Environmental Impact Statement

Uungula Wind Farm

Appendix S: Noise and Vibration Impact Assessment (Sonus Pty Ltd, 2020)

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Uungula Wind Farm

Noise and Vibration Impact Assessment

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GLOSSARY

A-weighting	Frequency adjustment applied to measured noise levels to replicate the frequency response of the human ear.
AGL	Above ground level.
Ambient noise level	The noise level with the presence of all existing noise sources in the environment.
Background noise level	The noise level in the absence of intermittent noise sources.
Bulletin	NSW Wind Energy: Noise Assessment Bulletin (EPA/DPE, 2016).
Day	The period between 7am and 10pm, when considering separated day and night periods in accordance with the NSW Draft Guidelines. The period defined by the NPI as 7am to 6pm Monday to Saturday, and 8am to 6pm on Sunday.
dB(A)	A-weighted noise or sound power level in decibels.
DECC	Department of Environment and Climate Change
DoPI	Department of Planning and Infrastructure.
DPE	Department of Planning and Environment.
EPA	Environment Protection Authority.
Evening	The period defined by the NPI as 6pm to 10pm Monday to Sunday.
Equivalent noise level	Energy averaged noise level.
ICN Guideline	Interim Construction Noise Guideline (DECC, 2009);
NPI	NSW Noise Policy for Industry (EPA, 2017).
L_{A90}	A-weighted noise level exceeded 90% of the time measured in decibels, representing the background noise level.
L_{Aeq}	A-weighted equivalent noise level measured in decibels.
Night	The period between 10pm and 7am, when considering day and night periods in accordance with the NSW Draft Guidelines. The period defined by the NPI as 10pm to 7am Monday to Saturday, and 10pm to 8am on Sunday.
NSW	New South Wales.
RBL	Rating Background Level.
RNP	NSW Road Noise Policy (DECCW, 2011).
SEARs	Secretary's Environment Assessment Requirements.
Sound power level	A measure of the sound energy emitted from a source of noise.
Technical Guideline	Assessing Vibration: A Technical Guideline (DECC, 2006).
Worst-case	Conditions resulting in the highest noise level at or inside residences.

EXECUTIVE SUMMARY

An environmental noise and vibration impact assessment has been made of the proposed Uungula Wind Farm based on an updated layout and arrangement, and the Secretary's Environmental Assessment Requirements (SEARS, dated 11 November 2019).

Changes to the proposed wind farm since the initial assessment in 2013 includes:

- a revised wind farm layout comprising 97 wind turbine generators (WTGs) with a hub height of up to 166m;
- different wind turbine model options consisting of Vestas *V162-5.6MW, Siemans Gamesa 170 6.0MW* and General Electric *GE5.5-158* WTGs;
- revised locations for potential substations; and,
- the addition of an energy storage facility.

The assessment specifically considers the following noise aspects as required by the SEARs:

- noise generated by wind turbine operation – the *NSW Wind Energy: Noise Assessment Bulletin* (EPA/DPE, 2016);
- noise generated by ancillary infrastructure - *NSW Industrial Noise Policy* (EPA 2000);
- construction noise - *Interim Construction Noise Guideline* (DECC, 2009);
- traffic noise – *NSW Road Noise Policy* (DECCW, 2011); and,
- vibration – *Assessing Vibration: A Technical Guideline* (DECC, 2006).

The assessment predicts the noise levels at residences located in the vicinity of the wind farm. Based on the predictions and analysis:

- the noise from the worst case (highest noise level) representative WTGs model will achieve the relevant noise criteria at all non-associated residences and wind speeds, with the exception of ILG006, for wind speeds greater than 6m/s. It is understood that residence ILG006 is derelict and on land owned by Water NSW and therefore the wind farm is not required to achieve the objective noise criteria at this location. It is therefore considered that the wind farm operation can achieve the relevant project noise criteria at residences in the vicinity;
- the noise from ancillary infrastructure at the proposed wind farm, mainly from the transformers at the substation and battery inverters at the energy storage facility, will be no greater than 30 dB(A) at nearby residences and therefore achieve the *NSW Noise Policy for Industry 2017* (NPI);
- the noise from construction activity, road traffic and vibration can be addressed through the establishment of a construction noise and vibration framework that adequately controls noise and vibration from the construction of the project, consistent with the recommendations of the relevant guidelines and policy.

Based on the above, the construction and operation of the proposed Uungula Wind Farm can achieve the SEARs with the implementation of reasonable and practicable noise mitigation measures.

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1 INTRODUCTION

Sonus has been engaged by CWP Renewables Pty Ltd to conduct a noise and vibration impact assessment of the proposed Uungula Wind Farm, located to the east of Wellington, New South Wales (NSW).

Noise assessments of the wind farm have previously been conducted for several changes to the wind farm design since 2013 to address the NSW Department of Planning and Infrastructure (DoPI) Director-General's Requirements (DGRs, dated 14 April 2011).

The changes to the proposed wind farm project since the original assessment include:

- a revised wind farm layout comprising 97 wind turbine generators (WTGs) with a hub height of up to 166m (following the removal of the eastern WTG cluster and reduction in WTG numbers from 249 WTGs);
- different wind turbine model options consisting of Vestas *V162-5.6MW, Siemans Gamesa 170 6.0MW* and General Electric *GE5.5-158* WTGs;
- revised locations for potential substations; and,
- the addition of an energy storage facility.

The Department of Planning and Environment (DPE) has also issued Secretary's Environmental Assessment Requirements (SEARS, dated 20 December 2016 and revised 11 November 2019) which outline the requirements for the environmental noise and vibration impact assessment. The SEARs are provided in Appendix A.

Therefore, this assessment has been conducted to consider the changes to the proposed wind farm and address the SEARs relating to noise and vibration. The SEARs specifically reference the following guidelines for the assessment of noise and vibration from the proposed wind farm:

- wind turbine noise – the *NSW Wind Energy: Noise Assessment Bulletin* (EPA/DPE, 2016);
- noise generated by ancillary infrastructure - *NSW Noise Policy for Industry* (EPA 2017);
- construction noise - *Interim Construction Noise Guideline* (DECC, 2009);
- traffic noise – *NSW Road Noise Policy* (DECCW, 2011); and,
- vibration – *Assessing Vibration: A Technical Guideline* (DECC, 2006).

The assessment has been conducted in accordance with the guidelines above, based on the revised wind farm layout and arrangement as provided in Appendix B.

Noise levels at residences in the vicinity of the wind farm have been predicted. The locations of the residences and the status of the landowner with respect to whether a landowner agreement has been entered into are provided in Appendix C.

2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The SEARs specify the aspects of noise to be addressed in the environmental noise and vibration impact assessment, and the relevant guidelines to be used (refer Appendix A). The requirements of the specific aspects of noise, the relevant guidelines and resultant objective criteria in accordance with SEARs are detailed below.

2.1 Wind Turbine Noise

The SEARs require wind turbine noise to be assessed in accordance with the *NSW Wind Energy: Noise Assessment Bulletin* (DPE, 2016, the Bulletin), which adopts the methodology of the South Australian Environment Protection Authority's *Wind Farms – Environmental Noise Guidelines 2009* (SA 2009) and supplements it with specific variations for NSW requirements.

2.1.1 Noise Limits

The Bulletin defines noise limits at relevant receiver locations (residences) as follows:

> *The predicted equivalent noise level ($L_{Aeq,10\ minute}$)*, adjusted for tonality and low frequency noise in accordance with these guidelines, should not exceed 35 dB(A) or the background noise ($L_{A90(10\ minute}$)) by more than 5 dB(A), whichever is the greater, at all relevant receivers for wind speed from cut-in to rated power of the wind turbine generator and each integer wind speed in between.*
>
> ** Determined in accordance with SA 2009, Section 4.*

The Bulletin recognises that some landowners may enter into an agreement with the wind farm developer as host landowners, or where the noise limits above are not achieved at their residences. At these residences, the applicable noise limits are based on the limits specified in the agreement.

2.1.2 Special Noise Characteristics

The Bulletin prescribes a 5 dB(A) penalty adjustment (added to the measured or predicted noise level) for the presence of repeated and excessive tonality and/or low frequency which occurs for more than 10 percent of an assessment period. Excessive tonality and low frequency are determined as follows:

Tonality

The Bulletin references the methodology described in *ISO 1996.2: 2007 Acoustics - Description, measurement and assessment of environmental noise – Determination of environmental noise levels (Annex D – Objective method for assessing the audibility of tones in noise – Simplified method)*. Excessive tonality is present at a particular one-third octave band level if the band level exceeds the adjacent bands on both sides by at least:

- 5 dB , if the centre frequency of the band is in the range 500 Hz to 10,000 Hz;

- 8 dB, if the centre frequency of the band is in the range 160 Hz to 400 Hz; and/or
- 15 dB, if the centre frequency of the band is in the range 25 Hz to 125 Hz.

The penalty for tonality only applies if the tone from the wind farm is audible at the receiver location. The absence of a tone at an intermediate location will be sufficient to demonstrate that the wind farm noise at the relevant receiver location is non-tonal.

Low Frequency Noise

Excessive low frequency noise is present if the low frequency noise levels at non-associated residences exceed 60 dB(C).

2.1.3 Cumulative Noise Impact from Other Existing Wind Farms

SA 2009 has been widely described as one of the most stringent assessment approaches of any jurisdiction in the World. The NSW baseline criterion of 35 dB(A) is set at least 5 dB(A) less than SA 2009 and the *New Zealand Standard 1998* baseline used in Victoria.

Due to its stringency, SA 2009 explicitly accounts for the cumulative effect of other wind farms. The baseline criterion specified by SA 2009 (and the Bulletin) accounts for cumulative impacts according to the following:

> *The base noise level is typically 5 dB(A) lower than the level considered to reflect the amenity of the receiving environment. Designing new developments at a lower level accounts for the cumulative effect of noise from other similar development and for the increased sensitivity of receivers to a new noise source.*

2.2 Ancillary Infrastructure

The SEARs reference the *NSW Noise Policy for Industry* (EPA, 2017, the NPI) for the assessment of ancillary infrastructure noise. Ancillary infrastructure at the proposed wind farm with significant noise sources includes the substation and the energy storage facility.

The NPI establishes objective criteria based on the existing ambient noise environment and the envisaged amenity of the area. The most onerous criteria provided by the two methods are then selected. If the noise levels are exceeded, then all feasible and reasonable noise reduction measures should be implemented.

In accordance with the NPI, the Rating Background Level (RBL) is used to characterise the existing ambient noise environment for each of the day, evening and night periods. The RBL is determined from the lower tenth percentile of the background noise level (L_{A90}) in the environment and effectively represents the “lulls”. That is, the RBL effectively “selects” the quietest periods at the monitoring locations. Where the RBL is

measured to be below 30 dB(A), then it is set to 30 dB(A). The RBL requires a different procedure to the SA 2009 background noise data analysis.

The ambient noise environment was monitored at 15 residences in the vicinity of the wind farm, as described in Section 3. Based on the measured ambient noise levels, the RBLs were calculated to be less than 30 dB(A) at all monitoring locations. Therefore, in accordance with the NPI, an RBL of 30 dB(A) has been applied for all residences in this assessment.

The NPI requires that noise from industrial sources should not exceed the measured RBL by more than 5 dB(A). Therefore the most onerous criterion in accordance with the NPI's ambient noise method is 35 dB(A). A noise level of 35 dB(A) is more onerous than the amenity based noise criterion of 40 dB(A) for a dwelling in a rural environment and therefore becomes the assessment criterion for the ancillary infrastructure in accordance with the NPI.

It is noted that if the assessed noise is found to have a character that has the potential to be annoying, such as tonality, modulation or dominant low-frequency content, a correction factor is to be applied to the measured level. The plant at the substation and/or the energy storage facility has the potential to exhibit tonality if it is audible, and therefore a 5 dB(A) correction factor may be applicable. For conservatism, a 5 dB(A) correction has been applied in the assessment, which effectively reduces the criterion to 30 dB(A).

Therefore, in order to achieve the criteria provided by the NPI, it is recommended that noise from the proposed ancillary infrastructure achieves a level of 30 dB(A) at all residences.

2.3 Construction Noise

The construction of a wind farm comprises activities such as road construction, civil works, excavation, foundation construction, electrical infrastructure works and turbine erection requiring processes such as heavy vehicle movements, crushing and screening, possible concrete batching, loaders, excavators, generators, cranes and, subject to local conditions, possibly blasting.

To assess construction noise in accordance with the SEARs, the *Interim Construction Noise Guideline* (DECC, 2009, the ICN Guideline) is used.

The ICN Guideline provides an emphasis on implementing "feasible" and "reasonable" noise reduction measures and does not set mandatory objective criteria. However, the ICN Guideline does establish a quantitative approach, whereby "management levels" are defined based on the existing RBL. The management levels as defined by the ICN Guideline are provided in Table 1.

Table 1: The ICN Guideline management levels.

Time of Day	***Management Level $L_{Aeq(15min)}$***	***How to apply***
Recommended standard hours: *Monday to Friday* *7 am to 6 pm* *Saturday* *8 am to 1 pm* *No work on Sundays or public holidays*	*Noise affected RBL + 10 dB*	*The noise affected level represents the point above which there may be some community reaction to noise.* • *Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.* • *The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.*
	Highly noise affected *75 dB(A)*	*The highly noise affected level represents the point above which there may be strong community reaction to noise.* • *Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:* 1. *times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences* 2. *if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.*
Outside recommended standard hours	*Noise affected RBL + 5 dB*	• *A strong justification would typically be required for works outside the recommended standard hours.* • *The proponent should apply all feasible and reasonable work practices to meet the noise affected level.* • *Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.*

2.4 Traffic Noise

In accordance with the SEARs, road traffic noise during the construction of the wind farm is to be assessed against the *NSW Road Noise Policy* (DECCW, 2011, the RNP). The RNP provides two sets of assessment criteria which are based on the road category, and a relative increase to the existing traffic noise levels.

For existing local roads with a potential increase in traffic activity generated by development, the RNP recommends the criteria in Table 2 to be achieved at residences. The recommended limits for the relative increase in existing traffic noise levels are also provided in Table 2.

Table 2: Road traffic noise criteria.

Period	Criterion based on Road Category, dB(A)	Relative Increase Criterion, dB(A)
Day (7am to 10pm)	$L_{Aeq,(1hour)}$ 55	Existing traffic $L_{Aeq,(15hour)}$ + 12 dB
Night (10pm to 7am)	$L_{Aeq,(1hour)}$ 50	Existing traffic $L_{Aeq,(9hour)}$ + 12 dB

Note: Where the existing traffic noise level is less than 30 dB(A), such as in rural areas, it is deemed to be 30 dB(A).

The noise criteria above are to be achieved outside the residences, at a distance of 1m from the facade and at a height of 1.5m from the ground.

2.5 Vibration

To assess vibration levels during construction in accordance with the SEARs, reference is made to the *Assessing Vibration: A Technical Guideline* (DECC, 2006, the Technical Guideline). The Technical Guideline provides an emphasis on construction activity implementing feasible and practicable vibration reduction measures and does not set mandatory standards or objective criteria.

The Technical Guideline establishes a quantitative approach, whereby goal vibration levels are established based on human response to continuous, intermittent and impulsive vibration. Continuous vibration is uninterrupted for an extended period of time. Intermittent vibration is an interrupted form of continuous vibration, and impulsive vibration is a sudden event or events.

For construction activity occurring during the day time, the Technical Guideline can be interpreted to provide the vibration criteria in Table 3 at dwellings, based on the core document used as the technical basis for the Technical Guideline, the British Standard *BS 6472-1992 Evaluation of human exposure to vibration in buildings (1-80Hz).*

Table 3: Vibration criteria.

Continuous mm/s^2 Vertical (rms.)	Impulsive mm/s^2 Vertical (rms)	Intermittent $m/s^{1.75}$ Vibration Dose Value
10-20	30-60	0.2-0.4

Note: Continuous and impulsive vibration criteria are provided as “rms” values for acceleration. The term “rms” relates to a mathematical process that is effectively an average. The “rms” value for acceleration is expressed in millimetres per second squared (mm/s2). The intermittent vibration criterion is derived from a prescribed mathematical process performed on the results and therefore its quantity and units ($m/s^{1.75}$) differ from those for continuous and intermittent vibration.

3 BACKGROUND NOISE MONITORING

Background noise monitoring was previously conducted as part of the 2013 assessment at 15 locations in the vicinity of the proposed wind farm, between 12 September 2012 and 6 November 2012. The monitoring was conducted in accordance with SA 2009.

The 15 monitoring locations, as summarised in Table 4, had been selected based on preliminary noise predictions of the initial wind farm layout. Preference was given to residences with the highest predicted noise levels and without agreements, subject to permission being granted by the landowner to place a noise logger.

Following the modification to the wind turbine layout with the removal of the eastern WTG cluster, a number of the monitored locations which are located in the vicinity of the removed WTGs are now irrelevant when considering the residences in close proximity to the current layout. These locations and the residences in the vicinity of the removed turbines are included in the assessment for information purposes only.

Table 4: Monitoring locations and periods.

