US (download their report from http://www.wind-watch.org/documents/bruce-mcpherson-infrasound-and-low-frequency-noise-study/) as is Rick James, another American noise engineer (download his conference proceedings from http://www.wind-watch.org/documents/dynamic-measurements-of-wind-turbine-acoustic-signals/

Australian Acousticians who have measured infrasound and low frequency noise from wind turbines at wind developments in Australia include Dr Bob Thorne, Mr Steven Cooper, Professor Colin Hansen & colleagues from Adelaide University, and Mr Les Huson. Mr Cooper presented some of his information at the Wellington Public meeting on 22nd July, 2012 attended by Infigen representatives and their acoustic consultant from Sonus. There was no challenge to the accuracy of Mr Cooper's data in that meeting.

This is the most up to date "evidence based" field research, from these acousticians who are completely independent of the wind industry, who have been out in the field, actually measuring the full sound spectrum of noise. All of them have been accused by the wind industry and its supporters of being "anti-wind" as a way of dismissing them and their field work. This is standard practice by the wind industry, unfortunately, and they do the same for any doctor who speaks out about their concerns. We understand that staff from the NSW department of planning have been similarly dismissive, and called Mr Cooper "anti-wind".

Now that the presence of infrasound has been established by these acousticians, (inside the homes of sick people), having previously been denied by the wind industry and still denied by the noise regulatory authorities, it is worth going back to the evidence which does exist for what infrasound can do to humans and animals. One useful reference, 10 years old, is the NIEHS Literature review from 2001 (download from http://www.wind-watch.org/documents/infrasound-brief-review-of-toxicological-literature/).

There is not a lot of empirical research literature relating to chronic exposure, however study number 58 is of relevance. It shows that chronic exposure can lead to focal organ damage, which was reduced in the group of rats who had antioxidants. This suggests that oxidative stress is one mechanism of damage. Other experimental data show that cumulative exposure worsens the pathology, and that there is a

physiological stress reaction (release of stress hormones) with exposure to infrasound.

Other peer reviewed published data, which has emerged since the 2010 NHMRC rapid review is a research paper by Dr Daniel Shepherd and colleagues from New Zealand. Their research showed that there are measurable detrimental changes to sleep quality in residents living near wind turbines, (the commonest complaint from residents is sleep deprivation) and a measurable decrease in various indices of quality of life. This document can be accessed from http://www.wind-watch.org/documents/evaluating-the-impact-of-wind-turbine-noise-on-health-related-quality-of-life/

Professor Phillip Dickinson is one of the oldest acousticians and has extensive professional experience in the field of infrasound and low frequency noise, having been involved in some of the early experiments early in his career. His updated paper gives useful information, and he too recommends a precautionary setback of 5-10km (http://www.wind-watch.org/documents/pragmatic-view-of-a-wind-turbine-noise-standard/)

There are also a number of peer reviewed published articles about this topic including an editorial in the prestigious British Medical Journal, which were published since the Rapid Review, all indicating that there is a serious problem and that research is required. Abstracts of those articles are attached.

Finally, Professor Carl Phillips is an epidemiologist from the USA who was part of the team of international experts giving evidence in the court case in Ontario where the judges found that wind turbines cause adverse health if sited too close to residents. His words in the abstract of his journal article are well worth repeating here, as they fit exactly with what the other clinicians who have actually seen sick people are saying:

"*There is overwhelming evidence that wind turbines cause serious health problems in nearby residents, usually stress-disorder type diseases, at a nontrivial rate. The bulk of the evidence takes the form of thousands of adverse event reports. There is also a small amount of systematically-gathered data*. *The adverse event reports provide compelling evidence of the seriousness of the problems and of causation in this case because of their volume, the ease of observing exposure and outcome incidence, and case-crossover data. Proponents of turbines have sought to deny these problems by making a collection of contradictory claims including that the evidence does not "count", the outcomes are not "real" diseases, the outcomes are the victims' own fault, and that acoustical models cannot explain why there are health problems so the problems must not exist. These claims appeared to have swayed many non-expert observers, though they are easily debunked. Moreover, though the failure of models to explain the observed problems does not deny the problems, it does mean that we do not know what, other than kilometers of distance, could sufficiently*

mitigate the effects. There has been no policy analysis that justifies imposing these effects on local residents."

"The attempts to deny the evidence cannot be seen as honest scientific disagreement, and represent either gross incompetence or intentional bias."

Professor Phillips' paper is downloadable from the following: http://www.wind-watch.org/documents/properly-interpreting-the-epidemiologic-evidence-about-the-health-effects-of-industrial-wind-turbines-on-nearby-residents/

EXPLICIT CAUTIONARY NOTICE

TO THOSE RESPONSIBLE FOR WIND TURBINE

SITING DECISIONS

Including Specifically Directors of Wind Developers, Publicly Elected Officials from Federal, State and Local Government, and Bureaucrats in Relevant Departments

BE ADVISED that, as a result of information gathered from the Waubra Foundation's own field research, and from the clinical and acoustic research available internationally, ***the following serious medical conditions have been identified in people living, working, or visiting within 10km of operating wind turbine developments.*** The onset of these conditions corresponds directly ***with the operation of wind turbines:***

- chronic severe sleep deprivation;
- acute hypertensive crises;
- new onset hypertension;
- heart attacks (including Tako Tsubo episodes);
- worsening control of preexisting and previously stable medical problems such as angina, hypertension (high blood pressure), diabetes, migraines, tinnitus, depression, and post traumatic stress disorder;
- severe depression, with suicidal ideation;
- development of irreversible memory dysfunction, tinnitus, and hyperacusis.

Other symptoms include those described by Medical Practitioners such as Dr Amanda Harry, and Dr Nina Pierpont in her landmark Case Series Crossover Peer Reviewed Study (submission No 13 to the Australian Federal Senate Inquiry into Rural Wind Farms) and published in Dr Pierpont's book entitled "Wind Turbine Syndrome, A Report on a Natural Experiment", 2009, published by K-Selected Books, Santa Fe.

These serious health problems were also identified by Australian GP Dr David Iser in 2004. Dr Iser formally notified the Victorian Government of the time after his patients became

unwell following the start up of the Toora wind project. His warnings were ignored without being properly investigated by the authorities and politicians.

All this and supportive material has been made available to the Boards of the major developers, State Ministers for Health and Planning and senior health bureaucrats. The time for denial, and of using the Clean Energy Council to shoulder the increasingly difficult task of denying the link between adverse health and operating wind turbines, is over.

At the Toora and Waubra wind projects, some seriously ill affected residents have been bought out by the developers; but only after they signed confidentiality agreements specifically prohibiting them from speaking about their health problems. This buy-out activity would support a conclusion that developers are aware of the health problems.

Meanwhile, wind developments have continued, with developers asserting that their projects meet acceptable standards, and thereby implying that they cannot be causing health problems.

The Foundation is also concerned that Vibroacoustic Disease, as recorded and described by Professor Mariana Alves-Pereira's team from Portugal, will develop in people chronically exposed to wind turbines. The disease has already been identified in the occupants of a house with levels of infrasound and low frequency noise identical to levels the Foundation is recording in the homes of affected residents in Australia.

The Foundation is aware of over 20 families in Australia who have abandoned their homes because of serious ill health experienced since the turbines commenced operating near their homes. Most recently, five households from Waterloo in South Australia have relocated, where the larger 3 MW turbines have had a devastating impact on the health of these residents. Some of these people have walked away from their only financial asset, to live in a shed or a caravan on someone else's land.
The Foundation notes the mid-2010 advice from the National Health and Medical Research Council that a "***precautionary approach***" be followed. We are not aware that either industry or planning authorities have adopted this exceedingly valuable and important advice.

The Foundation's position, as the most technically informed entity in Australia upon the effects of wind turbines on human health, is this: ***Until the recommended studies are completed, developers and planning authorities will be negligent if human health is damaged as a result of their proceeding with, or allowing to proceed, further construction and approvals of turbines within 10km of homes. It is our advice that proceeding otherwise will result in serious harm to human health.***

We remind those in positions of responsibility for the engineering, investment and planning decisions about project and turbine siting that their primary responsibility is to ensure that developments cause no harm to adjacent residents; and, if there is possibility of any such harm, then the project should be re-engineered or cancelled. To ignore existing evidence by continuing the current practice of siting turbines close to homes is to run the dangerous risk of breaching a fundamental duty of care, thus attracting grave liability.

The Waubra Foundation, 29 June, 2011

Enquiries: Dr Sarah Laurie, Medical Director, 0439 865 914

The volume of reports cannot be ignored or dismissed as the rantings of jealous non host families. There are now reports of host families being affected and leaving their homes as a consequence (personal communication). Health effects are real and their cause can be found in both non-compliant audible sound, and from infrasound which is consistently denied by the wind industry. Infrasound and non-compliant audible sound have made the lives of a significant number of residents close to wind turbines intolerable and has put them at considerable health risk (mental and physiological.)

Reports contained with-in this submission are the most up to date and credible reference on health, written by people with the most knowledge in the field in this area.

Appendix A:

A Review of Published Research on Low Frequency Noise and its Effects

Report for Defra by Dr Geoff Leventhall, Assisted by Dr Peter Pelmear and Dr Stephen Benton

May 2003

Appendix B:

WIND TURBINE ACOUSTIC POLLUTION ASSESSMENT REQUIREMENTS

Waubra Foundation

Industrial Wind Turbines and Health:
Wind Turbines Can Harm Humans if too Close to Residents [1]

A summary of peer reviewed articles their abstracts and citations regarding adverse health effects and industrial wind turbines [2]

The Noise from Wind Turbines: Potential Adverse Impacts on Children's Well-Being

Arline L. Bronzaft

Bulletin of Science Technology & Society 2011 31: 256, DOI: 10.1177/0270467611412548, http://bst.sagepub.com/content/31/4/291

Bio: Dr. Arline L. Bronzaft is a Professor Emerita of Lehman College, City University of New York. She serves on the Mayor's GrowNYC, having been named to this organization by three previous Mayors as well. Dr. Bronzaft is the author of landmark research on the effects of elevated train noise on children's classroom learning; has examined the impacts of airport- related noise on quality of life; and has published articles on noise in environmental books, academic journals and the more popular press. In 2007, she assisted in the updating of the New York City Noise Code.

Abstract

Research linking loud sounds to hearing loss in youngsters is now widespread, resulting in the issuance of warnings to protect children's hearing. However, studies attesting to the adverse effects of intrusive sounds and noise on children's overall mental and physical health and well-being have not received similar attention. This, despite the fact that many studies have demonstrated that intrusive noises such as those from passing road traffic, nearby rail systems, and overhead aircraft can adversely affect children's cardiovascular system, memory, language development, and learning acquisition. While some schools in the United States have received funds to abate intrusive aircraft noise, for example, many schools still expose children to noises from passing traffic and overhead aircraft. Discussion focuses on the harmful effects of noise on children, what has to be done to remedy the situation, and the need for action to lessen the impacts of noise from all sources. Furthermore, based on our knowledge of the harmful effects of noise on children's health and the growing body of

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[1] Excerpted from Case Nos.: 10-121/10-122 Erickson v. Director, Ministry of the Environment

Environmental Review Tribunal, Decision, p 207 “This case has successfully shown that the
debate should not be simplified to one about whether wind turbines can cause harm to humans. The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents. The debate has now evolved to one of degree.”

[2] Summary focuses on the evidence regarding risk to health: summaries from published literature 2010 to March
20
12

evidence to suggest the potential harmful effects of industrial wind turbine noise, it is strongly urged that further studies be conducted on the impacts of industrial wind turbines on their health, as well as the health of their parents, before forging ahead in siting industrial wind turbines.

Wind Turbine Noise
John P. Harrison
Bulletin of Science Technology & Society 2011 31: 256, DOI: 10.1177/0270467611412549,
http://bst.sagepub.com/content/31/4/256

Bio: Dr. John P. Harrison has expertise in the properties of matter at low temperatures with emphasis on high frequency sound waves (phonons). For the past 5 years he has studied wind turbine noise and its regulation. He has presented invited talks on the subject at 3 conferences, including the 2008 World Wind Energy Conference.

Abstra ct
Following an introduction to noise and noise regulation of wind turbines, the problem of adverse health effects of turbine noise is discussed. This is attributed to the characteristics of turbine noise and deficiencies in the regulation of this noise. Both onshore and offshore wind farms are discussed.

Editorial
Wind turbine noise
Christopher D Hanning and Alun Evans
British Medical Journal, BM J2 012;344d oi: 10.1136/ bmj.e1527 (8 March 2012)
www.bmj.com

BMJ

Bio: Christopher Hanning, BSc, MB, BS, MRCS, LRCP, FRCA, MD is an honorary consultant in sleep medicine Sleep Disorders Service, University Hospitals of Leicester, Leicester General Hospital, Leicester, UK
Dr Chris Hanning is Honorary Consultant in Sleep Disorders Medicine to the University Hospitals of Leicester NHS Trust, UK. He retired in September 2007 as Consultant in Sleep Disorders Medicine.

