APPENDIX 10

Crudine Ridge Wind Farm Noise Impact Assessment

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Crudine Ridge Wind Farm

Environmental Noise Assessment

Prepared For

Wind Prospect CWP
45 Hunter Street, Newcastle NSW 2300

S3736C5
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EXECUTIVE SUMMARY

The proposed Crudine Ridge Wind Farm is located 45km south of Mudgee and 45km north of Bathurst, New South Wales. The proposal includes two planning layouts, designated A and B, which comprise up to 106 and 77 wind turbine generators (turbines), respectively.

The Crudine Ridge Wind Farm Environmental Noise Assessment report was commissioned to address the Director General's Requirements (DGRs) relating to operational noise and construction noise and vibration, issued in March 2011 (the DGRs are provided in Appendix C).

The DGRs require operational noise to be assessed against the stringent South Australian *Environmental Noise Wind Farm Guidelines 2003* (the SA Guidelines). The SA Guidelines compare the predicted noise levels from the wind farm against criteria developed from the background noise levels measured in the area.

In addition, the NSW Department of Planning and Infrastructure (DPI) has recently released the *Draft NSW Planning Guidelines for Wind Farms* (the NSW Draft Guidelines), in December 2011. The DPI has requested that the assessment also consider the background noise levels when separated into daytime and night-time periods, as per the approach of the NSW Draft Guidelines.

The operational noise assessment has been based on Acciona AW77 turbines for Layout A and Siemens SWT2.3-101 for Layout B. These turbines were based on the likely "worst case" (highest noise level) turbine selection available to Wind Prospect CWP at the time of the assessment. The process included consideration of a number of potential turbines for the each layout and subsequent selection of the turbines that would result in the highest noise level scenario for that layout. Noise predictions indicate that both layouts achieve the SA Guidelines at all dwellings.

Further, the predictions also indicate that both layouts can achieve the criteria based on the day and night period split at all dwellings, with the implementation of a recommended noise mitigation strategy for Layout A.

Based on the above, turbines with sound power levels and hub height[1] that are equal to or less than that assessed for the 106 Acciona AW77 and the 77 Siemens SWT2.3-101 turbines for Layouts A and B, respectively, can achieve the stringent requirements of the SA Guidelines.

If a turbine model with higher sound power levels or an alternative hub height is later considered during procurement, then the ability to achieve compliance with the SA Guidelines will need to be demonstrated prior to construction, in a form similar to this assessment. The ability to achieve compliance may require measures such as landowner agreements, the operation of some turbines under low noise operating modes and/or removal of turbines.

A construction noise and vibration framework has also been developed in this assessment to achieve the relevant DGRs for general construction activity and road transport.

It is noted that there are three non-associated residences, HER04, CR28 and CR34, which are located within 2km of turbines based on the two planning layouts. A commitment has been made by Wind Prospect CWP not to place any turbines within 2km of CR28 and CR34. In order to abide with this commitment, the closest turbine to the two residences will be "microsited" by up to 20m from the current proposed location, in a direction away from the CR28 and CR34. This micrositing will not result in any increase to the predicted noise levels summarised in this report.

[1] The sound power level is the most important factor in determining suitable turbines for both layouts in the procurement stage of the project. There is expected to be greater flexibility in the final hub height of suitable turbines.

GLOSSARY

Ambient noise level	The noise level with the presence of all existing noise sources in the environment
A-weighting	Frequency adjustment applied to measured noise levels to replicated the frequency response of the human ear
Background noise level	The noise level in the absence of intermittent noise sources
Day	The period between 7am and 10pm, when considering day and night periods. The period defined by the INP as 7am to 6pm Monday to Saturday, and 8am to 6pm on Sunday.
Evening	The period defined by the INP as 6pm to 10pm Monday to Sunday.
dB(A)	A-weighted noise or sound power level in decibels
Equivalent noise level	Energy averaged noise level
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. The period defined by the INP as 10pm to 7am Monday to Saturday, and 10pm to 8am on Sunday.
RBL	Rating Background Level
Sound power level	A measure of the sound energy emitted from a source of noise.
Worst-case	Conditions resulting in the highest noise level at or inside residences.

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INTRODUCTION

Sonus Pty Ltd has been engaged by Wind Prospect CWP to conduct an environmental noise assessment of the proposed Crudine Ridge Wind Farm, located 45km south of Mudgee and 45km north of Bathurst, New South Wales.

The environmental noise assessment was commissioned to address the Director-General's Requirements (DGRs) relating to operational noise and construction noise and vibration. The DGRs, issued in March 2011, specify that the assessment must be conducted in accordance with the following guidelines:

- Wind Turbines – the South Australian Environment Protection Authority's *Wind Farms – Environmental Noise Guidelines* (2003) (operational noise);
- Substation - *NSW Industrial Noise Policy* (EPA 2000) (operational noise);
- Site Establishment and Construction - *Interim Construction Noise Guideline* (DECC 2009) (construction noise);
- Traffic Noise – *Environmental Criteria for Road Traffic Noise* (NSW EPA, 1999) (construction noise); and
- Vibration – *Assessing Vibration: A Technical Guideline* (DECC, 2006) (construction vibration).

In December 2011, the Department of Planning and Infrastructure (the DPI) released the *Draft NSW Planning Guidelines: Wind Farms* (the NSW Draft Guidelines). The DPI has requested that consideration be made to the background noise levels when separated into daytime and night-time periods, as per the approach of the NSW Draft Guidelines. This consideration has been made and addressed in this assessment.

Two layouts, designated A and B, have been assessed for the Crudine Ridge Wind Farm using sound power level data provided by the wind turbine generator manufacturer. The locations of the turbines and associated substations for both layouts are provided in Appendix A.

Noise levels for both layouts have been predicted to residences up to 5.5km from the wind farm. The locations of the residences and their relative distance to the closest turbine and substation locations are provided in Appendix B. Appendix B also provides the status of the landowner with respect to whether a landowner agreement has been entered into.

It is noted that there are three non-associated residences, HER04, CR28 and CR34, which are located within 2km of turbines based on the two planning layouts. Wind Prospect CWP has indicated that a commitment has been made to not place any turbines within 2km of CR28 and CR34. In order to abide with this commitment, the closest turbine to the two residences will be “microsited” by up to 20m from the current proposed location, in a westerly direction away from the CR28 and CR34. This micrositing will not result in any increase to the predicted noise levels summarised in this report.

DIRECTOR GENERAL'S REQUIREMENTS

The Director-General's Requirements (DGRs) for the project, dated 17th of March, 2011, provide the key issues to be addressed in the environmental noise assessment and specify the relevant guidelines for each aspect of noise from the project to be considered. These are discussed below. The relevant section of the DGRs is provided in Appendix C.

Wind Turbines

The DGRs require operational noise to be assessed against the South Australian Environment Protection Authority's *Wind Farms – Environmental Noise Guidelines 2003* (the SA Guidelines). The SA Guidelines were developed to protect the amenity of the surrounding community from adverse noise impacts when taking into account the acoustic environment of that community.

Criteria - Landowners without Commercial Agreements

The SA Guidelines state:

> *The predicted equivalent noise level ($L_{Aeq,10}$), adjusted for tonality in accordance with these guidelines, should not exceed:*
>
> - *35 dB(A), or*
> - *the background noise level ($L_{A90,10}$) by more than 5 dB(A),*
>
> *whichever is the greater, at all relevant receivers for each integer wind speed[2] from cut-in to rated power of the WTG.*

Where the wind farm noise exhibits tonal characteristic, a 5 dB(A) penalty is to be applied to the criteria, in accordance with the SA Guidelines.

In addition, the SA Guidelines note that:

> *The criteria have been developed to minimise the impact on the amenity of premises that **do not** have an agreement with the wind farm developers.*

[2] Where wind speed is referenced in this report, it is taken to be the wind speed measured 10m above the ground in accordance with the SA Guidelines, unless specifically noted otherwise.

Criteria - Landowners with Commercial Agreements

The landowners of a number of residences have entered into commercial agreements with the developers of the wind farm. These landowners are listed in Appendix B.

As each of these landowners has an agreement with the wind farm developer, suitable noise criteria for each residence will be agreed between the developer and the landowner. However, to protect landholders with an agreement in this project from unreasonable interference to amenity, it is recommended that reference is made to the World Health Organisation (WHO) *Guidelines for Community Noise*[3] (the WHO Guidelines). The WHO Guidelines recommend an indoor noise level of 30 dB(A) to protect against sleep disturbance. The indoor limit of 30 dB(A) equates to an outdoor noise level of 45 dB(A) with windows open or 52 dB(A) with windows closed.

It is proposed that the noise at residences of landholders with an agreement achieve the recommendations of the WHO Guidelines in lieu of the baseline criterion of 35 dB(A) provided by the SA Guidelines.

Background Noise Monitoring and Resultant Criteria

To determine the background noise level at various wind speeds, background noise levels were measured at seven locations in the vicinity of the proposed wind farm between the 20th of July and the 27th of September, 2011. The measurements were conducted in accordance with the SA Guidelines.

The seven monitoring locations, summarised in Table 1, were selected based on initial predictions of the wind farm noise. Preference was given to residences with the highest predicted noise levels and without commercial agreements, subject to access permission.

[3] "WHO Guidelines for Community Noise" World Health Organisation, 1999.

Table 1: Monitoring locations and periods.

Residence ID	Residence Name	Coordinates (WGS84 map datum)		Monitoring Period
		Easting	Northing	
CR14	Athlone	752482	6353156	21/07/2011 – 24/08/2011
CR18	Glen Daire	752181	6351501	21/07/2011 – 24/08/2011
CR28	Willow Downs	750058	6349288	21/07/2011 – 24/08/2011
CR33	Trelawney	747514	6346900	24/08/2011 – 27/09/2011
HER04	Round Hill	744138	6341260	21/07/2011 – 24/08/2011
HER07	Clare Hills	741306	6343883	20/07/2011 – 24/08/2011
SFR05	Kotara	741866	6348888	20/07/2011 – 24/08/2011

The background noise was measured with Rion NL21 type 2 sound level meters, calibrated at the beginning and end of the measurement period with a Rion NC74 Calibrator. All microphones were fitted with 90mm weather proof windshields, with the microphone positioned approximately 1500mm above ground level. Each noise logger was located in accordance with the SA Guidelines (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 at each location are provided in Appendix D.

During the background noise monitoring regime, Wind Prospect CWP measured the wind speed at two wind masts located locally within the wind farm area. The wind speed was measured in 10 minute intervals at various measurement heights on each wind mast. Table 2 provides details of the wind masts. It is noted that wind mast SOF 2 started operating from the 7th of August, 2011. The wind speed data were extrapolated to obtain 10m above ground level (AGL) wind speeds for analysis in accordance with the SA Guidelines.

Table 2: Wind mast details.

Mast ID	Coordinates (WGS84 map datum)		Measurement Heights (m)	Period of Wind Speed Measurements
	Easting	Northing		
SOF 1	749710	6352918	60, 45, 30	Entire monitoring regime period
SOF 2	744453	6345790	100, 80, 60, 40	From the 7th of August, 2011

A HOBO Micro Station Weather Logger H21-002 was also concurrently deployed at residence HER07 which measured rainfall and wind speed at the microphone height (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.

During the monitoring period, the weather station was damaged by livestock. To supplement the data, weather data from the closest weather stations to the wind farm site, which are Mudgee Airport and Bathurst Airport Stations, were obtained from the Bureau of Meteorology.

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.

Table 3 summarises the number of useable data points at each monitoring location, following the removal of wind data which may have had the influence of weather. Data below the cut-in wind speed of the turbine models considered (i.e., 3m/s at 10m AGL) have also been removed in accordance with the SA Guidelines. It is noted that the resultant number of useable data points achieves the SA Guidelines' minimum requirement of 2,000 data points.

Table 3: Useable data points.

Residence ID	Closest Weather Mast	Number of Useable Data Points
CR14	SOF 1	2824
CR18	SOF 1	2835
CR28	SOF 1	2832
CR33	SOF 2	2595
HER04	SOF 2	2450
HER07	SOF 2	2538
SFR05	SOF 2	2535

Following data removal, the background noise data were correlated with the wind speed data measured at the closest wind mast[4]. A least squares regression analysis of the data was undertaken to determine the line of best fit for the correlations in accordance with the SA Guidelines. 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 turbines is provided in Table 4.

It is noted that where the background noise level could not be determined from the regression analysis due to insufficient data, generally at higher wind speeds, a conservative assumption was made that the background noise level does not increase with wind speed. This is indicated in Table 4 using ***bold italic.***

Table 4: Background noise levels (dB(A)) – 24 hour period.

Residence ID	Background Noise Level (dB(A)) by 10m AGL Wind Speed (m/s) - 24 Hour Period									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CR14	28	30	32	34	36	38	39	40	41	***41***
CR18	29	30	31	32	33	34	35	37	40	***40***
CR28	22	24	26	29	31	33	35	37	38	***38***
CR33	25	28	31	34	37	39	42	44	45	47
HER04	25	27	28	30	32	34	36	37	***37***	***37***
HER07	29	31	34	37	40	42	43	44	***44***	***44***
SFR05	28	30	32	35	37	40	41	***41***	***41***	***41***

The background noise levels in Table 4 have been used to established noise criteria for each residence, in accordance with the SA Guidelines. The noise criteria are summarised in Appendix G. Where background noise monitoring has not occurred at a residence, the measured background levels at the closest monitoring location located on the same side of the wind farm as the residence have been used to derive the criteria.

[4] Wind data from wind mast SOF2 were not available for the period prior to 7th of August, 2011. Therefore, where relevant, data from wind mast SOF1 were used instead for the correlation corresponding to that period.

Substation

The DGRs reference the New South Wales Environment Protection Authority's *Industrial Noise Policy 2000* (the INP) for the assessment of substation noise levels.

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

In accordance with the INP, 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 is a different procedure to the SA Guidelines background noise data analysis.

The ambient noise environment was monitored at seven residences in the vicinity of the wind farm, as described for the SA Guidelines. 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 INP, an RBL of 30 dB(A) was considered for all residences in this assessment.

The INP requires that noise from industrial sources should not exceed the measured RBL by more than 5 dB(A). Therefore the most stringent criterion in accordance with the INP's ambient noise method is 35 dB(A). This is more stringent than the amenity based noise criterion of 40 dB(A) for a dwelling in a rural environment.

If the noise is found to have a character that has the potential to be more annoying, such as tonality, modulation or dominant low-frequency content, a modifying correction factor is to be applied to the measured level. A substation has the potential to exhibit tonality, however, based on the predicted noise levels such a characteristic is unlikely to be audible at the nearest residential locations. Notwithstanding, it is recommended that a conservative

approach is adopted, and a 5 dB(A) correction is applied to the relevant criteria to allow for the presence of an annoying characteristic.

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

Site Establishment and Construction

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

To assess construction noise in accordance with the DGRs, the Department of Environment & Climate Change *Interim Construction Noise Guideline 2009* (the ICN Guideline) is referenced by the DGRs.

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 5.

Table 5: The ICN Guideline management levels.

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.

Traffic Noise

In accordance with the DGRs, traffic noise associated with the construction of the wind farm is to be assessed against the NSW Environment Protection Authority, *Environmental Criteria for Road Traffic Noise* (the ECRTN).

Traffic noise criteria are provided for a range of scenarios. The most appropriate classification for the Crudine Ridge Wind Farm construction site and its associated traffic is considered to be "land use developments with the potential to create additional traffic on local roads". However, it should be noted that this criteria applies to an ongoing operation, as distinct to a temporary construction process and as such provides a conservative (more stringent) approach.

The criteria are equivalent ($L_{Aeq,\ 1hour}$) noise levels of no greater than 55 dB(A) during the daytime (7am to 10pm) and 50 dB(A) during the night-time (10pm to 7am). This noise level is to be achieved outside, at a distance of 1.5m from the facade of a dwelling.

It is noted that in March 2011, the Office of Environment and released the *NSW Road Noise Policy* (the RNP) which effectively replaced the ECRTN from 1 July 2011. At the time of the DGRs's issue (i.e., in March 2011), the ECRTN was the most relevant and had been referenced in the DGRs. The criteria recommended by the ECRTN are however consistent with the RNP.

Construction Vibration

To assess construction vibration levels in accordance with the DGRs, the DECC document "Assessing Vibration: A Technical Guideline", February 2006 (the Technical Guideline) is referenced.

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 does establish a quantitative approach, whereby goal vibrations 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 6 at the 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 6: 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

Continuous and impulsive vibration criteria are provided as "rms" values for acceleration. The term "rms" relates to a mathematical process that is regularly performed on varying noise and vibration signals to assist in their expression, quantification and comparison. The "rms" value for acceleration is expressed in millimetres per second squared (mm/s^2). 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.

DEPARTMENT OF PLANNING AND INFRASTRUCTURE'S ADDITIONAL REQUIREMENT

In December 2011, the NSW Department of Planning and Infrastructure (DPI) released the *Draft NSW Planning Guidelines: Wind Farms* (the NSW Draft Guidelines). The DPI has requested that the assessment also consider noise criteria based on separate analysis of daytime and night-time background noise data, as per the general approach of the NSW Draft Guidelines.

Separated Day and Night Background Noise Levels and Resultant Criteria

Based on the background noise level data collected (as summarised on pages 9 to 12), the analysis of data corresponding to the daytime (7am to 10pm) and night-time (10pm to 7am) period has been conducted. The correlations and regression lines for the daytime and night-time periods are presented in Appendix F. The resultant background noise levels are listed in Tables 7 and 8.

It is noted that where the background noise level could not be determined from the regression analysis due to insufficient data, generally at higher wind speeds, a conservative assumption was made that the background noise level does not increase with wind speed. This is indicated in Tables 7 and 8 using ***bold italic.***

Table 7: Background noise levels (dB(A)) – daytime period.

Residence ID	Background Noise Level (dB(A)) by 10m AGL Wind Speed (m/s) - Daytime Period									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CR14	32	33	34	36	37	38	40	41	43	***43***
CR18	30	31	32	33	34	35	37	39	41	***41***
CR28	24	26	28	30	33	35	37	38	***38***	***38***
CR33	26	29	33	36	39	41	43	45	46	47
HER04	28	28	30	31	33	35	36	37	***37***	***37***
HER07	31	33	35	37	40	42	44	45	***45***	***45***
SFR05	30	32	33	35	37	38	40	41	***41***	***41***

Table 8: Background noise levels (dB(A)) – night-time period.

Residence ID	Background Noise Level (dB(A)) by 10m AGL Wind Speed (m/s) - Night-time Period									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CR14	24	26	28	31	34	36	37	***37***	***37***	***37***
CR18	27	28	29	30	31	32	33	33	34	***34***
CR28	19	21	23	25	27	29	31	33	35	***35***
CR33	23	25	27	29	31	32	34	35	***35***	***35***
HER04	22	23	26	28	30	32	***32***	***32***	***32***	***32***
HER07	26	29	33	37	40	42	***42***	***42***	***42***	***42***
SFR05	25	26	29	34	39	44	47	***47***	***47***	***47***

Based on the above, the assessment criteria at each residential location for both associated (with an agreement) and non-associated (without an agreement) land holders have been determined. The established criteria for each residence are summarised in Appendix H. Where background noise monitoring has not occurred at a residence, the measured background levels at the closest monitoring location with similar settings to that residence have been used to derive the criteria.

Comparison against SA Guidelines

The SA Guidelines and the associated noise criteria are established based on analysis of background noise levels measured over a 24 hour period.

With the data set separated into the daytime and night-time periods, the available data points for regression analysis associated with the night-time period was no greater than 970 points, which is less than the 2000 points recommended by the SA Guidelines. Further, more onerous criteria are obtained for the night-time period, as compared to the criteria in accordance to the SA Guidelines.

It is noted that the UK Department of Trade and Industry[5] has prepared guidelines that separate the background noise data into day and night periods. The baseline noise level for the night time period is increased to 43 dB(A) to account for sleep disturbance effects. A

[5] UK Department of Trade and Industry 1996, The assessment and rating of windfarm noise. Noise Working Group Final Report, ETSU-R-97.

reason the SA Guidelines do not require the assessment procedure to be separated into day and night periods is the onerous nature of the approach relative to the potential onset of sleep disturbance effects.

ASSESSMENT

Wind Farm Noise

Turbine Layout and Details

Noise from the wind farm has been assessed based on two planning layouts, consisting of 106 and 77 turbines, respectively. The coordinates of turbines for each layout are provided in Appendix A. The assessment considered the following turbine models[6] with a hub height of 80m for each layout:

- Planning Layout A – 106 Acciona AW77 turbines;
- Planning Layout B – 77 Siemens SWT2.3-101 turbines.

The predictions of noise from the turbines have been based on the sound power level data from the manufacturers which include the following:

- Acciona AW77 :
    - warranted sound power levels for wind speeds between 3m/s and 12m/s; and,
    - octave band sound power level spectra for 8m/s and 9m/s, measured at 10m AGL.
- Siemens SWT2.3-101:
    - warranted sound power levels for wind speeds between 4m/s and 18m/s; and,
    - octave band sound power level spectra for 6m/s and 8m/s, referenced at 10m AGL.

[6] The turbines models assessed were based on the likely "worst case" (highest noise level) turbine selection available to Wind Prospect CWP at the time of the assessment. The process included consideration of a number of potential turbines for the each layout and the subsequent selection of the turbines that would result in the highest noise level scenario for that layout.