Residence ID	Residence Name	Coordinates (UTM WGS84 z55)		Monitoring Period
		Easting	Northing	
ILG001	Fashion's Mount	698565	6397763	12/09/2012 - 6/11/2012
TMR019	Hope Royal	708735	6405892	10/10/2012 - 6/11/2012
YARR003	Burra Murra	715225	6401187	12/09/2012 - 13/10/2012
GUL010	Pinaroo Park	729358	6407323	10/10/2012 - 5/11/2012
TMR010	Belmont	713699	6403801	12/09/2012 - 06/11/2012
UAM005	Mt Molly	710861	6409832	12/09/2012 - 3/11/2012
UUN009	Tilbelah	714173	6399311	12/09/2012 - 5/11/2012
UUN011	Glen Esk	714010	6402388	12/09/2012 - 6/11/2012
HR001	Glenlea	724808	6407031	12/09/2012 - 5/11/2012
LPBR004	Binomea	722523	6404886	12/09/2012 - 24/10/2012
LPBR008	Crowie Station	723177	6401780	10/10/2012 - 5/11/2012
LPBR013	Madara	725270	6400792	12/09/2012 - 31/10/2012
LPBR014	Cooraloo	726003	6401582	10/10/2012 - 25/10/2012
LPBR017	Bailey's Creek	726654	6402151	12/09/2012 - 05/11/2012
TMR006	Elouera Park	716226	6409344	12/09/2012 - 6/11/2012

The background noise was measured with *Rion Type 1 and 2* sound level meters, with a noise floor of less than 20 dB(A), calibrated at the beginning and end of the measurement period with a *Rion NC74* calibrator (negligible drift observed). All microphones were fitted with weather proof windshields, with the microphone positioned approximately 1500mm above ground level. Each noise logger was located in accordance with SA 2009 (e.g., at an equivalent distance from the facade of the dwelling as any significant trees whilst minimising the influence of fixed noise sources such as air conditioning units) and placed on the wind farm side of the dwellings.

The background noise level was measured in 10 minute intervals at each of the monitoring locations. Photographs of the noise monitoring equipment are provided in Appendix D, which show the monitoring equipment arrangement at representative locations.

During the background noise monitoring regime, wind speed was measured by the developer at two wind masts located locally within the wind farm site. The wind speed was measured in 10 minute intervals at various measurement heights on each wind mast. Table 5 provides details of the wind masts.

Table 5: Wind mast details.

Mast ID	Coordinates (UTM WGS84 z55)		Measurement Height (m)
	Easting	Northing	
BER01	718673	6400552	30, 45, 61
WEL01	705654	6399971	30, 45

SA 2009 specifies that the background noise data are to be correlated with wind speed data referenced at hub height (i.e. up to 166m). Therefore, the wind speed data collected at the wind masts in Table 5 were sheared using the power law wind profile model (by the developer) to derive the 10 minute average wind speed at 166m hub height.

Local weather loggers were also deployed which measured rainfall and wind speed at approximately 1.5m above ground level. The rainfall and wind speed data were collected to determine the periods when weather directly on the microphone may have influenced the measured background noise levels in the vicinity. Table 6 summarises the location and monitoring period of the local weather loggers.

Table 6: Local weather logger details.

Residence ID	Monitoring Period
UAM005	13/9/2012 – 7/11/2012
LPBR004	10/10/2012 – 7/11/2012

The noise data corresponding to any periods of measured rainfall and/or measured wind speed exceeding 5 m/s at the microphone height for more than 90% of the measurement period were discarded. Data corresponding to the periods with average wind speed below the cut-in wind speed (i.e. 3m/s) and above the rated power wind speed (approximately 12m/s) were also discarded.

Table 7 summarises the number of data points at each monitoring location before and after the removal of data points.

Table 7: Useable data points.

Residence ID	Closest Wind Mast	Number of Data Points	
		Before Removal	After Removal
ILG001	WEL01	7942	6594
TMR010	BER01	7781	6561
TMR019	WEL01	3881	3126
UAM005	BER01	7344	6001
UUN009	BER01	7619	6408
UUN011	BER01	7779	6559
YARR003	BER01	4334	3806
GUL010[1]	BER01	3800	3070
HR001	BER01	7764	6481
LPBR004	BER01	5989	5081
LPBR008	BER01	3774	3048
LPBR013	BER01	6945	5921
LPBR014[2]	BER01	2210	1833
LPBR017	BER01	7625	6412
TMR006	BER01	7910	6410

Following data removal, the background noise data were correlated with the hub height wind speed data measured at the closest wind mast. A least squares regression analysis of the data was undertaken to determine the line of best fit for the correlations in accordance with SA 2009. The data and the regression curves are shown in Appendix E. Based on the regression analysis, the background noise level ($L_{A90,10}$) at a range of wind speeds within the operating range of the wind turbine is provided in Table 8.

Table 8: Background noise levels (dB(A))

Residence ID	Background Noise Level (dB(A)) for Integer Hub Height (166m AGL) Wind Speed									
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s
ILG001	27	27	28	28	29	30	30	31	32	33
TMR010	29	30	30	30	30	31	31	31	32	32
TMR019	25	26	26	27	27	27	27	28	29	30
UAM005	32	32	32	32	32	32	32	32	32	32
UUN009[3]	33	34	34	34	34	34	34	35	35	35
UUN011	28	28	28	28	28	28	29	29	29	30
YARR003	28	27	27	27	28	28	29	29	30	30
GUL010	31	31	30	31	31	31	31	32	31	31
HR001	26	25	25	25	26	26	27	29	30	32
LPBR004	28	29	29	29	30	30	31	32	33	35
LPBR008	27	26	26	27	27	29	30	31	32	33
LPBR013	27	26	26	27	27	28	29	31	32	33
LPBR014	27	26	26	26	27	28	30	32	34	35
LPBR017	25	25	25	26	27	28	29	31	32	34
TMR006	29	28	28	28	28	29	29	29	30	30

1 Equipment failed during the logging period.

2 The number of usable data points was less than the 2000 recommended by SA 2009.

3 High background noise levels were measured due to water noise from the adjacent river. It is understood that noise from flowing water is typically present at this location. Due to its specific nature, the background noise levels at this location have not been used to represent the background noise at any other location.

The correlation coefficient of each regression curve in Appendix E indicates the relationship between the background noise at the dwelling and the wind speed at the wind farm site. A low correlation co-efficient indicates a limited relationship, as will naturally occur in many circumstances including locations that are shielded from the wind across the wind farm site, rather than indicating any deficiency in the data analysis. The detailed background noise measurement methodology and data analysis (as outlined above) is the same for each location.

4 ASSESSMENT CRITERIA

The objective criteria summarised below have been used in the assessment to address the SEARs detailed in Section 2.

Wind Turbine Noise

The background noise levels (summarised in Table 8) have been used to establish noise criteria in Table 9 for each non-associated residence in accordance with SA 2009. Where background noise monitoring has not occurred at a residence, the criteria at the closest monitoring location, on the same side of the wind farm as the residence, have been assigned to that residence. The representative logging location corresponding to each residence is provided in Appendix C for determining the criteria at each residence.

Table 9 below summarises the criteria for non-associated residences based on each background noise logging location, as assigned in Appendix C.

Table 9: Wind turbine noise criteria (dB(A)) at non-associated residences.

Representative Residence ID	Wind Turbine Noise Criteria (dB(A)) for Integer Hub Height (166m AGL) Wind Speed									
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s
ILG001[4]	35	35	35	35	35	35	35	36	37	38
TMR019	35	35	35	35	35	35	35	35	35	35
TMR010	35	35	35	35	35	36	36	36	37	37
UAM005	37	37	37	37	37	37	37	37	37	37
UUN009	38	39	39	39	39	39	39	40	40	40
UUN011	35	35	35	35	35	35	35	35	35	35
YARR003	35	35	35	35	35	35	35	35	35	35
GUL010	36	36	35	36	36	36	36	37	36	36
HR001	35	35	35	35	35	35	35	35	35	37
LPBR004	35	35	35	35	35	35	36	37	38	35
LPBR008	35	35	35	35	35	35	35	36	37	38
LPBR013	35	35	35	35	35	35	35	36	37	38
LPBR014	35	35	35	35	35	35	35	37	39	40
LPBR017	35	35	35	35	35	35	35	36	37	39
TMR006	35	35	35	35	35	35	35	35	30	30

Ancillary Infrastructure

A noise criterion of 30 dB(A) is applied at all non-associated residences, established in accordance with the NPI and includes (subtracted from the criterion) a 5 dB(A) correction factor for tonality.

[4] Although an associated residence, the background noise levels and criteria have been assigned to other non-associated residences in the vicinity (refer Appendix C).

Construction Noise

Noise levels from construction activity are compared with the $L_{Aeq(15min)}$ level below to determine the management level and mitigation requirements:

- Standard hours : *Noise affected* RBL + 10 dB , *Highly noise affected* 75 dB(A)
- Outside standard hours : *Noise affected* RBL + 5 dB

Traffic Noise

The road traffic noise criteria established in accordance with the RNP are $L_{Aeq,(1hour)}$ 55 dB(A) during the day (7am to 10pm) and $L_{Aeq,(1hour)}$ 50 dB(A) at night (10pm to 7am). Considering that the main impact from road traffic noise is during construction, and that the activity is temporary in nature, the relative increase criteria are not considered to be applicable.

Vibration

For construction activity occurring during the day time, the following maximum vibration criteria are applied at the dwellings based on the Technical Guideline:

- continous (vertical rms) : 10 – 20 mm/s^2
- impulsive (vertical rms) : 30 – 60 mm/s^2
- intermittent (vibration dose value) : 0.2 – 0.4 $m/s^{1.75}$

5 ASSESSMENT

5.1 Wind Farm Noise

5.1.1 Wind Turbine Layout and Details

The noise from the WTGs at the proposed wind farm has been predicted based on a worst case (highest noise level) representative WTG model for the 97 WTGs layout and 166m hub height. The coordinates of the WTGs are provided in Appendix B.

The three WTG model options currently under consideration are the Vestas *V162-5.6MW, Siemans Gamesa 170 6.0MW* and General Electric *GE5.5-158* . The sound power level data for the WTGs were sourced from the WTG manufacturers in the following documents:

- V162-5.6MW Third octave noise emission, 2019-23-01, Document Reference DMS 0079-5298_01;
- Technical Documentation – Wind Turbine Generator Systems 5.3/5.5-158 – 50 Hz, Product Acoustic Specifications, Normal Operation according to IEC Incl. Octave and 1/3rd Octave Band Spectra, Document Reference Noise_Emission-NO_5.3_5.5-158-50Hz_IEC_EN_r01; and,
- SG 6.0-170 Developer Package with document reference D2056872 / 02 and dated 2019-04-01.

Based on the available sound power level data for each of the turbine options, predictions of the noise from the wind farm have been made for the Vestas V162 wind turbine, without serrated trailing edge blades as this option had the highest sound power level of the three options. The predictions have been conducted based on this turbine to demonstrate that the noise criteria at residences can be achieved. The predictions will be updated for the final turbine selection and layout prior to construction of the wind farm to ensure compliance with the noise criteria.

The 1/3rd octave band and overall sound power levels of the WTG model used in the predictions are summarised in Table 10.

Table 10: 1/3 Octave band sound power levels of the Vestas V162 5.6MW WTG.

Frequency	Overall Sound Power Levels (dB(A)) at Hub Height (166m) Integer Wind Speed									
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s
6.3 Hz	14.2	14.2	15.2	18.2	21.1	23.9	25.1	25.1	24.6	24.6
8 Hz	21.5	21.4	22.4	25.5	28.4	31.2	32.5	32.4	32	31.9
10 Hz	27.9	27.9	28.9	32	34.9	37.7	39	38.9	38.5	38.4
12.5 Hz	34	34	35	38.1	41.1	43.9	45.1	45.1	44.7	44.6
16 Hz	40.4	40.4	41.3	44.5	47.5	50.3	51.6	51.5	51.1	51.1
20 Hz	45.8	45.8	46.7	49.9	52.9	55.7	57	57	56.6	56.5
25 Hz	50.8	50.8	51.8	55	58	60.8	62.1	62.1	61.7	61.6
31.5 Hz	55.7	55.8	56.7	59.9	62.9	65.7	67	67	66.6	66.6
40 Hz	60.4	60.5	61.4	64.6	67.6	70.5	71.7	71.7	71.4	71.3
50 Hz	64.5	64.5	65.4	68.6	71.6	74.5	75.7	75.7	75.4	75.4
63 Hz	68.3	68.3	69.2	72.4	75.5	78.3	79.6	79.5	79.2	79.2
80 Hz	71.9	71.9	72.8	76	79	81.9	83.1	83.1	82.8	82.8
100 Hz	74.9	74.9	75.8	79	82	84.8	86.1	86.1	85.8	85.8
125 Hz	77.5	77.6	78.4	81.6	84.6	87.5	88.7	88.7	88.5	88.4
160 Hz	80.1	80.2	81	84.1	87.2	90	91.2	91.2	91	91
200 Hz	82	82.2	82.9	86.1	89.1	91.9	93.1	93.1	92.9	92.9
250 Hz	83.7	83.8	84.5	87.7	90.7	93.5	94.7	94.6	94.5	94.5
315 Hz	85	85.2	85.9	89	92	94.7	95.9	95.9	95.8	95.8
400 Hz	86	86.2	86.9	89.9	92.9	95.7	96.8	96.8	96.7	96.7
500 Hz	86.6	86.8	87.4	90.5	93.4	96.2	97.3	97.3	97.2	97.2
630 Hz	86.9	87.1	87.7	90.7	93.6	96.3	97.4	97.4	97.4	97.4
800 Hz	86.8	87	87.5	90.5	93.4	96.1	97.2	97.2	97.2	97.2
1 kHz	86.3	86.5	87.1	90	92.9	95.6	96.6	96.6	96.7	96.7
1.25 kHz	85.5	85.8	86.3	89.2	92	94.7	95.7	95.7	95.8	95.8
1.6 kHz	84.3	84.6	85	87.9	90.7	93.3	94.3	94.3	94.4	94.5
2 kHz	82.8	83.1	83.5	86.3	89.1	91.6	92.6	92.6	92.8	92.9
2.5 kHz	81	81.3	81.7	84.5	87.2	89.7	90.6	90.7	90.9	90.9
3.15 kHz	78.8	79.1	79.4	82.1	84.8	87.3	88.2	88.2	88.5	88.6
4 kHz	76.1	76.4	76.7	79.4	82	84.4	85.3	85.4	85.7	85.7
5 kHz	73.2	73.6	73.8	76.4	79	81.4	82.3	82.3	82.7	82.7
6.3 kHz	69.9	70.3	70.5	73.1	75.6	77.9	78.8	78.8	79.2	79.3
8 kHz	66.1	66.6	66.7	69.2	71.6	73.9	74.7	74.8	75.2	75.3
10 kHz	62.3	62.7	62.8	65.2	67.6	69.8	70.6	70.6	71.1	71.2
Overall	**96.3**	**96.5**	**97.1**	**100.1**	**103**	**105.7**	**106.8**	**106.8**	**106.8**	**106.8**

5.1.2 Ancillary Infrastructure Layout and Details

Three potential locations have been identified for substations and two for energy storage (battery facility). The final layout of the infrastructure will be subject to detailed design and may be constructed at any or all of the nominated locations.

The main noise sources at the substation will be two 300MVA rated transformers, whilst the main noise sources at the energy storage facility will be battery inverters with a combined capacity of up to 150MW. The coordinates of the main noise source at each potential location are provided in Appendix B.

The sound power level of a 300MVA transformer has been derived from the Australian/New Zealand Standard *AS/NS60076.10:2009 Power transformers - Determination of sound levels (IEC 60076-10, Ed. 1(2001) MOD)*. The octave band sound power levels assumed for the transformer are provided in Table 11.

The total sound power levels for the battery inverters have been estimated based on 60 inverter package units with 2.5MW capacity (SMA *Sunny Central 2500-EV* inclusive of inverter, transformer and air conditioning), as provided in Table 11.

Table 11: Transformer and battery inverter sound power levels.

Equipment	Sound Power Level (dB(A)) for each Octave Band Centre Frequency (Hz)								Total Sound Power Level dB(A)
	63	125	250	500	1000	2000	4000	8000	
Transformer 300 MVA	79	87	95	97	89	86	79	75	100
Inverters 150 MW	79	87	99	97	98	100	108	97	110

5.1.3 Noise Propagation Model - CONCAWE

The predictions of environmental noise from the proposed wind farm have been made using the CONCAWE[5] noise propagation model and SoundPLAN noise modelling software. The sound propagation model considers the following influences:

- sound power levels and locations of noise sources;
- separation distances between noise sources and receivers;
- topography of the area;
- influence of the absorption provided by the ground;
- air absorption; and,
- meteorological conditions.

The CONCAWE system divides meteorological conditions into six separate “weather categories”, depending on wind speed, wind direction, time of day and level of cloud cover. Weather Category 1 provides the weather conditions associated with the “lowest” propagation of noise, whilst Weather Category 6 provides “worst-case” (i.e. highest noise level) conditions. Weather Category 4 provides “neutral” weather conditions for noise propagation (that is, conditions which do not account for the effects of temperature inversion or wind on propagation).

[5] CONCAWE - The oil companies’ international study group for conservation of clean air and water – Europe, ‘The propagation of noise from petrochemical complexes to neighbouring communities’, May 1981.

The following input conditions have been used in the prediction model:

- weather category 6 (night with no clouds and wind from the wind farm to the dwelling under consideration);
- atmospheric conditions at 10°C and 80% relative humidity;
- wind direction from all WTGs to the particular residence under consideration, even in circumstances where WTGs are located in opposite directions from the residence;
- acoustically soft ground to reflect the pastoral nature of the land; and,
- maximum barrier attenuation from topography of 2 dB(A).

5.1.4 Wind Turbine Noise

The noise levels at the residences in the vicinity of the wind farm from the representative WTG model have been predicted for each relevant wind speed and compared with the relevant noise criteria (as provided in Section 4). Table 12 provides the predicted noise level at all associated residences and the comparisons of criteria and predicted noise levels at the closest residences without agreements are summarised in Table 13.

The predictions were conducted without a penalty applied for the presence of excessive tonality. To provide certainty, it is recommended that a guarantee is sought from the manufacturer as part of the procurement process. The general form of the guarantee should be that a penalty for tonality is not applicable at any residence when tested in accordance with the methodology of the Bulletin (*ISO 1996.2:2007).*

The highest predicted low frequency noise level at non-associated residences is 53 dB(C) at ILG006, which is less than 60 dB(C) and therefore a penalty for excessive low frequency noise is not applicable.