After initial training in anaesthesia, he developed an interest in Sleep Medicine. He founded and ran the Leicester Sleep Disorders Service, one of the longest standing and largest services in the UK. He was a founder member and President of the British Sleep Society

His expertise in this field has been accepted by the civil, criminal and family courts. He chairs the Advisory panel of the SOMNIA study, a major project investigating sleep quality in the elderly, and sits on Advisory panels for several companies with interests in sleep medicine.

Bio: Alun Evans, is an epidemiologist, Centre for Public Health, Queen's University of Belfast, Institute of Clinical Science B, Belfast, UK

Except from BMJ web site:

Seems to affect health adversely and an independent review of evidence is needed.

The evidence for adequate sleep as a prerequisite for human health, particularly child health, is overwhelming. Governments have recently paid much attention to the effects of environmental noise on sleep duration and quality, and to how to reduce such noise. However, governments have also imposed noise from industrial wind turbines on large swathes of peaceful countryside.

The impact of road, rail, and aircraft noise on sleep and daytime functioning (sleepiness and cognitive function) is well established. Shortly after wind turbines began to be erected close to housing, complaints emerged of adverse effects on health. Sleep disturbance was the main complaint. Such reports have been dismissed as being subjective and anecdotal, but experts contend that the quantity, consistency, and ubiquity of the complaints constitute epidemiological evidence of a strong link between wind turbine noise, ill health, and disruption of sleep.

The noise emitted by a typical onshore 2.5 MW wind turbine has two main components. A dynamo mounted on an 80 m tower is driven through a gear train by …

Literature Reviews on Wind Turbines and Health : Are They Enough?
Brett Horner, Roy D. Jeffery and Carmen M. E. Krogh
Bulletin of Science Technology & Society 2011 31: 399. DOI: 10.1177/0270467611421849
http://bst.sagepub.com/content/31/5/399

Bio: Brett Horner, BA, is a certified management accountant and has held senior manager positions in international business consulting groups. He has provided information technology consulting and accounting/auditing services to a wide variety of clientele. He has dedicated over 2 years reviewing and analyzing references on the subject of industrial wind turbines and reported health effects.

Bio: Roy D. Jeffery, MD, is a rural family physician and a clinical preceptor for the University of Ottawa and the Northern Ontario Medical Schools. He practices rural medicine with special interests regarding geriatric home care and rural health. He has the distinction of being awarded the Ontario Family Physician of the Year–Northern Division in 2008.

Bio: Carmen M. E. Krogh, BSc Pharm, is a retired pharmacist with more than 40 years of experience in health. She has held senior executive positions at a major teaching hospital, a professional association, and Health Canada. She was a former director of Publications and editor-in-chief of the Compendium of Pharmaceutical and Specialties, the book used in Canada by physicians, nurses, and other health professions for prescribing information on medication.

Abstract
Industrial wind turbines (IWTs) are a new source of community noise to which relatively few people have yet been exposed. IWTs are being erected at a rapid pace in proximity to human habitation. Some people report experiencing adverse health effects as a result of living in the environs of IWTs. In order to address public concerns and assess the plausibility of reported adverse health effects, a number of literature reviews have been commissioned by various organizations. This article explores some of the recent literature reviews on IWTs and adverse health effects. It considers the completeness, accuracy, and objectivity of their contents and conclusions. While some of the literature reviews provide a balanced assessment and draw reasonable scientific conclusions, others should not be relied on to make informed decisions. The article concludes that human health research is required to develop authoritative guidelines for the siting of IWTs in order to protect the health and welfare of exposed individuals.

Wind Turbines Make Waves:
Why Some Residents Near Wind Turbines Become Ill
Magda Havas and David Colling
Bulletin of Science Technology & Society 2011 31: 414. DOI: 0.1177/0270467611417852
http://bst.sagepub.com/content/31/5/369

Bio: Magda Havas, PhD, is an associate professor at Trent University where she teaches and conducts research on the biological and health effects of electromagnetic and chemical pollutants. She received her BSc and PhD at the University of Toronto and did postdoctoral research at Cornell University on acid rain and aluminum toxicity.

Bio: David Colling has applied his electrical engineering studies at Ryerson Polytechnical Institute and his specialized training in electrical pollution to conduct electrical pollution testing for Bio-Ag on farms, homes, and office buildings. Some of the homes tested are located in the environs of industrial wind turbines.

Abstract
People who live near wind turbines complain of symptoms that include some combination of the following: difficulty sleeping, fatigue, depression, irritability, aggressiveness, cognitive dysfunction, chest pain/pressure, headaches, joint pain, skin irritations, nausea, dizziness, tinnitus, and stress. These symptoms have been attributed to the pressure (sound) waves that wind turbines generate in the form of noise and infrasound. However, wind turbines also generate electromagnetic waves in the form of poor power quality (dirty electricity) and ground current, and these can adversely affect those who are electrically hypersensitive. Indeed, the symptoms mentioned above are consistent with electrohypersensitivity. Sensitivity to both sound and electromagnetic waves differs among individuals and may explain why not everyone in the same home experiences similar effects. Ways to mitigate the adverse health effects of wind turbines are presented.

Industrial Wind Turbine Development and Loss of Social Justice?
Carmen M.E. Krogh
Bulletin of Science Technology & Society 2011 31: 321, DOI: 10.1177/0270467611412550,
http://bst.sagepub.com/content/31/4/321

Bio: Carmen M. E. Krogh, BScPharm is a retired pharmacist with more than 40 years of experience in health. She has held senior executive positions at a major teaching hospital, a professional association and Health Canada. She was a former Director of Publications and Editor-in-chief of *the Compendium of Pharmaceutical and Specialties (CPS)*, the book used in Canada by physicians, nurses and other health professions for prescribing information on medication.

Abstract
This article explores the loss of social justice reported by individuals living in the environs of industrial wind turbines (IWTs). References indicate that some individuals residing in proximity to IWT facilities experience adverse health effects. These adverse health effects

are severe enough that some families have abandoned their homes. Individuals report they welcomed IWTs into their community and the negative consequences were unexpected. Expressions of grief are exacerbated by the emotional and physical toll of individuals' symptoms, loss of enjoyment of homes and property, disturbed living conditions, financial loss, and the lack of society's recognition of their situation. The author has investigated the reported loss of social justice through a review of literature, personal interviews with, and communications from, those reporting adverse health effects. The author's intention is to create awareness that loss of social justice is being associated with IWT development. This loss of justice arises from a number of factors, including the lack of fair process, the loss of rights, and associated disempowerment. These societal themes require further investigation. Research by health professionals and social scientists is urgently needed to address the health and social impacts of IWTs operating near family homes.

WindVOiCe , a Self-Reporting Survey: Adverse Health Effects, Industrial Wind Turbines, and the Need for Vigilance Monitoring
Carmen M.E. Krogh, Lorrie Gillis, Nicholas Kouwen, and Jeffery Aramini

Bulletin of Science Technology & Society 2011 31: 334, DOI: 10.1177/0270467611412551,
http://bst.sagepub.com/content/31/4/334

Bio: Carmen M. E. Krogh, BScPharm is a retired pharmacist with more than 40 years of experience in health. She has held senior executive positions at a major teaching hospital, a professional association and Health Canada. She was a former Director of Publications and Editor-in-chief of the *Compendium of Pharmaceutical and Specialties (CPS)*, the book used in Canada by physicians, nurses and other health professions for prescribing information on medication.

Bio: Ms Lorrie Gillis is the process administrator for the WindVOiCe health survey. Ms Gillis volunteers her time and ensures the processes for administering the protocols are maintained.

Bio: Dr. Nicholas Kouwen is a Distinguished Professor Emeritus in the Department of Civil and Environmental Engineering of the University of Waterloo, Waterloo, Ontario, Canada. He is a registered Professional Engineer (Ontario) and a Fellow of the American Society of Civil Engineers. His field of expertise is in hydraulic and hydrological modelling and is currently involved in studies dealing with the impact of climate change on water availability.

Bio: Dr. Jeff Aramini is a public health epidemiologist with expertise in the investigation of health concerns using epidemiological principles. DVM and M.Sc. from the University of

Saskatchewan; Ph.D. from the University of Guelph. Former senior epidemiologist with Health Canada/Public Health Agency of Canada. Currently, President and CEO of an organization that addresses public health, patient care, public safety and information management for clients in government, industry and academia.

Abstract
Industrial wind turbines have been operating in many parts of the globe. Anecdotal reports of perceived adverse health effects relating to industrial wind turbines have been published in the media and on the Internet. Based on these reports, indications were that some residents perceived they were experiencing adverse health effects. The purpose of the WindVOiCe health survey was to provide vigilance monitoring for those wishing to report their perceived adverse health effects. This article discusses the results of a self reporting health survey regarding perceived adverse health effects associated with industrial wind turbines.

Low-frequency noise from large wind turbines

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[DOI: 10.1121/1.3543957] J. Acoust. Soc. Am. 129 (6), June 2011 PACS number(s): 43.50.Rq, 43.28.Hr, 43.50.Cb, 43.50.Sr [ADP] Pages: 3727–3744

Abstract
As wind turbines get larger, worries have emerged that the turbine noise would move down in frequency and that the low-frequency noise would cause annoyance for the neighbors. The noise emission from 48 wind turbines with nominal electric power up to 3.6 MW is analyzed and discussed. The relative amount of low-frequency noise is higher for large turbines (2.3–3.6 MW) than for small turbines (≤2 MW), and the difference is statistically significant. The difference can also be expressed as a downward shift of the spectrum of approximately one-third of an octave. A further shift of similar size is suggested for future turbines in the 10-MW range. Due to the air absorption, the higher low-frequency content becomes even more pronounced, when sound pressure levels in relevant neighbor distances are considered. Even when A-weighted levels are considered, a substantial part of the noise is at low frequencies, and for several of the investigated large turbines, the one-third-octave band with the highest level is at or below 250 Hz. It is thus beyond any doubt that the low-frequency part of the spectrum plays an important role in the noise at the neighbors.

Toward a Case Definition of Adverse Health Effects in the Environs of Industrial Wind Turbines: Facilitating a Clinical Diagnosis

Robert Y. McMurtry

Bulletin of Science Technology & Society 2011 31: 316, DOI: 10.1177/0270467611415075,
http://bst.sagepub.com/content/31/4/316

Bio: Dr. Robert Y. McMurtry is the former Dean of Medicine for the University of Western Ontario. He was a member of the Health Council of Canada for 3½ years and a member and special advisor to the Royal Commission under Roy Romanow on the future of health care in Canada. Dr. McMurtry was a visiting Cameron Chair to Health Canada for providing policy advice to the Minister and Deputy Minister of Health. He was the Founding and Associate Deputy Minister of Population & Public Health, Canada. Dr. McMurtry also sat on the National Steering Committee on Climate Change and Health Assessment. Presently Dr. McMurtry is Professor (Emeritus) of Surgery, University of Western Ontario.

Abstract

Internationally, there are reports of adverse health effects (AHE) in the environs of industrial wind turbines (IWT). There was multidisciplinary confirmation of the key characteristics of the AHE at the first international symposium on AHE/IWT. The symptoms being reported are consistent internationally and are characterized by crossover findings or a predictable appearance of signs and symptoms present with exposure to IWT sound energy and amelioration when the exposure ceases. There is also a revealed preference of victims to seek restoration away from their homes. This article identifies the need to create a case definition to establish a clinical diagnosis. A case definition is proposed that identifies the sine qua non diagnostic criteria for a diagnosis of adverse health effects in the environs of industrial wind turbines. Possible, probable, and confirmed diagnoses are detailed. The goal is to foster the adoption of a common case definition that will facilitate future research efforts.

Properly Interpreting the Epidemiologic Evidence About the Health Effects of Industrial Wind Turbines on Nearby Residents

Carl V. Phillips

Bulletin of Science Technology & Society 2011 31: 303, DOI: 10.1177/0270467611412554,
http://bst.sagepub.com/content/31/4/303

Bio: Dr. Carl V. Phillips is a consultant and author specializing in epidemiology, science-based policy making, and communicating scientific concepts to the public. He spent most of his career as a professor of public health and now works in litigation support, scientific advising, and grant-supported research. He blogs at ep-ology.blogspot.com, which provides links to his other writings.