Prior to the predictions, the spectral data were extrapolated to obtain octave band sound power levels associated with the other wind speeds. Tables 9 and 10 contain the sound power levels used in the predictions.

Table 9: Acciona AW77 sound power levels.

Octave Band Centre Frequency (Hz)	Sound Power Levels (dB(A)) by 10m AGL Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
63	76.6	78.6	80.6	82.5	83.3	83.4	83.5	83.5	83.5	83.5
125	84.1	86.1	88.1	90.0	90.8	90.9	91.0	91.0	91.0	91.0
250	90.9	92.9	94.9	96.8	97.6	97.7	97.8	97.8	97.8	97.8
500	92.6	94.6	96.6	98.5	99.3	99.4	99.5	99.5	99.5	99.5
1000	93.9	95.9	97.9	99.8	100.6	100.7	100.8	100.8	100.8	100.8
2000	86.0	88.0	90.0	91.9	92.7	92.8	92.9	92.9	92.9	92.9
4000	81.2	83.2	85.2	87.1	87.9	88.0	88.1	88.1	88.1	88.1
8000	67.8	69.8	71.8	73.7	74.5	74.6	74.7	74.7	74.7	74.7
Warranted Total	98.0	100.0	102.0	103.9	104.7	104.8	104.9	104.9	104.9	104.9

Table 10: Siemens SWT2.3-101 sound power levels.

Octave Band Centre Frequency (Hz)	Sound Power Levels (dB(A)) by 10m AGL Wind Speed (m/s)								
	4	5	6	7	8	9	10	11	12
63	71.1	75.8	80.6	82.5	82.5	82.5	82.5	82.5	82.5
125	82.3	87.0	91.8	93.4	93.4	93.4	93.4	93.4	93.4
250	86.4	91.1	95.9	97.1	97.1	97.1	97.1	97.1	97.1
500	90.0	94.7	99.5	101.1	101.1	101.1	101.1	101.1	101.1
1000	90.2	94.9	99.7	101.1	101.1	101.1	101.1	101.1	101.1
2000	86.8	91.5	96.3	97.4	97.4	97.4	97.4	97.4	97.4
4000	79.4	84.1	88.9	90.2	90.2	90.2	90.2	90.2	90.2
8000	75.1	79.8	84.6	86.2	86.2	86.2	86.2	86.2	86.2
Warranted Total	95.1	99.8	104.6	106.0	106.0	106.0	106.0	106.0	106.0

The predictions have been conducted without a penalty for the presence of tonal characteristics. 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 an accepted methodology. Such a methodology may include that provided in the NSW Draft Guidelines.

Substations

The noise from the proposed substations at the wind farm has been considered for assessment against the INP. Three location options are being considered for the main collector station, and one location for the secondary collection station, as listed in Appendix A. It is proposed that up to two transformers with capacities between 80 to 100MVA, or a single 180MVA transformer will be installed at the main collector station, and up to three medium voltage transformers will be installed at the secondary collector station.

The sound power levels of transformers have been derived from the Australian/New Zealand Standard AS/NS60076.10:2009 [7]. The worst-case (i.e., highest predicted noise level) transformer selections associated with the potential collector station arrangement have been used. The octave band sound power levels at the main and secondary collection stations are provided in Table 11.

Table 11: Transformer sound power levels.

Transformer Capacity	Sound Power Level (dB(A)) by Octave Band Centre Frequency (Hz)								
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**Total**
Main Collector Station – 1 x 180MVA transformer									
180 MVA	76.7	84.8	92.3	94.7	86.9	84.1	76.9	72.8	97.6
Secondary Collector Station – 3 x 60MVA transformer									
60 MVA	70.0	78.1	85.6	88.0	80.2	77.4	70.2	66.1	90.9

Noise Propagation Model - ISO 9613-2:1996

Noise predictions were conducted using the propagation model, ISO 9613-2:1996 “Acoustics – Attenuation of sound during propagation outdoors” (ISO 9613) in the SoundPlan noise modelling software. This noise propagation model is widely accepted as an appropriate model for the assessment of wind farms when appropriate inputs are used. The ISO 9613 model has the ability to take into account the distance between the source and receiver, topography, hardness of the ground and atmospheric absorption at different frequencies in either temperature inversion or downwind conditions (conditions conducive to noise propagation).

[7] Australian/New Zealand Standard AS/NZS60076.10:2009, *Power transformers - Determination of sound levels (IEC 60076-10, Ed. 1(2001) MOD).*

The assessment has been based on appropriate selection of inputs agreed upon by UK experts[8] (in a joint paper), which are as follows:

- warranted sound power levels;
- 10°C temperature;
- 70% relative humidity;
- 50% acoustically hard ground and 50% acoustically soft ground;
- barrier attenuation of no greater than 2 dB(A); and,
- 4m receiver height.

Turbine Noise

The noise levels at the residences in the vicinity of the wind farm from turbines have been predicted and compared against the established environmental noise criteria.

Assessment against the SA Guidelines

Appendix G provides the predicted noise levels at residences from turbines for both layouts and the criteria in accordance with the SA Guidelines for each residence at each relevant wind speed.

Based on the predicted noise levels, the 106 Acciona AW77 turbines arranged in accordance with Layout A and the 77 Siemens SWT2.3-101 turbines arranged in accordance with Layout B, will comply with the relevant criteria at all residences (both with and without an agreement) for all wind speeds. Appendix I provides the predicted noise level contours under worst-case (highest predicted level) wind speed for both layouts, showing compliance at all residences.

Assessment against the Separated Criteria for Daytime and Night Periods

Appendix H provides the predicted noise levels at residences from turbines for both layouts and the night-time criteria for each residence at each relevant wind speed. It is noted that the derived night-time criteria are more stringent than the daytime criteria.

[8] Institute of Acoustics Vol 34 No2 March/April 2009, "Prediction and Assessment of Wind Turbine Noise – Agreement about relevant factors for noise assessment from wind energy projects".

Layout A – 106 Acciona AW77 Turbines

Based on the predicted noise levels shown in Appendix H, the 106 turbines arranged in accordance with Layout A are predicted to comply with the relevant criteria at all residences (both with and without an agreement) for all wind speeds, except at CR34, which exceeds the criteria by 1 dB for 6m/s and 7m/s wind speeds.

To achieve the criteria at all residences for all wind speeds, two noise reduction options have been recommended below.

Noise Reduction Option 1

Remove the turbines listed in Table 12.

Table 12: Recommended turbines to be removed.

Turbine ID	Coordinates	
	Easting	Northing
A87	744607	6345442
A89	744563	6345251

Noise Reduction Option 2

Alternatively, considering that the Acciona AW77 turbine has the capacity to operate in low noise modes with reductions in the maximum noise level of 2 to 6 dB(A), a noise reduction operating strategy may be considered to achieve the criteria at all residences, in lieu of removing turbines. Several operating scenarios have been determined, as summarised in Table 13, which are predicted to result in compliance at all residences.

Table 13: Noise reduction mode scenarios.

Turbine ID	Coordinates		Noise Reduction Mode			
	Easting	Northing	Scenario 1	Scenario 2	Scenario 3	Scenario 4
A87	744607	6345442	- 5 dB	- 4 dB	- 3 dB	- 2 dB
A89	744563	6345251	- 3 dB	- 4 dB	- 3 dB	- 2 dB
A83	744447	6346218	0	0	- 2 dB	- 2 dB
A85	744529	6345707	0	0	0	- 2 dB

Note: The -6 dB operating mode was not considered to allow for a contingency strategy which is described below.

Planning Layout B – 77 Siemens SWT2.3-101 Turbines

Based on the predicted noise levels shown in Appendix H, the 77 turbines arranged in accordance with Planning Layout B are predicted to comply with the relevant criteria at all residences (both with and without an agreement) for all wind speeds.

Substation

Noise from the main and secondary collector station has been predicted and summarised in Appendix G. Based on the predictions, the noise level at the worst-case residence (highest predicted noise level) will be no greater than 12 dB(A). This level easily achieves the conservative criteria of 30 dB(A) developed under the INP, and as such will not adversely impact on the amenity of residences in the locality of the wind farm. The very low predicted noise level is associated with separation distances greater than 3km between the stations and dwellings.

Other Considerations

In addition to considering the predicted noise levels against relevant criteria, the DGRs also require information relating to a range of other consideration as provided below.

Cumulative Impacts

The SA Guidelines have been widely described as one of the most stringent assessment approaches of any jurisdiction in the World. The baseline criterion of 35 dB(A) is set at least 5 dB(A) less than the New Zealand Standard 1998 baseline used in Victoria and 10 dB(A) less than the World Health Organisation's (WHO) recommendation for the prevention of sleep disturbance effects.

Due to their stringency, the SA Guidelines explicitly account for the cumulative effect of other wind farms. The baseline criterion specified by the SA Guidelines 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.

Section 2.5 of the SA Guidelines is titled "Cumulative Development", this section is repeated below:

Separate wind farm developments in close proximity to each other may impact on the same relevant receiver.

Therefore, as for staged development, any additional wind farm that may impact on the same relevant receiver as an existing wind farm should meet the criteria using the background noise levels as they existed before the original wind farm site development. The noise generated by existing WTGs from another wind farm should not be considered as part of the background noise in determining criteria for subsequent development.

Notwithstanding the above, there are currently no existing wind farms in proximity to the proposed Crudine Ridge Wind Farm to result in any significant cumulative noise impacts. The proposed Uungula Wind Farm is located greater than 30km from Crudine Ridge Wind Farm.

Modulation

Amplitude modulation, or "swish", is an inherent noise character associated with wind farms. The SA Guidelines explicitly account for "swish" as a fundamental characteristic of noise from a wind farm regardless of its depth, provided that it is generated by a properly maintained and operated wind turbine or wind farm. This is a key reason for the stringency of the SA Guidelines.

The ability to hear "swish" depends on a range of factors. It will be most prevalent when there is a stable environment (temperature inversion) at the wind farm and the background noise level at the listening location is low. In addition, "swish" is greater when located cross wind from a wind turbine. It is noted that whilst the amplitude modulation is greater at a cross

wind location, the actual noise level from the wind farm will be lower than at a corresponding downwind location (the predicted noise levels conservatively assume that each residence is located downwind of all turbines).

The conditions noted above are most likely to occur when wind speeds at the wind farm are low under a clear night sky. The Van Den Berg effect is an increase of the modulation depth from a wind farm under very specific meteorological and operational conditions which include those conditions described above.

The Van Den Berg effect was observed on a flat site in Europe under specific conditions. In two matters before the NSW Land and Environment Court (Gullen Range Wind Farm NSW LEC 41288 of 2008 and Taralga Wind Farm NSW LEC 11216 of 2007), it has been determined by the relevant meteorological experts that the required meteorological conditions to trigger the effect were not a feature of the environment. In Gullen Range (NSW LEC 41288 of 2008), the meteorological analysis prepared by Dr Chris Purton concluded that suitable conditions for this effect were not a feature because of the elevated ridgeline location of the wind farm (Purton, evidence NSW LEC 41288 of 2008).

A specific assessment of the meteorological conditions at the Crudine Ridge site with respect to the Van Den Berg effect has not been made.

Notwithstanding, if suitable conditions did exist to regularly generate high levels of swish, then there is no scientific research to indicate that the stringent SA Guidelines do not adequately account for it. Indeed, given the conditions are more likely to occur at night, then sleep disturbance would be the main issue to address, and the noise standards applied by the SA Guidelines to wind farms are significantly more onerous than limits established for the potential onset of sleep disturbance. In addition, an assessment has been made against the background noise data collected during the night time period only, which is a more onerous assessment than that required under the SA Guidelines.

Low Frequency Noise

Noise sources that produce low frequency content, such as a freight train locomotive or diesel engine; have dominant noise content in the frequency range between 20 and 200 Hz. Low frequency noise is often described as a “rumble”.

Aerodynamic noise from a wind turbine is not dominant in the low frequency range. The main content of aerodynamic noise generated by a wind turbine is often in the area known generically as the mid-frequencies, being between 200 and 1000Hz. For example, this is evident in the octave band sound power levels for the Acciona AW77 and Siemens SWT2.3-101 turbines provided in Tables 9 and 10, respectively.

Noise reduces over distance due to a range of factors including atmospheric absorption. The mid and high frequencies are subject to a greater rate of atmospheric absorption compared to the low frequencies and therefore over large distances, whilst the absolute level of noise in all frequencies reduces, the relative level of low frequency noise compared to the mid and high frequency content increases. For example, when standing alongside a road corridor, the mid and high frequency noise from the tyre and road interaction is dominant, particularly if the road surface is wet. However, at large distances from a road corridor in a rural environment, the remaining audible content is the low frequency noise of the engine and exhaust.

In addition to this effect, wind farms are located in an environment that includes masking noise in the mid and high frequencies, such as that produced by wind in nearby trees.

At a distance from a wind farm, in an ambient environment where wind in the trees is present, it is therefore possible that only low frequencies remain audible and detectable, albeit at very low levels.

Low frequency sound produced by wind farms is not unique in overall level or content. Low frequency sound can be easily measured and heard at a range of locations at levels well in excess than in the vicinity of a wind farm. Compliance with the SA Guidelines will therefore inherently provide an adequate level of protection of amenity in the surrounding area from low frequency noise impacts.

Notwithstanding, predictions of the C-weighted noise level (the C-weighting is used to indicate the low frequency content) at residences have been made based on the worst-case (highest noise level) sound power level spectra for the Acciona AW77 and Siemens SWT2.3-101 turbines, for Layouts A and B, respectively. The predictions have considered the available sound power level data for frequencies down to 20 Hz.

Based on the predictions, the low frequency noise from the wind farm will be no greater than 55 dB(C) and 50 dB(C) at all residences for Layouts A and B, respectively. These levels are well below low frequency noise limits considered by the NSW authorities for recent development and the Draft NSW Guidelines.

Infrasound

Infrasound is generally defined as noise at frequencies less than 20 Hz. The generation of infrasound was detected on early turbine designs, which incorporated the blades 'downwind' of the tower structure. The mechanism for the generation was that the blade passed through the wake caused by the presence of the tower.

Modern turbines locate the blades upwind of the tower and it is found that turbines of contemporary design produce much lower levels of infrasound.

Infrasound is often described as inaudible, however, sound below 20 Hz remains audible provided that the sound level is sufficiently high. The thresholds of hearing for infrasound have been determined in a range of studies. Non-audible perception of infrasound through felt vibrations in various parts of the body only occurs at levels well above the threshold of hearing.

Weighting networks are applied to measured sound pressure levels to adjust for certain characteristics. The A-weighting network (dB(A)) is the most common, and it is applied to simulate the human response for sound in the most common frequency range. The A-weighting network is used by the SA Guidelines. The G-weighting network has been standardised to determine the human perception and annoyance due to noise that lies within the infrasound frequency range.

A common audibility threshold from the range of studies is an infrasound noise level of 85 dB(G) or greater. This is used by the Queensland Department of Environment and Resource Management's (DERM's) draft Guideline for the assessment of low frequency noise as the acceptable level of infrasound in the environment from a noise source to protect against the potential onset of annoyance and is consistent with other approaches, including the UK Department for Environment, Food and Rural Affairs (DEFRA).

Whilst the aerodynamic noise from a rotating turbine blade produces energy in the infrasound range, a large range of measurements of infrasound noise emissions from modern upwind turbines indicates that at distances of 200 metres, infrasound is in the order of 25 dB below the recognised perception threshold of 85 dB(G). A 25 dB difference is significant and represents at least a 100 fold difference in energy content. Infrasound also reduces in level when moving away from the source, and separation distances between wind farms and dwellings are well in excess of 200m.

Notwithstanding the above, there are natural sources of infrasound including wind and breaking waves, and a wide range of man-made sources such as industrial processes, vehicles and air conditioning and ventilation systems that make infrasound prevalent in the natural and urban environment at a similar or greater level than that regularly measured within 200m of a modern wind turbine.

Contingency Strategy

The DGR's require that a contingency strategy exists in the event of commissioned turbine noise exceeding the noise predictions. It is noted that the Acciona AW77 and Siemens SWT2.3-101 turbine have operating modes which produce lower noise levels than that of the mode used in this assessment, which relates to the highest noise level mode.

Therefore, in the event of commissioned turbine noise exceeding the predicted noise, opportunities exist to reduce the noise of the turbines using lower noise modes that can be implemented under certain operating conditions. Notwithstanding, the predictions are based on conservative (higher noise level) modelling assumptions as a means of reducing the potential for commissioned turbine noise levels exceeding the predictions.

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 of 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 daytime construction.

The separation distance of 1650m is approximately that of the closest non-associated dwelling to a proposed WTG. Greater distances than 1650m will result in lower noise levels than that presented below in Table 11. The required separation distance in order to achieve 10 dB(A) above the RBL (i.e., a limit of 40 dB(A)) is provided in Table 11.

Table 11: Predicted construction noise levels.

Phase	Main Plant and Equipment	Predicted Noise Level at 1650m	Separation to Achieve 40 dB(A) Criterion
Site Set-Up and Civil Works	Generator Transport truck Excavator Low loader	40 dB(A)	1650m
Road and Hard Stand Construction	Mobile crushing and screening plant Dozer Roller Low loader Tipper truck Excavator Scraper Transport truck	46 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	46 dB(A)	2400m
Electrical Installation	Rock trencher Concrete mixer truck Low loader Tipper truck Mobile crane	46 dB(A)	2400m
Turbine Delivery and Erection	Extendable trailer truck Low loader Mobile crane	41 dB(A)	1800m

Based on the predicted noise levels, it is expected that construction noise will be greater than 40 dB(A) and less than 75 dB(L_{Aeq}) at a distance of 1650m. In accordance with the ICN Guideline it is expected that a dwelling located between 1650m and up to 2400m from construction activity may be “noise affected” but not “highly noise affected”. Therefore, the developer *should apply all feasible and reasonable work practices to meet the noise affected level*, and should inform any impacted 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 actual construction activities have been finalised:

Scheduling

Construction works, including heavy vehicle movements into and out of the site, restricted to 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 relevant New South Wales authority.

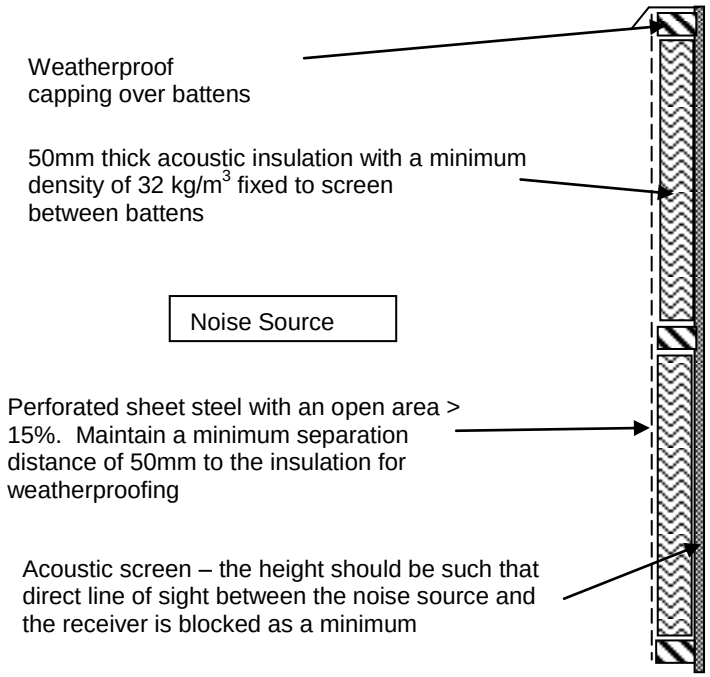
Location of Fixed Noise Sources

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

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 2100m of a non-associated dwelling and do not have direct line of sight blocked to that dwelling, in accordance with the following requirements:

- Locate 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 the 2100m limit;
- 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;
- If barriers (rather than mounding from excavated soil) are constructed, then include acoustic insulation facing into the noise source in accordance with the following detail.



In addition, the site topography, and other shielding features (e.g. large stationary machines, mounds of topsoil and piles of materials) should be used to an advantage in terms of increased shielding when locating fixed noise sources within the 2100m distance.

Enclose Generators and Compressors

Provide proprietary acoustic enclosures for site compressors and generators.

Alternative Processes

Investigate and implement alternative processes where feasible and practicable, 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.

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 an off-site 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.

Equipment and Vehicle Management

- Ensure equipment has Original Equipment Manufacturer (OEM) mufflers 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.

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 and an ability to register for email updates of the newsletter;
- 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 non-associated dwelling, 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[9];
- 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.

Project Mitigation Measures in Context

It is unlikely that the above measures will result in meeting the construction noise goals at all times due to the stringency of these goals, and the variable nature of construction activity. However, they will serve to reduce the impacts and represent the extent of feasible and practicable noise reduction measures in accordance with the ICN Guidelines.