A predicted noise level contour map corresponding to 9 m/s wind speed (results in the highest noise levels) is provided in Appendix F.

Based on the predictions, the noise from the wind farm will comply with the noise criteria at all non-associated residences, with the exception of ILG006 for wind speeds of 7m/s and greater.

Notwithstanding the above, ILG006 is understood to be a derelict house on land owned by Water NSW and therefore is not considered to be a relevant sensitive receptor.

Based on the above, the operation of the wind farm will achieve the project noise criteria at all relevant receivers.

Table 12: Predicted noise levels from *V162-5.6* WTGs at Associated Receivers.

Receiver ID	Predicted Noise Level (dB(A)) at Integer Wind Speed									
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s
UUN005	36	36	37	40	43	46	47	47	47	47
ILG005	30	31	31	34	37	40	41	41	41	41
ILG001	30	30	31	34	37	39	41	41	40	40
ILG003	30	30	30	33	36	39	40	40	40	40
ILG004	29	29	30	33	36	38	39	39	39	39
UUN004	26	26	26	30	33	35	36	36	36	36
WUU002	25	25	26	29	32	34	36	36	36	36
ILG002	22	23	23	26	29	32	33	33	33	33
UUN003	22	22	23	26	29	32	33	33	33	33
UUN002	21	21	22	25	28	31	32	32	32	32
TMR024	18	19	19	22	25	28	29	29	29	29
TMR025	17	17	18	21	24	26	28	28	27	27
TMR026	16	17	17	20	23	26	27	27	27	27
TMR027	15	15	16	19	22	24	26	26	25	25
UUN014	12	12	13	16	19	22	23	23	23	23
TMR043	4	5	5	9	12	14	16	16	15	15

Table 13: Predicted noise levels from *V162-5.6* WTGs and relevant criteria at Non-Associated Receivers.

Receiver ID	Representative Logging Location	Noise Level (dB(A)) at Integer Wind Speed																			
		3m/s		4m/s		5m/s		6m/s		7m/s		8m/s		9m/s		10m/s		11m/s		12m/s	
		Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction
ILG006****	ILG001	35	30	35	30	35	31	35	34	35	37	35	40	35	41	36	41	37	41	38	41
TMR016	TMR019	35	23	35	23	35	24	35	27	35	30	35	33	35	34	35	34	35	34	35	34
TMR022	TMR019	35	22	35	22	35	23	35	26	35	29	35	32	35	33	35	33	35	33	35	33
WUU007	ILG001	35	21	35	21	35	22	35	25	35	28	35	31	35	32	36	32	37	32	38	32
WUU008	ILG001	35	20	35	21	35	21	35	24	35	27	35	30	35	31	36	31	37	31	38	31
UUN007	YARR003	35	19	35	20	35	20	35	23	35	26	35	29	35	30	35	30	35	30	35	30
TMR031	ILG001	35	18	35	19	35	19	35	22	35	25	35	28	35	29	36	29	37	29	38	29
UUN001	ILG001	35	18	35	19	35	19	35	22	35	25	35	28	35	29	36	29	37	29	38	29
TMR023	ILG001	35	18	35	18	35	19	35	22	35	25	35	27	35	29	36	29	37	28	38	28
UUN008	YARR003	35	16	35	17	35	17	35	20	35	23	35	26	35	27	35	27	35	27	35	27
WUU005	ILG001	35	16	35	16	35	17	35	20	35	23	35	26	35	27	36	27	37	27	38	27

Receiver ID	Representative Logging Location	Noise Level (dB(A)) at Integer Wind Speed																			
		3m/s		4m/s		5m/s		6m/s		7m/s		8m/s		9m/s		10m/s		11m/s		12m/s	
		Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction
WUU006	ILG001	35	14	35	14	35	15	35	18	35	21	35	24	35	25	36	25	37	25	38	25
TMR050	TMR019	35	14	35	14	35	15	35	18	35	21	35	24	35	25	35	25	35	25	35	25
WUU001	ILG001	35	14	35	14	35	15	35	18	35	21	35	24	35	25	36	25	37	25	38	25
UUN013*	YARR003	35	14	35	14	35	14	35	18	35	21	35	23	35	25	35	24	35	24	35	24
TMR036	TMR019	35	13	35	14	35	14	35	17	35	20	35	23	35	24	35	24	35	24	35	24
TMR029	ILG001	35	13	35	13	35	14	35	17	35	20	35	22	35	24	36	24	37	23	38	23
TMR030	ILG001	35	12	35	13	35	13	35	16	35	19	35	22	35	23	36	23	37	23	38	23
WUU009	ILG001	35	12	35	13	35	13	35	16	35	19	35	22	35	23	36	23	37	23	38	23
TMR021	TMR019	35	12	35	12	35	13	35	16	35	19	35	22	35	23	35	23	35	23	35	23
TMR032	ILG001	35	11	35	11	35	12	35	15	35	18	35	21	35	22	36	22	37	22	38	22
TMR020	TMR019	35	11	35	11	35	11	35	14	35	17	35	20	35	21	35	21	35	21	35	21
YARR018	YARR003	35	10	35	10	35	11	35	14	35	17	35	20	35	21	35	21	35	21	35	21
TMR019	TMR019	35	10	35	10	35	11	35	14	35	17	35	19	35	21	35	21	35	20	35	20
TMR041	TMR019	35	10	35	10	35	10	35	14	35	17	35	19	35	21	35	21	35	20	35	20
TMR042	ILG001	35	9	35	9	35	10	35	13	35	16	35	19	35	20	36	20	37	20	38	20

* *Possible Future Dwelling*
**** *Derelict House on land owned by Water NSW*

5.1.5 Ancillary Infrastructure Noise

The noise level at residences in the vicinity of the potential substation and energy storage locations has been predicted based on the plant layout and details in Section 5.1.2.

Given the final locations are not yet known and to provide flexibility in the detailed design, predictions have been made based on all locations being used, although this is unlikely to occur. The noise level is predicted to be no more than 24 dB(A) at any residence, from the combined operation of all three substations and two energy storage facilities. Contours of the predicted noise levels are provided in Appendix F.

Based on the predictions, the criterion of 30 dB(A) will be achieved at all locations and as such will not adversely impact on the amenity of residences in the locality of the substation and energy storage facility.

5.2 Construction Noise

The equipment and activities on site will vary throughout the project, depending on various stages of construction. The predicted noise from construction activity is presented as a worst case (highest noise level)

scenario, where it is assumed all equipment is present and operating simultaneously on site for each stage of construction.

The weather conditions used for the predictions are the most conducive for the propagation of noise, comprising an overcast day with a breeze from the construction activity to the receiver. Other weather conditions would result in lower noise levels than those predicted for day-time construction.

The separation distance of 1000m is approximately that of the closest non-associated dwelling (excluding potential future dwellings) to a proposed WTG. A separation distance greater than 1000m will result in lower noise levels than those presented in Table 14. The required separation distance in order to achieve the criterion of 40 dB(A)), which is 10 dB(A) above the RBL, is provided in Table 14.

Table 14: Predicted construction noise levels.

Phase	Main Plant and Equipment	Predicted Noise Level at 1000m	Separation to Achieve 40 dB(A) Criterion
Site Set-Up and Civil Works	Generator Transport truck Excavator Low loader	44 dB(A)	1650m
Road and Hard Stand Construction	Mobile crushing and screening plant Dozer Roller Low loader Tipper truck Excavator Scraper Transport truck	49 dB(A)	2400m
Excavation and foundation construction	Excavator Front end loader Concrete batching plant Mobile crushing and screening plant Truck-mounted concrete pump Concrete mixer truck Mobile crane Transport truck Tipper truck	49 dB(A)	2400m
Electrical Installation	Rock trencher Concrete mixer truck Low loader Tipper truck Mobile crane	49 dB(A)	2400m
Turbine Delivery and Erection	Extendable trailer truck Low loader Mobile crane	45 dB(A)	1800m

Based on the predicted noise levels, it is expected that construction noise will be greater than 40 dB(A) at a distance of 1000m. The predicted noise levels are significantly less than the 75 dB(A) upper limit provided in the ICN Guideline.

Table 14 indicates that it is possible for a dwelling to be located between 1000m and up to 2400m from construction activity, and may be defined as "noise affected" but not "highly noise affected" in the ICN Guideline. Such a definition under the ICN Guideline requires the developer to apply all feasible and reasonable work practices, and to inform the residents of the proposed construction work.

"Feasible and reasonable" noise control strategies to minimise noise during construction may include engineering measures such as the construction of temporary acoustic barriers, the use of proprietary enclosures around machines, the use of silencers, the substitution of alternative construction processes and the fitting of broadband reversing signals. It may also include administrative measures such as inspections, scheduling and providing training to establish a noise minimisation culture for the works.

The following mitigation measures are recommended to be implemented for the construction works and provide the framework for the development of a Construction Management Plan by the construction team once the final construction methods, timing, locations and equipment has been determined.

1. Scheduling

Construction works, including heavy vehicle movements into and out of the site, restricted to the hours between 7am and 6pm Monday to Friday, and between 8am and 1pm on Saturdays. Works carried out outside of the hours will only entail:

- works that do not cause noise emissions to be audible at any nearby residences not located on the site; or
- the delivery of materials as requested by Police or other authorities for safety reasons; or
- emergency work to avoid the loss of lives, property, and/or to prevent environmental harm.

If any other works are required outside of the specified hours, they will only be carried out with the prior consent of the relevant New South Wales authority.

2. Location of Fixed Noise Sources

Locate fixed noise sources such as crushing and screening plant, concrete batching plant, generators and compressors at the maximum practicable distance to the nearest residences, and where possible, use existing landforms to block line of sight between the fixed noise source and the residence.

3. Provide Acoustic Screens around Fixed Noise Sources

Provide acoustic screens or mounding for fixed crushing and screening plant, and concrete batching plant wherever these noise sources are located within 2400m of a non-associated residence and do not have direct line of sight blocked to that residence, in accordance with the following requirements:

- Locate the screen as close as practicable to the noise source;
- Construct from mounding using excavated soil from the site or a material with a minimum surface density of 10 kg/m^2, such as 1.2mm thick sheet steel or 9mm thick compressed fibre cement sheeting, or use purpose built transportable sound barriers such as the Peace "Sound Barriers";
- Construct to a minimum height that blocks direct line of sight between the noise source and any receiver within 2400m;
- Construct such that there are no air gaps or openings at joints;
- Extend such that the length is at least 5 times greater than its height or so that it is bent around the noise source.

In addition, the site topography, and other shielding features (e.g. large stationary machines, mounds of topsoil and piles of materials) should be used for increased shielding when locating fixed noise sources within the 2400m distance.

4. Enclose Generators and Compressors

Provide proprietary acoustic enclosures for site compressors and generators located within 2400m of a non-associated residence.

5. Alternative Processes

Investigate and implement alternative processes where feasible and reasonable, such as hydraulic or chemical splitters as an alternative to impact rock breaking, or the use of broadband reversing alarms in lieu of the high pitched devices. A broadband reversing alarm emits a unique sound which addresses the annoyance from the high pitched devices. The fitting of a broadband alarm should be subject to an appropriate risk assessment, with the construction team being responsible for ensuring the alarms are installed and operated in accordance with all relevant occupational, health and safety legislative requirements.

6. Site Management

- Select and locate centralised site activities and material stores as far from noise-sensitive receivers as possible;

- Care should be taken not to drop materials such as rock, to cause peak noise events, including materials from a height into a truck. Site personnel should be directed as part of a training regime to place material rather than drop it;
- Plant known to emit noise strongly in one direction, such as the exhaust outlet of an attenuated generator set, shall be orientated so that the noise is directed away from noise sensitive areas if practicable;
- Machines that are used intermittently shall be shut down in the intervening periods between works or throttled down to a minimum;
- Implement worksite induction training, educating staff.

7. Equipment and Vehicle Management

- Ensure equipment has Original Equipment Manufacturer (OEM) mufflers (or better) installed;
- Ensure equipment is well maintained and fitted with adequately maintained silencers which meet the OEM design specifications. This inspection should be part of a monitoring regime;
- Ensure silencers and enclosures are intact, rotating parts are balanced, loose bolts are tightened, frictional noise is reduced through lubrication and cutting noise reduced by keeping equipment sharp. These items should be part of a monitoring regime;
- Use only necessary power to complete the task;
- Inspect, as part of a monitoring regime, plant and equipment to determine if it is noisier than other similar machines, and replace or rectify as required.

8. Community Consultation

Implement the following noise and vibration elements into the overall community consultation process. The aim of the consultation is to ensure adequate community awareness and notice of expected construction noise.

The minimum elements should include:

- Regular Community Information newsletters, providing details of the construction plan and duration of the construction phases;
- A site notice board in a community location providing copies of the newsletters, updated construction program details, and contact details of relevant project team members;
- A feedback mechanism for the community to submit questions to the construction team, and for the construction team to respond;
- Regular updates on the construction activities to local authorities to assist in complaint management if necessary;

- Contact details of the project manager and/or site "Environmental Representative".

In addition, prior to any construction activity occurring within 2400m of a residence without an agreement, or significant construction traffic periods or impacts on local road conditions:

- Contact the local community potentially affected by the proposed works and inform them of the proposed work, the location of the work, the day(s) and date(s) of the work and the hours involved[6];
- This contact shall be made a reasonable time before the proposed commencement of the work; and
- Contact details of the project manager and / or site "Environmental Representative" should be provided.

The above measures should be incorporated and implemented through a Construction Noise Management Plan for the site. The Plan should be developed by the construction team once the actual construction activities have been determined.

5.3 Traffic Noise

The main impact from road traffic noise is during construction, which will include passenger vehicle and heavy vehicle movements to and from the site along local roads in the vicinity of the wind farm. These vehicles will include semi-trailers, low loaders, haulage trucks, mobile cranes, water tankers, four-wheel-drive vehicles and passenger vehicles.

The day-time criterion provided by the RNP is an equivalent noise level ($L_{Aeq,\ 1hour}$) of 55 dB(A) during any given hour.

It is predicted that at a distance of approximately 30m from the road side, the 55 dB(A) criterion can be achieved for 30 passenger vehicle movements and 9 heavy vehicle movements in one hour. Notwithstanding, the projected number of vehicles within one hour for specific local roads as part of the construction activity will exceeded the above levels. The vehicle numbers on Twelve Mile Road are estimated to average 16 heavy vehicles within one hour (spread throughout the day) and 120 light vehicles (concentrated at morning and evening peaks) . For this level of traffic flow, a noise level of approximately 58 dB(A) is predicted at a residence 30m from the road side. In addition, during peak construction activity, the traffic volume may include up to 21 heavy vehicles within one hour (spread throughout the day) and 200 light vehicles (concentrated at morning and evening peaks). For this level of activity and a setback distance of 30m, it is predicted noise levels would be approximately 60 dB(A).

6 It is preferable to overestimate the hours of work, rather than extending the work hours for longer than anticipated.

In accordance with the general principles of dealing with temporary construction noise impacts (compared to permanent operational noise) the following mitigation measures should be employed as part of the Construction Noise Management Plan to reduce construction traffic noise where the RNP is temporarily exceeded:

- Communicate with the affected community in accordance with the provisions above;
- Establish and maintain a route into the site so that heavy vehicles do not enter noise sensitive areas for access where practicable;
- Incorporate information regarding the route to all drivers prior to accessing the site and the need to minimise impacts through driver operation at certain locations;
- Schedule construction traffic deliveries such that it is as evenly dispersed as practicable;
- Restrict construction to the day-time operating hours for the construction site, subject to the scheduling caveats in the Construction Noise Management Plan.

5.4 Vibration

It is expected that the main sources of vibration associated with the project will be the rock trenching equipment and roller operation during the road and hard stand construction. The level of vibration at a distance will be subject to the energy input of the equipment and the local ground conditions. Typically, the distances required to achieve the construction vibration criteria provided in the Technical Guideline are in the order of 20m. At 100m distance, vibration from these activities is unlikely to be detectable to humans.

Based on the separation distances between the construction activities and the nearest residences being well in excess of 100m, vibration levels are expected to easily achieve the criteria.

If construction activities producing high levels of vibration occur within 100m of a dwelling, it is recommended that a monitoring regime is implemented during these times to ensure compliance with the Technical Guideline.

6 CONCLUSION

An environmental noise and vibration impact assessment has been made of the proposed Uungula Wind Farm based on the updated layout and arrangement, comprising 97 wind turbine generators (WTGs) and three potential WTG model options (Vestas *V162-5.6MW, Siemans Gamesa 170 6.0MW* and General Electric *GE5.5-158*).

The assessment was conducted in accordance with the Secretary's Environmental Assessment Requirement (SEARs), and specifically considered the following noise aspects and references:

- noise wind turbine noise – the *NSW Wind Energy: Noise Assessment Bulletin* (EPA/DPE, 2016);
- noise generated by ancillary infrastructure - *NSW Noise Policy for Industry* (EPA 2017);
- construction noise - *Interim Construction Noise Guideline* (DECC, 2009);
- traffic noise – *NSW Road Noise Policy* (DECCW, 2011); and,
- vibration – *Assessing Vibration: A Technical Guideline* (DECC, 2006).