Abstra ct
There is overwhelming evidence that wind turbines cause serious health problems in nearby residents, usually stress-disorder type diseases, at a nontrivial rate. The bulk of the evidence takes the form of thousands of adverse event reports. There is also a small amount of systematically gathered data. The adverse event reports provide compelling evidence of the seriousness of the problems and of causation in this case because of their volume, the ease of observing exposure and outcome incidence, and case-crossover data. Proponents of turbines have sought to deny these problems by making a collection of contradictory claims including that the evidence does not "count," the outcomes are not "real" diseases, the outcomes are the victims' own fault, and that acoustical models cannot explain why there are health problems so the problems must not exist. These claims appeared to have swayed many nonexpert observers, though they are easily debunked. Moreover, though the failure of models to explain the observed problems does not deny the problems, it does mean that we do not know what, other than kilometers of distance, could sufficiently mitigate the effects. There has been no policy analysis that justifies imposing these effects on local residents. The attempts to deny the evidence cannot be seen as honest scientific disagreement and represent either gross incompetence or intentional bias.

Occupational Health and Industrial Wind Turbines: A Case Study
Robert W. Rand, Stephen E. Ambrose, and Carmen M. E. Krogh
Bulletin of Science Technology & Society 2011 31: 359DOI: 10.1177/0270467611417849
http://bst.sagepub.com/content/31/5/359

Bio: Robert W. Rand is a principal author with over 30 years of experience in industrial noise control, environmental sound, and general acoustics. A member of the Institute of Noise Control Engineering since 1993, he runs a small business providing consulting, investigator, and design services in acoustics.

Bio: Stephen E. Ambrose is a principal author with over 35 years of experience in industrial noise control. A member of the Institute of Noise Control Engineering since 1978, he runs a small business providing cost-effective environmental noise consulting services for industrial and commercial businesses, municipal and state governments, and private citizens.

Bio: Carmen M. E. Krogh, BScPharm, who provided health-related research and reference support, is a retired pharmacist with more than 40 years of experience in health. She has held senior executive positions at a major teaching hospital, a professional association, and Health Canada. She was a former Director of Publications and Editor in Chief of the *Compendium of Pharmaceutical and Specialties (CPS)*, the book used in Canada by physicians, nurses, and other health professions for prescribing information on medication.

Abstract
Industrial wind turbines (IWTs) are being installed at a fast pace globally. Researchers, medical practitioners, and media have reported adverse health effects resulting from living in the environs of IWTs. While there have been some anecdotal reports from technicians and other workers who work in the environs of IWTs, little is known about the occupational health sector. The purpose of this case study is to raise awareness about the potential for adverse health effects occurring among workers. The authors propose that there is a need for research regarding occupational worker exposure relating to IWTs.

Responses of the ear to low frequency sounds, infrasound and wind turbines.

Alec N. Salt and T.E. Hullar.
Department of Otolaryngology,
Washington University School of Medicine, St. Louis, MO, 63110, USA.

Hearing Research 2010 Sep 1; 268(1-2):12-21. Epub 2010 Jun 16

Abstract
Infrasonic sounds are generated internally in the body (by respiration, heartbeat, coughing, etc) and by external sources, such as air conditioning systems, inside vehicles, some industrial processes and, now becoming increasingly prevalent, wind turbines. It is widely assumed that infrasound presented at an amplitude below what is audible has no influence on the ear. In this review, we consider possible ways that low frequency sounds, at levels that may or may not be heard, could influence the function of the ear. The inner ear has elaborate mechanisms to attenuate low frequency sound components before they are transmitted to the brain. The auditory portion of the ear, the cochlea, has two types of sensory cells, inner hair cells (IHC) and outer hair cells (OHC), of which the IHC are coupled to the afferent fibers that transmit "hearing" to the brain. The sensory stereocilia ("hairs") on the IHC are "fluid coupled" to mechanical stimuli, so their responses depend on stimulus velocity and their sensitivity decreases as sound frequency is lowered. In contrast, the OHC are directly coupled to mechanical stimuli, so their input remains greater than for IHC at low frequencies. At very low frequencies the OHC are stimulated by sounds at levels below those that are

heard. Although the hair cells in other sensory structures such as the saccule may be tuned to infrasonic frequencies, auditory stimulus coupling to these structures is inefficient so that they are unlikely to be influenced by airborne infrasound. Structures that are involved in endolymph volume regulation are also known to be influenced by infrasound, but their sensitivity is also thought to be low. There are, however, abnormal states in which the ear becomes hypersensitive to infrasound. In most cases, the inner ear's responses to infrasound can be considered normal, but they could be associated with unfamiliar sensations or subtle changes in physiology. This raises the possibility that exposure to the infrasound component of wind turbine noise could influence the physiology of the ear.

Infrasound From Wind Turbines Could Affect Humans
Alec N. Salt and James A.KaltenbachInfrasound
Bulletin of Science Technology & Society 2011 31: 296, DOI: 10.1177/0270467611412555,
http://bst.sagepub.com/content/31/4/296

Bio: Alec N. Salt received his PhD from the University of Birmingham, UK, in 1977 and has been actively involved in research into the physiology of the ear for over 35 years.

Bio: James A. Kaltenbach received his PhD from the University of Pennsylvania in 1984. He specializes in the neurobiology of hearing disorders and is currently the Director of Otology Research at the Cleveland Clinic.

Abstra ct
Wind turbines generate low-frequency sounds that affect the ear. The ear is superficially similar to a microphone, converting mechanical sound waves into electrical signals, but does this by complex physiologic processes. Serious misconceptions about low-frequency sound and the ear have resulted from a failure to consider in detail how the ear works. Although the cells that provide hearing are insensitive to infrasound, other sensory cells in the ear are much more sensitive, which can be demonstrated by electrical recordings. Responses to infrasound reach the brain through pathways that do not involve conscious hearing but instead may produce sensations of fullness, pressure or tinnitus, or have no sensation. Activation of subconscious pathways by infrasound could disturb sleep. Based on our current knowledge of how the ear works, it is quite possible that low-frequency sounds at the levels generated by wind turbines could affect those living nearby.

Public Health Ethics, Legitimacy, and the Challenges of Industrial Wind Turbines: The Case of Ontario, Canada

Martin Shain

Bulletin of Science Technology & Society, 2011 31: 256, DOI: 10.1177/0270467611412552,
http://bst.sagepub.com/content/31/4/346

Bio: Martin Shain S.J.D. is trained in law and social sciences. He is principal and founder of the Neighbour at Work Centre® and assistant professor at the Dalla Lana School of Public Health, Occupational and Environmental Health Division, University of Toronto.

Abstract

While industrial wind turbines (IWTs) clearly raise issues concerning threats to the health of a few in contrast to claimed health benefits to many, the trade-off has not been fully considered in a public health framework. This article reviews public health ethics justifications for the licensing and installation of IWTs. It concludes that the current methods used by government to evaluate licensing applications for IWTs do not meet most public health ethical criteria. Furthermore, these methods are contrary to widely held fundamental principles of administrative law and governmental legitimacy. A set of decision-making principles are suggested to address this situation that are derived from existing and emerging legal principles in Canada and elsewhere. These include the Precautionary Principle, the Least Impactful Means (Proportionality) Test, and the Neighbor Principle.

Mitigating the Acoustic Impacts of Modern Technologies: Acoustic, Health, and Psychosocial Factors Informing Wind Farm Placement

Daniel Shepherd and Rex Billington

Bulletin of Science Technology & Society 2011 31: 389, DOI: 10.1177/0270467611417841
http://bst.sagepub.com/content/31/5/389

Bio: Daniel Shepherd has a PhD in psychoacoustics and holds a lectureship at the Faculty of Health, AUT University. As an environmental psychologist, he researches the psychological response to noise from both individual and social perspectives.

Bio: Dr. Rex Billington is a research health psychologist at AUT University after 18 years with the World Health Organization including directorships in Mental Health and the Global Program on AIDS.

Abstract
Wind turbine noise is annoying and has been linked to increased levels of psychological distress, stress, difficulty falling asleep and sleep interruption. For these reasons, there is a need for competently designed noise standards to safeguard community health and well-being. The authors identify key considerations for the development of wind turbine noise standards, which emphasize a more social and humanistic approach to the assessment of new energy technologies in society.

Evaluating the impact of wind turbine noise on health related quality of life by
Daniel Shepherd, David McBride, David Welch, Kim N. Dirks, Erin M. Hill
Noise & Health, September-October 2011, 13:54,333-9, DOI:
10.4103/1463-1741.85502
www.noiseandhealth.org

Abstract
We report a cross-sectional study comparing the health-related quality of life (HRQOL) of individuals residing in the proximity of a wind farm to those residing in a demographically matched area sufficiently displaced from wind turbines. The study employed a nonequivalent comparison group posttest-only design. Self-administered questionnaires, which included the brief version of the World Health Organization quality of life scale, were delivered to residents in two adjacent areas in semirural New Zealand. Participants were also asked to identify annoying noises, indicate their degree of noise sensitivity, and rate amenity. Statistically significant differences were noted in some HRQOL domain scores, with residents living within 2 km of a turbine installation reporting lower overall quality of life, physical quality of life, and environmental quality of life. Those exposed to turbine noise also reported significantly lower sleep quality, and rated their environment as less restful. Our data suggest that wind farm noise can negatively impact facets of HRQOL.

Acknowledgements: We are grateful to our colleagues and others whose reviews substantially improved the manuscript. We are especially grateful for the thorough review undertaken by Professor Rex Billington, who as the WHO Director of Mental Health in the 1990s oversaw the development of the WHO's program into quality of life, health and the environment.

The Problems With "Noise Numbers" for Wind Farm Noise Assessment

Bob Thorne

Bulletin of Science Technology & Society 2011 31: 262, DOI: 10.1177/0270467611412557, http://bst.sagepub.com/content/31/4/262

Bio: Bob Thorne, MSc, PhD, is the principal consultant of Noise Measurement Services Pty Ltd, Brisbane, Australia. He holds a PhD from Massey University, New Zealand, in health science and is an environmental health research associate in the Institute of Food, Nutrition and Human Health at Massey University. His research work involves using advanced specialized technology for intrusive noise assessment, and a specific application is personalized sound reinforcement for hearing assistive devices.

Abstract

Human perception responds primarily to sound character rather than sound level. Wind farms are unique sound sources and exhibit special audible and inaudible characteristics that can be described as modulating sound or as a tonal complex. Wind farm compliance measures based on a specified noise number alone will fail to address problems with noise nuisance. The character of wind farm sound, noise emissions from wind farms, noise prediction at residences, and systemic failures in assessment processes are examined. Human perception of wind farm sound is compared with noise assessment measures and complaint histories. The adverse effects on health of persons susceptible to noise from wind farms are examined and a hypothesis, the concept of heightened noise zones (pressure variations), as a marker for cause and effect is advanced. A sound level of LAeq 32 dB outside a residence and above an individual's threshold of hearing inside the home are identified as markers for serious adverse health effects affecting susceptible individuals. The article is referenced to the author's research, measurements, and observations at different wind farms in New Zealand and Victoria, Australia.

RESPONSE TO NSW PLANNING DEPARTMENT

DRAFT GUIDELINES

FOR WIND DEVELOPMENTS

SUBMITTED MARCH 14, 2012

DR SARAH LAURIE Bachelor of Medicine, Bachelor of Surgery
FLINDERS UNIVERSITY, 1995

CHIEF EXECUTIVE OFFICER

SUMMARY OF KEY ISSUES

On the basis of current limited knowledge, these proposed draft guidelines will inevitably result in serious and predictable harm, to the health of current and future rural residents in New South Wales, from the harmful effects of sound and vibration energy generated by industrial wind turbines.

The New South Wales Department of Health's refusal to acknowledge the existence of an emerging serious global public health problem with exposure to operating wind turbines, is a gross dereliction of their responsibilities to protect the health of rural citizens who will inevitably be adversely impacted by these developments.

Rural residents are already significantly disadvantaged with respect to decreased access to health care and related services, and suffer a greater illness burden as a result. The additional burden of ill health, which these turbines will directly cause rural citizens, is entirely preventable, if wind turbines are located appropriately. This is clearly a planning issue.

To proceed with the proposed setbacks outlined in the draft guidelines is deliberately ignoring the warnings of a growing number of clinicians and acousticians internationally,[1] based on limited but compelling empirical data and adverse event reports, from both residents and their treating doctors. Acousticians such as Professor Phillip Dickinson, from New Zealand, who is well aware of the problems experienced there, has suggested that a 5---10km setback[2] would prevent many of the problems, concurring with our advice.

Urgent independent collaborative multidisciplinary acoustics and clinical research is required to investigate the problems, in order to determine what a safe turbine setback distance is, given a multitude of different variables. The planning requirements need to take into account the "worst case" scenarios for noise impacts, because this is what people will be living with.

The effects of audible and inaudible sound and vibration energy are resulting in frequent sleep disturbance for residents up to 10km away[3] from thirty seven 3MW turbines in South Australia at TRU energy's Waterloo Wind Development. As 3MW turbines and larger are planned for multiple sites in NSW, it is inevitable that these adverse effects will be felt out to this distance and beyond. In France, at 4,000 feet above sea level, there are credible reports of people characteristically affected at distances of 12 km --- 14 km away[4] as the crow flies, from six 2MW turbines. This is of major concern, and highlights the knowledge vacuum we are operating in, and the need for urgent clinical and acoustic data collection globally.