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 finalised and should include the following additional elements and associated control provisions:

Construction Traffic

Construction activity will incorporate 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 daytime criterion provided by the ECRTN is an equivalent ($L_{Aeq,\ 1hour}$) noise level of 55 dB(A) during any given hour. It is predicted that a distance of 10m from the road side the

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

criterion can be achieved for 10 passenger vehicle movements and 3 heavy vehicle movements in one hour. The number of vehicle movements can double for every doubling of distance from the roadside and continue to achieve the 55 dB(A) criterion. That is, 20 passenger vehicles and 6 heavy vehicle movements could be accommodated in an hour at a dwelling that is 20m from the roadside. It is noted that care should be taken to avoid the acceleration of trucks and the use of truck engine brakes in close proximity to dwellings.

In accordance with the general principles of dealing with temporary construction noise impacts as compared to permanent operational noise, where the ECRTN is exceeded, the following mitigation measures should be employed to reduce construction traffic noise:

- 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 daytime operating hours for the construction site, subject to the scheduling caveats in the Construction Noise Management Plan.

Construction Vibration

It is expected that the main sources of vibration 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 to 100m. The 100m distance is a conservative estimate, with vibration from these activities unlikely to be detectable to humans at such a distance.

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

If construction activities do 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.

CONCLUSION

An environmental noise and vibration assessment has been made of the construction and operation of the proposed Crudine Ridge Wind Farm. The proposal consists of two planning layouts, designated A and B, which comprise up to 106 and 77 turbines, respectively.

The assessment considered the Director General's requirements (DGRs) for noise and vibration and compared the proposal against the following:

- Wind Turbines – the South Australian Environment Protection Authority's *Wind Farms – Environmental Noise Guidelines* (2003);
- Substation - *NSW Industrial Noise Policy* (EPA 2000);
- Site Establishment and Construction - *Interim Construction Noise Guideline* (DECC 2009);
- Traffic Noise – *Environmental Criteria for Road Traffic Noise* (NSW EPA, 1999); and,
- Vibration – *Assessing Vibration: A Technical Guideline* (DECC, 2006).

In addition, the assessment also considered the separation of the background noise data into day and night period as requested by the Department of Planning and Infrastructure.

The operational noise of the wind farm has been assessed based on Acciona AW77 turbines installed for Layout A and Siemens SWT2.3-101 turbines for Layout B, with a hub height of 80m for both layouts. Based on predictions, the noise from the turbines will achieve the SA Guidelines at all dwellings for both layouts.

Further, the predictions also indicate that the noise from turbines based on Layout B will achieve the criteria provided by the day and night split at all dwellings. For Layout A, the predictions indicate that the day and night split criteria can be achieved at all dwellings with the implementation of the recommended noise mitigation strategy.

Based on the above, for any turbine model with sound power levels and hub height that are equal to or less than that assessed for the Acciona AW77 and Siemens SWT2.3-101 turbines, the respective proposed planning layouts can achieve the stringent requirements of the SA Guidelines.

If a turbine model with higher sound power levels or an alternative hub height is later considered, then the ability to achieve compliance with the SA Guidelines will need to be demonstrated prior to construction, in a form similar to this assessment. The ability to achieve compliance may require measures such as landowner agreements, the reduction of turbines noise through low noise operating modes and/or removal of turbines.

In addition, through compliance with the SA Guidelines, the cumulative impacts of other wind farms in the vicinity and impacts from special characteristics such as “swish” and low frequency noise will be adequately addressed, as detailed in this report.

Construction activity is addressed through the establishment of a construction noise and vibration framework, developed to achieve the relevant DGRs for the adequate control of noise and vibration from general construction activity, transport and potential blasting activity.

Based on the above, the construction and operation of the proposed Crudine Wind Farm achieves the Director General’s requirements.

APPENDIX A: COORDINATES OF NOISE SOURCES

Planning Layout A – 106 WTGs

Turbine ID	Coordinates (WGS84 map datum)	
	Easting	Northing
A1	751341	6356501
A2	751252	6356181
A3	750744	6356219
A4	750785	6355965
A5	750748	6355699
A6	749769	6356019
A7	749694	6355769
A8	749499	6355437
A9	749443	6355112
A10	751219	6355394
A11	751561	6355219
A12	750780	6355333
A13	750903	6355110
A14	750819	6354844
A15	750133	6354974
A16	750065	6354676
A17	749930	6354425
A18	749912	6354156
A19	749994	6353969
A20	750594	6354469
A21	750427	6354203
A22	750476	6353901
A23	750469	6353644
A24	750441	6353372
A25	750052	6353479
A26	749561	6353341
A27	750096	6353201
A28	749696	6352956
A29	750207	6352954
A30	749599	6352703
A31	750019	6352707
A32	749816	6352445
A33	749439	6352205
A34	749847	6352174
A35	749752	6351903
A36	749403	6351750
A37	749101	6351621
A38	749465	6351478
A39	748769	6351494
A40	749096	6351350
A41	748418	6351294
A42	748794	6351145

Turbine ID	Coordinates (WGS84 map datum)	
	Easting	Northing
A43	749243	6351107
A44	747298	6351105
A45	748232	6351058
A46	748212	6350832
A47	748805	6350872
A48	748447	6350632
A49	748167	6350470
A50	747918	6350276
A51	747529	6350198
A52	746972	6350212
A53	746874	6349929
A54	746889	6349701
A55	746429	6349692
A56	746392	6349423
A57	746267	6349169
A58	746109	6348909
A59	744011	6349532
A60	743978	6349267
A61	744636	6349234
A62	743945	6349027
A63	744067	6348769
A64	744045	6348516
A65	743974	6348294
A66	745052	6348607
A67	744631	6348563
A68	744607	6348365
A69	744556	6348109
A70	743976	6347898
A71	744411	6347845
A72	743956	6347620
A73	744287	6347414
A74	743318	6347296
A75	743218	6346938
A76	743780	6347316
A77	743671	6347018
A78	744169	6347131
A79	744105	6346867
A80	743960	6346658
A81	743791	6346425
A82	744318	6346529
A83	744447	6346218
A84	744407	6345956

Turbine ID	Coordinates (WGS84 map datum)	
	Easting	Northing
A85	744529	6345707
A86	744169	6345618
A87	744607	6345442
A88	744205	6345429
A89	744563	6345251
A90	744234	6345142
A91	743678	6344954
A92	743247	6344785
A93	744051	6344914
A94	744469	6344920
A95	744267	6344662
A96	743843	6344596
A97	743469	6344447
A98	743945	6344318
A99	743491	6344182
A100	743867	6344045
A101	743520	6343918
A102	743294	6343722
A103	743863	6343758
A104	743616	6343396
A105	743625	6343149
A106	743545	6342873

Planning Layout B – 77 WTGs

Turbine ID	Coordinates (WGS84 map datum)	
	Easting	Northing
B1	751344	6356569
B2	751244	6356194
B3	750769	6355969
B4	749769	6356019
B5	748969	6355894
B6	749492	6355424
B7	749444	6355044
B8	750819	6355594
B9	751194	6355419
B10	751569	6355219
B11	751009	6355167
B12	750820	6354844
B13	750072	6354633
B14	750571	6354435
B15	749918	6354267
B16	750394	6354094
B17	749935	6353864
B18	750467	6353623
B19	750443	6353319
B20	749561	6353340
B21	750069	6353294
B22	749658	6353003
B23	750220	6352942
B24	749519	6352669
B25	749909	6352503
B26	749844	6352144
B27	749717	6351837
B28	749249	6352043
B29	749244	6351719
B30	749444	6351444
B31	748817	6351500
B32	748363	6351261
B33	749244	6351094
B34	747298	6351105
B35	748801	6350852
B36	748409	6350599
B37	747918	6350276
B38	746972	6350212
B39	746940	6349827
B40	746468	6349547
B41	746292	6349221
B42	746094	6348894

Turbine ID	Coordinates (WGS84 map datum)	
	Easting	Northing
B43	744019	6349441
B44	744619	6349244
B45	743946	6349035
B46	744040	6348387
B47	744644	6348469
B48	745069	6348569
B49	744594	6348194
B50	743939	6348015
B51	744444	6347869
B52	743870	6347625
B53	744294	6347394
B54	743806	6347203
B55	743219	6346944
B56	744089	6346883
B57	743719	6346544
B58	744319	6346519
B59	743619	6346169
B60	744444	6346194
B61	744519	6345719
B62	744144	6345494
B63	744619	6345394
B64	744111	6345222
B65	744466	6344947
B66	743946	6344906
B67	743669	6344894
B68	744269	6344644
B69	743762	6344561
B70	743429	6344303
B71	743969	6344344
B72	743877	6344082
B73	743869	6343744
B74	743287	6343698
B75	743581	6343449
B76	743629	6343149
B77	743529	6342800

Substations

Collector Station ID	Coordinates (WGS84 map datum)	
	Easting	Northing
Main Collector Station		
MCS 1	750333	6355703
MCS 2	750484	6355463
MCS 3	749786	6355065
Secondary Collector Station		
SCS	744185	6347754

APPENDIX B: COORDINATES OF RESIDENCES AND DISTANCE TO THE NOISE SOURCES

Planning Layout A – 106 WTGs

Residence ID	Associated	Coordinates (WGS84 map datum)		Closest Turbine	Distance to Closest Turbine (m)	Bearing from True North to Closest Turbine (°)
		Easting	Northing			
APR02	No	752190	6359222	A1	2851	197
APR03	No	752552	6359130	A1	2894	205
APR04	No	752661	6358918	A1	2754	209
APR05	No	752688	6358805	A1	2669	210
APR06	No	752800	6358645	A1	2594	214
APR07	No	753268	6358871	A1	3055	219
APR08	No	753611	6358833	A1	3254	224
APR09	No	754177	6358620	A1	3540	233
APR10	No	754384	6357601	A1	3236	250
CR10	Yes	756309	6354262	A11	4843	281
CR12	Yes	755649	6353837	A11	4315	289
CR13	Yes	752713	6353212	A24	2277	274
CR14	Yes	752482	6353156	A24	2053	276
CR15	No	752481	6352966	A24	2080	281
CR16	No	752403	6352112	A24	2332	303
CR18	No	752181	6351501	A34	2428	286
CR19	No	752157	6351479	A34	2411	287
CR20	No	752169	6351252	A34	2498	292
CR21	No	752122	6351129	A35	2493	288
CR24	No	752244	6350257	A35	2986	303
CR25	Yes	751106	6350196	A43	2074	296
CR26	No	750808	6349445	A43	2283	317
CR27	No	750783	6349077	A43	2548	323
CR28	No	750058	6349288	A43	1993	336
CR32	No	748594	6347479	A54	2800	322
CR33	No	747514	6346900	A58	2452	325
CR34	No	746436	6346324	A83	1992	267
CR35	No	746774	6343975	A94	2491	292
CR36	No	746472	6343762	A94	2313	300
CR37	No	745643	6341038	A106	2787	311
HER02	Yes	744824	6340558	A106	2645	331
HER03	No	745090	6341542	A106	2040	311
HER04	No	744138	6341260	A106	1719	340
HER06	Yes	741818	6342513	A106	1764	78
HER07	Yes	741306	6343883	A102	1994	95
HER08	Yes	741137	6344514	A92	2127	83
HER10	No	738787	6345315	A92	4492	97
HER11	No	738712	6345323	A92	4566	97
HER12	Yes	742188	6345650	A92	1367	129
HER13	No	739908	6345697	A92	3462	105
PL01	No	745823	6355856	A9	3695	102
PL02	No	745999	6355521	A9	3469	97
PL03	Yes	746483	6355735	A9	3025	102
PL04	Yes	745239	6350778	A55	1612	132

Residence ID	Associated	Coordinates (WGS84 map datum)		Closest Turbine	Distance to Closest Turbine (m)	Bearing from True North to Closest Turbine (°)
		Easting	Northing			
PR01	No	745203	6357804	A6	4902	111
PR03	No	745031	6358153	A6	5197	114
PR04	No	744972	6358158	A6	5252	114
PR05	Yes	745012	6358216	A6	5240	115
PR06	Yes	744964	6358230	A6	5289	115
PR07	Yes	745011	6358256	A6	5258	115
PR09	No	744875	6358372	A6	5430	116
PR10	No	745024	6358435	A6	5325	117
PR11	No	745006	6358669	A6	5450	119
PR12	Yes	745018	6358188	A6	5222	115
PR13	Yes	745070	6356340	A8	4520	102
SFR01	No	740239	6347028	A75	2981	92
SFR04	Yes	741830	6348722	A74	2062	134
SFR05	Yes	741866	6348888	A62	2083	86
SFR06	No	741882	6349955	A59	2171	101
SFR07	No	741576	6350499	A59	2621	112
SFR08	No	741351	6350695	A59	2904	114
SFR09	No	742023	6351349	A59	2695	132
SFR10	No	741321	6352343	A59	3891	136
SFR11	No	742286	6352297	A59	3259	148
SFR12	No	742431	6352386	A59	3263	151
SFR13	No	742076	6353776	A59	4665	155
SFR16	No	745009	6355872	A9	4498	100
SFR17	No	745194	6355865	A9	4315	100
SFR18	No	745358	6356022	A8	4182	98
SFR19	No	745424	6355847	A9	4086	100
TR01	No	745693	6339943	A106	3633	324
TR02	No	745654	6339837	A106	3697	325
TR03	No	745287	6338979	A106	4266	336
TR05	No	744151	6338385	A106	4530	352
TR06	No	744149	6338123	A106	4788	353

Planning Layout B – 77 WTGs

Residence ID	Associated	Coordinates (WGS84 map datum)		Closest Turbine	Distance to Closest Turbine (m)	Bearing from True North to Closest Turbine (°)
		Easting	Northing			
APR02	No	752190	6359222	B1	2785	198
APR03	No	752552	6359130	B1	2832	205
APR04	No	752661	6358918	B1	2693	209
APR05	No	752688	6358805	B1	2609	211
APR06	No	752800	6358645	B1	2536	215
APR07	No	753268	6358871	B1	3000	220
APR08	No	753611	6358833	B1	3204	225
APR09	No	754177	6358620	B1	3497	234
APR10	No	754384	6357601	B1	3211	251
CR10	Yes	756309	6354262	B10	4836	281
CR12	Yes	755649	6353837	B10	4307	289
CR13	Yes	752713	6353212	B19	2273	273
CR14	Yes	752482	6353156	B19	2046	275
CR15	No	752481	6352966	B19	2069	280
CR16	No	752403	6352112	B19	2302	302
CR18	No	752181	6351501	B26	2423	285
CR19	No	752157	6351479	B26	2406	286
CR20	No	752169	6351252	B26	2490	291
CR21	No	752122	6351129	B26	2494	294
CR24	No	752244	6350257	B27	2980	302
CR25	Yes	751106	6350196	B33	2067	296
CR26	No	750808	6349445	B33	2272	317
CR27	No	750783	6349077	B33	2537	323
CR28	No	750058	6349288	B33	1981	336
CR32	No	748594	6347479	B39	2872	325
CR33	No	747514	6346900	B42	2448	325
CR34	No	746436	6346324	B60	1996	266
CR35	No	746774	6343975	B65	2504	293
CR36	No	746472	6343762	B65	2330	301
CR37	No	745643	6341038	B77	2752	310
HER02	Yes	744824	6340558	B77	2589	330
HER03	No	745090	6341542	B77	2005	309
HER04	No	744138	6341260	B77	1656	338
HER06	Yes	741818	6342513	B77	1735	80
HER07	Yes	741306	6343883	B74	1990	95
HER08	Yes	741137	6344514	B74	2299	111
HER10	No	738787	6345315	B55	4722	70
HER11	No	738712	6345323	B55	4789	70
HER12	Yes	742188	6345650	B59	1522	70
HER13	No	739908	6345697	B55	3538	69
PL01	No	745823	6355856	B5	3146	89
PL02	No	745999	6355521	B5	2994	83
PL03	Yes	746483	6355735	B5	2491	86
PL04	Yes	745239	6350778	B44	1654	202
PR01	No	745203	6357804	B5	4222	117
PR03	No	745031	6358153	B5	4540	120
PR04	No	744972	6358158	B5	4594	120

Residence ID	Associated	Coordinates (WGS84 map datum)		Closest Turbine	Distance to Closest Turbine (m)	Bearing from True North to Closest Turbine (°)
		Easting	Northing			
PR05	Yes	745012	6358216	B5	4588	120
PR06	Yes	744964	6358230	B5	4636	120
PR07	Yes	745011	6358256	B5	4609	121
PR09	No	744875	6358372	B5	4785	121
PR10	No	745024	6358435	B5	4692	123
PR11	No	745006	6358669	B5	4838	125
PR12	Yes	745018	6358188	B5	4568	120
PR13	Yes	745070	6356340	B5	3925	97
SFR01	No	740239	6347028	B55	2981	92
SFR04	Yes	741830	6348722	B45	2139	82
SFR05	Yes	741866	6348888	B45	2085	86
SFR06	No	741882	6349955	B43	2198	104
SFR07	No	741576	6350499	B43	2663	113
SFR08	No	741351	6350695	B43	2948	115
SFR09	No	742023	6351349	B43	2762	134
SFR10	No	741321	6352343	B43	3962	137
SFR11	No	742286	6352297	B43	3340	149
SFR12	No	742431	6352386	B43	3346	152
SFR13	No	742076	6353776	B43	4751	156
SFR16	No	745009	6355872	B5	3960	90
SFR17	No	745194	6355865	B5	3775	90
SFR18	No	745358	6356022	B5	3613	92
SFR19	No	745424	6355847	B5	3546	89
TR01	No	745693	6339943	B77	3584	323
TR02	No	745654	6339837	B77	3646	324
TR03	No	745287	6338979	B77	4206	335
TR05	No	744151	6338385	B77	4459	352
TR06	No	744149	6338123	B77	4718	352

Substations

Residence ID	Associated	Coordinates (WGS84 map datum)		Closest Collector Station	Distance to Closest Collector Station (m)	Bearing from True North to Closest Collector Station (°)
		Easting	Northing			
APR02	No	752190	6359222	MCS 1	3979	208
APR03	No	752552	6359130	MCS 1	4083	213
APR04	No	752661	6358918	MCS 1	3970	216
APR05	No	752688	6358805	MCS 1	3895	217
APR06	No	752800	6358645	MCS 1	3840	220
APR07	No	753268	6358871	MCS 1	4319	223
APR08	No	753611	6358833	MCS 1	4532	226
APR09	No	754177	6358620	MCS 1	4825	233
APR10	Yes	754384	6357601	MCS 2	4448	241
CR13	No	752713	6353212	MCS 2	3168	315
CR14	No	752482	6353156	MCS 2	3052	319
CR15	No	752481	6352966	MCS 2	3198	321
CR16	No	752403	6352112	MCS 2	3862	330
CR18	No	752181	6351501	MCS 3	4294	326
CR19	No	752157	6351479	MCS 3	4298	327
CR20	Yes	752169	6351252	MCS 3	4496	328
CR21	No	752122	6351129	MCS 3	4577	329
CR32	No	748594	6347479	SCS 1	4418	274
CR33	No	747514	6346900	SCS 1	3437	284
CR34	No	746436	6346324	SCS 1	2667	302
CR35	No	746774	6343975	SCS 1	4580	326
CR36	No	746472	6343762	SCS 1	4600	330
HER07	No	741306	6343883	SCS 1	4824	37
HER08	No	741137	6344514	SCS 1	4448	43
HER12	No	742188	6345650	SCS 1	2901	44
HER13	No	739908	6345697	SCS 1	4746	64
PL01	No	745823	6355856	MCS 3	4041	101
PL02	No	745999	6355521	MCS 3	3815	97
PL03	No	746483	6355735	MCS 3	3370	101
PL04	No	745239	6350778	SCS 1	3202	199
PR13	No	745070	6356340	MCS 3	4885	105
SFR01	No	740239	6347028	SCS 1	4012	80
SFR04	No	741830	6348722	SCS 1	2547	112
SFR05	No	741866	6348888	SCS 1	2581	116
SFR06	No	741882	6349955	SCS 1	3186	134
SFR07	No	741576	6350499	SCS 1	3787	136
SFR08	No	741351	6350695	SCS 1	4084	136
SFR09	No	742023	6351349	SCS 1	4196	149
SFR11	No	742286	6352297	SCS 1	4924	157
SFR12	No	742431	6352386	SCS 1	4953	159
SFR16	No	745009	6355872	MCS 3	4844	100
SFR17	No	745194	6355865	MCS 3	4661	100
SFR18	No	745358	6356022	MCS 3	4530	102
SFR19	No	745424	6355847	MCS 3	4432	100
APR04	No	752661	6358918	MCS 1	3970	216

APPENDIX C: DIRECTOR-GENERAL'S REQUIREMENTS

Director-General's Requirements

Section 75F of the *Environmental Planning and Assessment Act 1979*

Project	Construction and operation of a wind farm comprising between 70 and 110 turbines, each with a nominal capacity of between 1.5 and 3.4 Megawatts to be located across a 16 kilometre span along the Crudine Ridge. Associated infrastructure includes underground connection (where possible) to a collector substation, the construction of a facilities building, a new easement of approximately 13 kilometres along which a 132 kV power line will be installed to connect to existing transmission lines, a switching substation, access tracks and a temporary concrete batching plant.
Site	Approximately 45 kilometres south of Mudgee and 45 kilometres north of Bathurst, to the south west of Aarons Pass Road in the Bathurst Regional and Mid-Western Regional Local Government Areas.
Proponent	Wind Prospect CWP Pty Ltd
Date of Issue	17 March 2011
Date of Expiration	17 March 2013
General Requirements	The Environmental Assessment (EA) must include: • an **executive summary**; • a **detailed description** of the project (both the wind farm and associated infrastructure) including: → construction, operation and decommissioning details; → the location and dimensions of all project components including the wind turbines (including map coordinates and AHD heights), underground/ overhead cabling between turbines, electrical substation and transmission line linking the wind farm to the grid, temporary concrete batching plant(s), construction compounds, access roads/road upgrades (including internal access tracks) and obstacle lighting; → a timeline identifying the proposed construction and operation of the project components including staging, their envisaged lifespan and arrangements for decommissioning; → supporting maps/plans clearly identifying existing environmental features (e.g. watercourses, vegetation), infrastructure and landuse (including nearby residences and approved residential developments or subdivisions, if any) and the location / siting of the project including associated infrastructure in the context of this existing environment; and → resourcing requirements (including, but not limited to, water supply and gravel). • consideration of any **relevant statutory provisions** including the consistency of the project with the objects of the *Environmental Planning and Assessment Act 1979* (i.e. section 5 of the Act) and any relevant development control plans; • an **assessment of the key issues** outlined below, during construction, operation and decommissioning (as relevant). The Environmental Assessment must assess the worst case as well as representative impact for all key issues; • consideration of any **cumulative impacts** as relevant, taking note of proposed wind farms in the locality including proposed Uungula Wind Farm; • demonstration that the wind farm will be capable of meeting relevant Building Code of Australia (BCA) standards and other **relevant codes** / manufacturers' specifications for the construction of wind farms; • a **draft Statement of Commitments** detailing measures for environmental mitigation, management and monitoring for the project; • a **conclusion justifying the project** taking into consideration the environmental, social and economic impacts of the project; the suitability of the site; and the public interest; and • **certification by the author** of the EA that the information contained in the Assessment is neither false nor misleading. The EA should present, with respect to each relevant transmission line impact, a

proposed mitigation measures and any residual impacts after these measures have been implemented.