The assessment predicted the noise levels at residences located within approximately 8km from the wind farm. Based on the predictions and analysis:

- the noise from the worst case (highest noise level) representative WTGs model will achieve the relevant noise criteria at all non-associated residences and wind speeds, with the exception of ILG006 for wind speeds of 7m/s and greater. Notwithstanding, it is understood that ILG006 is a derelict house, on land owned by Water NSW and not a sensitive receiver for the project. It is therefore considered the wind farm achieves the noise criteria at all relevant receivers;
- the noise from ancillary infrastructure at the proposed wind farm, mainly from the transformers at the substation and battery inverters at the energy storage facility, will be no greater than 30 dB(A) and therefore achieve the NPI;
- the noise from construction activity, road traffic and vibration can be addressed through the establishment of a construction noise and vibration framework that adequately controls noise and vibration from the construction of the project, consistent with the recommendations of the relevant guidelines and policy.

Based on the above, the construction and operation of the proposed Uungula Wind Farm can achieve the SEARs with the implementation of reasonable and practicable noise mitigation measures.

APPENDIX A: SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Planning Secretary's Environmental Assessment Requirements

Section 4.12(8) of the *Environmental Planning and Assessment Act 1979*
Schedule 2 of the Environmental Planning and Assessment Regulation 2000

Application Number	SSD 6687
Project Name	Uungula Wind Farm which includes the construction, operation and decommissioning of a wind farm with: · a maximum of 109 turbines and maximum height of 250 metres (to blade tip); and · ancillary infrastructure including access tracks, road upgrades, battery storage, electricity cabling, substations and grid connection.
Location	Approximately 20 km east of Wellington and 25 km west of Mudgee, within the Dubbo Regional local government area.
Applicant	Uungula Wind Farm Pty Ltd
Date of Issue	11/11/2019
General Requirements	The environmental impact statement (EIS) must be prepared in accordance with the requirements in Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (the Regulation). In particular, the EIS must include: · a stand-alone executive summary; · a full description of the development, including: - details of construction, operation and decommissioning, including any proposed staging of the development or refurbishing of turbines over time; - all infrastructure and facilities, such as substations, transmission lines, construction compounds, concrete batching plants, internal access roads, and road upgrades (including any infrastructure that would be required for the development, but the subject of a separate approvals process); - site plans and maps at an adequate scale with dimensions showing: o the location and dimensions of all project components including coordinates in latitude / longitude and maximum AHD heights of the turbines; o existing infrastructure, land use, and environmental features in the vicinity of the development, including nearby residences and approved residential developments or subdivisions within 5 km of a proposed turbine, and any other existing, approved or proposed wind farms in the region; and o the development corridor that has been assessed, including any allowance for micro-siting of turbines and identification of the key environmental constraints that have been considered in the design of the development; - details of the progressive rehabilitation of the site; · a list of any approvals that must be obtained before the development may commence; · the terms of any proposed voluntary planning agreement with the relevant local council · an assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including: - a description of the existing environment likely to be affected by the development using sufficient baseline data; - an assessment of the likely impacts of all stages of the development, taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans, industry codes of practice and including the *NSW Wind Energy Guideline for State Significant Wind Energy Development* (2016); - a description of the measures that would be implemented to avoid, mitigate and/or

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	offset residual impacts of the development and the likely effectiveness of these measures, including details of consultation with any affected non-associated landowners in relation to the development of mitigation management measures, and any negotiated agreements with these landowners; and - a description of the measures that would be implemented to monitor and report on the environmental performance of the development, including adaptive management strategies and contingency measures to address residual impacts; · a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; and · the reasons why the development should be approved having regard to: - relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act, evaluation of the merits of the project as a whole and how the principles of ecologically sustainable development have been incorporated in the design, construction and ongoing operations of the development; - the environmental, economic and social costs and benefits of the development, having regard to the predicted electricity demand in NSW and the National Electricity Market, the Commonwealth's Renewable Energy Target Scheme, and the greenhouse gas savings of the development; - a detailed consideration of the capability of the project to the security and reliability of the electricity system in the National Electricity Market, having regard to local system conditions and the Department's guidance on the matter; - the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses, including rural villages, rural dwellings, subdivisions, land of high scenic value, conservation areas (including National Parks / Reserves), strategic agricultural land, state forests, mineral resources, triangulation stations, tourism facilities, existing or proposed wind farms, and the capacity of the existing electricity transmission network to accommodate the development; and - feasible alternatives to the development (and its key components), including the consequences of not carrying out the development. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified person that includes an accurate estimate of the capital investment value of the development (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*).
Key issues	The EIS must address the following specific matters for the wind farm and associated infrastructure: **Landscape and Visual** – the EIS must include a detailed assessment of the visual impacts of all components of the project (including turbines, transmission lines, substations, and any other ancillary infrastructure) in accordance with the *Wind Energy: Visual Assessment Bulletin* (DPE, 2016); **Noise and Vibration** – the EIS must: · assess wind turbine noise in accordance with the *NSW Wind Energy: Noise Assessment Bulletin* (EPA/DPE, 2016); · assess noise generated by ancillary infrastructure in accordance with the *NSW Noise Policy for Industry* (EPA, 2017);

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- assess construction noise under the *Interim Construction Noise Guidelines* (DECC, 2009);
- assess traffic noise under the *NSW Road Noise Policy* (DECCW, 2011); and
- assess vibration under the *Assessing Vibration: A Technical Guideline* (DECC, 2006);

Biodiversity – the EIS must:

- assess biodiversity values and the likely biodiversity impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014) and *Framework for Biodiversity Assessment* (OEH, 2014), unless otherwise agreed by the Biodiversity and Conservation Division (BCD) (terrestrial biodiversity) or DPI Fisheries (aquatic biodiversity); and
- assess the impact of the development on birds and bats, including blade strike, low air pressure zones at the blade tips (barotrauma), alteration to movement patterns, and cumulative impacts of other wind farms in the vicinity;

Traffic and Transport – the EIS must:

- assess the construction, operational and decommissioning traffic impacts of the development;
- provide details of traffic volumes (both light and heavy vehicles) and transport routes during construction, operation and decommissioning, including traffic associated with sourcing raw materials (water, sand and gravel);
- assess the potential traffic impacts of the project on road network function (including intersection performance and site access arrangements and road safety, including school bus routes and school zones;
- assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the project (including over-mass / over-dimensional traffic haulage routes from port) during construction, operation and decommissioning;
- an assessment of the likely transport impacts to the site access and haulage routes, site access point, any rail safety issues, any Crown land, particularly in relation to the capacity and conditions of the roads;
- provide details of measures to mitigate and / or manage potential impacts including a schedule of all required road upgrades (including resulting from over mass / over dimensional traffic haulage routes), road maintenance contributions, and any other traffic control measures, developed in consultation with the relevant road authority;

Hazard / Risks – the EIS must include an assessment of the following:

- *Aviation Safety*:
  - assess the impact of the development under the *National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft*;
  - provide associated height and co-ordinates for each turbine assessed;
  - assess potential impacts on aviation safety, including cumulative effects of wind farms in the vicinity, potential wake / turbulence issues, the need for aviation hazard lighting, considering, defined air traffic routes, aircraft operating heights, approach/departure procedures, radar interference, communication systems, navigation aids;
  - identify aerodromes within 30 NM of the turbines and consider the impact to nearby aerodromes and aircraft landing areas;
  - address impacts on obstacle limitation surfaces, and
  - assess the impact of the turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the turbines and transmission line;
- *Telecommunications* – identify possible effects on telecommunications systems, assess impacts and mitigation measures including undertaking a detailed assessment to examine the potential impacts as well as analysis and agreement on the implementation of suitable options to avoid potential disruptions to radio communication services, which may include the installation and maintenance of alternative sites;

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	· *Health* – consider and document any health issues having regard to the latest advice of the National Health and Medical Research Council, and identify potential hazards and risks associated with electric and magnetic fields (EMF) and demonstrate the application of the principles of prudent avoidance; · *Bushfire* – identify potential hazards and risks associated with bushfires / use of bushfire prone land, including the risks that a wind farm would cause bush fire and any potential impacts on the aerial fighting of bush fires and demonstrate compliance with *Planning for Bush Fire Protection 2006* (if located on bushfire prone land); and · *Blade Throw* – assess blade throw risks, including potential interactions with battery storage; · *Battery Storage* – including a preliminary risk screening in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying SEPP 33* (DoP, 2011) and if the preliminary risk screening indicates the development is "potentially hazardous", a Preliminary Hazard Analysis (PHA) must be prepared in accordance with *Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis* (DoP, 2011) and *Multi-Level Risk Assessment* (DoP, 2011). **Heritage** – the EIS must: · assess the impact on Aboriginal cultural heritage impact (archaeological and cultural) in accordance with the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH, 2011) and the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW, 2010); · provide evidence of consultation with Aboriginal communities in determining and assessing impacts, developing options and selecting options and mitigation measures (including the final proposed measures), having regard to the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010); and · assess the impact on historic heritage having regard to the *NSW Heritage Manual.* **Water and Soils** – the EIS must: · quantify water demand, identify water sources (surface and groundwater), including any licensing requirements, and determine whether an adequate and secure water supply is available for the development; · access potential impacts on the quantity and quality of surface and groundwater resources, including impacts on other water users and watercourses; · where the project involves works within 40 metres of the high bank of any river, lake (including wetlands) or estuary (collectively waterfront land), identify likely impacts to the waterfront land, and how the activities are to be designed and implemented in accordance with the DPI *Guidelines for Controlled Activities on Waterfront Land* (2018) and (if necessary) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (DPI, 2003); and · describe the measures to minimise surface and groundwater impacts, including how works on steep gradient land or erodible soils types would be managed and any contingency requirements to address residual impacts. **Waste** – the EIS must: · identify, quantify and classify the likely waste stream to be generated during construction and operation, and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste.
Consultation	During the preparation of the EIS, you should consult with relevant local, State and Commonwealth Government authorities, service providers, community groups and affected landowners (including holders or applicants of mineral exploration licences, quarry operators and mineral title holders).

	In particular, you must: · establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects*, and consult with the committee during the preparation of the EIS; and · carry out detailed consultation with the following: - Mid-Western Regional Council - Dubbo Regional Council - Office of Environment and Heritage - Biodiversity and Conservation Division - Department of Industry - Resources and Energy - Department of Primary Industries (Office of Water, Fisheries and Agriculture) - Roads and Maritime Services - Western Region - Central Tablelands Local Land Services - NSW Rural Fire Service - Department of Defence - Civil Aviation Safety Authority - AirServices Australia The EIS must include a description of what consultation was carried out during the preparation of the EIS, identify the issues raised during this consultation, and explain how these issues have been addressed in the EIS.
Further consultation after 2 years	If you do not lodge a Development Application and EIS for the development within 2 years of the issue date of these SEARs, you must consult further with the Secretary in relation to the preparation of the EIS.
References	The assessment of the key issues listed above must take into account relevant guidelines, policies, and plans as identified. While not exhaustive, the following attachment contains a list of some of the guidelines, policies, and plans that may be relevant to the environmental assessment of this proposal.

APPENDIX B: WIND FARM LAYOUT AND COORDINATES

Coordinates of WTGs – 97 Turbine Layout

WTG ID	Coordinates (UTM WGS84 z55)	
	Easting	Northing
1	701569.5	6401928
2	701580.3	6401569
3	702290.2	6402040
4	702162.1	6401684
5	702705	6401224
6	703150	6400483
7	702682	6400548
8	703283	6400092
9	702984	6401995
10	703488	6401830
11	703872	6401744
12	704035	6401475
13	704347	6401535
14	704604	6401263
15	704809.9	6401030
16	705171	6400475
17	705387	6400027
18	705770	6400352
19	706034	6400846
20	706081	6399935
21	706299	6399576
22	706886	6400218
23	706481	6399295
24	706057	6399237
25	706059	6398848
26	702099	6399595
27	701876	6399255
28	701774	6398880
29	702407	6399045
30	702821	6399092
31	702079	6398630
32	701810	6398358
33	701484	6397999
34	702090	6397776

WTG ID	Coordinates (UTM WGS84 z55)	
	Easting	Northing
35	702525	6397933
36	702906	6397693
37	702590	6397388
38	702132	6397054
39	702861	6396851
40	702086	6396167
41	703685.2	6397101
42	703879	6397473
43	703804	6397974
44	704041	6398513
45	704586	6397614
46	704949	6398339
47	703497	6396749
48	703706	6396401
49	704083	6395983
50	704620	6396071
51	705155	6396493
52	704127	6395394
53	704556	6395230
54	704733	6394671
55	705344	6395169
56	705593	6395419
57	705826	6395769
58	705222	6394706
59	705792	6394572
60	706016	6394933
61	706235	6395084
62	706509	6395167
63	705936	6394269
64	706146	6393966
65	706406	6394271
66	706156.1	6393477
67	705801.3	6393240
68	706397.4	6393302

WTG ID	Coordinates (UTM WGS84 z55)	
	Easting	Northing
69	705897	6392850
70	705749	6392498
83	704248	6393006
84	704058	6393365
85	703599	6392997
86	701724	6392658
87	702031	6393018
88	700445	6392140
89	700586	6391683
90	701773.5	6394574
91	702139.3	6394678
92	701885	6395084
93	701616	6395256
94	701060.2	6395204
95	701044.6	6395562
96	701221.2	6396484
97	700895	6396735
98	700584	6397185
99	700086	6396718
100	699414	6396443
101	699689	6396138
102	700211	6395928
103	699644	6395773
104	698793	6396400
105	698662	6395948
106	698111.4	6394707
107	697381	6396261
108	697176	6395899
109	696892	6395306

Coordinates of Substation and Energy Storage Plant

Potential Location	Substation Coordinates (UTM WGS84 z55)		Energy Storage Coordinates (UTM WGS84 z55)	
	Easting	Northing	Easting	Northing
Location A	699454	6401671	699313	6401722
Location B	702954	6398395	703094	6398458
Location C	695405	6404682	N/A	

APPENDIX C: NOISE SENSITIVE RECEIVERS

Receiver ID	Landowner Agreement	Coordinates (UTM WGS84 z55))		Representative Logging Location
		Easting	Northing	
TMR023	No	699748.3	6404640	ILG001
TMR021	No	704031.9	6407244	TMR019
UUN010	No	713500.4	6400255	YARR003
TMR031	No	699902.4	6404592	ILG001
UAM006	No	708560.4	6408529	TMR019
TMR025	Yes	698778.9	6403943	N/A
YARR014	No	717682.5	6392503	YARR003
TMR022	No	703335.8	6404755	TMR019
YARR006	No	713968.7	6398069	YARR003
UUN005	Yes	704342.7	6400268	N/A
YARR008	No	714627.9	6395991	YARR003
TMR017	No	711875.2	6405721	TMR019
UAM005	No	710860.6	6409832	UAM005
UUN004	Yes	698948.4	6399242	N/A
TMR008	No	713983.8	6404999	TMR010
UUN011	No	713989.7	6402382	UUN011
YARR013	No	716302.8	6391861	YARR003
ILG002	Yes	696067.4	6397987	N/A
WUU002	Yes	695870.4	6397135	N/A
YARR003	No	715224.9	6401187	YARR003
UUN008	No	710256.6	6396024	YARR003
ILG004	Yes	699691.7	6393372	N/A
TMR027	Yes	697882	6403657	N/A
UUN003	Yes	697072	6398768	N/A
YARR004	No	713887	6400662	YARR003
TMR019	No	708735	6405892	TMR019
YARR009	No	714920.3	6396467	YARR003
UUN009	No	714173.3	6399311	UUN009
YARR001	No	714386.7	6402649	UUN011
TMR009	No	714181.9	6404568	TMR010
TMR010	No	713699	6403801	TMR010
TMR020	No	705420.1	6407309	TMR019
TMR030	No	696323.5	6402510	ILG001
UUN002	Yes	696631	6398772	N/A
WUU001	No	694686.3	6399451	ILG001
YARR012	No	716432.5	6392353	YARR003
TMR014	No	712773.6	6402982	UUN011
TMR015	No	713210.3	6402471	UUN011
TMR024	Yes	699104.4	6403775	N/A
TMR029	No	696861.1	6402971	ILG001
TMR013	No	713247.1	6402890	UUN011
TMR012	No	713480.6	6403225	UUN011
TMR011	No	713468	6403802	TMR010
YARR002	No	715616.5	6401272	YARR003
YARR005	No	714339.8	6398476	YARR003
WUU005	No	694460.8	6393267	ILG001
ILG001	Yes	698565.3	6397763	N/A
ILG003	Yes	699928.9	6393647	N/A
ILG005	Yes	699964.4	6392840	N/A
TMR026	Yes	698626.8	6403970	N/A
YARR011	No	716793.4	6393097	YARR003
YARR010	No	715128.9	6396432	YARR003
YARR007	No	714968.5	6396111	YARR003
UUN012*	No	713886.5	6402753	UUN011