There is a complete lack of knowledge nationally and internationally about the actual dose of sound energy at different frequencies being experienced by people inside their homes and workplaces, and no knowledge of what constitutes a "safe" dose with cumulative exposure. Consistently, people's health relentlessly deteriorates with ongoing exposure, if they are affected.

Siting turbines too close to institutions such as schools, jails, hospitals and nursing homes, with vulnerable and powerless groups, will result in serious harm to those living, and working in those establishments. This will be the inevitable outcome from many of the currently planned and unsafely sited wind developments in NSW, particularly those with larger turbines, placed on hills.

Rural residents in New South Wales are currently being damaged by the sound and vibration pollution emissions from existing wind developments at Capital, Woodlawn, Crookwell, and Cullerin.[5] NSW Department of Health deny the problem exists, because there is "insufficient credible peer reviewed published evidence" but refuse to investigate the reports of serious health problems occurring in rural residents for themselves, apart from one or two phone calls which have not resulted in follow up, according to the residents.[6]

Nor has there been any proper independent and comprehensive acoustic assessment of the full range of acoustic pollution to which residents are exposed, inside their homes, and in their workplaces, despite numerous complaints being made. Preliminary acoustic data of this type collected by an independent acoustician at residences impacted adversely by Infigen's Capital and Woodlawn Wind Developments and funded by concerned rural residents suggests that there are indeed problems relating to the infrasound and low frequency sound energy measured inside resident's homes where those residents are becoming ill. [7]

The current NSW audit of wind turbine noise does not include full spectrum noise assessments, nor does it include inside home measurements. This is ignoring the precise frequencies and locations (inside homes and workplaces) which we suspect are doing the most damage to health.

There may well be additional health effects from Electromagnetic field effects for some residents, in some locations, which similarly remain uninvestigated.[8]

These serious health problems are entirely preventable, by adopting a truly precautionary approach, based on existing relevant information including field observations, until more definitive independent multidisciplinary acoustic and medical longditudinal research is conducted. This is precisely what the Waubra

Foundation's Explicit Cautionary notice[9] suggested, in **June 2011**, and it was based on the best field observations and limited research literature available at that time. Subsequent information is revealing that even this distance may be inadequate to protect the health of surrounding neighbours in some locations.[10]

Two research proposals by suitably qualified and experienced independent acousticians, Dr Bob Thorne and Professor Colin Hansen, were first suggested to the NSW government Health Department representatives at an En Health meeting in **November 2010**. Subsequent proposals have been submitted directly to the NSW government by Acoustics researchers since that time.

Research was also recommended by the Australian Federal Senate inquiry into Rural Wind Farms in **June, 2011**.[11]

In the meantime, the suggestion by the NHMRC to "adopt a precautionary approach"[12] is being ignored by developers and bureaucrats from planning and health departments alike. The justification given is that "there is no evidence" or "there is no credible peer reviewed published scientific evidence".

Yet people's health is being seriously damaged, and has been for years in Europe, the UK, North America, New Zealand, and in Australia. The voices of the sick residents, their clinicians, and their advocates, have been universally ignored by these bureaucrats, and the politicians they advise.

This lack of relevant research, despite the longstanding reported problems, is a global public health disgrace. So are the attempts of the wind industry to deny the problems, despite being well aware of them, as the letter from the Vestas CEO to the then Minister for the Environment in Denmark shows. Clearly corporate profits are being put ahead of the health of rural residents, the world over.[13]

THEREFORE: to proceed with these inadequate guidelines, and without investigation into the current problems at existing developments, is reckless and irresponsible in the extreme.

What is urgently needed is:

1. Full sound spectrum acoustic monitoring at all the homes of impacted residents in New South Wales, by acousticians who do not rely on the wind developers for their income, including inside and outside measurements concurrently. Data required by the acousticians from the developers to properly determine their results must be handed over.

2. Thorough clinical assessment of impacted residents, paying particular attention to the commonly reported health problems experienced by residents elsewhere.

3. Concurrent sleep and acoustic studies at the homes of people reporting regularly disturbed sleep, to assist with determining the cause of their sleep disturbance.

4. Other broader epidemiological studies will be dependent on available funding, but as a minimum there should be an assessment which includes the population within 10km of existing developments, and suitable controls not exposed to low frequency noise for comparison. There must also be longditudinal data collected, as it is widely observed that symptoms deteriorate over time, with increasing exposure.

Relevant Excerpts from the proposed DRAFT Guidelines are reproduced below:

Page 7:

(e) Health
The approach to health issues in these guidelines have been developed in consultation with the NSW Ministry of Health. The guidelines adopt a precautionary approach for the consideration of health issues. This includes requiring proponents to explicitly consider health issues as well as comply with stringent operational performance criteria including stringent noise criteria. Applications may also be referred to the Ministry of Health as part of the assessment process.

AND page 21 of Appendix A

Health issues
The potential for the proposed wind farm to impact on human health should be considered, focusing on neighbours' houses within 2 km of any proposed wind turbine. This may be undertaken with reference to the following:
_ up to date evidence---based research
_ statements from relevant health bodies, such as the National Health and Medical Research
Council's (2010) Public Statement: Wind Turbines and Health.
_ the predicted level of impact from the wind farms including impacts from noise, shadow flicker, blade glint, night lighting, electric and magnetic fields

_ *consultation undertaken regarding health issues and concerns*
The Department of Planning and Infrastructure may refer applications to the NSW Department of Health (NSW Health) as part of the assessment.

As the following discussion makes clear, these draft guidelines have clearly not adopted an adequate precautionary approach, nor are they informed by the latest evidence and information.

International knowledge in this field is rapidly increasing, and waiting for the National Health and Medical Research Council (NHMRC) to issue updated statements inevitably means the information is not the most recent and up to date, if that is all that is relied on.

At the time the proposed NSW guidelines were issued, the NHMRC had not issued their report of the June 2011 workshop, which they released in early January. [14] The NHMRC have reported that they are in the process of constructing a panel of suitably qualified and experienced experts, and are in the process of updating the original Rapid Review with a subsequent literature review. It is hoped that this subsequent review will include material omitted in that initial Rapid Review of July 2010, as well as relevant information and peer reviewed research, which has been subsequently published.

In the meantime, the Australian Research Council have awarded Professor Colin Hansen's team from Adelaide University a grant to investigate wind turbine noise at existing developments. Information about the true sound energy exposure levels at different frequencies, which residents are living with, and are being so adversely impacted by, will be of international relevance.

Given the current well known attitude of the NSW Health department to this issue, I see little benefit from the proposed guidelines suggesting that it would be useful to refer projects to the NSW Department of Health, unless there is a serious change in attitude by departmental employees, or a change of staff.

Finally, the noise guidelines can be the "toughest in the world" ,but if they do not mandate measuring the very sound energy which is thought to be making people sick, inside their homes, and if they do not mandate independent ongoing noise monitoring and ensure that the relevant work is done by independent acousticians who are approved by the affected residents and who have sufficient expertise and the right equipment, the guidelines are of absolutely no practical use or protection for the residents.

Transparent continuous full spectrum noise monitoring, available on line for the whole world to see, and properly recorded so that the data can be analysed properly, would go some way towards restoring faith in the existing wind turbine noise compliance systems and procedures, which are currently considered to be completely useless (and too open to manipulation by wind developers) by the residents who have to live with the effects of this audible and inaudible sound energy pollution.

WHAT IS CURRENTLY KNOWN, and WHO has KNOWN WHAT WHEN?

A significant recent development in conceptual understanding

Wind turbines emit infrasound (0---20Hz), low frequency sound (20---200Hz) and audible sound. Many sound frequencies can cause damage to health if they are at a high enough sound pressure level, for a long enough time, particularly in susceptible individuals. Protection of the health of individuals and of manmade structures is the rationale for much of the work of acousticians.

The recent pioneering acoustic survey by Rand & Ambrose[15] in a house in Falmouth, USA has measured exactly what acoustic energy is being experienced **inside** one home where the resident has become seriously unwell with the characteristic symptoms now reported widely around the world, which have been called "wind turbine syndrome". Just one turbine has been enough to do the damage to this resident's health.

The sound energy inside this home had markedly different proportions to the sound energy outside the home, and it is this change in proportion of sound energy, and the amplification of that sound energy inside the home, which acousticians and medical clinicians think may help explain the problems now being consistently reported by some turbine neighbours including hosts and their families.

Some hosts and former residents living near wind turbines in Australia have advised myself and others that they cannot speak publicly about the health problems they and their families have developed, because of binding confidentiality clauses in their sale contracts if they were bought out by the developers,[16] or because of broad clauses which prohibit them as turbine hosts from saying anything which might portray the wind development in a negative light. I have also been advised of these clauses by some of the lawyers these people have consulted, who have confirmed the existence of these clauses. I

have also been told by international researchers and residents this practice is global.

This data from Falmouth is the only publicly available data anywhere in the world on the precise exposures of sound energy including infrasound and low frequency INSIDE the home of an affected resident. This sort of acoustic assessment is clearly urgently needed at the homes of impacted people, in order to determine precisely what 'dose' of sound energy and which frequencies they are being exposed to and which correlate with their symptoms.

Unexpectedly for Rand and Ambrose, they too developed the characteristic symptoms, which correlated with wind turbine operation, and specifically correlated with the sound energy down in the lowest part of the frequency spectrum, ie the infrasound low frequency range (ILFN) of 0 – 200 Hz. This is clearly not an epidemiological study, but it is a crucial breakthrough in our understanding of what "dose" and frequencies of sound energy might be directly causing the problems, which so many people report.

Historical Background

Many frequencies of sound and vibration energy can cause serious illness if the sound pressure levels are high enough, exposure occurs for long enough, or occurs in specific frequencies. Acousticians have known for some time that infrasound and low frequency noise can directly cause many of these characteristic symptoms and health problems.

Abstracts of studies relating specifically to **infrasound** and its effects on animals and humans have been listed in a very useful Literature review[17] compiled in 2001 by researchers at the National Institute of Environmental Health Sciences, in the USA, and there are a few other studies in the public domain since this review was published.

Professor Geoffrey Leventhall and his colleagues wrote a very useful literature review of the effects of **low frequency noise** in a report for DEFRA[18] in the UK, in 2003, which lists many of the symptoms now being reported to occur in residents exposed to wind turbine noise. Professor Leventhall's article clearly demonstrates that **this knowledge is out in the public domain of acousticians, and has been for some time, and that the symptoms are directly caused by exposure to certain frequencies of sound energy**.

Indeed, Professor Leventhall publicly stated during his lecture at the National Health and Medical Research Council Workshop on 7th June, 2011 **that he had known about the symptoms of "wind turbine syndrome" for years**.[19] Indeed he has. Professor Leventhall has conducted research, which has directly confirmed the deleterious effects of exposure to low frequency noise on work performance published in a peer reviewed journal in 1997, for example. In that particular study, he noted that the symptoms worsen with cumulative exposure, just as we are observing with exposure to operating wind turbines.[20]

Historically, these health problems occurring in relation to low frequency noise exposure from any source have been referred to by Acousticians as "annoyance", and medical clinicians working in this area believe it is this terminology which has led to the current situation of widespread clinical ignorance of these issues amongst our colleagues, and a concurrent lack of collaborative multidisciplinary research involving both clinicians and acousticians, despite the problems being reported globally for many years.

Clinicians have simply not realized there is a problem with wind turbine noise, unless, like Dr Amanda Harry in Cornwall in 2003, or Dr David Iser in Toora, Victoria, Australia in 2004, they have suddenly been confronted with their longstanding patients developing an unfamiliar pattern of serious clinical illnesses, which had not previously been described in the English language medical literature which is most accessible to clinicians in Australia, for example.

The presentation of these illnesses in both those rural locations in the UK and in Australia over 8 years ago, coincided with the start up of a new wind development in the vicinity of their rural practices. Both doctors decided to investigate further, and reported their symptoms at the time to their respective health authorities, and were ignored.[21,22]

Every other medical practitioner since who has become aware of the problems by talking directly to affected residents, and publicized their concerns, has been consistently either ignored or vilified, often by the very Health Departments who themselves refuse to investigate the resident's complaints, because there is "no evidence" of a problem.