- **Noise Impacts** - the EA must:
  - → include a comprehensive noise assessment of all phases and components of the project including: turbine operation, the operation of the electrical substation, corona and / or aeolian noise from the transmission line, construction noise (focusing on high noise-generating construction scenarios and works outside of standard construction hours), traffic noise during construction and operation, and vibration generating activities (including blasting) during construction and / or operation. The assessment must identify noise / vibration sensitive locations (including approved but not yet developed dwellings), baseline conditions based on monitoring results, the levels and character of noise (eg. tonality, impulsiveness, low frequency etc.) generated by noise sources, noise / vibration criteria, modelling assumptions and worst case and representative noise / vibration impacts;
  - → in relation to wind turbine operation, determine the noise impacts under operating meteorological conditions (i.e. wind speeds from cut in to rated power), including impacts under meteorological conditions that exacerbate impacts (including varying atmospheric stability classes and the van den Berg effect for wind turbines). The probability of such occurrences must be quantified;
  - → include monitoring to ensure that there is adequate wind speed / profile data and ambient background noise data that is representative for all sensitive receptors;
  - → provide justification for the nominated average background noise level used in the assessment process, considering any significant difference between daytime and night time background noise levels at background noise levels higher than 30 dB(A);
  - → identify any risks with respect to tonal, low frequency or infra-noise;
  - → clearly outline the noise mitigation, monitoring and management measures that would be applied to the project. This must include an assessment of the feasibility, effectiveness and reliability of proposed measures and any residual impacts after these measures have been incorporated;
  - → if any noise agreements with residents are proposed for areas where noise criteria cannot be met, provide sufficient information to enable a clear understanding of what has been agreed and what criteria have been used to frame any such agreements; and
  - → include a contingency strategy that provides for additional noise attenuation should higher noise levels than those predicted result following commissioning and / or noise agreements with landowners not eventuate.

  The assessment must be undertaken consistent with the following guidelines:
  - → Wind Turbines - the South Australian Environment Protection Authority's *Wind Farms - Environmental Noise Guidelines* (2003);
  - → Substation – *NSW Industrial Noise Policy* (EPA, 2000);
  - → Site Establishment and Construction – *Interim Construction Noise Guidelines* (DECC, 2009);
  - → Traffic Noise – *Environmental Criteria for Road Traffic Noise* (NSW EPA, 1999); and
  - → Vibration – *Assessing Vibration: A Technical Guideline* (DECC, 2006).

- **Ecological Impacts** – the EA must include an ecological assessment considering terrestrial and aquatic ecosystems (as relevant), including groundwater dependent ecosystems, consistent with *Guidelines for Threatened Species Assessment* (DEC, 2005). The EA must:
  - → identify threatened species, populations and communities listed under both State and Commonwealth legislation that have the potential to occur on site;
  - → map existing vegetation by vegetation/ community type and include details on existing site conditions, including whether the vegetation comprises a highly

	considered overview of potential impacts along the length of the line, to identify areas of potentially significant impact for further, more detailed assessment. In addition to detailed assessment of areas of potentially significant impact, other areas along the length of the line should be assessed in a more general manner, with a particular focus on the development of frameworks for the mitigation, management and monitoring of more minor and generic environmental issues.
Key Assessment Requirements	The EA must include assessment of the following key issues for both the wind farm and transmission line: • **Strategic Justification** - the EA must: → include a strategic assessment of the need, scale, scope and location for the project in relation to predicted electricity demand, predicted transmission constraints and the strategic direction of the region and the State in relation to electricity supply, demand and electricity generation technologies, and its role within the Commonwealth's Renewable Energy Target Scheme. The EA must clearly demonstrate that the existing transmission infrastructure has sufficient capacity to accommodate the project; → include a clear demonstration of quantified and substantiated greenhouse gas benefits, taking into consideration sources of electricity that could realistically be replaced and the extent of their replacement, with reference to the Department of Environment, Climate Change and Water *NSW wind farm greenhouse gas savings tool* (http://www.environment.nsw.gov.au/climatechange/greenhousegassavingstool.htm); → include an analysis of the suitability of the project with respect to potential land use conflicts with existing and future surrounding land uses (including rural residential development, building entitlements and subdivision potential, land of significant scenic or visual value, land of high agricultural value, mineral reserves, forestry, conservation areas and Crown land), taking into account local and strategic landuse objectives and the potential for social and economic impacts on the local community. The analysis of site suitability shall consider any Environmentally Sensitive Area Mapping held by the Bathurst and Mid-Western Regional Councils; and → describe the alternatives considered (location and / or design) for all project components, and provide justification for the preferred project demonstrating its benefits on a local and strategic scale and how it achieves stated objectives and any measures to offset residual impacts (for example community enhancement programmes). • **Visual Impacts** - the EA must: → provide a comprehensive assessment of the landscape character and values and any scenic or significant vistas of the area potentially affected by the project, including an assessment of the significance of landscape values and character in a local and regional context. This should describe community and stakeholder values of the local and regional visual amenity and quality, and perceptions of the project based on surveys and consultation; → assess the impact of shadow "flicker", blade "glint" and night lighting from the wind farm; → identify the zone of visual influence of the wind farm including consideration to night lighting (no less than 10 kilometres) and assess the visual impact of all project components on this landscape; → include an assessment of any cumulative visual impacts from transmission line infrastructure; → include photomontages of the project taken from potentially affected residences (including approved but not yet developed dwellings or subdivisions with residential rights), settlements and significant public view points, and provide a clear description of proposed visual amenity mitigation and management measures for both the wind farm and the transmission line. The photomontages must include representative views of turbine night lighting if proposed; and → provide an assessment of the feasibility, effectiveness and reliability of

APPENDIX D: PHOTOGRAPHS OF LOGGING EQUIPMENT AT RESIDENCES

Noise Logger at CR14

Noise Logger at CR28

Noise Logger at CR18

Location of equipment at deployment

Location of equipment at collection

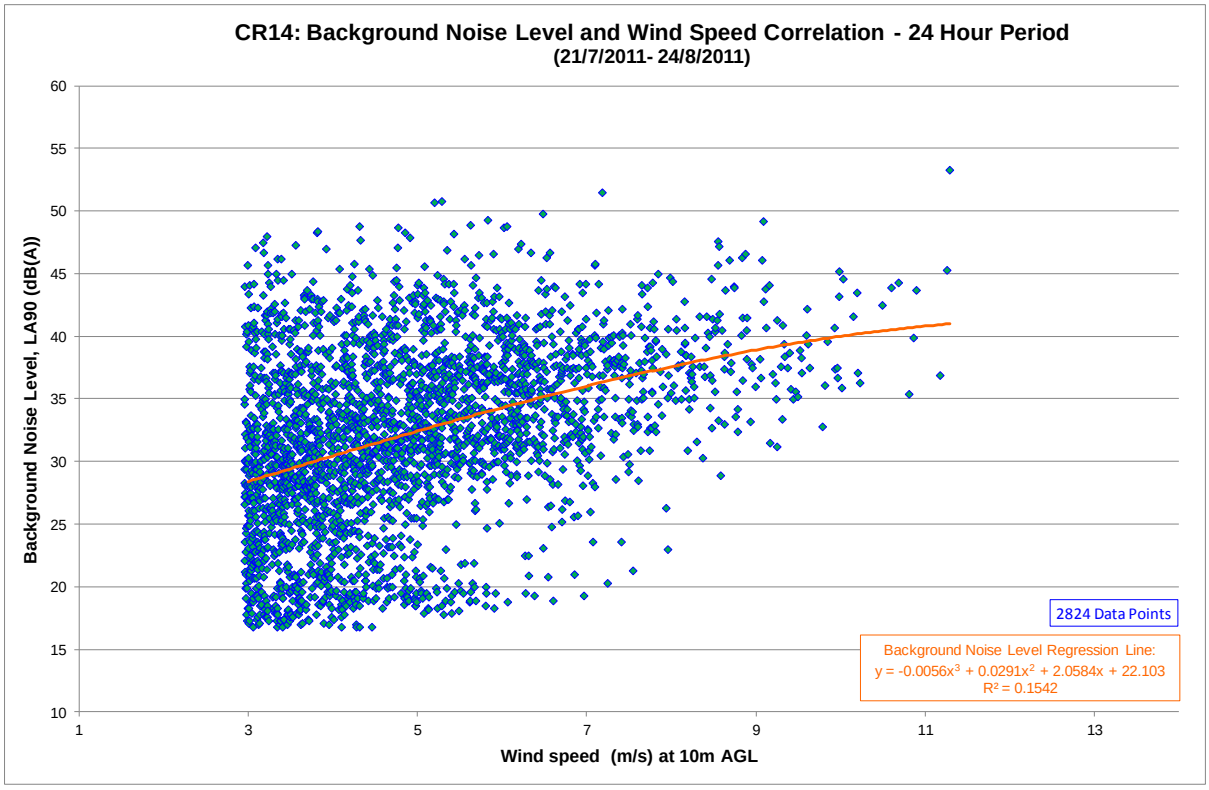
Noise Logger at CR33

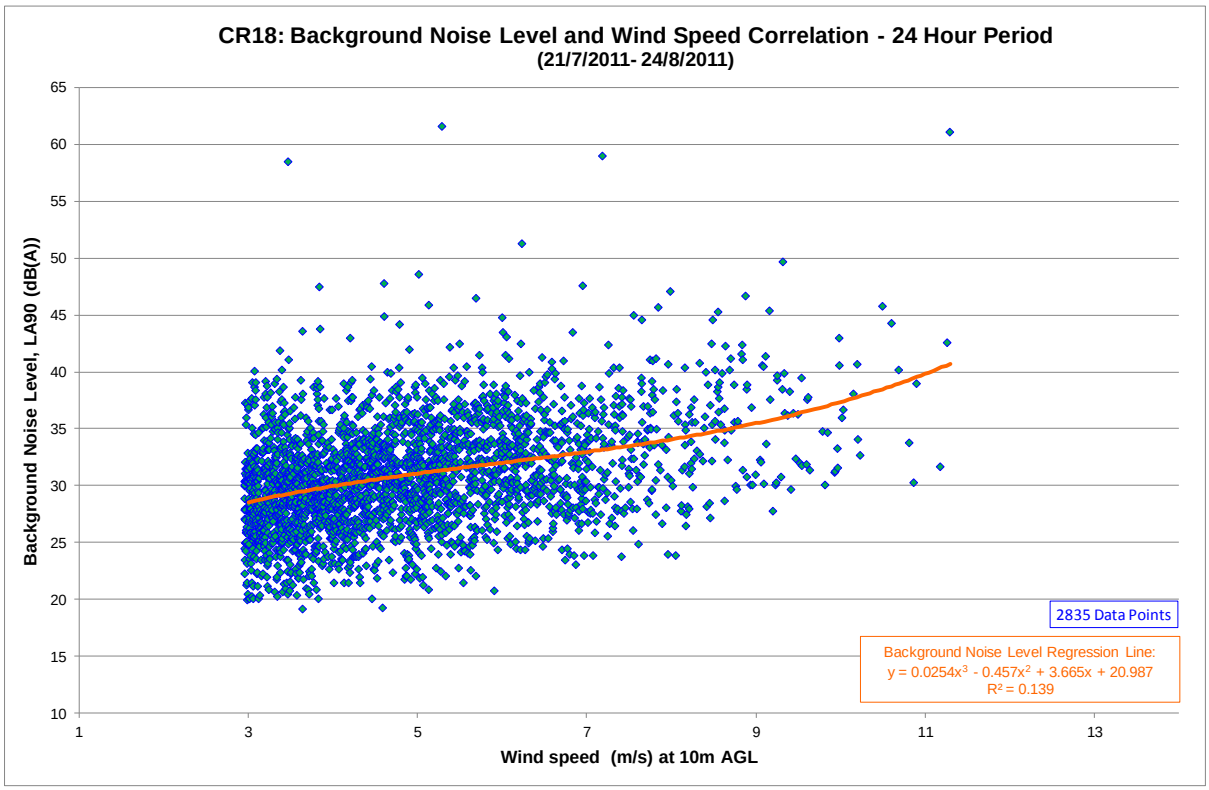
Noise Logger at HER04

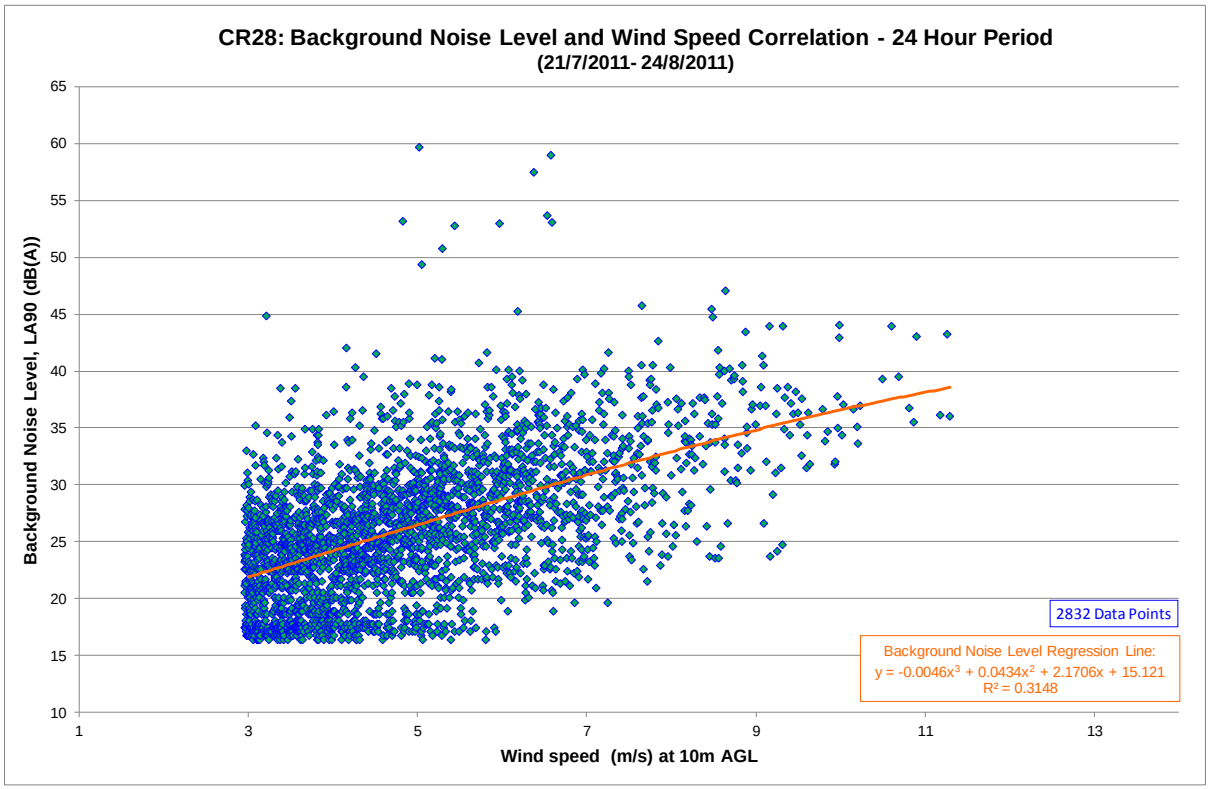
Noise Logger and Weather Station at HER07