Receiver ID	Landowner Agreement	Coordinates (UTM WGS84 z55))		Representative Logging Location
		Easting	Northing	
WUU006	No	694589.3	6392576	ILG001
UAM005B	No	712591.3	6408034	UAM005
UUN013*	No	710832.6	6393491	YARR003
TMR042	No	692986	6400016	ILG001
WUU007	No	694872.3	6396232	ILG001
WUU008	No	694625	6395249	ILG001
WUU009	No	694644	6391758	ILG001
WUU010	No	693864.4	6389835	ILG001
TMR032	No	695056.2	6401317	ILG001
TMR033	No	692477.8	6400156	ILG001
TMR034	No	691974.3	6399982	ILG001
TMR041	No	708841.9	6405894	TMR019
YARR016	No	717269.2	6391275	YARR003
TMR043	Yes	691203.7	6401151	N/A
TMR036	No	701340	6406613	TMR019
WUU011	No	695586	6387408	ILG001
BDR001	No	714866	6388572	YARR003
YARR017	No	715205.2	6391509	YARR003
ENC001**	No	711775.1	6387846	YARR003
BDR002	No	713925.7	6386527	YARR003
GUNR003	No	703545.3	6409452	TMR019
GUNR002	No	703631.8	6409764	TMR019
GUNR001	No	703351.7	6409949	TMR019
GOOR002	No	699848.8	6410699	TMR019
GOOR001	No	696912.6	6409394	ILG001
BRR001	No	689531.4	6398061	ILG001
GIL001	No	689629.9	6395581	ILG001
GIL002	No	691609.3	6392088	ILG001
BCR001	No	692255	6391476	ILG001
BCR003	No	693439.7	6388914	ILG001
YARR018	No	712846.5	6395298	YARR003
GUNR004	No	703597.4	6409610	TMR019
BRR002	No	689721.6	6399010	ILG001
TMR044	No	687695.1	6400010	ILG001
TMR045	No	686987.3	6400382	ILG001
TMR046	No	686592.7	6399526	ILG001
CAD003	No	686241.4	6400043	ILG001
CAD001	No	685775.2	6400021	ILG001
CAD002	No	685856.6	6400080	ILG001
CAD004	No	686023.9	6400202	ILG001
CAD005	No	686372	6400140	ILG001
CADP001	No	686083.4	6400261	ILG001
CADP002	No	686020	6400321	ILG001
CADP003	No	685885.8	6400312	ILG001
CADP004	No	685945.9	6400401	ILG001
CADP005	No	685804.8	6400365	ILG001
CADP006	No	685832.2	6400431	ILG001
TMR047	No	685577.3	6400038	ILG001
TMR048	No	685377.5	6400025	ILG001
TMR049	No	685188.3	6398333	ILG001
INV001	No	691514.6	6405373	ILG001
TMR016	No	708493.2	6401455	TMR019
TMR050	No	704124.6	6406614	TMR019
RCECC***	No	696019.5	6383901	ILG001

Receiver ID	Landowner Agreement	Coordinates (UTM WGS84 z55))		Representative Logging Location
		Easting	Northing	
UUN014	Yes	694961.9	6400932	N/A
GR016	No	724430.2	6412353	HR001
TMR001	No	719627.6	6411785	TMR006
UPBR002	No	725046	6397164	LPBR013
GR038	No	705395.5	6412065	UAM005
HR002	No	725288.6	6407242	HR001
TMR004	No	718769.6	6407740	TMR006
TMR002	No	719069.1	6411150	TMR006
GR018	No	724306.2	6411621	HR001
GUL010	No	729358.3	6407323	GUL010
UAM001	No	716359.9	6411084	TMR006
LPBR004	No	722523.2	6404886	LPBR004
GR032	No	723694.8	6411637	HR001
LPBR001	No	722155.4	6408406	HR001
GR034	No	721817	6411673	HR001
UPBR001	No	726494	6398481	LPBR013
UAM004	No	713035.1	6410390	UAM005
GR021	No	724037.9	6413333	HR001
LPBR015	No	726790.4	6401132	LPBR014
GR035	No	722173.7	6411919	HR001
GR033	No	722742.9	6412070	HR001
LPBR006	No	721581.6	6402958	LPBR008
LPBR008	No	723176.6	6401780	LPBR008
LPBR007	No	723324.6	6402186	LPBR008
LPBR009	No	723293.1	6401771	LPBR008
LPBR012	No	725283	6400813	LPBR013
TMR005	No	716996.3	6409759	TMR006
UPBR004*	No	722786	6397974	LPBR013
UAM002	No	715478.5	6410986	TMR006
GR037	No	718996.7	6412339	TMR006
GR036	No	720165.1	6412963	TMR006
GR019	No	723693.7	6412175	HR001
GR031	No	723853.3	6411462	HR001
GR030	No	724233.3	6411288	HR001
GR026	No	724854.7	6413744	HR001
GR012	No	726718.5	6413847	GUL010
TMR007	No	715929.7	6407887	TMR006
TMR006	No	716226.2	6409344	TMR006
TMR003	No	719008.6	6407773	TMR006
LPBR002	No	722085.1	6408266	HR001
LPBR005	No	722278.4	6404312	LPBR004
LPBR011	No	725008.8	6400970	LPBR013
LPBR016	No	727084.9	6401777	LPBR017
UPBR003	No	723982.8	6395653	LPBR013
LPBR019	No	729735.2	6400050	LPBR017
LPBR018*	No	728109.6	6401764	LPBR017
GUL001	No	732561.9	6404678	GUL010
GUL002	No	732250.8	6404749	GUL010
GUL003	No	732193.3	6404642	GUL010
GUL006	No	732022.1	6404850	GUL010
GUL007	No	731913.6	6405282	GUL010
HR001	No	724808.2	6407031	HR001
GR002	No	731755.4	6411477	GUL010
GR001	No	731832.2	6412093	GUL010
UAM003	No	713866.7	6411614	TMR006
LPBR014	No	726003	6401582	LPBR014
LPBR013	No	725270.1	6400792	LPBR013

Receiver ID	Landowner Agreement	Coordinates (UTM WGS84 z55))		Representative Logging Location
		Easting	Northing	
GR017	No	723424.4	6399340	LPBR013
LPBR010	No	724472.3	6401368	LPBR013
UUN001	No	697288.1	6400243	ILG001
GUL008*	No	730441.4	6405306	GUL010
GUL009	No	729669.4	6406564	GUL010
GR022	No	724410.6	6413312	HR001
GR023	No	724506.8	6413375	HR001
GR024	No	724655.9	6413512	HR001
GR028	No	725213.2	6413825	HR001
GR029	No	725302.4	6413886	HR001
GR011	No	726797.8	6413145	GUL010
GR013	No	725685.2	6413536	HR001
GR014	No	725226.3	6412990	HR001
GR003	No	729587.4	6412973	GUL010
GR004	No	729361.2	6412832	GUL010
GR005	No	729138.6	6412912	GUL010
GR008	No	728728.1	6412861	GUL010
GR007	No	728769.9	6412777	GUL010
GR009	No	728541.8	6412740	GUL010
GR006	No	728859.3	6412426	GUL010
GR010	No	728342.8	6412556	GUL010
GUL005	No	732156.7	6404859	GUL010
GTW001	No	732981.1	6405492	GUL010
YARR015	No	722158.4	6394222	LPBR013
TMR038	No	714987.5	6409509	TMR006
TMR039	No	715028.5	6409026	TMR006
TMR040	No	715539.6	6408645	TMR006
YARR019	No	718066.3	6389772	UUN009
LPBR020	No	732952.6	6400448	LPBR017
LPBR021	No	732569.1	6399688	LPBR017
UPBR005	No	730154.5	6399345	LPBR017
UPBR006	No	730453.2	6398923	LPBR017
UPBR007	No	730423.8	6398750	LPBR017
UPBR008	No	730387.7	6398533	LPBR017
UPBR009	No	730325.9	6398395	LPBR017
UPBR010	No	730318.3	6398278	LPBR017
UPBR011	No	730272.6	6398163	LPBR017
UPBR012	No	730160.2	6397970	LPBR017
UPBR013	No	729866	6397850	LPBR017
UPBR014	No	729873.4	6397715	LPBR014
UPBR015	No	729681.2	6397615	LPBR014
UPBR016	No	729460.6	6397505	LPBR013
UPBR020	No	727419.6	6398144	LPBR013
UPBR017	No	727293.5	6397021	LPBR013
UPBR021	No	726948.3	6395542	LPBR013
UPBR018	No	727057.8	6397210	LPBR013
UPBR019	No	724991.1	6397009	LPBR013
LPBR022	No	731054.2	6399957	LPBR017
LPBR023	No	728315.2	6401141	LPBR017
LPBR024	No	728373.7	6400785	LPBR017
LPBR025	No	725784.9	6400180	LPBR013
LPBR026	No	723374.7	6401111	LPBR008
GL001	No	714047.1	6413758	TMR006
GL002	No	714514.4	6413852	TMR006
GR039	No	725061.3	6411976	HR001
GUL011	No	733018	6403606	GUL010
GUL012	No	731910.3	6404579	GUL010

GUL013	No	730062.3	6405982	GUL010
ILG006****	No	699837.8	6391385	ILG001
GR040	No	691922.2	6408030	ILG001
UUN007	No	709390.3	6396638	YARR003

* Potential future dwelling
** Holiday park
*** Convention Centre
**** Derelict House on Land owned by Water NSW