However, as Professor Warwick Anderson, current CEO of the National Health and Medical Research Council made abundantly clear in his oral evidence to the Australian Federal Senate Inquiry into Rural wind farms on 31st March, 2011, "**we do not say there are no ill effects**".[23] Professor Anderson and his staff are well aware that developers, bureaucrats, and ideological and financial

supporters of the wind industry have misused the summary statement of the Rapid Review to infer that wind turbines are completely safe.[24]

Professor Anderson went on to point out later on in his oral evidence that an absence of (peer reviewed published) evidence does not mean there is no problem, particularly where there has been so little research into this specific area of wind turbine noise and its effect on health.[25]

It is hardly surprising that there are endless literature reviews saying there is "no" or "little" evidence of a problem in the peer reviewed literature, given the lack of research, but what is surprising is that not even the most basic of epidemiological studies has ever been done, which have involved medical clinicians as part of the team. Nor has there been any attempt to work out the actual acoustic energy exposures of people, especially inside their own homes. Consequently this practice of using "annoyance" to describe what are in fact "serious health problems" has perpetuated the collective medical ignorance of the problems.

There are larger acoustic population surveys from Europe which certainly confirm the existence of "annoyance" with respect to wind turbine noise, and one from 2004[26] which makes it clear that wind turbine noise is "highly annoying" at much lower sound pressure levels of audible noise than other forms of industrial noise such as road, rail and air traffic noise. It is now thought by acousticians who do not rely on the wind industry for their income that this difference in the "annoyance" in that study relates to the low frequency component of wind turbine noise, which is acknowledged to be more annoying.

As Acousticians are generally engineers, and not medical practitioners, they have not had the specific education and training to understand the complexity of the pathophysiological processes which might underlie these symptoms, and their progression over time. Nor do sociologists have the requisite specific clinical or acoustics education and professional training, even if they do become Professors of Public Health at prestigious universities.

This is the province of trained medical clinicians and researchers with backgrounds in varied fields of general practice, paediatrics, physiology, neurology, endocrinology, cardiology, otolaryngology, psychiatry and no doubt others, as our understanding of this essentially "new illness" to medicine is further explored. Until now, medical practitioners and researchers have been generally unaware of the health problems associated with sound and vibration

energy, unless they were practicing in occupational medicine, or specializing in treatment of disorders of the inner ear and vestibular system.

In 2009, an American Paediatrician, Dr Nina Pierpont, published her study[27] which investigated the range of symptoms of all the members of 10 families exposed to operating wind turbines, where some of the family members had developed the characteristic health problems. What Dr Pierpont sought to do was establish if there were some characteristics about these people who became affected within those households which made them more likely to develop the symptoms she called "wind turbine syndrome".

Dr Pierpont found that people who have a history of migraines, motion sickness and inner ear pathology seem to be more susceptible to the effects of the wind turbine noise. She also found that children and the elderly seem to be particularly vulnerable. She recommended urgent further research, including epidemiological studies, to further define the problem.

Why then, has Dr Nina Pierpont's work which investigated the susceptibilities of certain population groups to develop "wind turbine syndrome" been so widely dismissed by acousticians, such as Professor Leventhall, who admit that the symptoms exist, and occur with exposure to low frequency noise, which wind turbines are known to emit? And why has it also been dismissed by Public Health experts, who often do not appear to have read it, and who have not then done their own due diligence, either by investigating the complaints made by residents in their own regions, or by talking to the treating medical practitioners who are trying to look after them?

Acousticians and sociologists are not qualified to speak on the clinical aspects of Dr Pierpont's work. Her clinical findings have been replicated by work done in Ontario,[28] and have been confirmed by my own field observations gathered from affected residents and their treating doctors in Australia.[29] Similar resident reports are emerging from many countries which have installed wind turbines near homes, including many in Europe, the UK, and North America.

One of the hallmarks of credible research is if the findings can be replicated. Dr Pierpont's clinical descriptions and findings of susceptible populations have been subsequently reported by residents and sometimes their treating doctors, around the world.

There has been widespread misinformation spread by advocates of the wind industry, including some in positions of power and authority in public health circles, about Dr Pierpont's qualifications. Dr Pierpont is a trained and

practicing **Paediatrician**, a former assistant Clinical Professor at Columbia University, and has a PhD in ornithology.

Similarly there have been comments made about Dr Pierpont's work not being "peer reviewed". This is a lie. Dr Pierpont's work has been extensively peer reviewed, and copies of those peer reviews, and the executive summary of her book are attached, together with her study and the raw data. The fact that it has not been published in a medical journal does not mean the work is not credible, despite the assertions of some who might wish this to be so. PhD's are accepted as credible pieces of original work, and they are not published in peer reviewed journals, but as standalone documents, just as Dr Pierpont's study has been.

The importance of Sleep

Severely disturbed sleep is being reported by many residents, at current wind developments across Australia and internationally, out to distances of at least 10km in some circumstances, especially with larger turbines, or where the turbines are at higher altitudes.

The audible noise is certainly a problem for some people, however by far the majority report a characteristic pattern of waking suddenly in a panicked state, wide awake, hyperalert, sweaty palms, racing heart, with all the hallmarks of intense arousal of their sympathetic nervous system. They often report that they cannot hear the turbines at the time, inside their homes. Nor can they see them when they are asleep, as is commonly suggested as a reason for them waking by wind turbine proponents, who say residents are waking up because the residents "don't like the look of them". The residents report that this does not happen on nights when the wind turbines are not turning, and does not happen with certain weather and wind conditions. Nor does it happen when they are away from their homes. It can be repetitive, occurring on multiple occasions within the same night, and may occur night after night.

The Falmouth acoustics survey by Rand and Ambrose[30] has shown that this pattern appears to be caused directly by sound energy penetrating into the home in the lowest frequencies. What is now required is the concurrent acoustic and sleep studies, to further examine exactly what the brain waves are doing at the time of the acoustic stimulus and immediately afterwards.

The clinical history these people give is the same, all over the world. Many of these people do not have access to the internet, and nor do they report

knowing anything about the reported effects of the turbines on sleep and health. Many are initially supportive of wind energy, until they find that their health is severely damaged, and they cannot sleep. Then their attitudes change.[31]

There is now peer reviewed published research, which confirms that sleep disturbance is occurring in these populations, from a recent study conducted in New Zealand by Dr Daniel Shepherd.[32] Dr Shepherd is an experienced Psychoacoustician who has worked in this area for some years, provided expert evidence at a number of tribunals. More recently he provided independent expert evidence in the Ontario court case where the judges found on the basis of expert evidence presented in that case, that there ARE adverse health effects from wind turbines, and that further research is required.[33]

Severe chronic sleep deprivation is well known to have a multitude of serious adverse health sequelae,[34] including hypertension, atherosclerosis, immune suppression, mental health disorders, diabetes. It is therefore clear that if severe chronic sleep deprivation is occurring, as reported, and now confirmed by Dr Shepherd's work, that the clinical sequelae are clear, well known, and extremely damaging. The timely recent editorial in the British Medical Journal by two well respected Sleep Physicians[35] from the UK and Ireland illustrates the rationale for serious concern about this issue clearly.

Yet again, two experienced and eminent clinicians are calling for research.

The role of Cortisol

A number of clinicians have been concerned more recently about the role of cortisol in the pathophysiological processes which are being observed.

Professor Gary Wittert, the paid medical expert for Acciona in the Paltridge vs Acciona & District Council of Grant court case in the South Australian ERD court in January 2011 admitted during his evidence that the people described in the court material submitted by me were sick, and that they were stressed. On those points we concur.

Professor Wittert then went on to assert that in his opinion, despite never having listened to these sick residents himself, nor to their concerned treating medical practitioners, that these people were sick because of scaremongering by trained clinicians such as myself, who are publicizing the reported health problems, and urging authorities to immediately fund and facilitate properly conducted, independent research.

Unfortunately, Professor Wittert's assertions do not withstand careful scrutiny. People at Waubra, Cape Bridgewater, Toora, Capital, Cullerin, Waterloo and Mt Bryan in South Australia all have documented formal complaints to the wind developers, to health authorities, to their GP's, and in some instances in the media,[36] **well before I was even aware there was a problem**. I was first convinced there was a serious problem, which had been ignored for too long, in July 2010.

There is no doubt that there is anxiety in the communities where wind turbines are planned, and proposed, however these residents get their information from a variety of sources, and many of them go and do their own "homework" by contacting and visiting residents in other areas who are already living with wind turbines, in order to make up their own minds. They soon find that unfortunately what I have been publicizing is all too true. They then become anxious because of fear about what they know is coming, and know that neither the health nor the planning authorities will help them protect their own and their family's health and well being.

In addition to the stress and anxiety created by being abandoned by their governments, there is growing concern amongst clinicians globally about the role which chronic elevation of cortisol might be playing in the development of a range of chronic conditions, which are emerging in populations chronically exposed to operating wind turbines. Professor Robert McMurtry and Dr Noel Kerin have been exploring this avenue of investigation in Ontario.

There are human pathology results, limited but compelling, from the US and from Canada, which support this concern. Results such as abnormally high levels of night time salivary cortisol when exposed to operating turbines compared to normal levels when residents have not been exposed for a few weeks and are starting to feel better, are focusing our attention back to the limited animal studies which are in the public domain, particularly those reported in the NIEHS Toxicology of Infrasound Literature review from 2001. There are a couple of studies referenced in that review or in the articles themselves, which refer to both adrenaline and cortisol secretion occurring after exposure to infrasound.[37] The clinical descriptions of adrenaline related conditions such as Tako Tsubo Heart attacks and acute hypertensive crises which are occurring in residents exposed to infrasound and low frequency noise from wind turbines and from open cut coal mining activities in the Upper Hunter region of NSW (Tako Tsubo events) would appear to be highly relevant, especially given that the usual causes for these unusual conditions were reported to be absent, and no other reason could be found for their occurrence.

There are other studies in mammals, which clearly show that chronic exposure to infrasound can cause focal damage to various organs including the heart, liver, kidneys and adrenals.[38] One study identifies oxidative stress directly caused by exposure to infrasound as the pathological process causing focal organ damage, and found that rodents who were given a trial of antioxidants did not show the degree of damage seen with controls.

The knowledge from the Rand and Ambrose data at Falmouth that infrasound and low frequency noise energy exposure may be significantly higher inside homes than first thought is adding to that clinical concern.

Additionally, the wide range of pathology which is being reported by residents who have been chronically exposed, some of which Teresa Simonetti, a medical student from Sydney University has compiled with Professor Simon Chapman,[39] could well be explained by abnormally high cortisol levels which will adversely affect a myriad of different body systems and organs.

In 1998 Bruce McEwen, an Australian researcher working at the Rockerfeller Institute in New York, had a paper published in the New England Journal of Medicine, where he discussed the concept of allostatic load with chronic stress.[40]

Since that time, work in areas such as the neurobiology of depression has revealed the connections between elevated cortisol, brain derived neurotrophic factor and a shrinking hippocampus being implicated in depressive illnesses,[41] particularly in recurrent depression if clinical intervention is not rapid, timely, and effective.

Chronically elevated cortisol is extraordinarily damaging for long term health and well being, and this is exactly what appears to be happening to many residents who are chronically exposed to wind turbine noise.

In addition to humans, there are credible reports of domestic pets and livestock being diagnosed by veterinary or agricultural officials with mysterious wasting diseases consistent with chronic stress, or farmers are doing their own autopsies on dead livestock and finding haemorrhaging of the adrenal glands in newborn calves, for example.[42] These are all signals that further research into this specific area is urgently required.