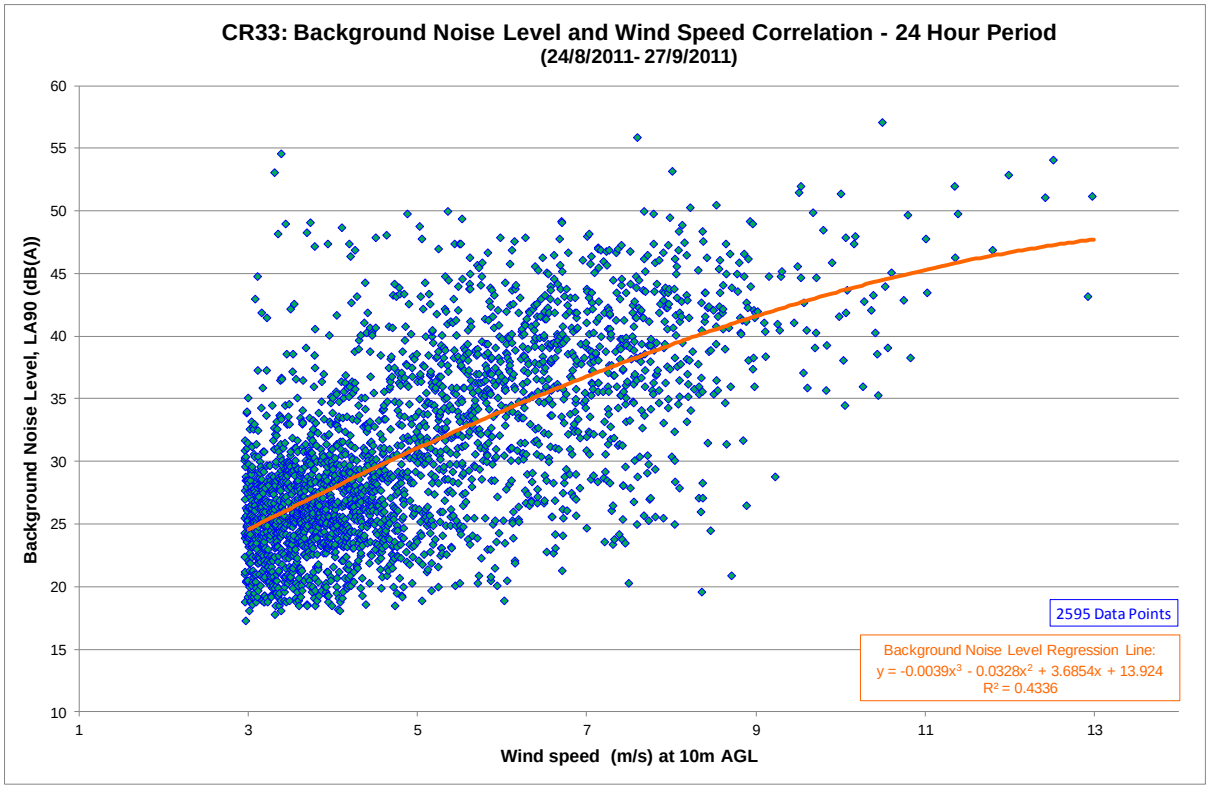
Noise Logger at SFR05

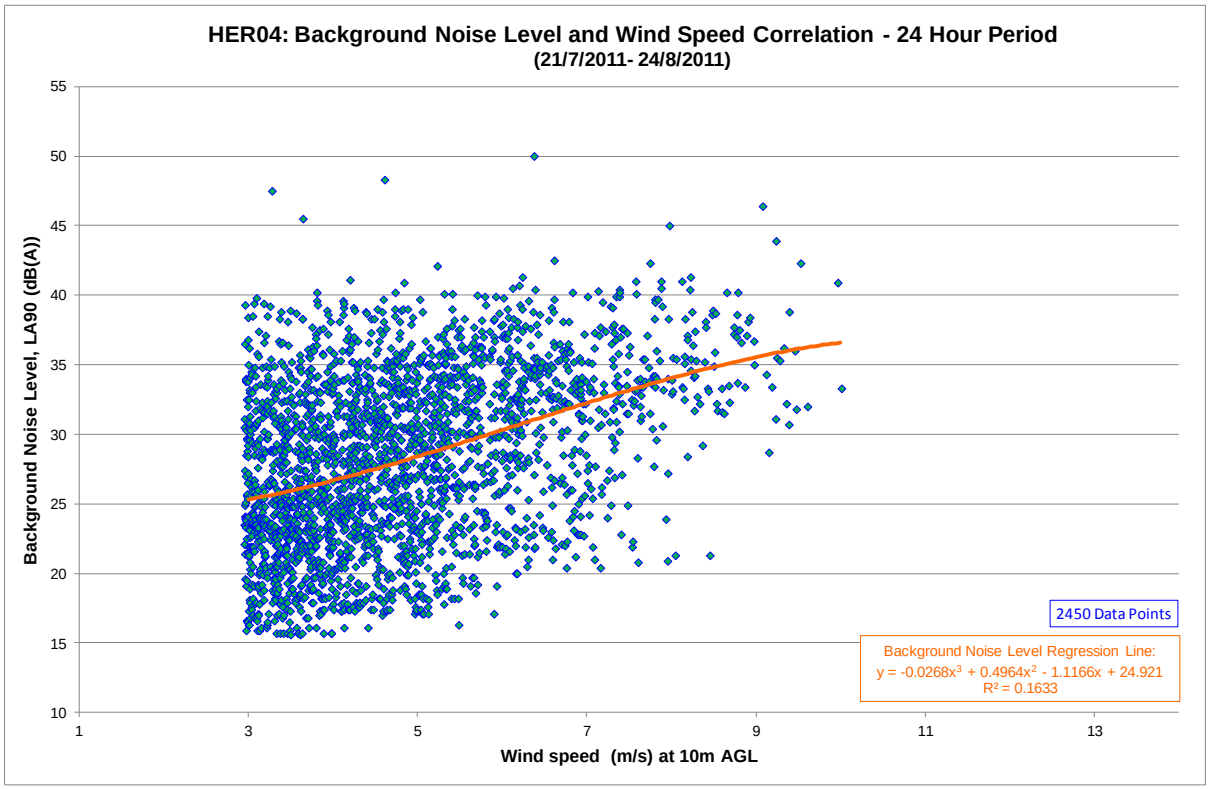
APPENDIX E: CORRELATIONS AND REGRESSION ANALYSIS - 24 HOUR PERIOD

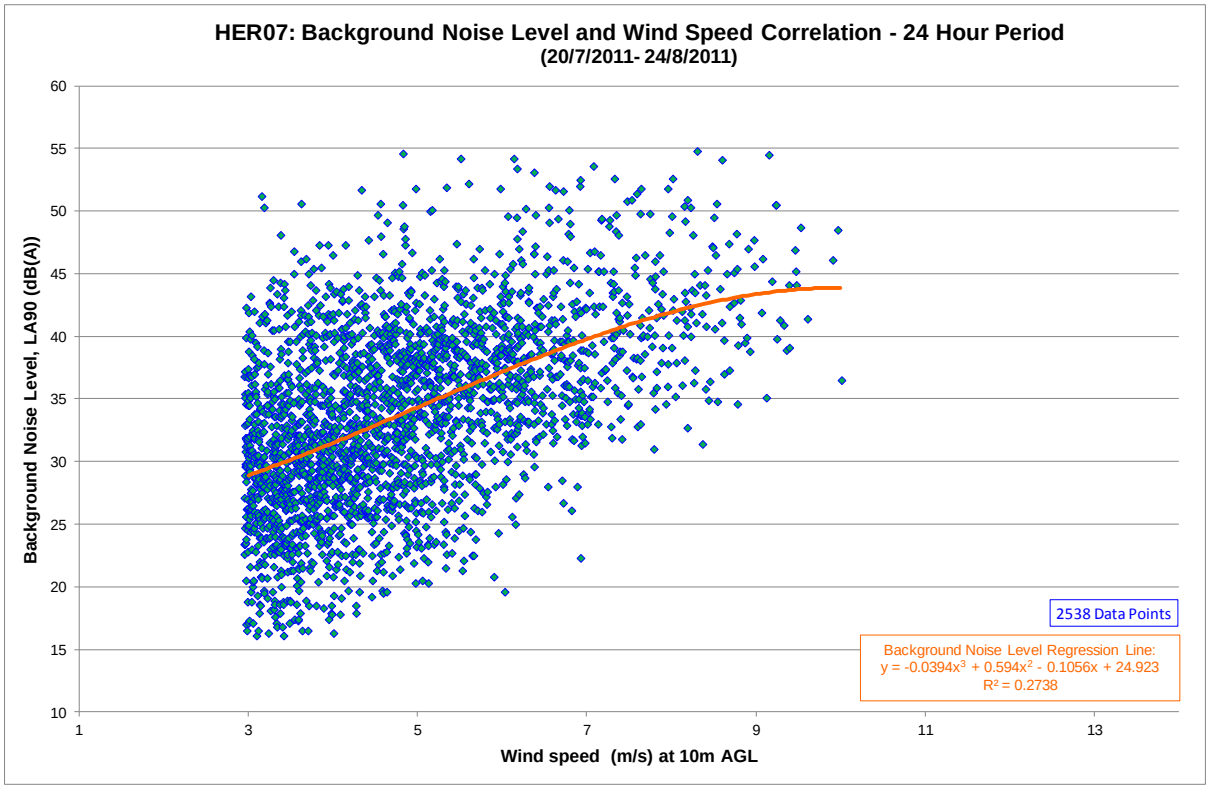


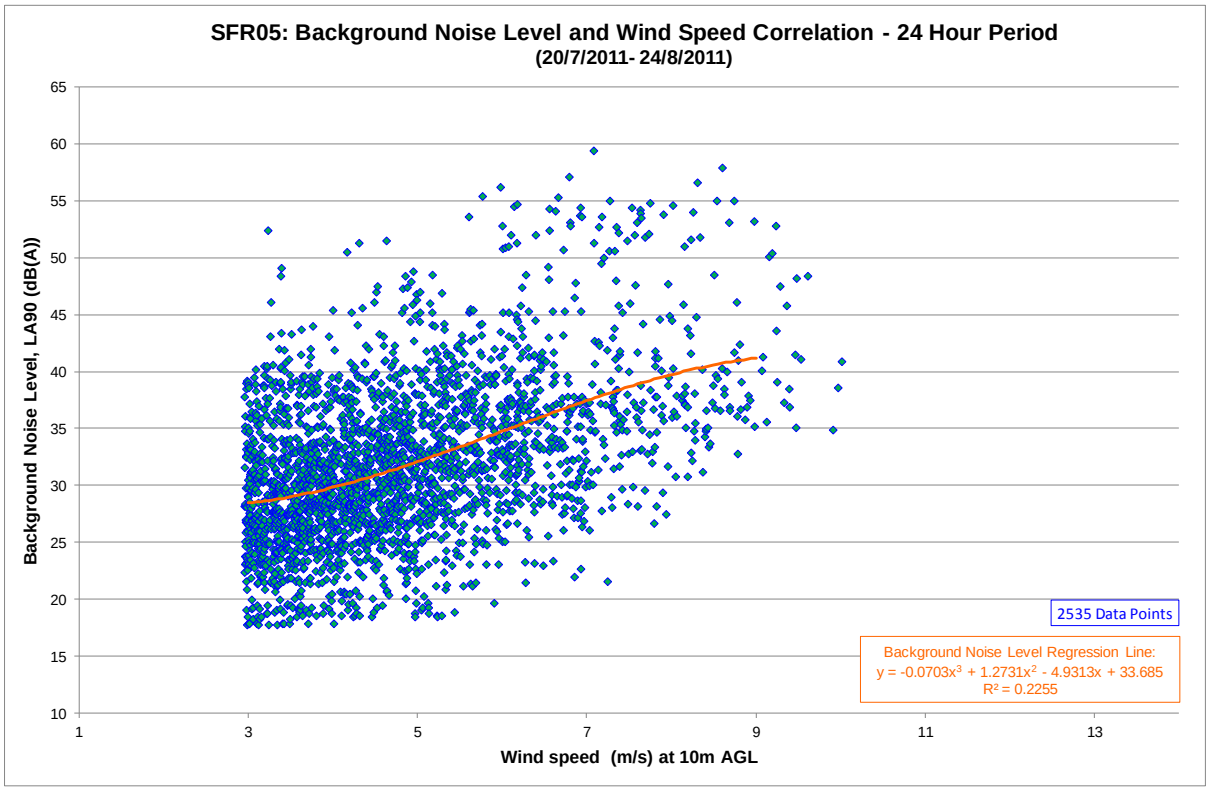



CR28: Background Noise Level and Wind Speed Correlation - 24 Hour Period
(21/7/2011- 24/8/2011)
Background Noise Level, LA90 (dB(A))
Wind speed (m/s) at 10m AGL
2832 Data Points
Background Noise Level Regression Line:
y = -0.0046x³ + 0.0434x² + 2.1706x + 15.121
R² = 0.3148

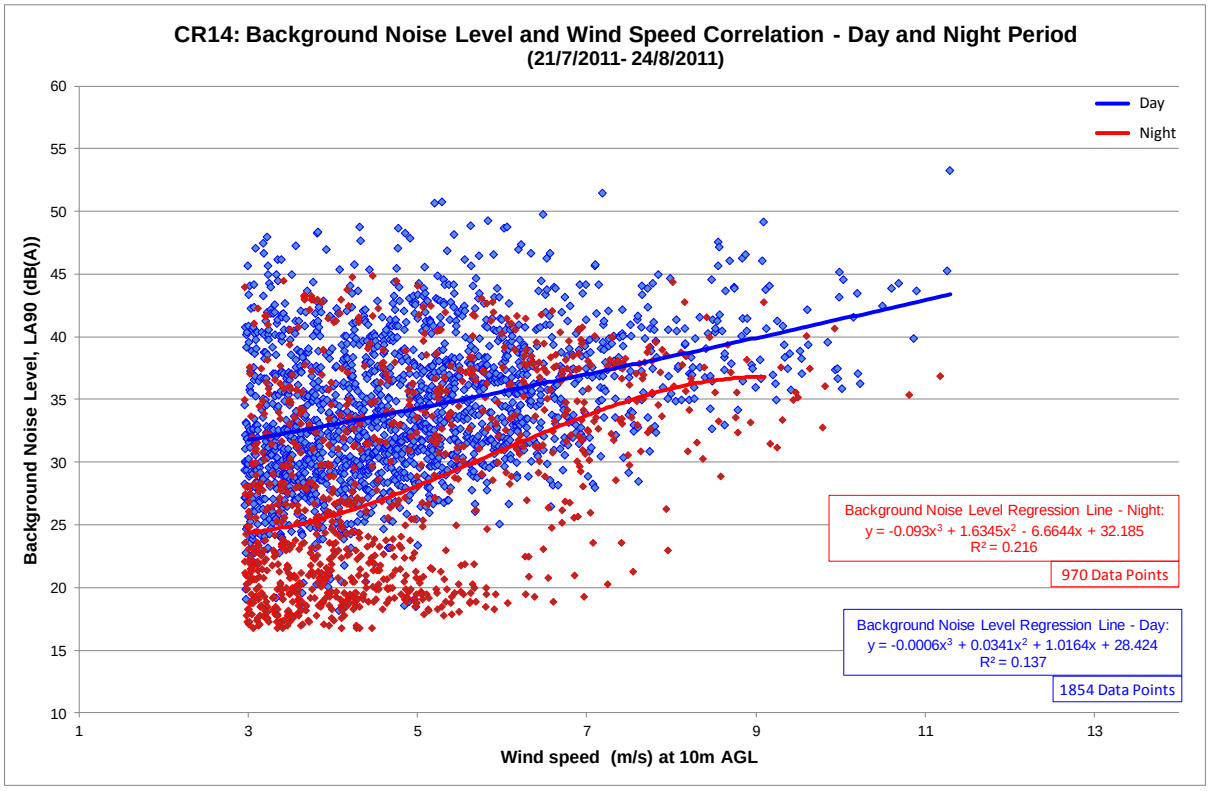

CR33: Background Noise Level and Wind Speed Correlation - 24 Hour Period
(24/8/2011- 27/9/2011)
Background Noise Level, LA90 (dB(A))
Wind speed (m/s) at 10m AGL
2595 Data Points
Background Noise Level Regression Line:
y = -0.0039x³ - 0.0328x² + 3.6854x + 13.924
R² = 0.4336

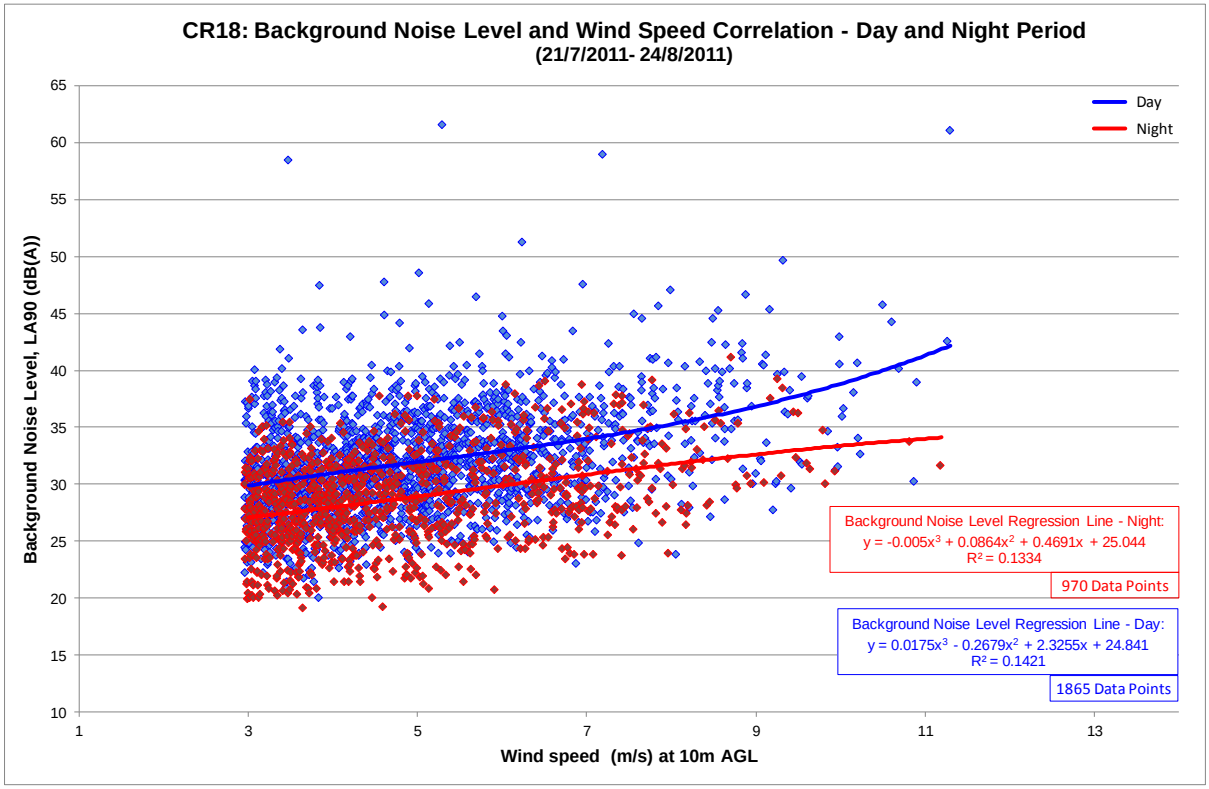

HER04: Background Noise Level and Wind Speed Correlation - 24 Hour Period
(21/7/2011- 24/8/2011)
Background Noise Level, LA90 (dB(A))
Wind speed (m/s) at 10m AGL
2450 Data Points
Background Noise Level Regression Line:
y = -0.0268x³ + 0.4964x² - 1.1166x + 24.921
R² = 0.1633

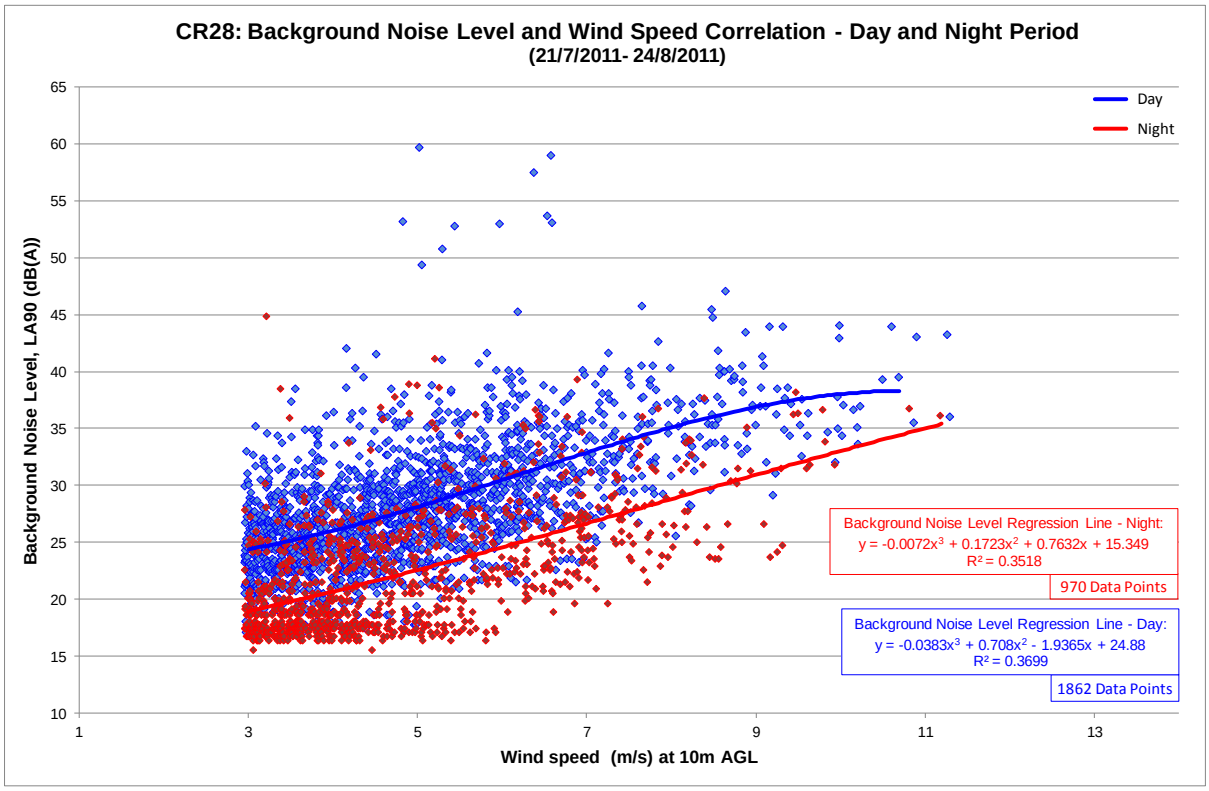

HER07: Background Noise Level and Wind Speed Correlation - 24 Hour Period
(20/7/2011- 24/8/2011)
Background Noise Level, LA90 (dB(A))
Wind speed (m/s) at 10m AGL
2538 Data Points
Background Noise Level Regression Line:
y = -0.0394x³ + 0.594x² - 0.1056x + 24.923
R² = 0.2738

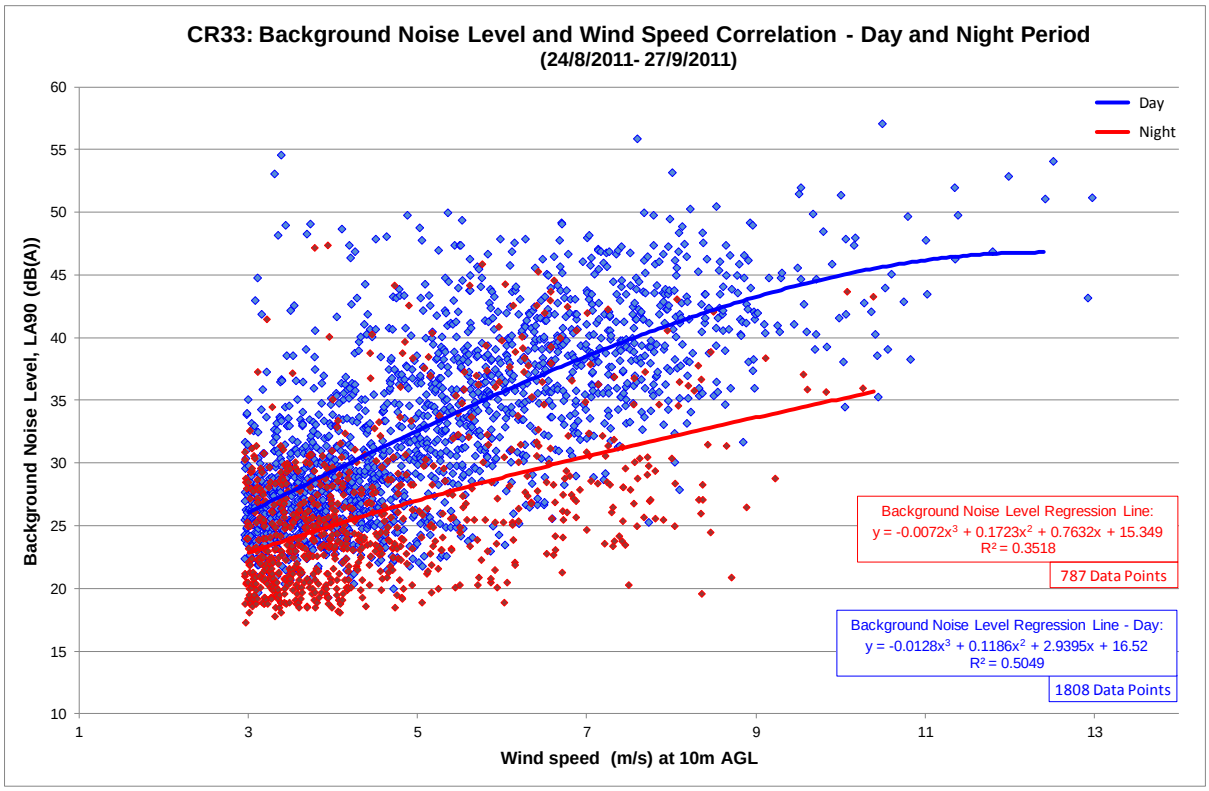

SFR05: Background Noise Level and Wind Speed Correlation - 24 Hour Period
(20/7/2011- 24/8/2011)
Background Noise Level, LA90 (dB(A))
65
60
55
50
45
40
35
30
25
20
15
10
1
3
5
7
9
11
13
Wind speed (m/s) at 10m AGL
2535 Data Points
Background Noise Level Regression Line:
y = -0.0703x³ + 1.2731x² - 4.9313x + 33.685
R² = 0.2255