APPENDIX D: PHOTOGRAPHS OF LOGGING EQUIPMENT AT RESIDENCES

Noise Logger at HR001

Noise Logger at ILG001

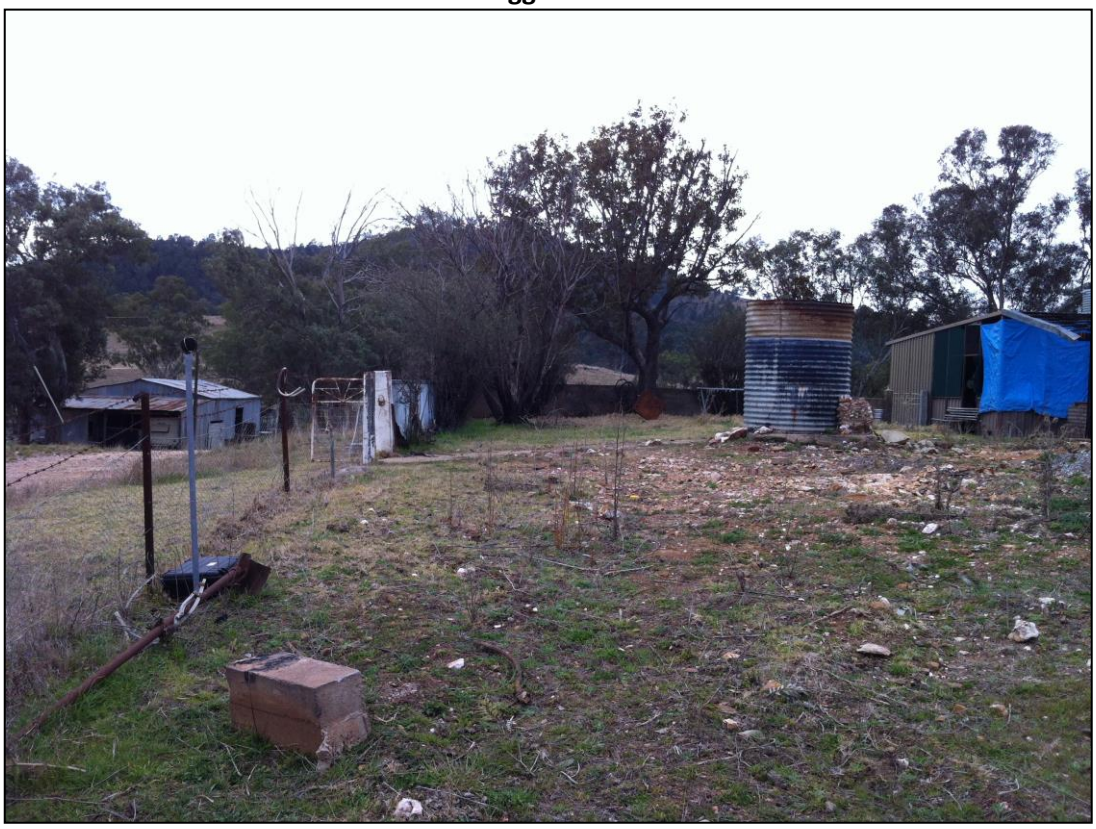
Noise Logger at LPBR004

Noise Logger at LPBR008

Noise Logger at LPBR014

Noise Logger at TMR006

Noise Logger at TMR010



Noise Logger at TMR019

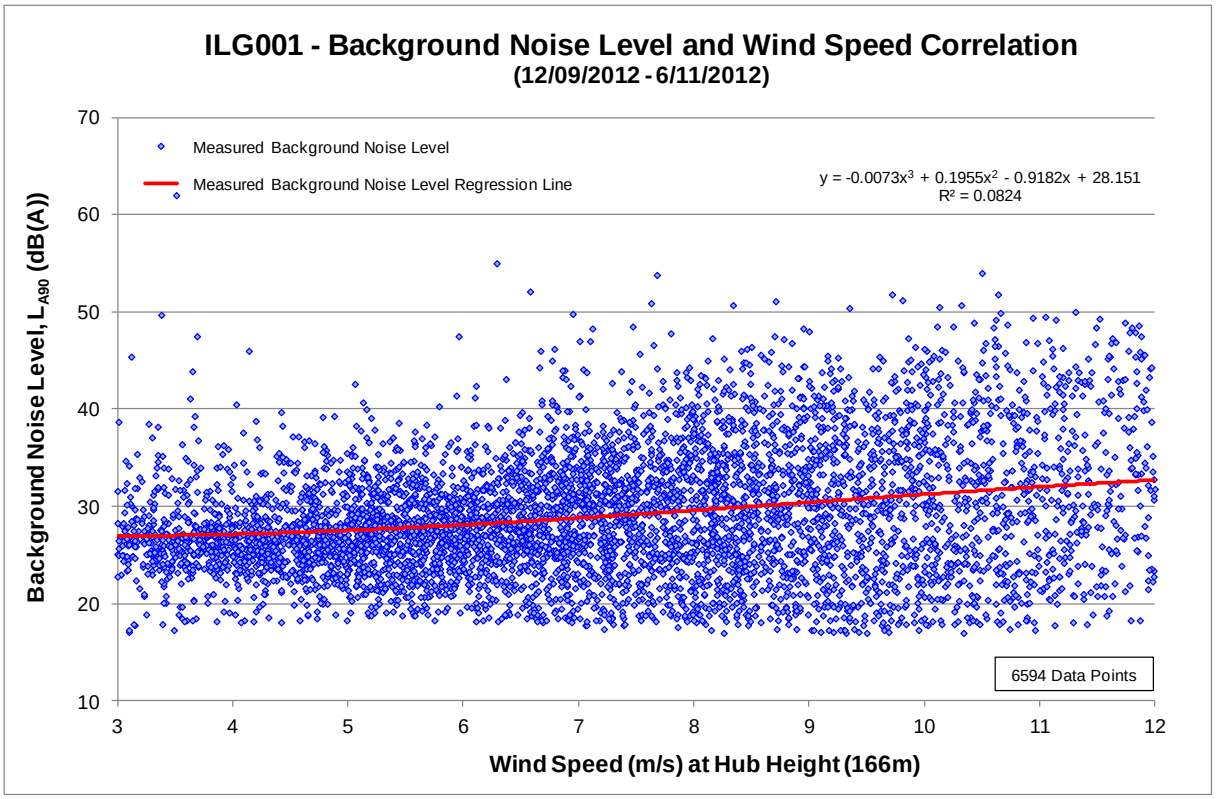
Noise Logger at UAM005

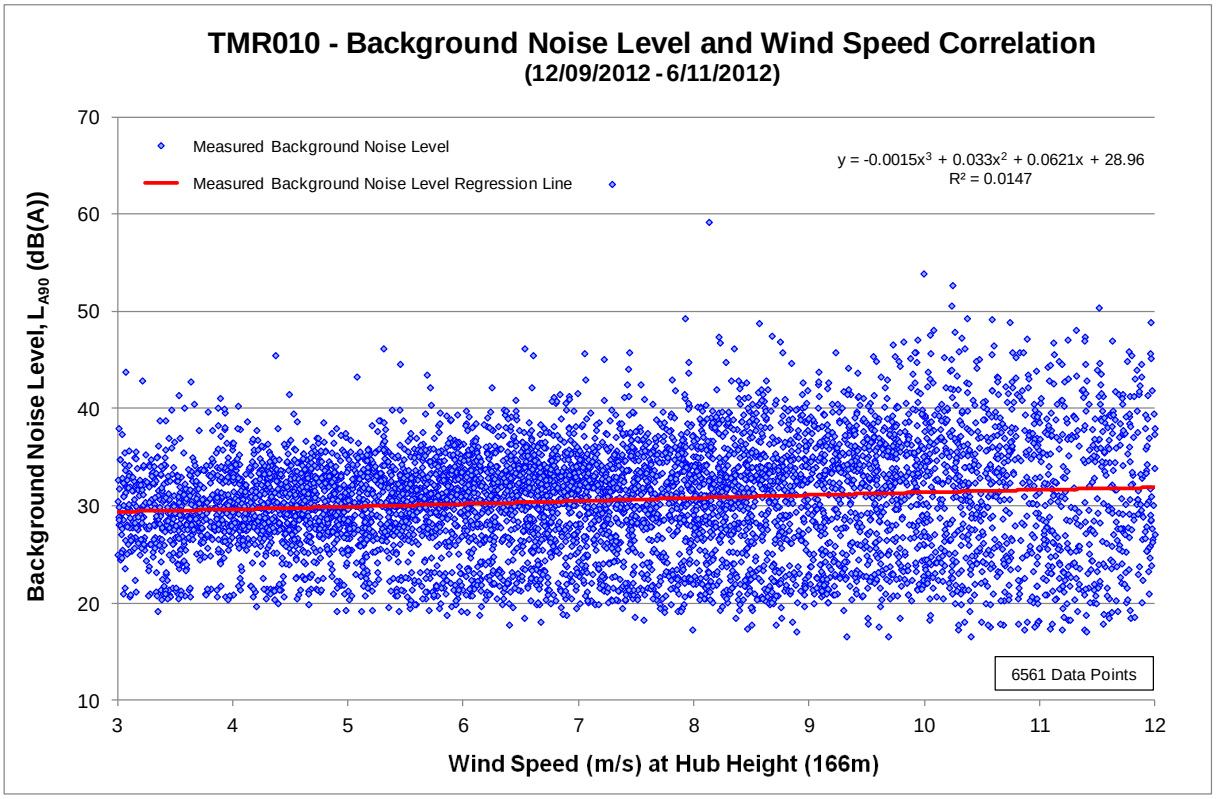
Noise Logger at UUN009

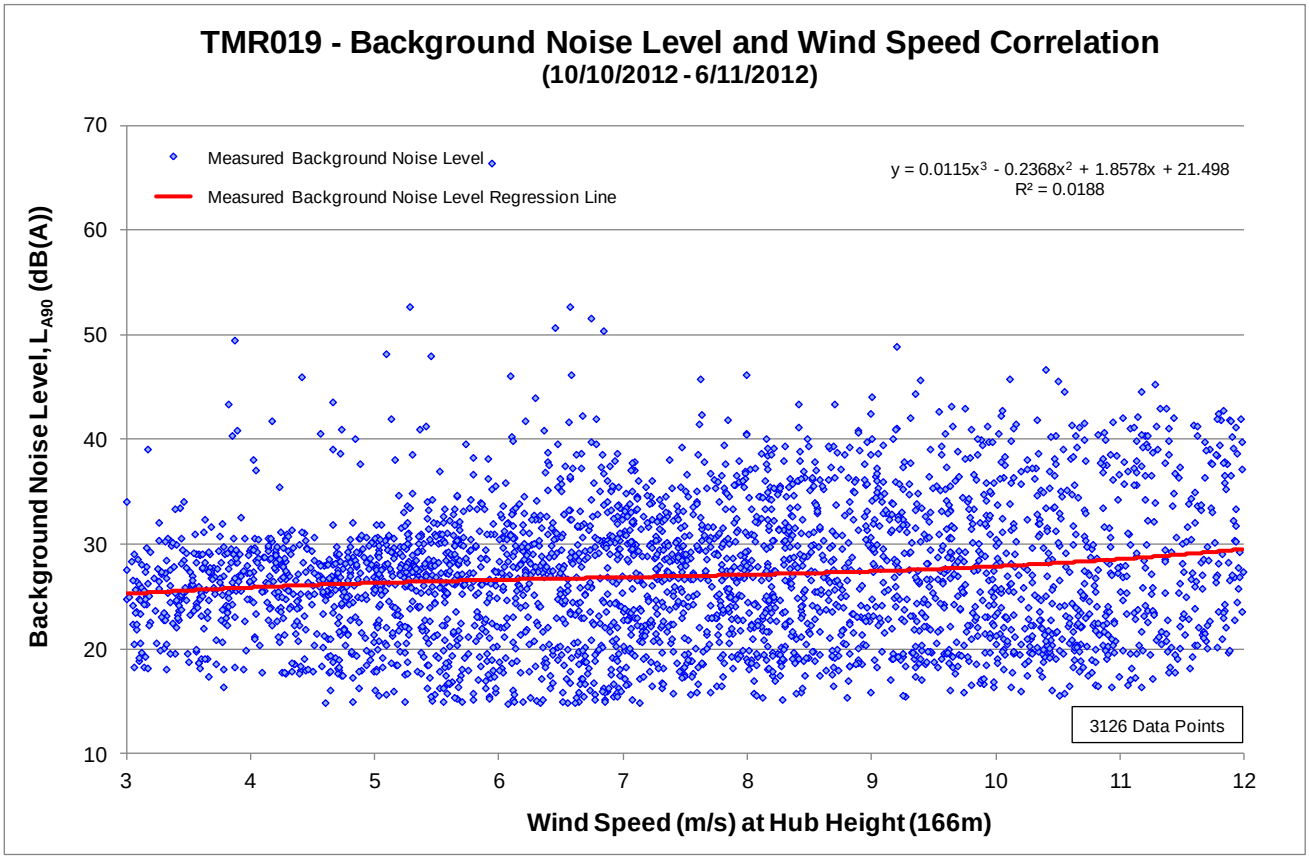
Noise Logger at UUN011

Noise Logger at YARR003

APPENDIX E: BACKGROUND NOISE AND WIND SPEED CORRELATION CURVES






TMR019 - Background Noise Level and Wind Speed Correlation
(10/10/2012 - 6/11/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = 0.0115x3 - 0.2368x2 + 1.8578x + 21.498
R² = 0.0188
3126 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
70
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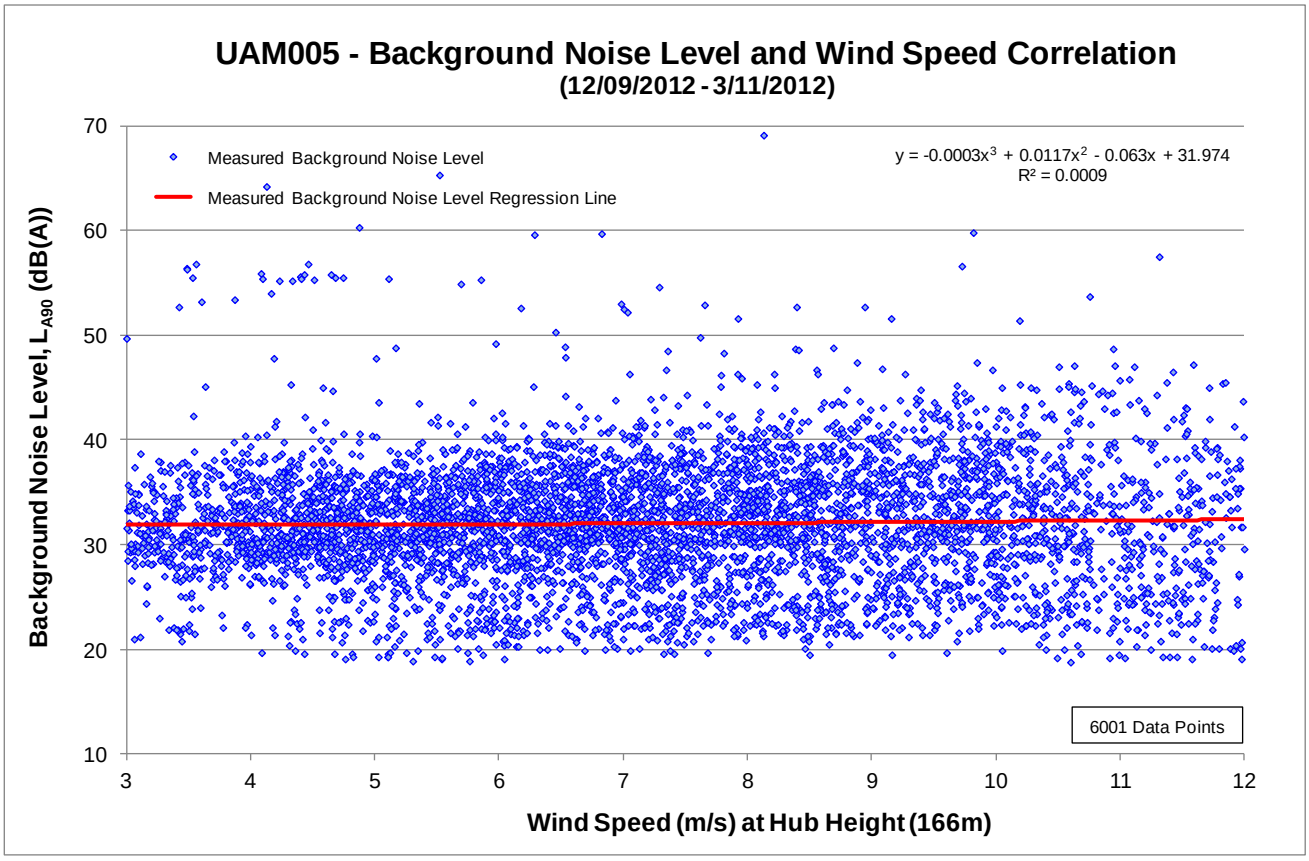
UAM005 - Background Noise Level and Wind Speed Correlation
(12/09/2012 - 3/11/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.0003x3 + 0.0117x2 - 0.063x + 31.974
R² = 0.0009
6001 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
70
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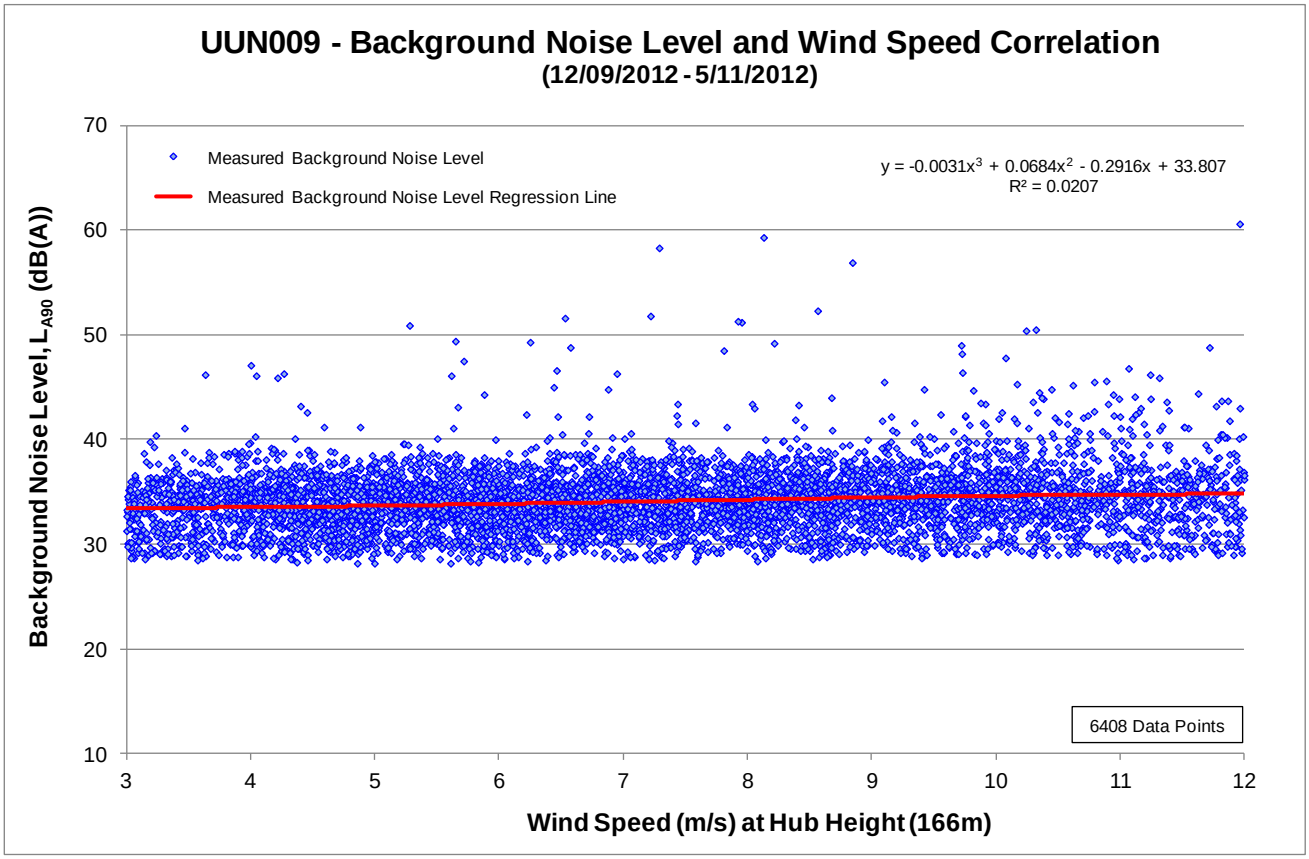
UUN009 - Background Noise Level and Wind Speed Correlation
(12/09/2012 - 5/11/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.0031x3 + 0.0684x2 - 0.2916x + 33.807
R² = 0.0207
6408 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
70
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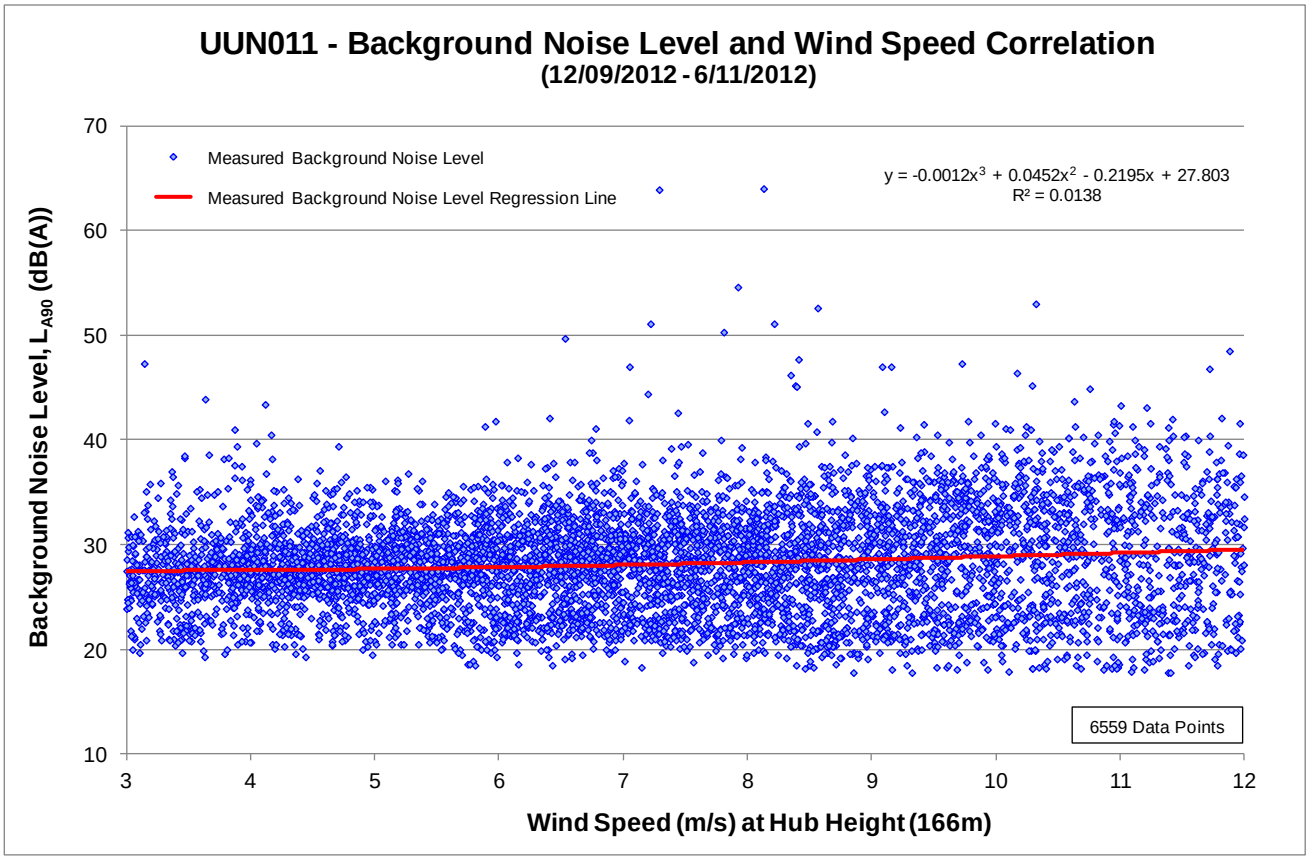
UUN011 - Background Noise Level and Wind Speed Correlation
(12/09/2012 - 6/11/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.0012x3 + 0.0452x2 - 0.2195x + 27.803