CONCLUSIONS

- The proposed NSW Wind Farm Planning guidelines are completely inadequate to protect health, on the basis of existing limited knowledge
- Investigation into the noise pollution and adverse health problems at existing wind developments needs to be urgently and thoroughly carried out by acoustics and clinical professionals who are objective in their approach, and who are not either driven by ideology or influenced by wind developers
- Independent multidisciplinary acoustic and clinical research needs to be urgently conducted on a national basis at a variety of wind developments, in order to remedy the knowledge vacuum, to enable the safe siting of wind developments in future
- We continue to advocate for adoption of a truly precautionary approach to the siting of any new wind developments, and our current recommendations are that no wind turbine should be constructed within 10km of a home or a workplace until the appropriate independent research is conducted.
- We further advocate that exising wind developments must be retrofitted with continuous noise monitoring systems, which are available 24/7 online, available for all to see, and that wind turbines which breach the evidence based noise guidelines are switched off if they are breaching appropriate noise guidelines, which include the measurement of internal infrasound and low frequency noise.
- In the interim, residents at impacted houses must be able to engage acousticians of their choice, at the developer's expense, in order to independently measure the full sound and vibration energy they are exposed to, over representative periods of weather and wind conditions which correlate with the worst case scenario

ATTACHMENTS & INCLUSIONS

Waubra foundation DVD Link:
http://www.youtube.com/user/WaubraFoundation

Video citations

Recommendations from the Federal Senate Inquiry

Waubra Foundation Explicit Cautionary Notice

Waubra Foundation submission to the Federal Senate Inquiry

Dr Nina Pierpont's Executive Summary and Peer Reviews, as part of her submission to the Australian Federal Senate Inquiry

Dr Amanda Harry's Study

Professor Carl Phillips's article

Dr Daniel Shepherd's Study in Noise & Health, 2011

Dr Chris Hanning & Dr Alun Evans BMJ Editorial March 2012

Professor Phillip Dickinson's article

Barbara Frey and Peter Hadden's 2012 Review

Carmen Krogh and Brett Horner's update from Ontario

REFERENCES

1. Concerned acousticians, clinicians and researchers include

   Dr Malcolm Swinbanks (Acoustician),

   Dr Chris Hanning (Sleep Physician),

   Professor Henrik Moller (Danish Acoustician),

   Dr Mauri Johansson (Occupational Physician, Denmark),

   Dr Henning Theorell, (Physician, Sweden),

   Professor Alec Salt (Physiologist, Washington State University),

   Professor John Harrison, (Physicist, Queen's University),

Professor Robert McMurtry, (former Dean of the Medical & Dental School of Western Ontario),

Professor Arline Bronzaft (Psychologist & international expert on the effects of Noise on children),

Dr Amanda Harry, (UK Rural GP),

Dr David Iser, (Rural GP Victoria),

Dr Wayne Spring, (Ballarat Sleep physician),

Dr Andja Mitric---Andjic (Daylesford Rural

GP) Dr Alan Watts, (Carcoar, NSW Rural GP)

2. Dickinson, Professor Philip "A pragmatic view of a wind turbine noise standard" updated paper originally presented at Acoustics 2009 in Adelaide, South Australia http://www.wind---watch.org/documents/pragmatic---view---of---a---wind---turbine---noise--- standard/
3. Field observations from Waterloo Wind Development, also Moller & Pedersen "Low Frequency Noise from Large Turbines" J Acoustical Society America 2011 129: 3727 --- 3744
4. Personal communication, Hubert De Bonneville, http://www.windturbinesyndrome.com/2012/french---writer---going---nuts--- from---wind---turbines---france/
5. Field observations
6. Personal communication, Capital resident
7. Personal communication, Steven Cooper, Acoustician
8. Personal communication, Crookwell & Cape Bridgewater residents
9. Waubra Foundation Explicit Cautionary notice, downloadable from www.waubrafoundation.com.au
10. Hubert De Bonneville, op cit
11. Australian Federal Senate Inquiry recommendations http://www.aph.gov.au/Parliamentary_Business/Committees/Senate_Committees?url=clac_ctte/impact_rural_wind_farms/report/index.htm

12. NHMRC Public Statement is downloadable from http://www.nhmrc.gov.au/your---health/wind---farms---and---human---health

13. http://www.epaw.org/media.php?lang=en&article=pr6

14. Workshop report is downloadable from http://www.nhmrc.gov.au/your---health/wind---farms---and---human---health

15. Stephen Ambrose and Robert Rand "The Bruce McPherson Infrasound and Low Frequency Noise Study" Falmouth, December, 2011 http://www.wind---watch.org/documents/bruce---mcpherson---infrasound--- and---low---frequency---noise---study/

16. http://www.abc.net.au/news/video/2010/02/19/2825235.htm

17. NIEHS (National Institute of Environmental Health Sciences) November 2001, "Infrasound Brief Review of Toxicological Literature"

ntp.niehs.nih.gov/ntp/htdocs/Chem_Background/.../Infrasound.pdf

18. Leventhall, Benton & Pelmear May 2003, A report for DEFRA "A review of published Research on Low Frequency Noise and its Effects" http://archive.defra.gov.uk/environment/quality/noise/research/lowfrequency/

19. Professor Leventhall's presentation to the National Health and Medical Research Council of Australia's forum on 7th June, 2011 in Canberra http://www.nhmrc.gov.au/your---health/wind---farms---and---human---health

20. Perrson Waye K, Leventhall, G et al "Effects on performance and work quality due to low frequency ventilation noise" Jnl Sound & Vibration 1997 205 (4) 467---474

21. Harry, Dr Amanda "Wind turbines, Noise and Health" 2007 http://www.wind---watch.org/documents/wind---turbines---noise---and--- health/

22. Iser, Dr David, personal communication

23. See Professor Warwick Anderson's comments as CEO of the National Health and Medical Research Council in his Oral testimony to the Federal Senate Inquiry into Rural Wind Farms p 86 202.14.81.34/**hansard**/senate/commttee/S13730.pdf

24. Email from Heather Bishop, NHMRC to Mr Paul Manning

25. Professor Warwick Anderson, op cit

26. Van Den Berg, G et al Project WINDFARMperception. "Visual and Acoustic impact of wind turbine farms on residents" University of Groningen, 2008 and Pederson and Waye, Perception and Annoyance due to wind turbine noise – a dose---response relationship in J Acous. Soc. Am. 116 (6) 2004 pp 3460---70

27. Pierpont, Dr Nina "Wind Turbine Syndrome, A report on a Natural Experiment" Published by K Selected Books, Santa Fe NM 2009 Available from www.windturbinesyndrome.com

28. Work by members of the Society for Wind Vigilance in Ontario, especially Professor Robert McMurtry & Carmen Krogh, published in the special edition of the Bulletin of Science & Technology in August 2011 available from http://bst.sagepub.com/content/31/4/316

29. Laurie, Dr Sarah Medical Director, Waubra Foundation, reported in Submission to the Australian Federal Senate Inquiry into Rural wind Farms, February 2011, accessible via senate submissions or www.waubrafoundation.com

30. Rand & Ambrose op cit.

31. Field observations, and personal communication, Carmen Krogh, Society for wind Vigilance

32. Shepherd, Daniel et al "Evaluating the impact of wind turbine noise on health related quality of life" Noise & Health 2011 13: 333---339

33. "This case has successfully shown that the debate should not be simplified to one about whether wind turbines can cause harm to humans. The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents. The debate has now evolved to one of degree" p207 Environmental Review Tribunal, Case Nos 10---121/10---122 /Erickson v Director, Ministry of the Environment, dated 19th July, 2011 http://www.ert.gov.on.ca/english/decisions/index.htm

34. Capuccio F et al, "Sleep Duration predicts cardiovascular outcomes: a systemic review and meta---analysis of prospective studies" European Heart Journal, (2011) 32, 1484---1492

35. Hanning, C & Evans, A BMJ 2012: 344 e 1527

36. For example http://www.abc.net.au/news/video/2010/02/19/2825235.htm

37. NIEHS November 2001, Op. cit., especially pp 16---30
eg Nishimura K,1988 "The effects of infrasound on pituitary adrenocortical response and gastric microcirculation in rats" J Low Frequency Noise & Vibration 7(1):20---33

38. Dadali, VA et al "Effects of infrasound and protective effect of adaptogens" in experimental animals, Gig. Sanit. (1):40---43 (Russian) MEDLINE record 92406047 cited as reference no 58 in NIEHS November 2001, Op. cit. (abstract)

39. Links posted on Yes2renewables website

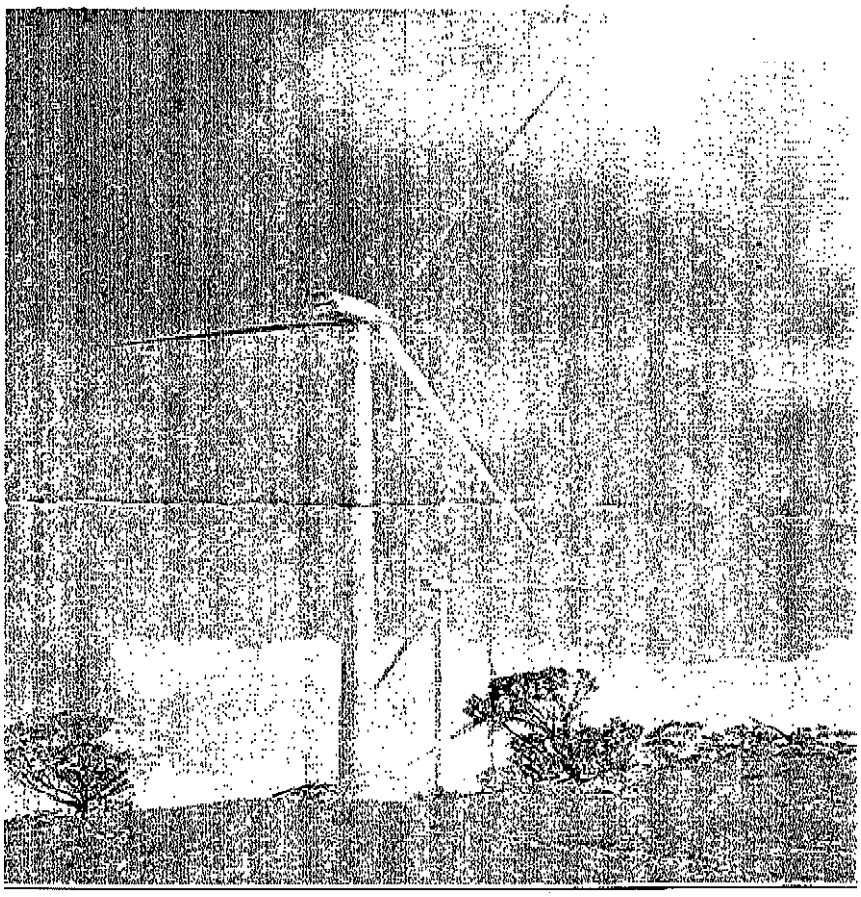
40. McEwen, Bruce "Protective and Damaging Effects of Stress Mediators" NEJM 1998, 338 171---179

41. Warner---Schmidt JL, Duman RS (2006). "Hippocampal neurogenesis: opposing effects of stress and antidepressant treatment". *Hippocampus* **16** (3): 239–49

42. Personal communication – Cape Bridgewater, Toora, and Cullerin Ranges. Animals involved included dogs, calves and goats. Also animals including dogs, cats, cattle & horses in Ontario, personal communication with residents in the Amaranth, Shelburne area in October 2010.

Evaluation of Wind Farm Noise Policies in South Australia

A case study of
Waterloo Wind Farm



By
ZHENHU AWANG
2011

1. lntroduction to the study

The government of South Australia issued two series of "Wind farms environmental noise guidelines" in 2003 and 2009, aiming to balance the advantage of wind energy development in South Australia with the protection of amenity of the surrounding c01mmmity from adverse noise impacts. These Guidelines for wind farms have in fact piayed regulatory roles in both the planning stage for wind project approval and the operation stage for noise management.

This briefing paper sums up a study undertaken during 2011 evaluating the efficiency and adequacy of these guidelines. The study examined two aspects: (1) the achievement and restrait1ts of the wind energy development; and (2) the situation relating to community amenity near the Waterloo Wind Fam1. The findings of this study are expected to help planning authorities and decision makers better devise the strategies for dealing with issues relating to wind farm noise.

This study was conducted as part of the completion of a Master's dissertation by, Zhenhua Wang who was studying in the Discipline of Geography, Environment and Population, University of Adelaide.

2. Overview of methods

Documentary analysis method was used to exan ine the achievement and restraints of the wind energy development in South Australia. Key paramete1·s such as annual growth. rat of win<,l_p9wer; wind power s11are in electricity supply and per capita wind power capacity, were examined and then compared within Australian and international contexts. A literature review provided information about issues relating to wind fam1 noise in an intemational context.

A questionnaire was undertaken in the Waterloo Township. A specific aim ofthe questionnaire was an assessment of community amenity in relation to wind farm noise after nine m011th's operatio11 of the Waterloo Wind Farm. The questionnaire was additionally supported by a series of in-depth semi-stmctured interviews with the local residents. These interviews interrogated in more depth community views and conceptions about wind farm 110ise and views on or about the efficacy of the State "Wind farms enviro11mentalnoise guidelines".

The questionnaire was conducted on July 15, 2011 at Waterloo Township. A total number of 75 questionnaires were delivered to the local residents (within 5 km from the wind farm) with attached return envelopes and return address. By the lOth August 2011, 48 valid questionnaires had been received. The response rate was 64%.

The semi-structured interviews with some of the Waterloo. residents were conducted on August 19, 2011 at Manoora Sports Club Room located about 10 kin from the Waterloo Township. Six local residents attended the interviews with about 45 minutes for each interviewee.

After further data analysis, conclusion drawing, thesis editing and revising, the dissertation was completed and submitted on November 21,2011.

3. Ethics

An ethics application for this study was submitted to the Hmnan Research Ethics Committee, University of Adelaide and was approved in April 2011.

4. Summary of the results

Documentary analysis showed that the average annual growth rate of wind powe1· (from 2003 to 2010) in South Australia was 62.18%. This is very high in contrast to the rate of Australia (30% in the last decade) and to the woddwide rate (28.68% from 1998 to 2010). The wind power share in electricity supply in South Australia in 2010 was 19.4%, being also very high in conttast to the share of Australia (5.1% in2010 i11 six main wind power States) and to the share of worldwide (2.5% in 2010); the per capita wind power capacity by the end of2010 in South Australia was 0.697kw/per capita, being eight times the value of Australiar1 (0.086) and more than three times the value of worldwide (0.:201).