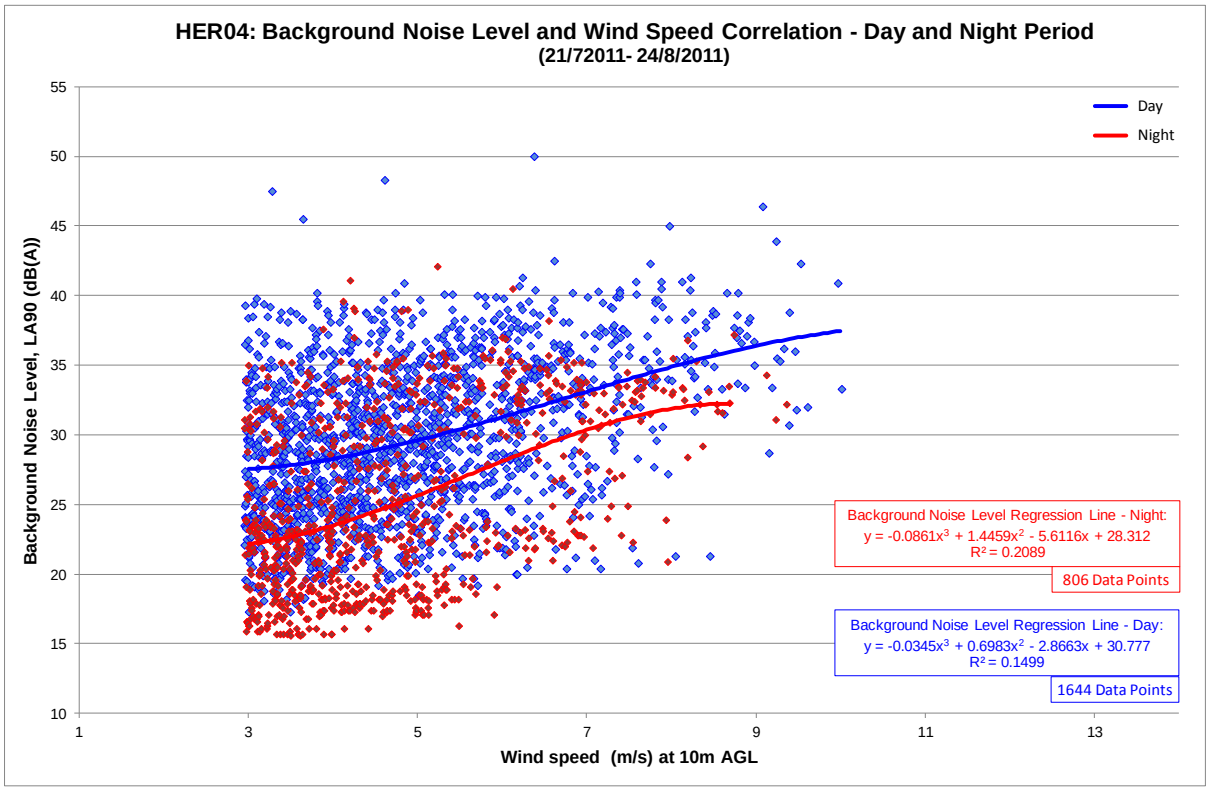
APPENDIX F: CORRELATIONS AND REGRESSION ANALYSIS – DAY AND NIGHT PERIODS

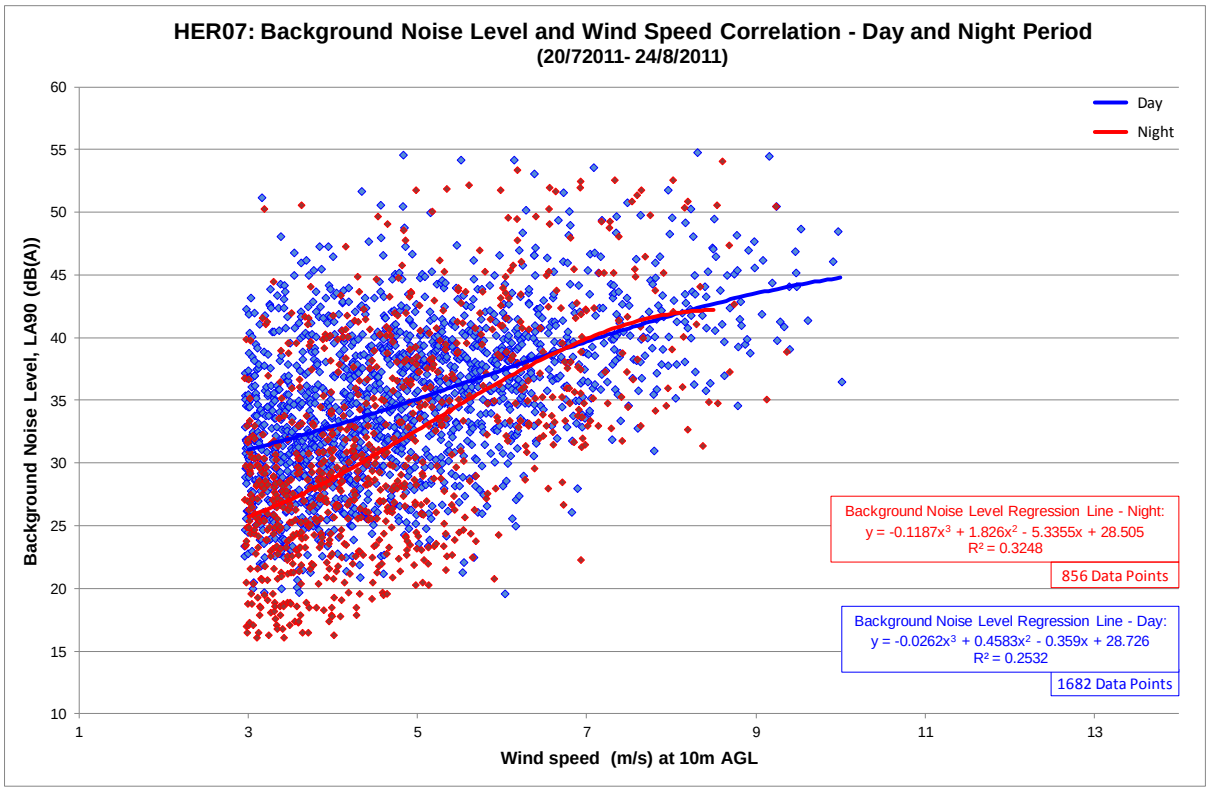


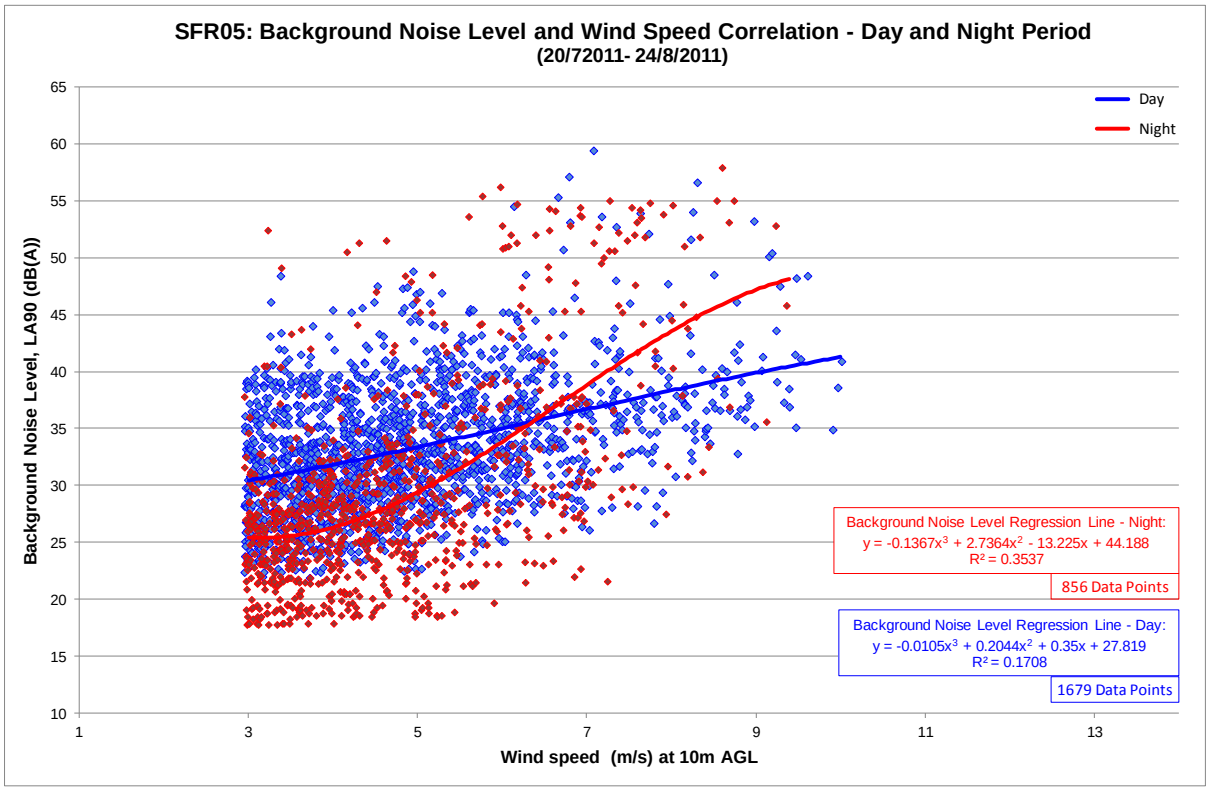



CR28: Background Noise Level and Wind Speed Correlation - Day and Night Period
(21/7/2011- 24/8/2011)
Day
Night
Background Noise Level, LA90 (dB(A))
Wind speed (m/s) at 10m AGL
Background Noise Level Regression Line - Night:
y = -0.0072x³ + 0.1723x² + 0.7632x + 15.349
R² = 0.3518
970 Data Points
Background Noise Level Regression Line - Day:
y = -0.0383x³ + 0.708x² - 1.9365x + 24.88
R² = 0.3699
1862 Data Points


CR33: Background Noise Level and Wind Speed Correlation - Day and Night Period
(24/8/2011- 27/9/2011)
Day
Night
Background Noise Level, LA90 (dB(A))
Wind speed (m/s) at 10m AGL
Background Noise Level Regression Line:
y = -0.0072x³ + 0.1723x² + 0.7632x + 15.349
R² = 0.3518
787 Data Points
Background Noise Level Regression Line - Day:
y = -0.0128x³ + 0.1186x² + 2.9395x + 16.52
R² = 0.5049
1808 Data Points


HER04: Background Noise Level and Wind Speed Correlation - Day and Night Period
(21/72011- 24/8/2011)
Day
Night
Background Noise Level, LA90 (dB(A))
Wind speed (m/s) at 10m AGL
Background Noise Level Regression Line - Night:
y = -0.0861x³ + 1.4459x² - 5.6116x + 28.312
R² = 0.2089
806 Data Points
Background Noise Level Regression Line - Day:
y = -0.0345x³ + 0.6983x² - 2.8663x + 30.777
R² = 0.1499
1644 Data Points


HER07: Background Noise Level and Wind Speed Correlation - Day and Night Period
(20/72011- 24/8/2011)
Day
Night
Background Noise Level, LA90 (dB(A))
Wind speed (m/s) at 10m AGL
Background Noise Level Regression Line - Night:
y = -0.1187x³ + 1.826x² - 5.3355x + 28.505
R² = 0.3248
856 Data Points
Background Noise Level Regression Line - Day:
y = -0.0262x³ + 0.4583x² - 0.359x + 28.726
R² = 0.2532
1682 Data Points


SFR05: Background Noise Level and Wind Speed Correlation - Day and Night Period
(20/72011- 24/8/2011)
Day
Night
Background Noise Level, LA90 (dB(A))
65
60
55
50
45
40
35
30
25
20
15
10
1
3
5
7
9
11
13
Wind speed (m/s) at 10m AGL
Background Noise Level Regression Line - Night:
y = -0.1367x³ + 2.7364x² - 13.225x + 44.188
R² = 0.3537
856 Data Points
Background Noise Level Regression Line - Day:
y = -0.0105x³ + 0.2044x² + 0.35x + 27.819
R² = 0.1708
1679 Data Points

APPENDIX G: NOISE CRITERIA (SA GUIDELINES) AND PREDICTED NOISE LEVELS

Planning Layout A – 106 Acciona AW77 WTGs

Residence ID	Representative Logging Location	Criteria (dB(A)) 10m AGL Wind Speed (m/s)										Predicted Noise Level (dB(A)) 10m AGL Wind Speed (m/s)									
		3	4	5	6	7	8	9	10	11	12	3	4	5	6	7	8	9	10	11	12
APR02	CR14	35	35	37	39	41	43	44	45	46	46	21	23	25	27	27	28	28	28	28	28
APR03	CR14	35	35	37	39	41	43	44	45	46	46	21	23	25	27	28	28	28	28	28	28
APR04	CR14	35	35	37	39	41	43	44	45	46	46	21	23	25	27	28	28	28	28	28	28
APR05	CR14	35	35	37	39	41	43	44	45	46	46	21	23	25	27	28	28	28	28	28	28
APR06	CR14	35	35	37	39	41	43	44	45	46	46	22	24	26	27	28	28	28	28	28	28
APR07	CR14	35	35	37	39	41	43	44	45	46	46	20	22	24	26	27	27	27	27	27	27
APR08	CR14	35	35	37	39	41	43	44	45	46	46	19	21	23	25	26	26	26	26	26	26
APR09	CR14	35	35	37	39	41	43	44	45	46	46	19	21	23	25	26	26	26	26	26	26
APR10	CR14	35	35	37	39	41	43	44	45	46	46	20	22	24	26	27	27	27	27	27	27
CR10	CR14	45	45	45	45	45	45	45	45	46	46	18	20	22	24	24	25	25	25	25	25
CR12	CR14	45	45	45	45	45	45	45	45	46	46	19	21	23	25	26	26	26	26	26	26
CR13	CR14	45	45	45	45	45	45	45	45	46	46	28	30	32	34	35	35	35	35	35	35
CR14	CR14	45	45	45	45	45	45	45	45	46	46	29	31	33	35	36	36	36	36	36	36
CR15	CR14	35	35	37	39	41	43	44	45	46	46	29	31	33	35	35	36	36	36	36	36
CR16	CR18	35	35	36	37	38	39	40	42	45	45	28	30	32	34	35	35	35	35	35	35
CR18	CR18	35	35	36	37	38	39	40	42	45	45	28	30	32	34	34	34	35	35	35	35
CR19	CR18	35	35	36	37	38	39	40	42	45	45	28	30	32	34	34	35	35	35	35	35
CR20	CR18	35	35	36	37	38	39	40	42	45	45	27	29	31	33	34	34	34	34	34	34
CR21	CR18	35	35	36	37	38	39	40	42	45	45	27	29	31	33	34	34	34	34	34	34
CR24	CR18	35	35	36	37	38	39	40	42	45	45	26	28	30	32	32	33	33	33	33	33
CR25	CR28	45	45	45	45	45	45	45	45	45	45	28	30	32	34	35	35	35	35	35	35
CR26	CR28	35	35	35	35	36	38	40	42	43	43	27	29	31	33	34	34	34	34	34	34
CR27	CR28	35	35	35	35	36	38	40	42	43	43	26	28	30	32	33	33	33	33	33	33
CR28	CR28	35	35	35	35	36	38	40	42	43	43	28	30	32	34	35	35	35	35	35	35
CR32	CR33	35	35	36	39	42	44	47	49	50	52	27	29	31	32	33	33	33	33	33	33
CR33	CR33	35	35	36	39	42	44	47	49	50	52	28	30	32	34	34	35	35	35	35	35
CR34	CR33	35	35	36	39	42	44	47	49	50	52	30	32	34	36	37	37	37	37	37	37
CR35	CR33	35	35	36	39	42	44	47	49	50	52	27	29	31	33	34	34	34	34	34	34
CR36	CR33	35	35	36	39	42	44	47	49	50	52	28	30	32	33	34	34	34	34	34	34
CR37	HER04	35	35	35	35	37	39	41	42	42	42	23	25	27	29	30	30	30	30	30	30
HER02	HER04	45	45	45	45	45	45	45	45	45	45	22	24	26	28	29	29	29	29	29	29
HER03	HER04	35	35	35	35	37	39	41	42	42	42	25	27	29	31	31	31	32	32	32	32
HER04	HER04	35	35	35	35	37	39	41	42	42	42	26	28	30	32	33	33	33	33	33	33
HER06	HER07	45	45	45	45	45	47	48	49	49	49	27	29	31	33	34	34	34	34	34	34
HER07	HER07	45	45	45	45	45	47	48	49	49	49	27	29	31	33	34	34	34	34	34	34
HER08	HER07	45	45	45	45	45	47	48	49	49	49	27	29	31	32	33	33	33	33	33	33
HER10	HER07	35	36	39	42	45	47	48	49	49	49	20	22	24	26	27	27	27	27	27	27
HER11	HER07	35	36	39	42	45	47	48	49	49	49	19	21	23	25	26	26	26	26	26	26

Residence ID	Representative Logging Location	Criteria (dB(A)) 10m AGL Wind Speed (m/s)										Predicted Noise Level (dB(A)) 10m AGL Wind Speed (m/s)									
		3	4	5	6	7	8	9	10	11	12	3	4	5	6	7	8	9	10	11	12
HER12	HER07	45	45	45	45	45	47	48	49	49	49	32	34	36	38	39	39	39	39	39	39
HER13	HER07	35	36	39	42	45	47	48	49	49	49	23	25	27	29	29	30	30	30	30	30
PL01	SFR05	35	35	37	40	42	45	46	46	46	46	22	24	26	28	29	29	29	29	29	29
PL02	SFR05	35	35	37	40	42	45	46	46	46	46	23	25	27	29	30	30	30	30	30	30
PL03	SFR05	45	45	45	45	45	45	46	46	46	46	24	26	28	29	30	30	30	30	30	30
PL04	SFR05	45	45	45	45	45	45	46	46	46	46	31	33	35	37	37	38	38	38	38	38
PR01	SFR05	35	35	37	40	42	45	46	46	46	46	18	20	22	24	25	25	25	25	25	25
PR03	SFR05	35	35	37	40	42	45	46	46	46	46	17	19	21	23	24	24	24	24	24	24
PR04	SFR05	35	35	37	40	42	45	46	46	46	46	17	19	21	23	24	24	24	24	24	24
PR05	SFR05	45	45	45	45	45	45	46	46	46	46	17	19	21	23	24	24	24	24	24	24
PR06	SFR05	45	45	45	45	45	45	46	46	46	46	17	19	21	23	24	24	24	24	24	24
PR07	SFR05	45	45	45	45	45	45	46	46	46	46	17	19	21	23	24	24	24	24	24	24
PR09	SFR05	35	35	37	40	42	45	46	46	46	46	17	19	21	23	24	24	24	24	24	24
PR10	SFR05	35	35	37	40	42	45	46	46	46	46	17	19	21	23	24	24	24	24	24	24
PR11	SFR05	35	35	37	40	42	45	46	46	46	46	17	19	21	22	23	23	23	23	23	23
PR12	SFR05	45	45	45	45	45	45	46	46	46	46	17	19	21	23	24	24	24	24	24	24
PR13	SFR05	45	45	45	45	45	45	46	46	46	46	20	22	24	26	27	27	27	27	27	27
SFR01	SFR05	35	35	37	40	42	45	46	46	46	46	23	25	27	29	30	30	30	30	30	30
SFR04	SFR05	45	45	45	45	45	45	46	46	46	46	28	30	32	34	35	35	35	35	35	35
SFR05	SFR05	45	45	45	45	45	45	46	46	46	46	28	30	32	34	35	35	35	35	35	35
SFR06	SFR05	35	35	37	40	42	45	46	46	46	46	27	29	31	33	33	33	34	34	34	34
SFR07	SFR05	35	35	37	40	42	45	46	46	46	46	24	26	28	30	31	31	31	31	31	31
SFR08	SFR05	35	35	37	40	42	45	46	46	46	46	24	26	28	30	31	31	31	31	31	31
SFR09	SFR05	35	35	37	40	42	45	46	46	46	46	23	25	27	29	30	30	30	30	30	30
SFR10	SFR05	35	35	37	40	42	45	46	46	46	46	20	22	24	26	27	27	27	27	27	27
SFR11	SFR05	35	35	37	40	42	45	46	46	46	46	22	24	26	28	29	29	29	29	29	29
SFR12	SFR05	35	35	37	40	42	45	46	46	46	46	22	24	26	28	29	29	29	29	29	29
SFR13	SFR05	35	35	37	40	42	45	46	46	46	46	19	21	23	25	25	26	26	26	26	26
SFR16	SFR05	35	35	37	40	42	45	46	46	46	46	21	23	25	27	27	27	28	28	28	28
SFR17	SFR05	35	35	37	40	42	45	46	46	46	46	21	23	25	26	27	27	27	27	27	27
SFR18	SFR05	35	35	37	40	42	45	46	46	46	46	21	23	25	27	27	27	28	28	28	28
SFR19	SFR05	35	35	37	40	42	45	46	46	46	46	21	23	25	27	28	28	28	28	28	28
TR01	HER04	35	35	35	35	37	39	41	42	42	42	19	21	23	25	26	26	26	26	26	26
TR02	HER04	35	35	35	35	37	39	41	42	42	42	19	21	23	25	26	26	26	26	26	26
TR03	HER04	35	35	35	35	37	39	41	42	42	42	17	19	21	23	24	24	24	24	24	24
TR05	HER04	35	35	35	35	37	39	41	42	42	42	17	19	21	23	24	24	24	24	24	24
TR06	HER04	35	35	35	35	37	39	41	42	42	42	16	18	20	22	23	23	23	23	23	23