R² = 0.0138
6559 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
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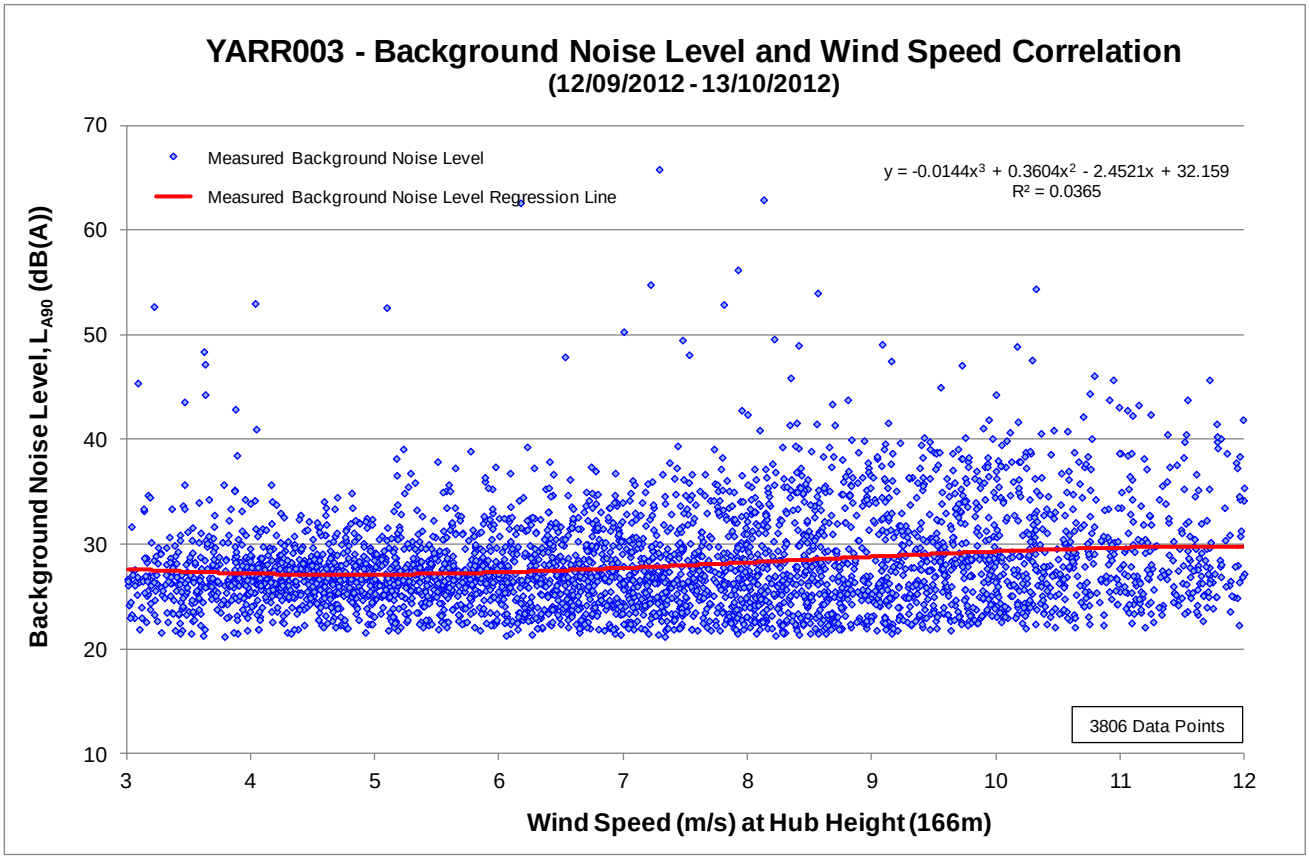
YARR003 - Background Noise Level and Wind Speed Correlation
(12/09/2012 - 13/10/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.0144x³ + 0.3604x² - 2.4521x + 32.159
R² = 0.0365
3806 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
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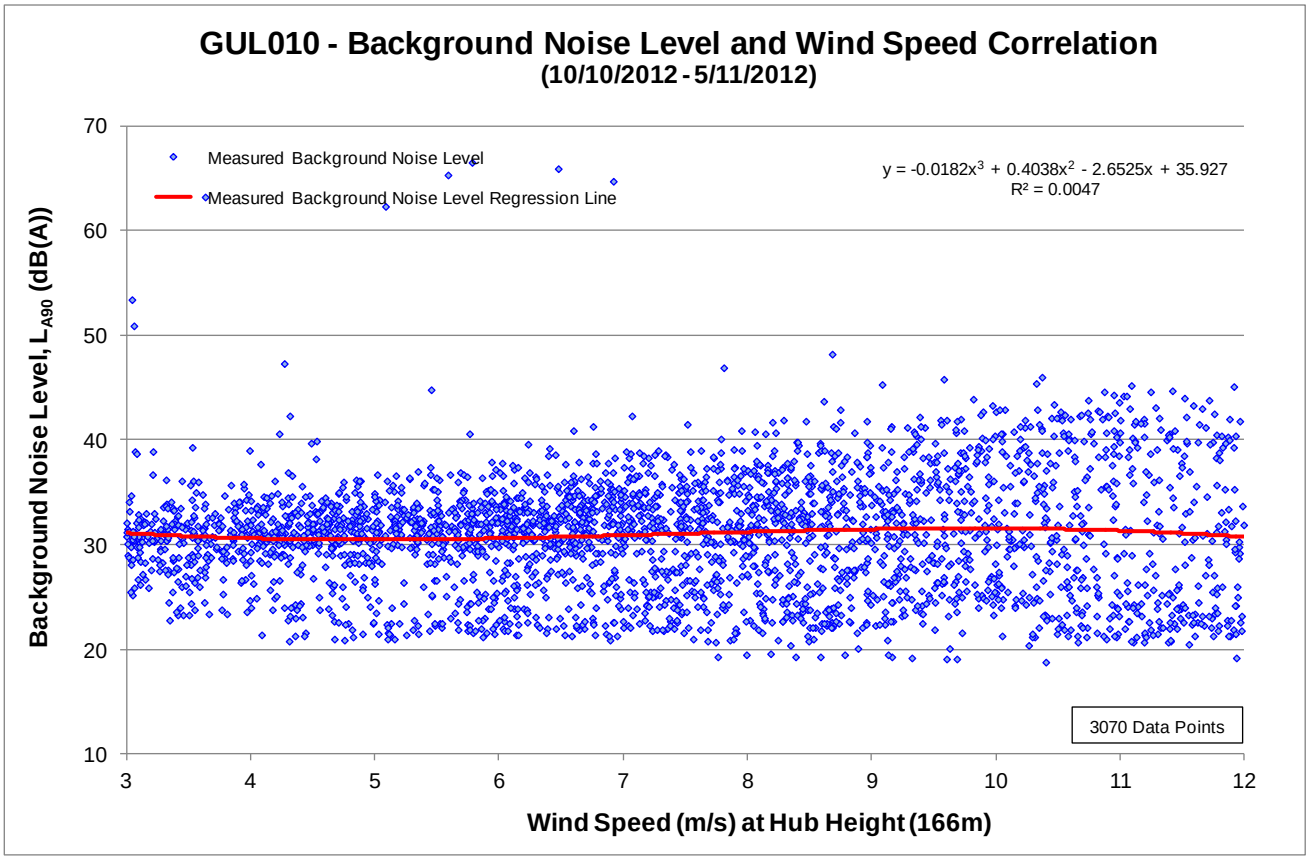
GUL010 - Background Noise Level and Wind Speed Correlation
(10/10/2012 - 5/11/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.0182x³ + 0.4038x² - 2.6525x + 35.927
R² = 0.0047
3070 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
70
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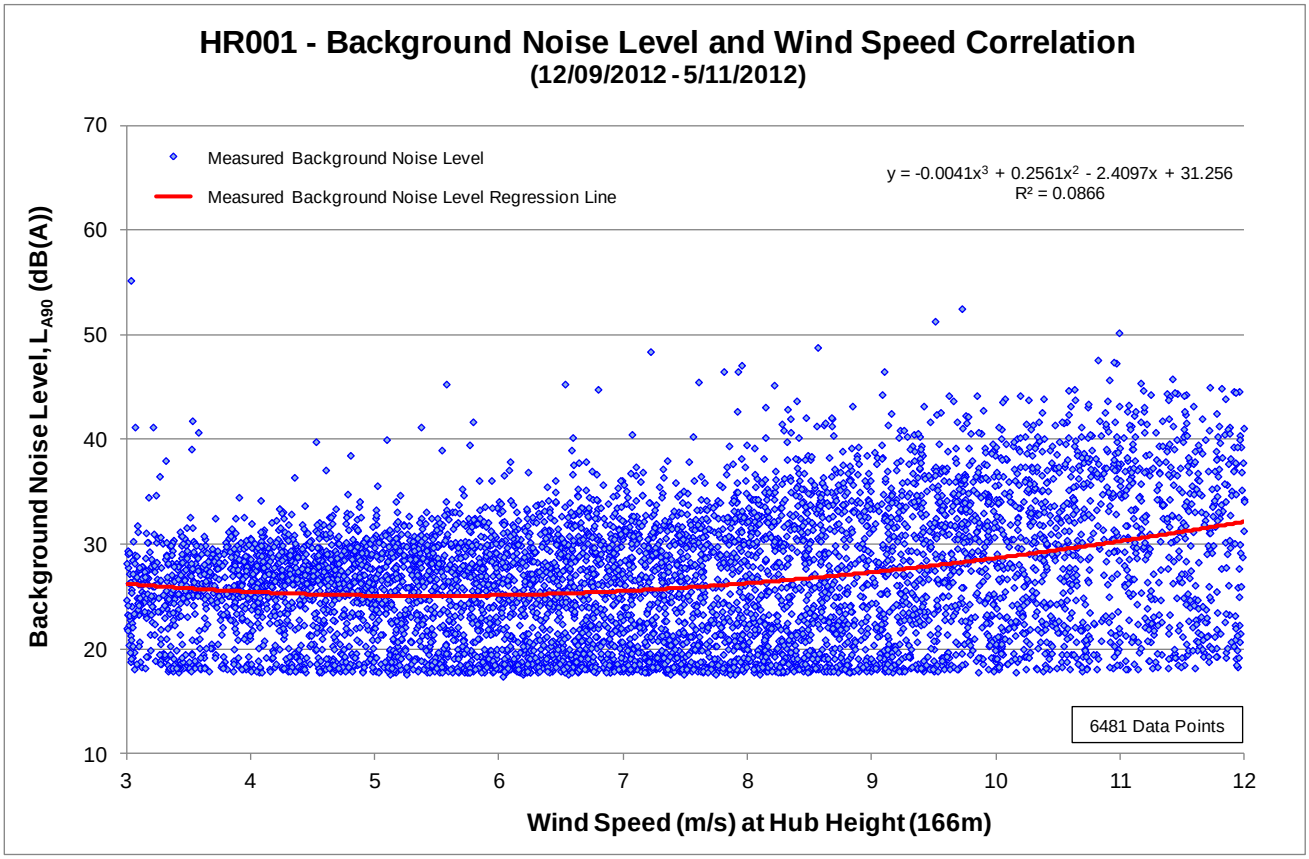
HR001 - Background Noise Level and Wind Speed Correlation
(12/09/2012 - 5/11/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.0041x³ + 0.2561x² - 2.4097x + 31.256
R² = 0.0866
6481 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
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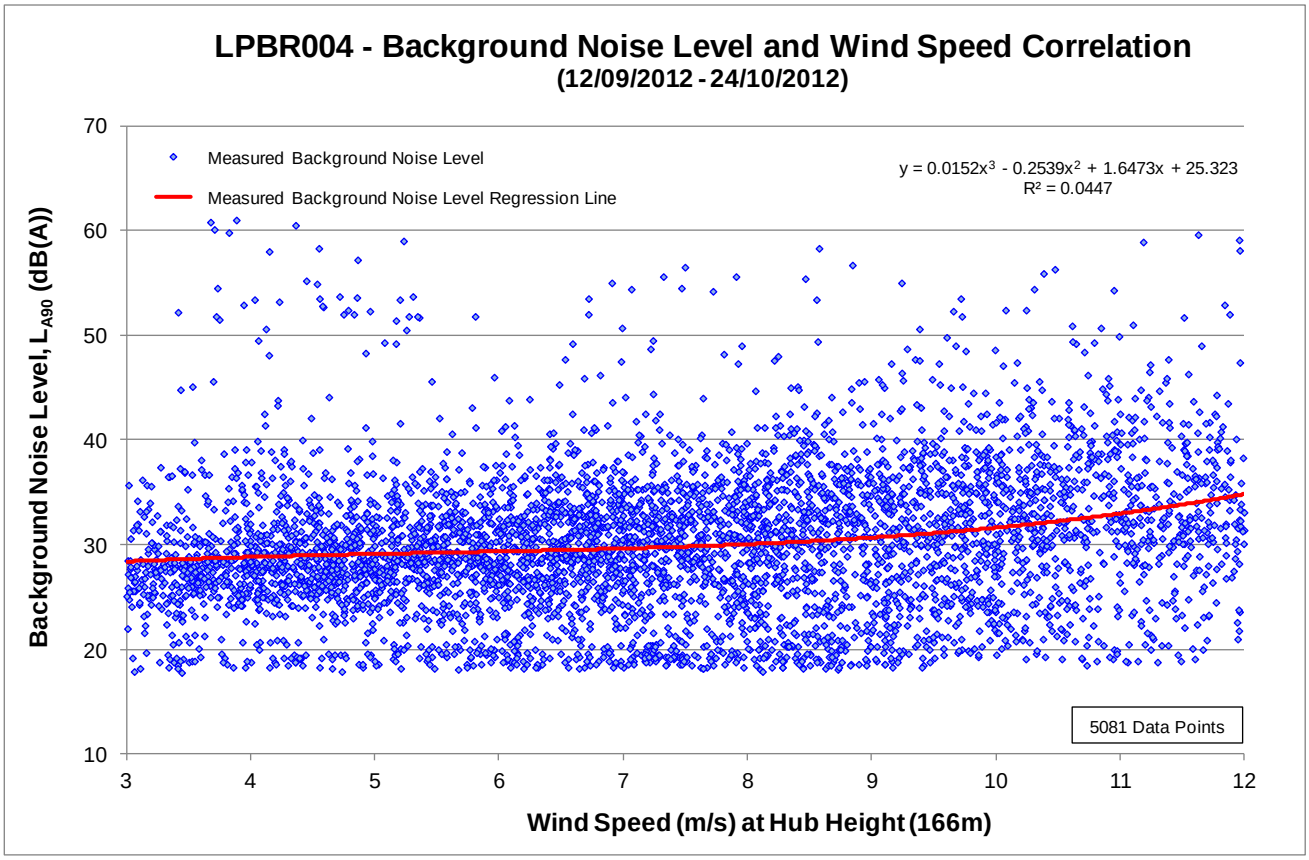
LPBR004 - Background Noise Level and Wind Speed Correlation
(12/09/2012 - 24/10/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = 0.0152x³ - 0.2539x² + 1.6473x + 25.323
R² = 0.0447
5081 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
70
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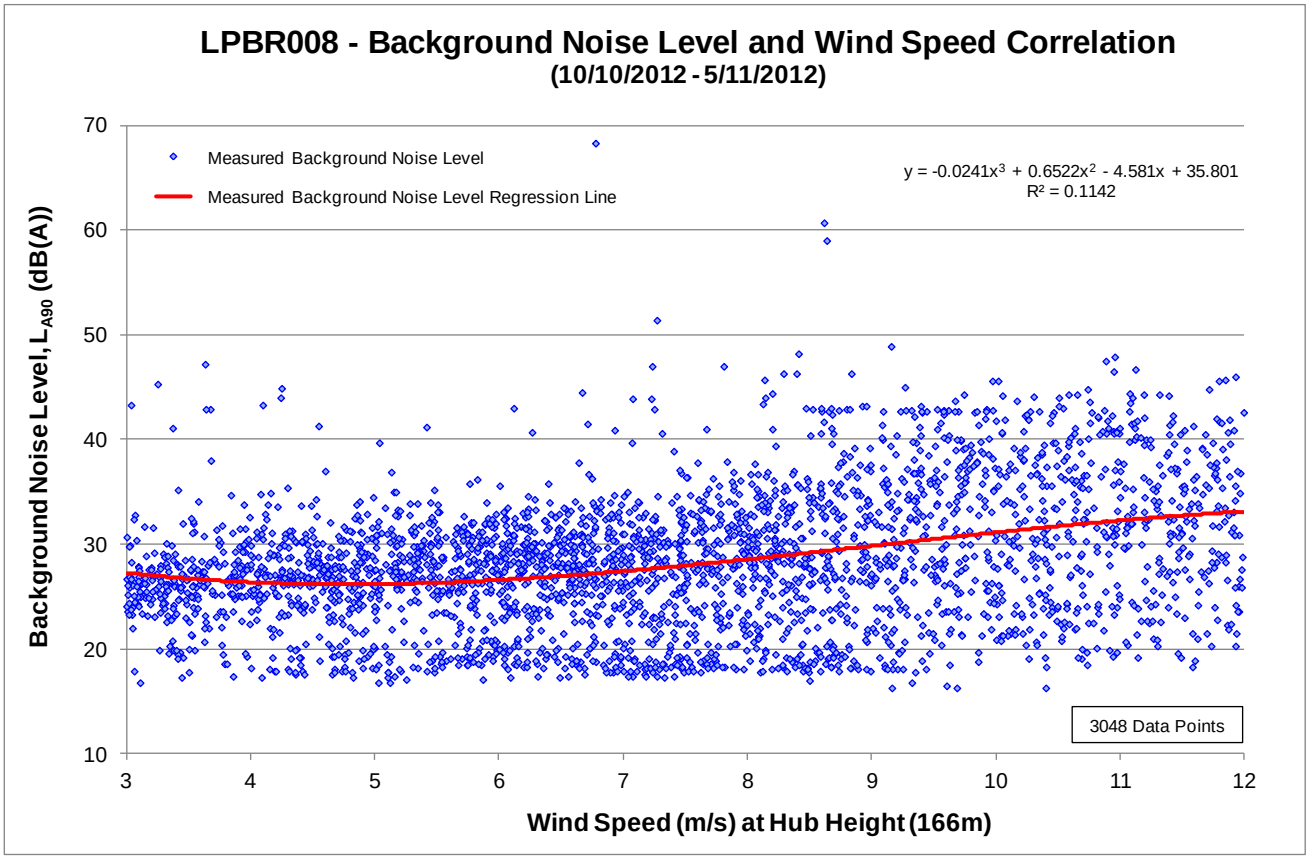
LPBR008 - Background Noise Level and Wind Speed Correlation
(10/10/2012 - 5/11/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.0241x³ + 0.6522x² - 4.581x + 35.801