Survey results showed that overall more than 70% of the respondents claimed they had been negatively affected by the wind fam1 noise. 35% of the respondents stated they had been 'moderately affected' and 19% claiined they had been 'very affected'. ltl total more than 50% of the respondents indicated they had been very or moderately negatively affected by wind farm noise. This is higher than evidence gathered" Til 'r; vious studies: early wim:(farm noise research in tlw early 1990s in tlu·ee European countries showed that the rate of residems who were annoyed by wind farm noise was only 6% to 7%. Later research in the Netlwrlands in 2007 highlighted that the rate of residents Jiving within 2.5 kilometers of a wind farm who were rather or very annoyed by wind farm noise was only 8%.

Those affected by noise from Waterloo Wind Fam1 noise experienced it about two days per week. A few respondents claimed that they had been affected every day. At the time of the survey, 39.6% of the respondents held neutral attitudes to wind e11ergy, 35.4% held opposed attitudes and 25% held supportive attitudes. Only 20.8% of the respondents supported further wind development in the area of Waterloo while 66.7% of them held a 'no' attitude and the other 12.5% claimed 'not sure' about supporting the further wind develop1'nent in their region.

The survey also showed that 38% of the respondents raised wind fam1 noise complaints to the developer; 25% to the local council; 19% to the Environment ProtectiM Autlmrity. 38% of the affected residents claimed experiencing health issues caused by wind farm noise, while 38% ciaimed they were not sure about whether their health had been damaged. Health issues mainly related to sleep deprivation and headaches. Many affected respondents took actions to address the annoyance being caused by the wind farm noise. Actions taken by these re pondents are highlighted by

these excerpts "moved to other areas for sleeping (resting) well when it is windy"; "had medicine or saw doctor to help sleeping well"; "installed double glazed window to block the wind farm noise"; "planted trees"; "used ear plugs"; even "played music all night" to protect themselves from the annoyance coming from the wind farm noise. Several respon ents have bought property in other areas where no wind farms are established. The top two expectations of the affected residents were "tum off the wind turbine during night time" and "affected residents obtain appropriate financial COU1pensatio11 from wind developers".

In summary, results from this study highlight that the guidelin<:>s have not fully met their core objective in terms of the case of Waterloo Wind Farm.

Interview results showed that the failure of those gllidelines to attain their core objective is attributed to some key flaws tesiding in the guidelines iucllllding: the lack of a clearly established integrated procedure which colllcl be employed to tackle the local community's complai11ts agai1:1St the wind farm noise; the failure to utilize an independent third party to conduct valid and trustworthy noise level testing procedures; and the Jack of apJ?rOpriate penalties to be applied if wind developers violate the terms of the guidelines.

5. Acknowledgements

I would like to express my gratitude to those who provided great help for my delivering study questionnaires and t.o those who successfully completed the questionnaires. I also wish to thank those who helped Jne organize a perfect interview site, and those who freely and enthusiastically attended my research interviews.

I extend my gratitude to those who provided valllable advice, documents and information for my stlldy.

6. Key references

Australian Bt\reau of Statistics (ABS) 2011, *Australian Demographic Statistics, Dec 2010,* ABS, viewed 01/09/2011, <http://www.abs.gov.au/mlSstats/abs@.nsf/mf/3!0J .0>.

Australian Energy Market Operator Limited (AEMO) 2011, *South Australian Supp/;1 and Demand Outlook (Draft),* AEMO, Melbourne Victoria.

Au;tralii\ll Greenhouse Of1lce 2003, *Renewable Opponunities-A Review {the Operation of the Renewable Energy (ElectriciO) Act 2000,* Austmlian Greenh<\use Offlce, CanbemL

Butler **O** 2005, *Sustar'nable communities: the important role of local government in building social capital,* 2nd Future of Australia's Country Towns Conference, Bendigo, Victoria, ll-13 July, 2005,

Clare & .Gilbett Valleys CouJtci12011, *Public & Environmental Health,* Clare & Gilbert Valleys Courtcil, viewed 26/08/20**11**, **<http://www.claregilbertva1leys.sa.gov.a:u/site/nage.cfi11?u=212>.**

Clean Enetgy Cocmcil 2010, *Clean Energy Australia 2010,* Swmt Energy, viewed 20/06/2011, <ht!:];>:/lswaneqergy.cpm.au/wp-coltt ltt/uploads/20**11**/0!/Clean-Encrgy-Austl'al.i. .-Repori-20I0-C.pd

f>.

Clean Energy Council (CEC) 201la, *All about Wind Energy,* Clean Energy Council (Australia), viewed 23/08/2011, <h!tp·//www.cleanenergycouneil.Qrg. au/cec/resourcecentre/factsheets.html>. Clean E!lergy Council20llb, *Stwf!Sh. Hill Wind Farm,* Clean Energy Council (Australia), viewed 20/08/20**11'** <http://www.cieanel1ergycouncil.org.au/cec/resourcecentre/casestudies/Wind/Starfish.html>.

COJill110ItWealth of Australia 2010, ***Australian Energy Resource Assessment?*** **COI'l:lmonwea1th of** Atlstralia, Crutberra.

Departme!lt ofClhnate Change and Energy Efficiellcy (DCCEE) 20!!a, *C/im(lte Change,* DCCEE, viewed 20/04/20**11,** <http://www.climatechange.gov.au/climate-chaitge.aspx>.

DCCEE 2011b, *Australian national greenhouse gas accounts,* DCCEE, viewed 26/03/2011, <htto://www.clbnatechange.gov.aul-/media/publications/grcenhouse-acctg/n,, tional-greenho 'se-gas **-inventOl'y-december201 0 pdf>.**

Environmtmt Pl'otection Authority (EPA) 2003, ***Wind Farms Envitomnenta/ Noise Guidelines,*** Atistralia11 Landscape Guardians, viewed 05/0312011, **<http://www.lal"J.dscapeguardians.org.au/resource /windfannnoise/SA_Noic_windfar_rns.pdf>.**

EPAZ009, *Wind Farms Environm ntal Noise Guidelines,* EPA, viewed 05103/2011, <http://www.epa.sa.gov au/xstd files/Noise/Quidelinolwindfarms.pctf.>.

Govemmei1t of South Australia 2011, *About South Australia,* Re110Wables SA., viewed 02/09/2011, <http://www,renewablessa.sfl.gov.aulabout-south-australia>.

New, R 2010, *ElecMcity generan:on Major development projects -Octobe/' 2010 listing,* Australian **Government, Car1bet'ta.**

Peoet·sen, E, Hal!beJ·g, LR-M & Waye, K P 2007 'Living in the Vicinity of Wind Turbines-A Gro nded Ti1eory Study', *Qualitative Research in Psychology,* vol. 4, 110. 1, pp. 49-63.

Pederse1'1E & Halmstad, H 2003, ***Noi..."te annoyance/rom wind turbines- a review*** **Swedish** Environmental Protection Agency, viewed 30/07/2011, <http://www.naturvardsverket.s./Doouments/publikationer/620-5308-6.pdf>.

Pode,·sel1, E, & Waye, K 2007, 'WiiJd tc rbine noise, annoym1ce and self-reported health and w'"ll-being in different living environments', *Occup Environ Med.* veL 64, pp. 480-486.

Power TeohMlogy 201!, *Canun.da Wind Farm, Lake Bonney, Australia,* Power Technology, viewed

0l/09/2011, <http://www.power-technologycom/projects/cantn1da/:>,

Teague, P, Foster, R 2006, *Acoustic Assessment q(Wind Farms- A Practical Perspective,* Proceedings of Acoustics 2006, 20-22 November, Christchurch New Zealand.

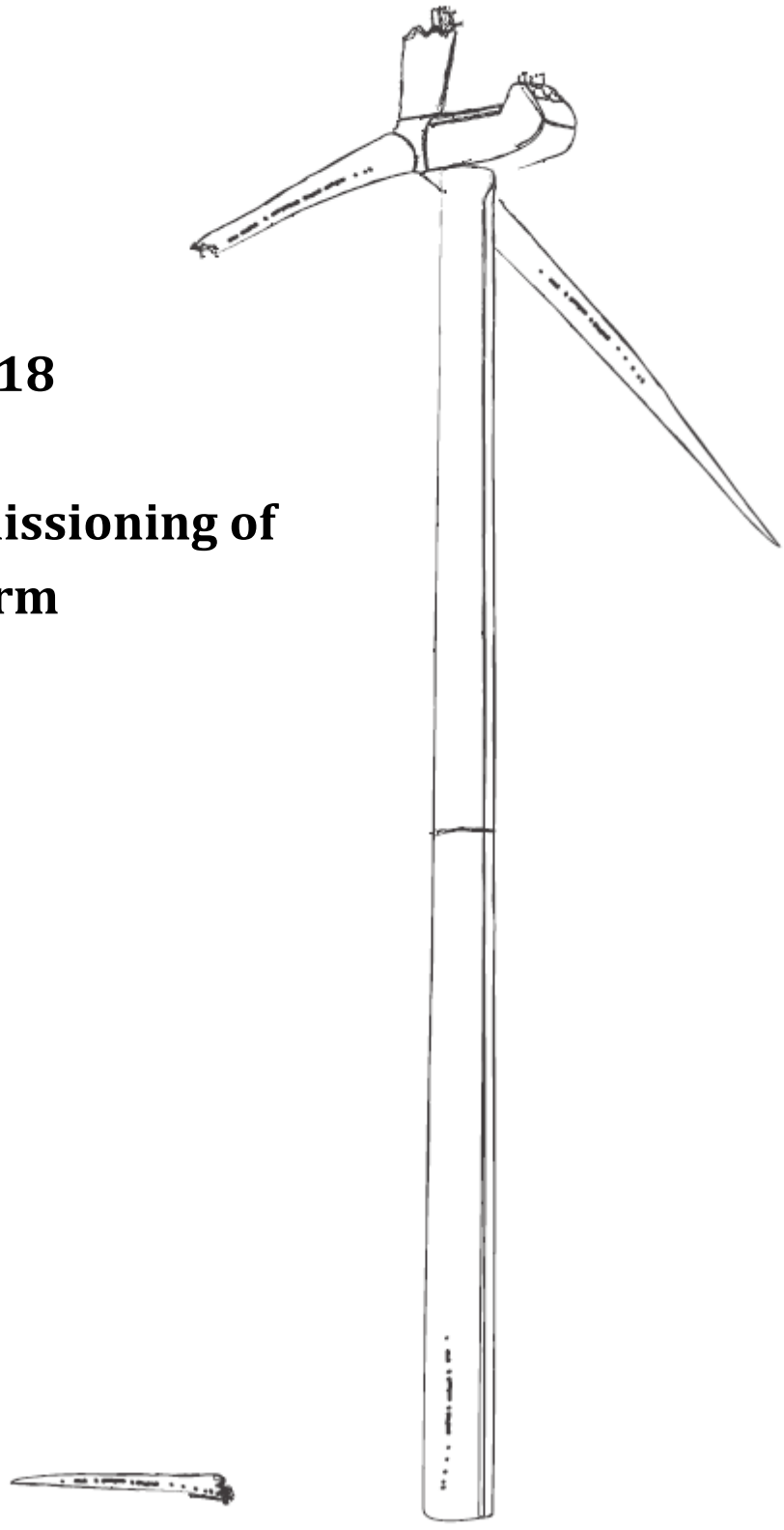
Tickell, C 2006, *Complaintsfi·om noise of wind turbines-Australia and New Zealand experience,* P!'oceedings of Acoustics 2006, 20-22 November, 2006, Christchurch, New Zealand.

Wolsh1k, M, Sprengers, M, Keuper, A, Pedersen T 1-l, Wesn-a, C A 1993, *Annoyance.from wind turbine noise on sixteen sites in. th1·ee countries,* **European community wjnd em:rgy cot1ference, 8-12 March,** 2003.

World Wind) l!tetgy Association 2011, *World Wind Energy Report 2010,* Worlr.l Wind Energy Assobiation, vieweo 28/08/2011, **<http://www.wwi ndea. orglhome:/images/stories/m1f /world windem:rgyreport2010 s.pdf.>,**

Chapter 18

Decommissioning of Wind Farm



CHAPTER 18 DECOMMISSIONING OF WIND FARMS

DIRECTOR GENERALS REQUIREMENTS

"A detailed description of the project for both wind farm and transmission line including: construction, operation and ***decommissioning".***

"A timeline identifying the proposed construction and operation of the project components, their envisaged lifespan and arrangements for decommissioning and staging".

The NSW Draft Planning Guidelines state:

Once installed, wind turbines typically have an expected operating life of around 20-25 years at which point they are usually decommissioned.

The guidelines require that the proponent/wind farm owner rather than the "host" landowner must retain responsibility for decommissioning.