Planning Layout B – 77 Siemens SWT2.3-101 WTGs

Residence ID	Representative Logging Location	Criteria (dB(A)) 10m AGL Wind Speed (m/s)										Predicted Noise Level (dB(A)) 10m AGL Wind Speed (m/s)									
		3	4	5	6	7	8	9	10	11	12	3	4	5	6	7	8	9	10	11	12
APR02	CR14	35	35	37	39	41	43	44	45	46	46	-	16	21	26	27	27	27	27	27	27
APR03	CR14	35	35	37	39	41	43	44	45	46	46	-	17	21	26	28	28	28	28	28	28
APR04	CR14	35	35	37	39	41	43	44	45	46	46	-	17	22	26	28	28	28	28	28	28
APR05	CR14	35	35	37	39	41	43	44	45	46	46	-	17	21	26	28	28	28	28	28	28
APR06	CR14	35	35	37	39	41	43	44	45	46	46	-	17	22	27	28	28	28	28	28	28
APR07	CR14	35	35	37	39	41	43	44	45	46	46	-	16	21	25	27	27	27	27	27	27
APR08	CR14	35	35	37	39	41	43	44	45	46	46	-	15	20	24	26	26	26	26	26	26
APR09	CR14	35	35	37	39	41	43	44	45	46	46	-	15	19	24	26	26	26	26	26	26
APR10	CR14	35	35	37	39	41	43	44	45	46	46	-	16	20	25	27	27	27	27	27	27
CR10	CR14	45	45	45	45	45	45	45	45	46	46	-	13	18	22	24	24	24	24	24	24
CR12	CR14	45	45	45	45	45	45	45	45	46	46	-	15	19	24	26	26	26	26	26	26
CR13	CR14	45	45	45	45	45	45	45	45	46	46	-	24	28	33	34	34	34	34	34	34
CR14	CR14	45	45	45	45	45	45	45	45	46	46	-	24	29	34	35	35	35	35	35	35
CR15	CR14	35	35	37	39	41	43	44	45	46	46	-	24	29	34	35	35	35	35	35	35
CR16	CR18	35	35	36	37	38	39	40	42	45	45	-	23	28	33	34	34	34	34	34	34
CR18	CR18	35	35	36	37	38	39	40	42	45	45	-	23	28	32	34	34	34	34	34	34
CR19	CR18	35	35	36	37	38	39	40	42	45	45	-	23	28	32	34	34	34	34	34	34
CR20	CR18	35	35	36	37	38	39	40	42	45	45	-	23	27	32	34	34	34	34	34	34
CR21	CR18	35	35	36	37	38	39	40	42	45	45	-	23	27	32	34	34	34	34	34	34
CR24	CR18	35	35	36	37	38	39	40	42	45	45	-	21	26	30	32	32	32	32	32	32
CR25	CR28	45	45	45	45	45	45	45	45	45	45	-	23	28	33	34	34	34	34	34	34
CR26	CR28	35	35	35	35	36	38	40	42	43	43	-	22	27	32	33	33	33	33	33	33
CR27	CR28	35	35	35	35	36	38	40	42	43	43	-	21	26	31	32	32	32	32	32	32
CR28	CR28	35	35	35	35	36	38	40	42	43	43	-	23	27	32	34	34	34	34	34	34
CR32	CR33	35	35	36	39	42	44	47	49	50	52	-	21	26	31	32	32	32	32	32	32
CR33	CR33	35	35	36	39	42	44	47	49	50	52	-	23	28	32	34	34	34	34	34	34
CR34	CR33	35	35	36	39	42	44	47	49	50	52	-	25	30	35	36	36	36	36	36	36
CR35	CR33	35	35	36	39	42	44	47	49	50	52	-	22	27	32	33	33	33	33	33	33
CR36	CR33	35	35	36	39	42	44	47	49	50	52	-	23	28	32	34	34	34	34	34	34
CR37	HER04	35	35	35	35	37	39	41	42	42	42	-	19	23	28	30	30	30	30	30	30
HER02	HER04	45	45	45	45	45	45	45	45	45	45	-	18	22	27	29	29	29	29	29	29
HER03	HER04	35	35	35	35	37	39	41	42	42	42	-	20	25	30	31	31	31	31	31	31
HER04	HER04	35	35	35	35	37	39	41	42	42	42	-	22	27	31	33	33	33	33	33	33
HER06	HER07	45	45	45	45	45	47	48	49	49	49	-	23	28	33	34	34	34	34	34	34
HER07	HER07	45	45	45	45	45	47	48	49	49	49	-	22	27	32	33	33	33	33	33	33
HER08	HER07	45	45	45	45	45	47	48	49	49	49	-	22	26	31	33	33	33	33	33	33
HER10	HER07	35	36	39	42	45	47	48	49	49	49	-	15	20	25	26	26	26	26	26	26
HER11	HER07	35	36	39	42	45	47	48	49	49	49	-	15	19	24	26	26	26	26	26	26

Residence ID	Representative Logging Location	Criteria (dB(A)) 10m AGL Wind Speed (m/s)										Predicted Noise Level (dB(A)) 10m AGL Wind Speed (m/s)									
		3	4	5	6	7	8	9	10	11	12	3	4	5	6	7	8	9	10	11	12
HER12	HER07	45	45	45	45	45	47	48	49	49	49	-	28	32	37	38	38	38	38	38	38
HER13	HER07	35	36	39	42	45	47	48	49	49	49	-	18	23	27	29	29	29	29	29	29
PL01	SFR05	35	35	37	40	42	45	46	46	46	46	-	18	22	27	29	29	29	29	29	29
PL02	SFR05	35	35	37	40	42	45	46	46	46	46	-	19	23	28	30	30	30	30	30	30
PL03	SFR05	45	45	45	45	45	45	46	46	46	46	-	19	24	29	30	30	30	30	30	30
PL04	SFR05	45	45	45	45	45	45	46	46	46	46	-	26	30	35	37	37	37	37	37	37
PR01	SFR05	35	35	37	40	42	45	46	46	46	46	-	13	18	23	24	24	24	24	24	24
PR03	SFR05	35	35	37	40	42	45	46	46	46	46	-	13	17	22	24	24	24	24	24	24
PR04	SFR05	35	35	37	40	42	45	46	46	46	46	-	13	17	22	24	24	24	24	24	24
PR05	SFR05	45	45	45	45	45	45	46	46	46	46	-	13	17	22	24	24	24	24	24	24
PR06	SFR05	45	45	45	45	45	45	46	46	46	46	-	13	17	22	24	24	24	24	24	24
PR07	SFR05	45	45	45	45	45	45	46	46	46	46	-	13	17	22	24	24	24	24	24	24
PR09	SFR05	35	35	37	40	42	45	46	46	46	46	-	12	17	22	23	23	23	23	23	23
PR10	SFR05	35	35	37	40	42	45	46	46	46	46	-	12	17	22	23	23	23	23	23	23
PR11	SFR05	35	35	37	40	42	45	46	46	46	46	-	12	17	21	23	23	23	23	23	23
PR12	SFR05	45	45	45	45	45	45	46	46	46	46	-	13	17	22	24	24	24	24	24	24
PR13	SFR05	45	45	45	45	45	45	46	46	46	46	-	15	20	25	26	26	26	26	26	26
SFR01	SFR05	35	35	37	40	42	45	46	46	46	46	-	18	23	28	29	29	29	29	29	29
SFR04	SFR05	45	45	45	45	45	45	46	46	46	46	-	23	28	32	34	34	34	34	34	34
SFR05	SFR05	45	45	45	45	45	45	46	46	46	46	-	23	27	32	34	34	34	34	34	34
SFR06	SFR05	35	35	37	40	42	45	46	46	46	46	-	21	26	31	32	32	32	32	32	32
SFR07	SFR05	35	35	37	40	42	45	46	46	46	46	-	19	23	28	30	30	30	30	30	30
SFR08	SFR05	35	35	37	40	42	45	46	46	46	46	-	19	23	28	30	30	30	30	30	30
SFR09	SFR05	35	35	37	40	42	45	46	46	46	46	-	18	23	27	29	29	29	29	29	29
SFR10	SFR05	35	35	37	40	42	45	46	46	46	46	-	15	19	24	26	26	26	26	26	26
SFR11	SFR05	35	35	37	40	42	45	46	46	46	46	-	17	22	27	28	28	28	28	28	28
SFR12	SFR05	35	35	37	40	42	45	46	46	46	46	-	17	22	27	28	28	28	28	28	28
SFR13	SFR05	35	35	37	40	42	45	46	46	46	46	-	14	18	23	25	25	25	25	25	25
SFR16	SFR05	35	35	37	40	42	45	46	46	46	46	-	16	21	26	27	27	27	27	27	27
SFR17	SFR05	35	35	37	40	42	45	46	46	46	46	-	16	20	25	27	27	27	27	27	27
SFR18	SFR05	35	35	37	40	42	45	46	46	46	46	-	16	21	25	27	27	27	27	27	27
SFR19	SFR05	35	35	37	40	42	45	46	46	46	46	-	17	22	26	28	28	28	28	28	28
TR01	HER04	35	35	35	35	37	39	41	42	42	42	-	15	19	24	26	26	26	26	26	26
TR02	HER04	35	35	35	35	37	39	41	42	42	42	-	14	19	24	25	25	25	25	25	25
TR03	HER04	35	35	35	35	37	39	41	42	42	42	-	13	17	22	24	24	24	24	24	24
TR05	HER04	35	35	35	35	37	39	41	42	42	42	-	13	17	22	24	24	24	24	24	24
TR06	HER04	35	35	35	35	37	39	41	42	42	42	-	12	17	21	23	23	23	23	23	23

Substations

Residence ID	Criteria (dB(A))	Predicted Noise Level (dB(A)) Combined with SCS 1		
		MCS 1	MCS 2	MCS 3
APR02	30	<15	<15	<15
APR03	30	<15	<15	<15
APR04	30	<15	<15	<15
APR05	30	<15	<15	<15
APR06	30	<15	<15	<15
APR07	30	<15	<15	<15
APR08	30	<15	<15	<15
APR09	30	<15	<15	<15
APR10	30	<15	<15	<15
CR13	30	<15	<15	<15
CR14	30	<15	<15	<15
CR15	30	<15	<15	<15
CR16	30	<15	<15	<15
CR18	30	<15	<15	<15
CR19	30	<15	<15	<15
CR20	30	<15	<15	<15
CR21	30	<15	<15	<15
CR32	30	<15	<15	<15
CR33	30	<15	<15	<15
CR34	30	<15	<15	<15
CR35	30	<15	<15	<15
CR36	30	<15	<15	<15
HER07	30	<15	<15	<15
HER08	30	<15	<15	<15
HER12	30	<15	<15	<15
HER13	30	<15	<15	<15
PL01	30	<15	<15	<15
PL02	30	<15	<15	<15
PL03	30	<15	<15	<15
PL04	30	<15	<15	<15
PR13	30	<15	<15	<15
SFR01	30	<15	<15	<15
SFR04	30	<15	<15	<15
SFR05	30	<15	<15	<15
SFR06	30	<15	<15	<15
SFR07	30	<15	<15	<15
SFR08	30	<15	<15	<15
SFR09	30	<15	<15	<15
SFR11	30	<15	<15	<15
SFR12	30	<15	<15	<15
SFR16	30	<15	<15	<15
SFR17	30	<15	<15	<15
SFR18	30	<15	<15	<15
SFR19	30	<15	<15	<15
APR04	30	<15	<15	<15

APPENDIX H: NOISE CRITERIA (NIGHT PERIOD) AND PREDICTED NOISE LEVELS

Planning Layout A – 106 Acciona AW77 WTGs

Residence ID	Representative Logging Location	Night-time Criteria (dB(A)) by 10m AGL Wind Speed (m/s)										Predicted Noise Level (dB(A)) by 10m AGL Wind Speed (m/s)									
		3	4	5	6	7	8	9	10	11	12	3	4	5	6	7	8	9	10	11	12
APR02	CR14	35	35	35	36	39	41	42	42	42	42	21	23	25	27	27	28	28	28	28	28
APR03	CR14	35	35	35	36	39	41	42	42	42	42	21	23	25	27	28	28	28	28	28	28
APR04	CR14	35	35	35	36	39	41	42	42	42	42	21	23	25	27	28	28	28	28	28	28
APR05	CR14	35	35	35	36	39	41	42	42	42	42	21	23	25	27	28	28	28	28	28	28
APR06	CR14	35	35	35	36	39	41	42	42	42	42	22	24	26	27	28	28	28	28	28	28
APR07	CR14	35	35	35	36	39	41	42	42	42	42	20	22	24	26	27	27	27	27	27	27
APR08	CR14	35	35	35	36	39	41	42	42	42	42	19	21	23	25	26	26	26	26	26	26
APR09	CR14	35	35	35	36	39	41	42	42	42	42	19	21	23	25	26	26	26	26	26	26
APR10	CR14	35	35	35	36	39	41	42	42	42	42	20	22	24	26	27	27	27	27	27	27
CR10	CR14	45	45	45	45	45	45	45	45	45	45	18	20	22	24	24	25	25	25	25	25
CR12	CR14	45	45	45	45	45	45	45	45	45	45	19	21	23	25	26	26	26	26	26	26
CR13	CR14	45	45	45	45	45	45	45	45	45	45	28	30	32	34	35	35	35	35	35	35
CR14	CR14	45	45	45	45	45	45	45	45	45	45	29	31	33	35	36	36	36	36	36	36
CR15	CR14	35	35	35	36	39	41	42	42	42	42	29	31	33	35	35	36	36	36	36	36
CR16	CR18	35	35	35	35	36	37	38	38	39	39	28	30	32	34	35	35	35	35	35	35
CR18	CR18	35	35	35	35	36	37	38	38	39	39	28	30	32	34	34	34	35	35	35	35
CR19	CR18	35	35	35	35	36	37	38	38	39	39	28	30	32	34	34	35	35	35	35	35
CR20	CR18	35	35	35	35	36	37	38	38	39	39	27	29	31	33	34	34	34	34	34	34
CR21	CR18	35	35	35	35	36	37	38	38	39	39	27	29	31	33	34	34	34	34	34	34
CR24	CR18	35	35	35	35	36	37	38	38	39	39	26	28	30	32	32	33	33	33	33	33
CR25	CR28	45	45	45	45	45	45	45	45	45	45	28	30	32	34	35	35	35	35	35	35
CR26	CR28	35	35	35	35	35	35	36	38	40	40	27	29	31	33	34	34	34	34	34	34
CR27	CR28	35	35	35	35	35	35	36	38	40	40	26	28	30	32	33	33	33	33	33	33
CR28	CR28	35	35	35	35	35	35	36	38	40	40	28	30	32	34	35	35	35	35	35	35
CR32	CR33	35	35	35	35	36	37	39	40	40	40	27	29	31	32	33	33	33	33	33	33
CR33	CR33	35	35	35	35	36	37	39	40	40	40	28	30	32	34	34	35	35	35	35	35
CR34	CR33	35	35	35	35	36	37	39	40	40	40	30	32	34	**36**	**37**	37	37	37	37	37
CR35	CR33	35	35	35	35	36	37	39	40	40	40	27	29	31	33	34	34	34	34	34	34
CR36	CR33	35	35	35	35	36	37	39	40	40	40	28	30	32	33	34	34	34	34	34	34
CR37	HER04	35	35	35	35	35	37	37	37	37	37	23	25	27	29	30	30	30	30	30	30
HER02	HER04	45	45	45	45	45	45	45	45	45	45	22	24	26	28	29	29	29	29	29	29
HER03	HER04	35	35	35	35	35	37	37	37	37	37	25	27	29	31	31	31	32	32	32	32
HER04	HER04	35	35	35	35	35	37	37	37	37	37	26	28	30	32	33	33	33	33	33	33
HER06	HER07	45	45	45	45	45	47	47	47	47	47	27	29	31	33	34	34	34	34	34	34
HER07	HER07	45	45	45	45	45	47	47	47	47	47	27	29	31	33	34	34	34	34	34	34
HER08	HER07	45	45	45	45	45	47	47	47	47	47	27	29	31	32	33	33	33	33	33	33
HER10	HER07	35	35	38	42	45	47	47	47	47	47	20	22	24	26	27	27	27	27	27	27
HER11	HER07	35	35	38	42	45	47	47	47	47	47	19	21	23	25	26	26	26	26	26	26

Residence ID	Representative Logging Location	Night-time Criteria (dB(A)) by 10m AGL Wind Speed (m/s)										Predicted Noise Level (dB(A)) by 10m AGL Wind Speed (m/s)									
		3	4	5	6	7	8	9	10	11	12	3	4	5	6	7	8	9	10	11	12
HER12	HER07	45	45	45	45	45	47	47	47	47	47	32	34	36	38	39	39	39	39	39	39
HER13	HER07	35	35	38	42	45	47	47	47	47	47	23	25	27	29	29	30	30	30	30	30
PL01	SFR05	35	35	35	39	44	49	52	52	52	52	22	24	26	28	29	29	29	29	29	29
PL02	SFR05	35	35	35	39	44	49	52	52	52	52	23	25	27	29	30	30	30	30	30	30
PL03	SFR05	45	45	45	45	45	49	52	52	52	52	24	26	28	29	30	30	30	30	30	30
PL04	SFR05	45	45	45	45	45	49	52	52	52	52	31	33	35	37	37	38	38	38	38	38
PR01	SFR05	35	35	35	39	44	49	52	52	52	52	18	20	22	24	25	25	25	25	25	25
PR03	SFR05	35	35	35	39	44	49	52	52	52	52	17	19	21	23	24	24	24	24	24	24
PR04	SFR05	35	35	35	39	44	49	52	52	52	52	17	19	21	23	24	24	24	24	24	24
PR05	SFR05	45	45	45	45	45	49	52	52	52	52	17	19	21	23	24	24	24	24	24	24
PR06	SFR05	45	45	45	45	45	49	52	52	52	52	17	19	21	23	24	24	24	24	24	24
PR07	SFR05	45	45	45	45	45	49	52	52	52	52	17	19	21	23	24	24	24	24	24	24
PR09	SFR05	35	35	35	39	44	49	52	52	52	52	17	19	21	23	24	24	24	24	24	24
PR10	SFR05	35	35	35	39	44	49	52	52	52	52	17	19	21	23	24	24	24	24	24	24
PR11	SFR05	35	35	35	39	44	49	52	52	52	52	17	19	21	22	23	23	23	23	23	23
PR12	SFR05	45	45	45	45	45	49	52	52	52	52	17	19	21	23	24	24	24	24	24	24
PR13	SFR05	45	45	45	45	45	49	52	52	52	52	20	22	24	26	27	27	27	27	27	27
SFR01	SFR05	35	35	35	39	44	49	52	52	52	52	23	25	27	29	30	30	30	30	30	30
SFR04	SFR05	45	45	45	45	45	49	52	52	52	52	28	30	32	34	35	35	35	35	35	35
SFR05	SFR05	45	45	45	45	45	49	52	52	52	52	28	30	32	34	35	35	35	35	35	35
SFR06	SFR05	35	35	35	39	44	49	52	52	52	52	27	29	31	33	33	33	34	34	34	34
SFR07	SFR05	35	35	35	39	44	49	52	52	52	52	24	26	28	30	31	31	31	31	31	31
SFR08	SFR05	35	35	35	39	44	49	52	52	52	52	24	26	28	30	31	31	31	31	31	31
SFR09	SFR05	35	35	35	39	44	49	52	52	52	52	23	25	27	29	30	30	30	30	30	30
SFR10	SFR05	35	35	35	39	44	49	52	52	52	52	20	22	24	26	27	27	27	27	27	27
SFR11	SFR05	35	35	35	39	44	49	52	52	52	52	22	24	26	28	29	29	29	29	29	29
SFR12	SFR05	35	35	35	39	44	49	52	52	52	52	22	24	26	28	29	29	29	29	29	29
SFR13	SFR05	35	35	35	39	44	49	52	52	52	52	19	21	23	25	25	26	26	26	26	26
SFR16	SFR05	35	35	35	39	44	49	52	52	52	52	21	23	25	27	27	27	28	28	28	28
SFR17	SFR05	35	35	35	39	44	49	52	52	52	52	21	23	25	26	27	27	27	27	27	27
SFR18	SFR05	35	35	35	39	44	49	52	52	52	52	21	23	25	27	27	27	28	28	28	28
SFR19	SFR05	35	35	35	39	44	49	52	52	52	52	21	23	25	27	28	28	28	28	28	28
TR01	HER04	35	35	35	35	35	37	37	37	37	37	19	21	23	25	26	26	26	26	26	26
TR02	HER04	35	35	35	35	35	37	37	37	37	37	19	21	23	25	26	26	26	26	26	26
TR03	HER04	35	35	35	35	35	37	37	37	37	37	17	19	21	23	24	24	24	24	24	24
TR05	HER04	35	35	35	35	35	37	37	37	37	37	17	19	21	23	24	24	24	24	24	24
TR06	HER04	35	35	35	35	35	37	37	37	37	37	16	18	20	22	23	23	23	23	23	23