R² = 0.1142
3048 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
70
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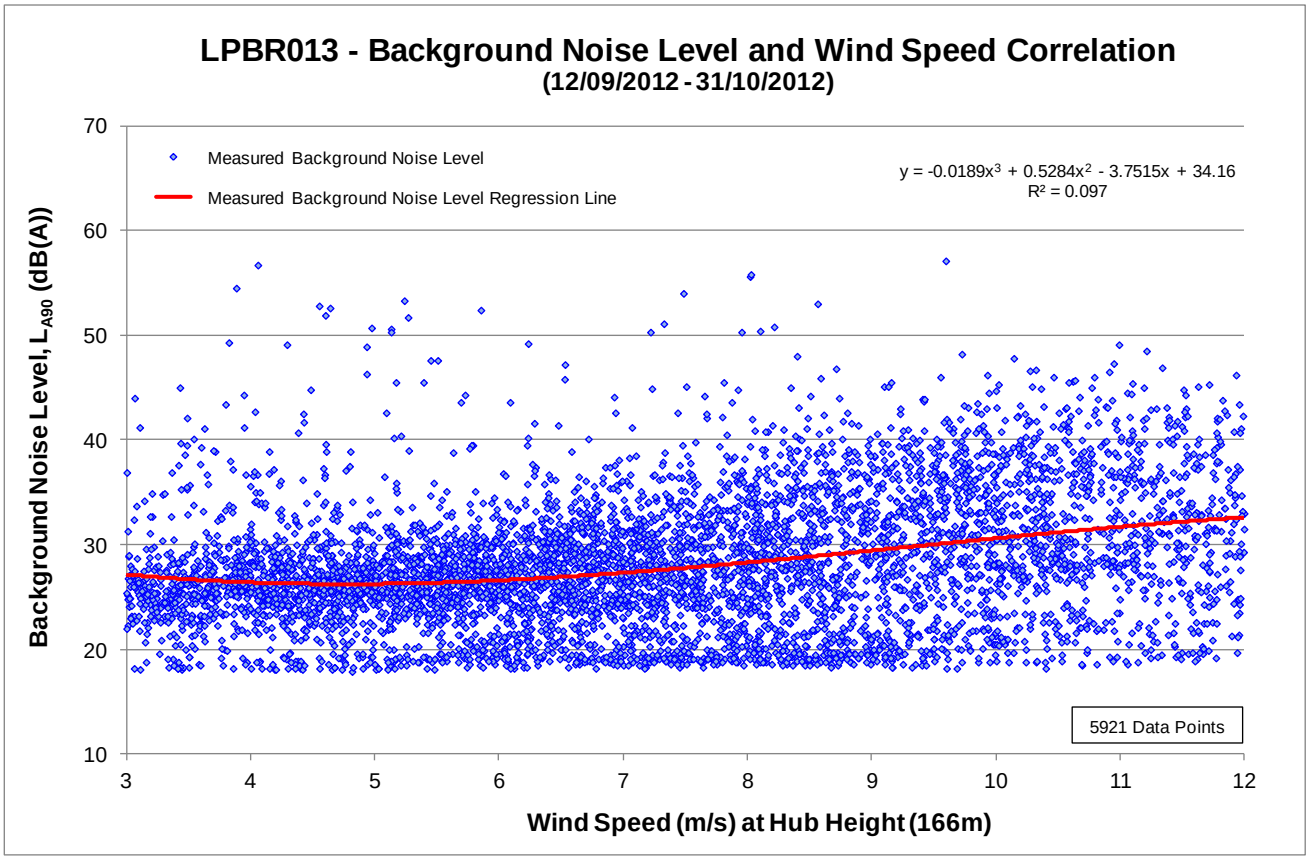
LPBR013 - Background Noise Level and Wind Speed Correlation
(12/09/2012 - 31/10/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.0189x³ + 0.5284x² - 3.7515x + 34.16
R² = 0.097
5921 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
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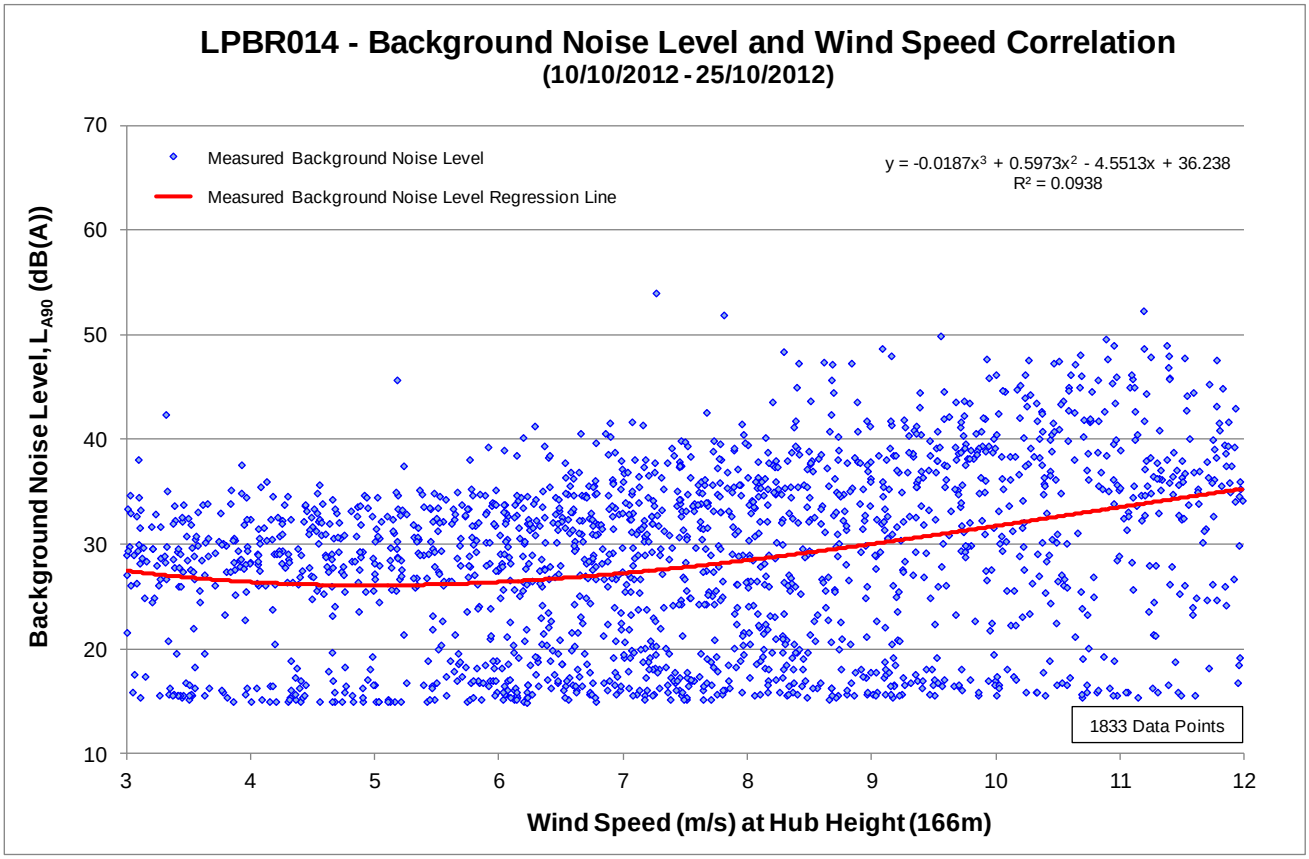
LPBR014 - Background Noise Level and Wind Speed Correlation
(10/10/2012 - 25/10/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.0187x³ + 0.5973x² - 4.5513x + 36.238
R² = 0.0938
1833 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
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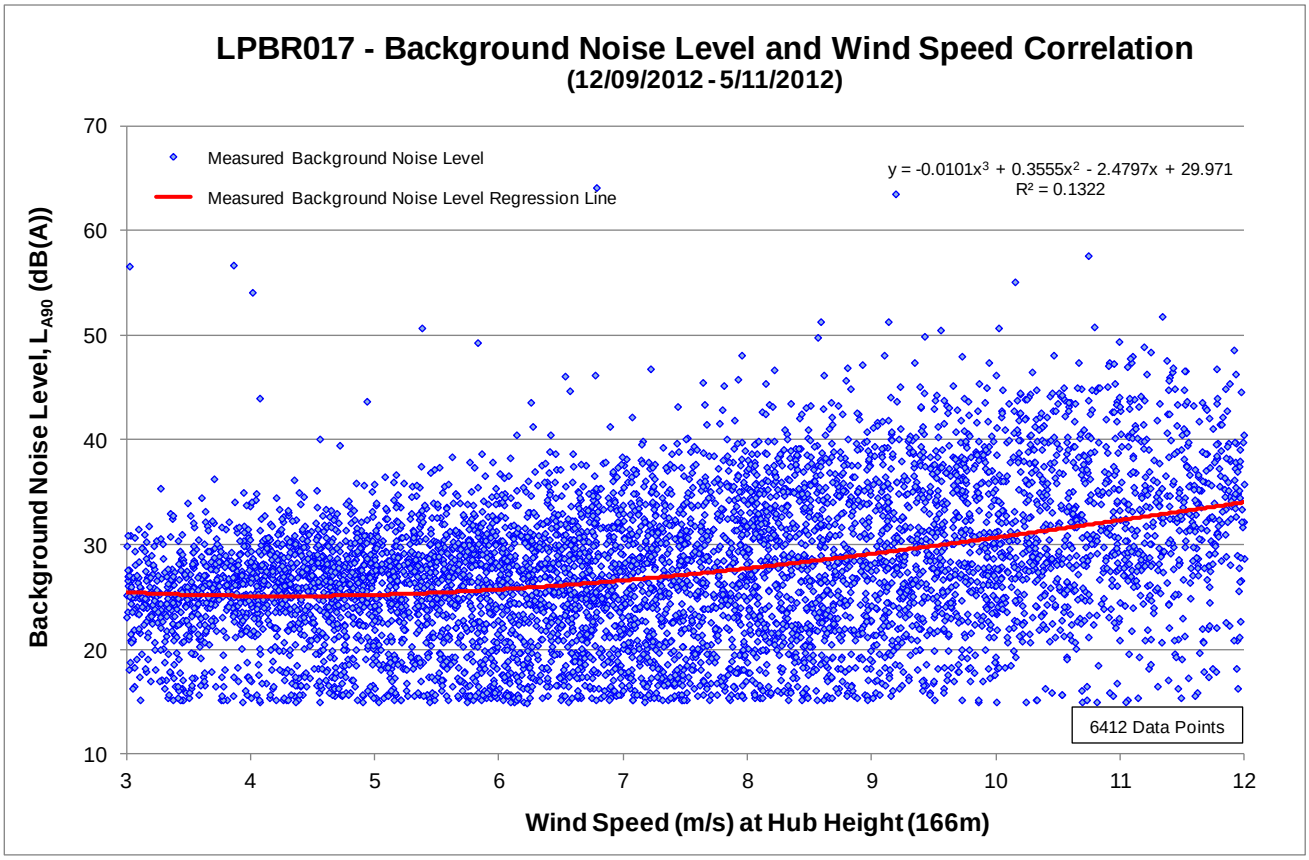
LPBR017 - Background Noise Level and Wind Speed Correlation
(12/09/2012 - 5/11/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.0101x³ + 0.3555x² - 2.4797x + 29.971
R² = 0.1322
6412 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
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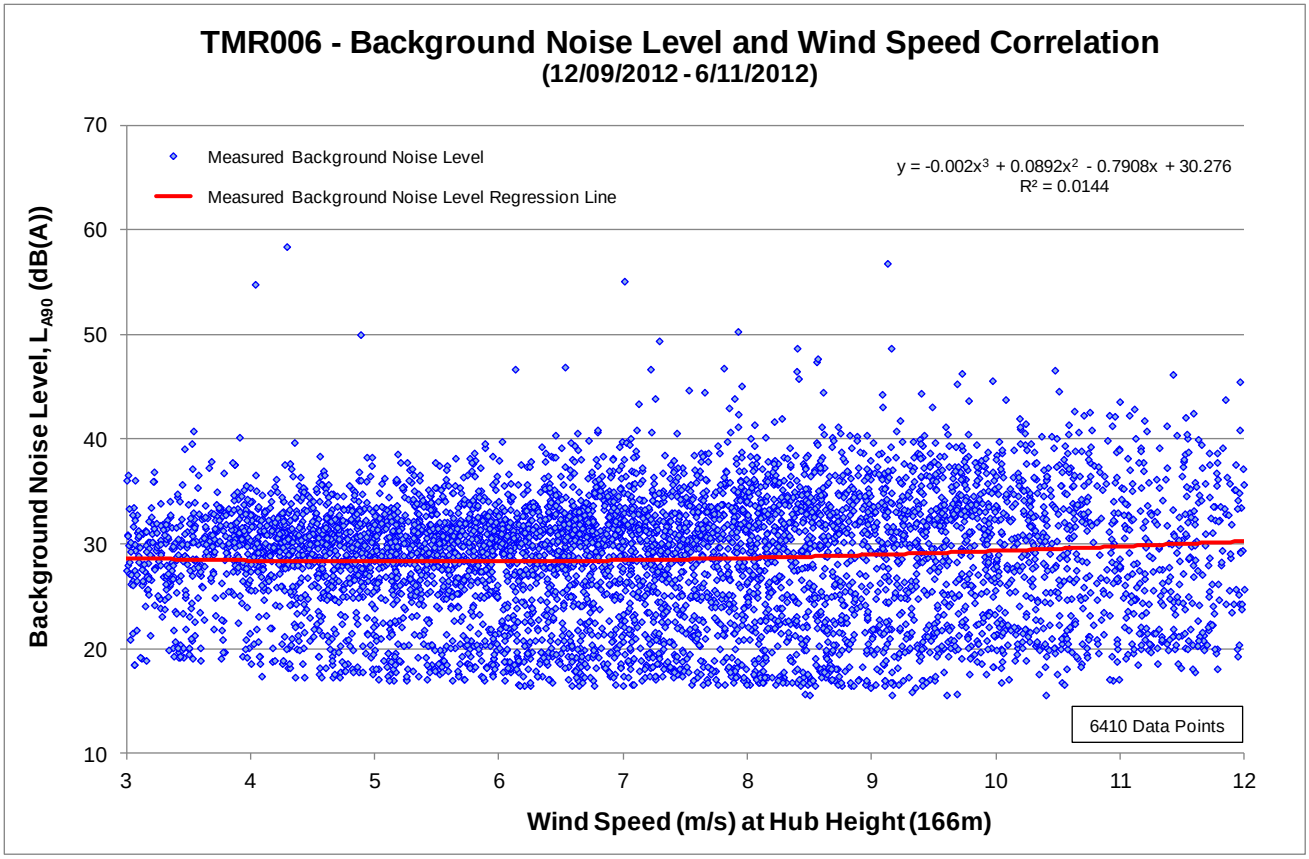
TMR006 - Background Noise Level and Wind Speed Correlation
(12/09/2012 - 6/11/2012)
Measured Background Noise Level
Measured Background Noise Level Regression Line
y = -0.002x³ + 0.0892x² - 0.7908x + 30.276
R² = 0.0144
6410 Data Points
Background Noise Level, LA90 (dB(A))
Wind Speed (m/s) at Hub Height (166m)
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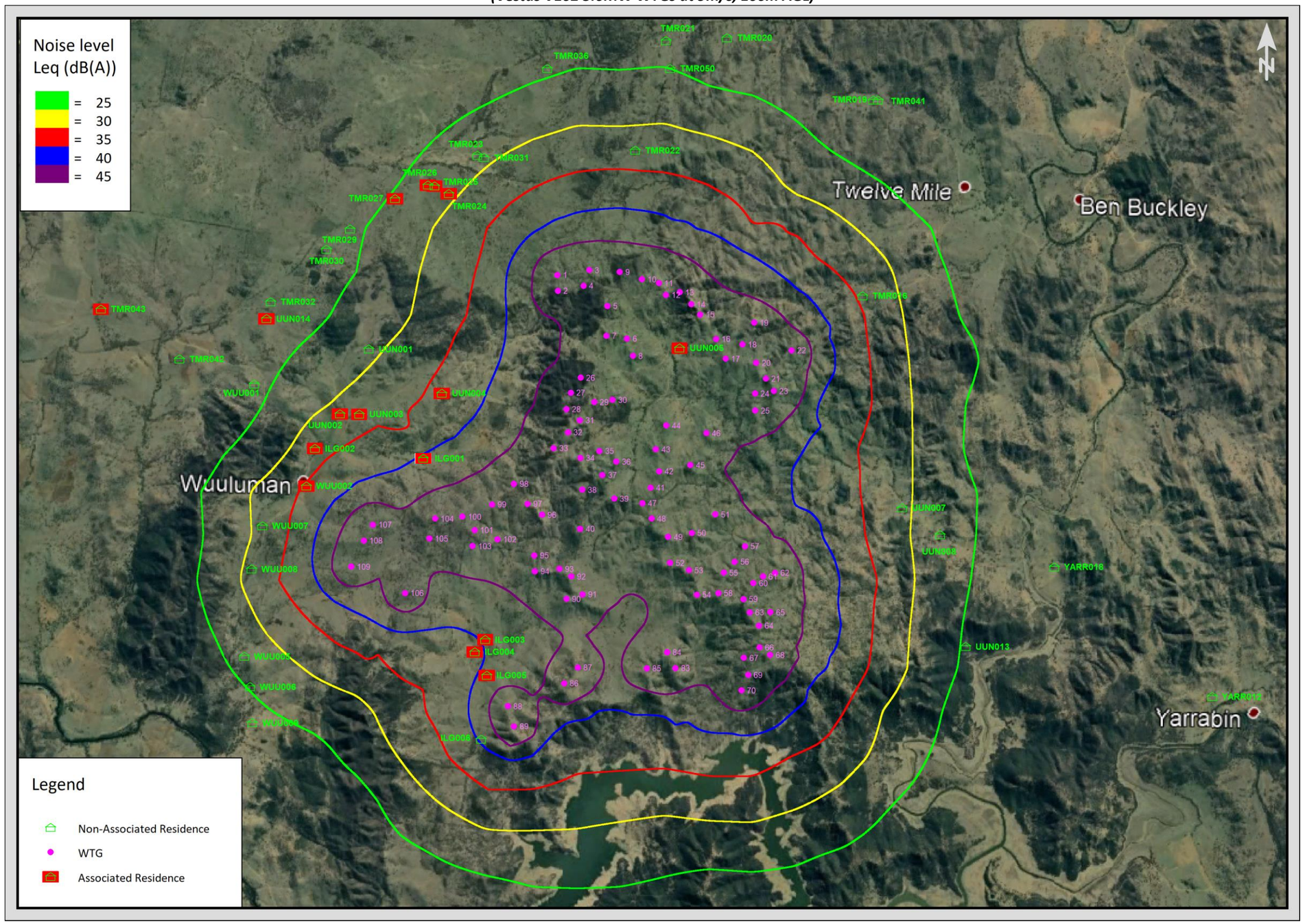
APPENDIX F: PREDICTED NOISE LEVEL CONTOURS

(Vestas V162 5.6MW WTGs at 9m/s, 166m AGL)



(Energy Storage & Substation Noise Level)