Additionally, the guidelines require applicants to include a Decommissioning and Rehabilitation Plan in their environmental assessment report. Where this is deemed to be inadequate, but the Development Application is granted consent, a condition of consent will be imposed requiring the proponent to pay a decommissioning bond.

Decommissioning and Rehabilitation:

The applicant should include an outline Decommissioning and Rehabilitation Plan in their assessment report setting out: Additionally, the guidelines require applicants to include a Decommissioning and Rehabilitation Plan in their environmental ssessment report. Where this is deemed to be inadequate, but the Development Application is granted consent, a condition of consent will be imposed requiring the proponent to pay a decommissioning bond.

Consultation undertaken with the landowner regarding decommissioning and rehabilitation issues including the amount of consultation and issues covered

The expected operational life of the wind farm.

The proposed approach to dismantle individual non-operational turbines or the whole farm and associated infrastructure except where the local electricity network operator or the land owner agrees they should be retained. This includes:

- turbines and associated slab in the ground

- any manager's residence, viewing facilities, maintenance shed or other facilities
- site transmission cabling and control room
- any associated electricity substation, switchyard, over head transmission line connected to
- the grid
- any access roads.

The proposed approach to transport the dismantled turbines and associated facilities from the site, including any temporary storage facilities.

The proposed resource recovery / recycle / reuse strategy to minimise disposal of material in accordance with the EPA *Guidelines Assessment, Classification and Management of Liquid and Non-Liquid Wastes*. The method for disposing or recycling of the wind turbine's blades should be addressed.

How the site will be restored and rehabilitated. This should be developed with the agreement of the landowner.

The estimated cost of dismantling and proposed funding arrangements for that cost to be met.

The estimated cost of dismantling should be based on recent actual examples of decommissioning costs, either locally or in comparable situations overseas, as well as estimates from independent, credible and reputable service providers regarding decommissioning costs.

These estimates should be included as an attachment to the Decommissioning and Rehabilitation Plan. If the turbines' scrap metal value is proposed to fund decommissioning, estimates should also be obtained from independent, credible and reputable service providers regarding the likely scrap metal value at the time of decommissioning. The level of confidence in the estimates should also be assessed and measures to deal with uncertainty and risk identified. Where the proponent's cost estimate and funding plan is deemed to be inadequate, a condition of consent may be imposed requiring the proponent to pay a decommissioning bond in the event the Development Application is approved.

- The timeframe to undertake the decommissioning and rehabilitation works.
- The consultation and notification procedures including informing the council and neighbours when decommissioning works are to be undertaken

- Identification of responsibility for decommissioning. The decommissioning of individual turbines or the whole farm is the responsibility of the owner of the wind farm and not the landowner as part of the lease agreement. The applicant/wind farm owner must provide evidence to demonstrate this.

If a DA for a wind farm classed as State significant development is approved, decommissioning requirements will be included in the Conditions of Consent issued by the consent authority.

Conditions of Consent will generally require that:
The wind farm owner is responsible for decommissioning (not the landowner) and that the applicant/wind farm owner must provide evidence to demonstrate this prior to construction commencement.

- The Decommissioning and Rehabilitation Plan must be updated every 5 years and made public on the applicant's website as well as providing a copy to the relevant consent authority.
- The turbines and associated facilities must be decommissioned within 18 months of cessation of the operation of the project.
- Any individual turbine that cease operating for more than 12 months must be dismantled within 18 months
- The wind farm owner must keep independently verified annual records of each wind turbine electricity generation production. Copies of these records should be made available to the consent authority on request.

18.1.0 SUMMARY OF OBJECTIONS

Decommissioning of Wind Farm: The Bodangora Wind Turbine Awareness group objects to the proposed Bodangora wind farm.

The EA fails to consider the Draft DGRs. In submitting the General and Administrative Commitment (Table 20.1) the EA also shows disregard to the requirements of the Director General in all other areas.

The EA states, "BWFPL *will implement all practicable measures to prevent and minimise any harm to the environment that may result from the construction, commissioning, operation, maintenance and decommissioning of the development."*
However, the DGRs require a *"detailed description of the project……..including decommissioning".*

No details of the proponents decommissioning plan exist in the EA. The closest the EA gets to any sort of plan is to mention that specific measures are required, but fails to outline exactly what "specific measures" the proponent has in mind. This is inadequate and **does not meet the DGRs.**

In Table 20.1, the proponent indicates that they will, *"implement all practicable measures to prevent and minimise any harm to the environment that may result from the construction, commissioning, operation, maintenance and decommissioning of the development".*

No information is given as to exactly what "practicable measures" are proposed. After 25 years (or the life of the wind farm), it is highly probable that the environmental assessment (inadequate as it is), that was carried out prior to the construction of the wind farm will no longer be applicable in the decommissioning phase.

For the BWFPL to claim that they will make the commitment that it has stated is no commitment at all. The EA goes into some small detail as to what they may or may not do in the construction and operation phase, but no processes are offered specifically in the decommissioning phase other than to say, *"Replacement may be subject to new approvals. Decommissioning would involve dismantling or removal of all equipment, and site rehabilitation."* **This does not meet the DGRs.**

It would be almost impossible to rehabilitate a site without the complete removal of ALL concrete footings. To leave the a concrete slab 4m underground will not sufficiently allow any trees to grow. A large number of trees will definitely be removed in the construction phase, (refer Chapter 8 of this submission). Rehabilitation can only successfully occur with the complete removal of all concrete. The tree root system goes many metres into the ground and will be restricted by an impenetrable barrier of concrete should the proponent not be required to remove it. This will also involve significant impact on the environment.

The BWTAG OBJECTS to the proposal.

No evidence of how the decommissioning costs are to be off-set is provided. Scrap value is not sufficient to cover the cost of decommissioning (Refer to Report by John Schneider in this chapter.)

Appendix 1

Report to the Bodangora Wind Farm Awareness Group In response to the Environmental Assessment by the proponent Bodangora Wind Farm pty ltd, Infigen Energy

By John Schneider

Decommissioning of wind Turbines

"absent security to ensure the proper decommissioning of wind turbines and restoration of the lands on which they are constructed, the costs, both financial and in terms of human health and the environment, will again be passed on to a future generation".

(The abandoned Kamaoa Wind Farm – South Point USA)

An example of costs outweighing any scrap value is the case of the Kamaoa Wind Farm in Hawaii (see photo above) which came on line in 1987 and has laid abandoned for many years due to the fact that the costs for removing the turbines have been prohibitively high, according to Steven Pace CEO of San Francisco based Apollo Energy Partners, which owns the wind farm.

Previously Pace had stated that costs would approach US$1 million and while parts could be sold for scrap metal he said that would only net about US$300,000. It must be noted that these units are only a third of the size of the units planned for Bodangora Wind Farm, therefore one could assume quite confidently that the issues would manifest themselves at a minimum of twice as much, if not more. In March/April of 2012, it is understood that the Kamaoa wind turbines have been dismantled at an undisclosed cost. The fact that the costs are not disclosed adds fuel to the fire that decommissioning costs far outweigh any salvage recovery, and therefore it is critically important to provide some sort of security to cover all rehabilitation costs.

In many American jurisdictions government regulations require the wind turbine developer to post security for the decommissioning and dismantling of the turbines and restoration of the lands. It is clearly incumbent on the NSW Government to ensure that these same controls and regulations be put in place to protect future generations.

There have been numerous submissions related to wind farm developments in Australia and overseas that have addressed decommissioning and restoration of lands to their original condition, all of them stating emphatically that costs of decommissioning far outweigh the value of any scrap value recovered. Particular reference is made to the recent Flyers Creek Wind Turbine Awareness Group's submission on costs and potential recovery rates as well as Energy Ventures Analysis report for the Beech Ridge Energy Project in Greenbrier County, West Virginia USA, where it was clearly demonstrated that the costs to decommission wind turbines were severely underestimated.

Bodangora Wind Farm Pty. Limited, a limited liability company (LLC), has confirmed in its EA that it will be responsible for decommissioning of the wind farm, and this is tied to every lease and legally binding even if the parties change. What happens if Bodangora Wind Farms P/L goes "belly up" when the funding runs out? Who will be responsible then? It is a well known fact that wind farm projects are not sustainable without government subsidies and tax breaks, so it is inevitable that regardless of any ten year warranties on equipment it is possible that the wind farm could be abandoned, such as many projects littering the US and European landscapes.

It also states in Attachment C – Decommissioning, that Infigen will also monitor repowering opportunities and is also very confident that the salvage value of the turbines will outweigh the decommissioning costs. Firstly it is apparent that Infigen is the parent company of Bodangora Wind Farms Pty. Ltd, and It is assumed that they are also a limited liability company. So will both companies be linked to fulfill the guarantees of decommissioning and replacement? It is also stated in Ch. 3.9 of the EA that "at the end of its economic life, all equipment will either be replaced with comparable new equipment or the wind farms will be decommissioned". It is assumed that this means if the company becomes insolvent and abandons the project, then in

fact Bodangora Wind Farm P/L will no longer be in a position or capable of decommissioning the wind turbines.

Attachment D:

Decommissioning and Rehabilitation Plan:

Consultation: It is evident here that we have a situation of the "blind leading the blind" when it is stated that on all occasions the landowner shared the same opinion as Infigen (where is Bodangora Wind Farm P/L's opinion?) that the salvage potential would outweigh the decommissioning costs.

It is a well known fact that you will never achieve full cost recovery when it comes to operational salvage on a general scale. This was clearly demonstrated in the early part of this report with the abandoned Kamaoa Wind Farm in Hawaii and an admission from the wind farm owner that the costs outweighed any salvage value, and the Beech Ridge Energy Project in West Virginia, USA, that clearly identified the costs associated with decommissioning.

The Lease Agreement states that plant and equipment sited below the surface of the Leased Property shall be removed to a depth of four hundred (400) millimeters and concrete foundations shall be expressly excluded from this commitment, but only upon the condition that a smoothed, even covering of soil is placed to a minimum depth of four hundred (400) millimeters over such concrete foundations.

This is totally unacceptable as requirements in the US indicate a minimum of nine hundred (900) millimeters or thirty six (36) inches of rehabilitation to occur, including the removal of concrete foundations.

Dismantling: It is clearly stated that the proponent is Bodangora Wind Farms Pty. Ltd yet time after time in this EA there is reference to Infigen making all the decisions such as " unless the local electricity network operator or landowner requests and **Infigen agrees**, that certain wind farm infrastructure be retained on land, it will be removed and restored to its previous condition". (ONLY IF INFIGEN AGREES) It must be made very clear whose responsibility it will be to decommission these turbines at the end of its economical life or upon abandonment, whichever occurs first.

Removal of turbines must be similar to the construction of the wind turbines however, the proponent forgets that unless the large steel sections that make up the tower, are cut into more manageable transportable pieces, then the small recycling companies (that are mentioned) will be unable to handle larger sections and therefore will reduce substantially any rate likely to be paid.

Be very clear that the tower sections will not be transported away from the site in the same way that they were delivered, which means that many man hours and oxy acetylene equipment will be required to reduce these huge steel sections into a more manageable size, both for handling and transport.

As stated previously, there is no way that the salvage value will compensate the operational costs to remove the wind turbines, let alone cover additional decommissioning work.

Blade Recycling: It is somewhat possible to deal with the blades in the manner that Bodangora Wind Farm P/L is suggesting however, the only problem is that this is only possible where you you have the facilities to do so, such as Europe and the US. Australia and particularly remote areas like Bodangora /Dubbo do not have these facilities available and this would mean that the blades would need to be transported (at great cost) to the nearest facility. It is not believed that one even exists in Australia.

Bodangora Wind Farms P/L and Infigen are both delusional in their continuous statements that funding from salvage value will cover decommissioning costs and therefore it is only right and appropriate that some form of financial security or Bond be required to cover fully all of the decommissioning costs. Any salvage value could be used to partially offset those costs and/or contribute the salvage funds to improve the local roads in the area, or some other worthwhile project .

It is recommended that a surety bond of no less than AUD two hundred and fifty thousand dollars ($250,000) per turbine be posted by the developer to cover any decommissioning costs either after the turbines have reached their useful life or abandonment, whichever happens first. It is also recommended that this value be increased every five years to cover any inflationary aspects. Previous suggestions of AUD 100,000 per turbine as surety, have been updated to fully reflect the total costs for decommissioning and rehabilitation.

Prepared and Submitted by John Schneider on behalf of Bodangora Wind Turbine Awareness
Group.

John Schneider is currently working in Abu Dhabi as Head of Contracts Department with the Abu Dhabi Waste Management Authority. He has over thirty years of waste management experience both in contracting and consulting on a global level. He spent many years in Australia and is fully conversant with all aspects of waste management and recycling. He is currently the focal point for a new waste to energy plant for Abu Dhabi, and believes in renewable energy as a future source for energy. He is also of the firm belief that wind farms must be appropriately sited in industrial locations, not to cause any inconvenience to farming communities or individual