Planning Layout B – 77 Siemens SWT2.3-101 WTGs

Residence ID	Representative Logging Location	Night-time Criteria (dB(A)) by 10m AGL Wind Speed (m/s)										Predicted Noise Level (dB(A)) by 10m AGL Wind Speed (m/s)									
		3	4	5	6	7	8	9	10	11	12	3	4	5	6	7	8	9	10	11	12
APR02	CR14	35	35	35	36	39	41	42	42	42	42	-	16	21	26	27	27	27	27	27	27
APR03	CR14	35	35	35	36	39	41	42	42	42	42	-	17	21	26	28	28	28	28	28	28
APR04	CR14	35	35	35	36	39	41	42	42	42	42	-	17	22	26	28	28	28	28	28	28
APR05	CR14	35	35	35	36	39	41	42	42	42	42	-	17	21	26	28	28	28	28	28	28
APR06	CR14	35	35	35	36	39	41	42	42	42	42	-	17	22	27	28	28	28	28	28	28
APR07	CR14	35	35	35	36	39	41	42	42	42	42	-	16	21	25	27	27	27	27	27	27
APR08	CR14	35	35	35	36	39	41	42	42	42	42	-	15	20	24	26	26	26	26	26	26
APR09	CR14	35	35	35	36	39	41	42	42	42	42	-	15	19	24	26	26	26	26	26	26
APR10	CR14	35	35	35	36	39	41	42	42	42	42	-	16	20	25	27	27	27	27	27	27
CR10	CR14	45	45	45	45	45	45	45	45	45	45	-	13	18	22	24	24	24	24	24	24
CR12	CR14	45	45	45	45	45	45	45	45	45	45	-	15	19	24	26	26	26	26	26	26
CR13	CR14	45	45	45	45	45	45	45	45	45	45	-	24	28	33	34	34	34	34	34	34
CR14	CR14	45	45	45	45	45	45	45	45	45	45	-	24	29	34	35	35	35	35	35	35
CR15	CR14	35	35	35	36	39	41	42	42	42	42	-	24	29	34	35	35	35	35	35	35
CR16	CR18	35	35	35	35	36	37	38	38	39	39	-	23	28	33	34	34	34	34	34	34
CR18	CR18	35	35	35	35	36	37	38	38	39	39	-	23	28	32	34	34	34	34	34	34
CR19	CR18	35	35	35	35	36	37	38	38	39	39	-	23	28	32	34	34	34	34	34	34
CR20	CR18	35	35	35	35	36	37	38	38	39	39	-	23	27	32	34	34	34	34	34	34
CR21	CR18	35	35	35	35	36	37	38	38	39	39	-	23	27	32	34	34	34	34	34	34
CR24	CR18	35	35	35	35	36	37	38	38	39	39	-	21	26	30	32	32	32	32	32	32
CR25	CR28	45	45	45	45	45	45	45	45	45	45	-	23	28	33	34	34	34	34	34	34
CR26	CR28	35	35	35	35	35	35	36	38	40	40	-	22	27	32	33	33	33	33	33	33
CR27	CR28	35	35	35	35	35	35	36	38	40	40	-	21	26	31	32	32	32	32	32	32
CR28	CR28	35	35	35	35	35	35	36	38	40	40	-	23	27	32	34	34	34	34	34	34
CR32	CR33	35	35	35	35	36	37	39	40	40	40	-	21	26	31	32	32	32	32	32	32
CR33	CR33	35	35	35	35	36	37	39	40	40	40	-	23	28	32	34	34	34	34	34	34
CR34	CR33	35	35	35	35	36	37	39	40	40	40	-	25	30	35	36	36	36	36	36	36
CR35	CR33	35	35	35	35	36	37	39	40	40	40	-	22	27	32	33	33	33	33	33	33
CR36	CR33	35	35	35	35	36	37	39	40	40	40	-	23	28	32	34	34	34	34	34	34
CR37	HER04	35	35	35	35	35	37	37	37	37	37	-	19	23	28	30	30	30	30	30	30
HER02	HER04	45	45	45	45	45	45	45	45	45	45	-	18	22	27	29	29	29	29	29	29
HER03	HER04	35	35	35	35	35	37	37	37	37	37	-	20	25	30	31	31	31	31	31	31
HER04	HER04	35	35	35	35	35	37	37	37	37	37	-	22	27	31	33	33	33	33	33	33
HER06	HER07	45	45	45	45	45	47	47	47	47	47	-	23	28	33	34	34	34	34	34	34
HER07	HER07	45	45	45	45	45	47	47	47	47	47	-	22	27	32	33	33	33	33	33	33
HER08	HER07	45	45	45	45	45	47	47	47	47	47	-	22	26	31	33	33	33	33	33	33
HER10	HER07	35	35	38	42	45	47	47	47	47	47	-	15	20	25	26	26	26	26	26	26
HER11	HER07	35	35	38	42	45	47	47	47	47	47	-	15	19	24	26	26	26	26	26	26

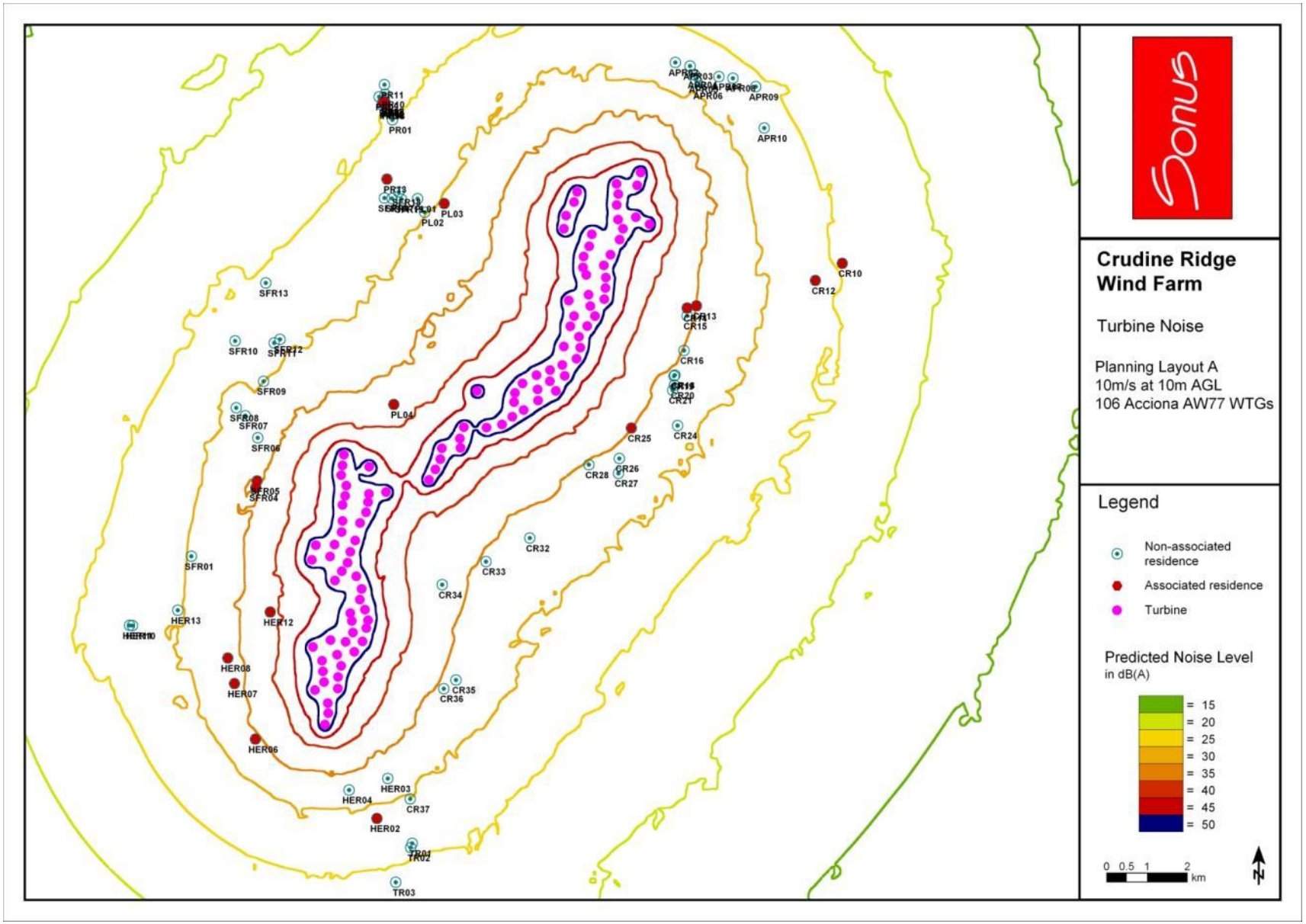
Residence ID	Representative Logging Location	Night-time Criteria (dB(A)) by 10m AGL Wind Speed (m/s)										Predicted Noise Level (dB(A)) by 10m AGL Wind Speed (m/s)									
		3	4	5	6	7	8	9	10	11	12	3	4	5	6	7	8	9	10	11	12
HER12	HER07	45	45	45	45	45	47	47	47	47	47	-	28	32	37	38	38	38	38	38	38
HER13	HER07	35	35	38	42	45	47	47	47	47	47	-	18	23	27	29	29	29	29	29	29
PL01	SFR05	35	35	35	39	44	49	52	52	52	52	-	18	22	27	29	29	29	29	29	29
PL02	SFR05	35	35	35	39	44	49	52	52	52	52	-	19	23	28	30	30	30	30	30	30
PL03	SFR05	45	45	45	45	45	49	52	52	52	52	-	19	24	29	30	30	30	30	30	30
PL04	SFR05	45	45	45	45	45	49	52	52	52	52	-	26	30	35	37	37	37	37	37	37
PR01	SFR05	35	35	35	39	44	49	52	52	52	52	-	13	18	23	24	24	24	24	24	24
PR03	SFR05	35	35	35	39	44	49	52	52	52	52	-	13	17	22	24	24	24	24	24	24
PR04	SFR05	35	35	35	39	44	49	52	52	52	52	-	13	17	22	24	24	24	24	24	24
PR05	SFR05	45	45	45	45	45	49	52	52	52	52	-	13	17	22	24	24	24	24	24	24
PR06	SFR05	45	45	45	45	45	49	52	52	52	52	-	13	17	22	24	24	24	24	24	24
PR07	SFR05	45	45	45	45	45	49	52	52	52	52	-	13	17	22	24	24	24	24	24	24
PR09	SFR05	35	35	35	39	44	49	52	52	52	52	-	12	17	22	23	23	23	23	23	23
PR10	SFR05	35	35	35	39	44	49	52	52	52	52	-	12	17	22	23	23	23	23	23	23
PR11	SFR05	35	35	35	39	44	49	52	52	52	52	-	12	17	21	23	23	23	23	23	23
PR12	SFR05	45	45	45	45	45	49	52	52	52	52	-	13	17	22	24	24	24	24	24	24
PR13	SFR05	45	45	45	45	45	49	52	52	52	52	-	15	20	25	26	26	26	26	26	26
SFR01	SFR05	35	35	35	39	44	49	52	52	52	52	-	18	23	28	29	29	29	29	29	29
SFR04	SFR05	45	45	45	45	45	49	52	52	52	52	-	23	28	32	34	34	34	34	34	34
SFR05	SFR05	45	45	45	45	45	49	52	52	52	52	-	23	27	32	34	34	34	34	34	34
SFR06	SFR05	35	35	35	39	44	49	52	52	52	52	-	21	26	31	32	32	32	32	32	32
SFR07	SFR05	35	35	35	39	44	49	52	52	52	52	-	19	23	28	30	30	30	30	30	30
SFR08	SFR05	35	35	35	39	44	49	52	52	52	52	-	19	23	28	30	30	30	30	30	30
SFR09	SFR05	35	35	35	39	44	49	52	52	52	52	-	18	23	27	29	29	29	29	29	29
SFR10	SFR05	35	35	35	39	44	49	52	52	52	52	-	15	19	24	26	26	26	26	26	26
SFR11	SFR05	35	35	35	39	44	49	52	52	52	52	-	17	22	27	28	28	28	28	28	28
SFR12	SFR05	35	35	35	39	44	49	52	52	52	52	-	17	22	27	28	28	28	28	28	28
SFR13	SFR05	35	35	35	39	44	49	52	52	52	52	-	14	18	23	25	25	25	25	25	25
SFR16	SFR05	35	35	35	39	44	49	52	52	52	52	-	16	21	26	27	27	27	27	27	27
SFR17	SFR05	35	35	35	39	44	49	52	52	52	52	-	16	20	25	27	27	27	27	27	27
SFR18	SFR05	35	35	35	39	44	49	52	52	52	52	-	16	21	25	27	27	27	27	27	27
SFR19	SFR05	35	35	35	39	44	49	52	52	52	52	-	17	22	26	28	28	28	28	28	28
TR01	HER04	35	35	35	35	35	37	37	37	37	37	-	15	19	24	26	26	26	26	26	26
TR02	HER04	35	35	35	35	35	37	37	37	37	37	-	14	19	24	25	25	25	25	25	25
TR03	HER04	35	35	35	35	35	37	37	37	37	37	-	13	17	22	24	24	24	24	24	24
TR05	HER04	35	35	35	35	35	37	37	37	37	37	-	13	17	22	24	24	24	24	24	24
TR06	HER04	35	35	35	35	35	37	37	37	37	37	-	12	17	21	23	23	23	23	23	23

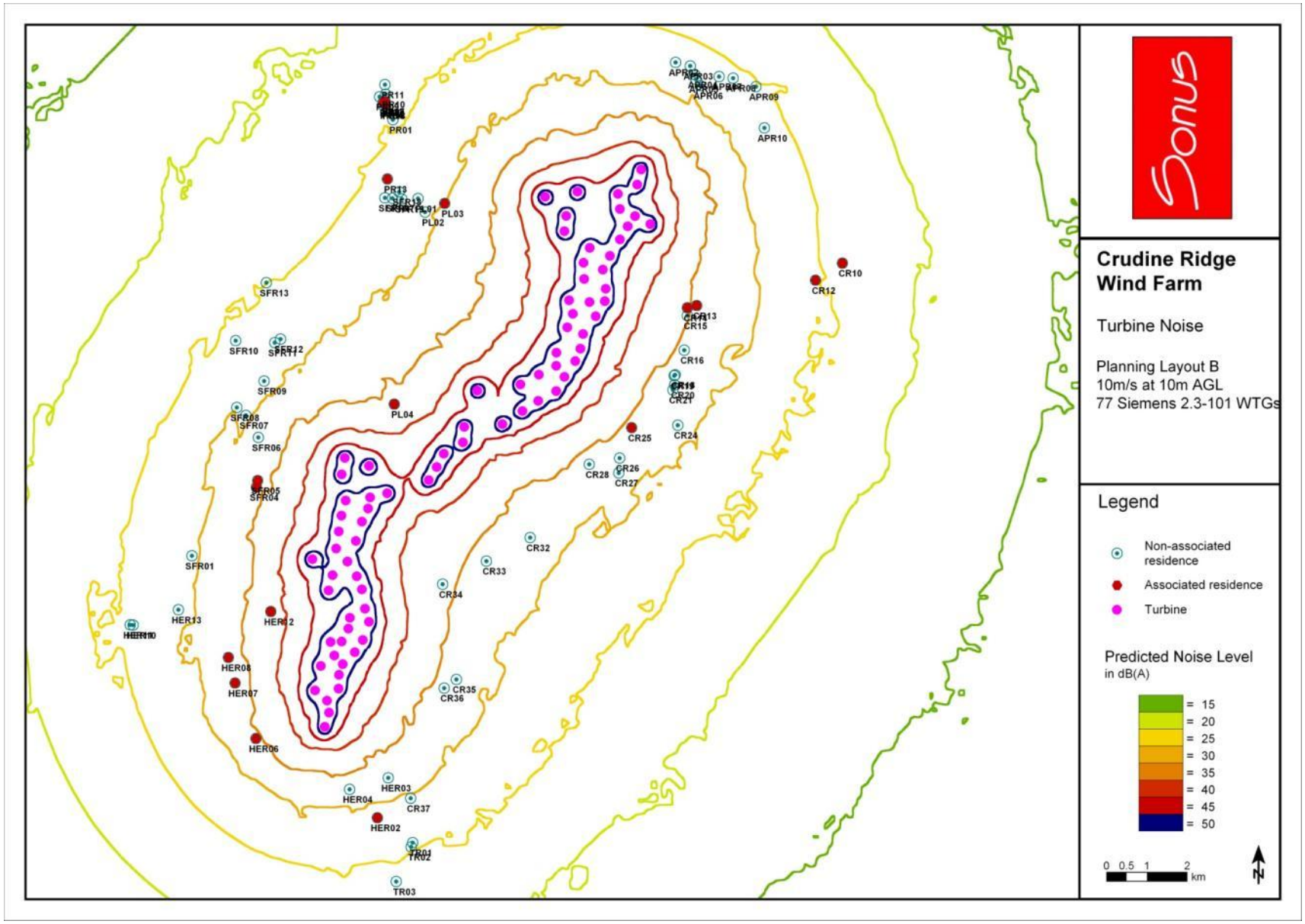
APPENDIX I: PREDICTED NOISE LEVEL CONTOURS

Below are predicted noise level contours for the following scenarios:

- Layout A with 106 Acciona AW77 turbines at 10m/s wind speed – showing compliance at all residences without specific mitigation measures;
- Layout B with 77 Siemens SWT2.3-101 turbines at 10 m/s wind speed – showing compliance at all residences without specific mitigation measures.

It is noted that the noise criterion corresponding to the 6m/s and 10m/s wind speeds are different for each residence, which were derived based on the measured background noise levels at different locations. Refer Appendices H and I for the relevant criterion at each residence.


Sonus
Crudine Ridge Wind Farm
Turbine Noise
Planning Layout A
10m/s at 10m AGL
106 Acciona AW77 WTGs
Legend
Non-associated residence
Associated residence
Turbine
Predicted Noise Level in dB(A)
= 15
= 20
= 25
= 30
= 35
= 40
= 45
= 50
0 0.5 1 2 km
N
PR01
PR11
PL02
PL03
PL04
APR06
APR09
APR10
CR10
CR12
CR15
CR16
CR20
CR21
CR24
CR25
CR26
CR27
CR28
CR32
CR33
CR34
CR35
CR36
CR37
SFR01
SFR04
SFR05
SFR06
SFR07
SFR08
SFR09
SFR10
SFR11
SFR12
SFR13
HER02
HER03
HER04
HER06
HER07
HER08
HER12
HER13
TR01
TR02
TR03


Sonus
Crudine Ridge Wind Farm
Turbine Noise
Planning Layout B
10m/s at 10m AGL
77 Siemens 2.3-101 WTGs
Legend
Non-associated residence
Associated residence
Turbine
Predicted Noise Level in dB(A)
= 15
= 20
= 25
= 30
= 35
= 40
= 45
= 50
0 0.5 1 2 km
N
PR01
PL01
PL02
PL03
PL04
APR09
APR10
CR10
CR12
CR16
CR24
CR25
CR26
CR27
CR28
CR32
CR33
CR34
CR35
CR36
CR37
SFR13
SFR10
SFR09
SFR08
SFR07
SFR06
SFR05
SFR04
SFR01
HER13
HER12
HER08
HER07
HER06
HER04
HER03
HER02
TR01
TR02
TR03