Flyers Creek Wind Farm

Noise Impact Assessment

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EXECUTIVE SUMMARY

A noise impact assessment has been performed of the proposed Flyers Creek Wind Farm (FCWF) project near Blayney, New South Wales. This modelling was performed to determine the noise generated by a proposed 44 Wind Turbine Generators located at the site.

The likely noise impact of the proposed wind farm configuration has been predicted for a range of operational and wind scenarios using an accurate Predictive Noise Model (based on the accepted Concawe algorithm for meteorological conditions and the ISO9613 standard). The algorithms used in the model take into account the likely effects of atmospheric absorption, ground absorption/reflection, diffraction and attenuation by topographic features, screening effect of barriers and the propagation effect of wind speed and direction.

There are approximately 100 residential premises (receivers) within 3 km of the proposed wind farm of which 30 are non-relevant receivers.

The background noise levels at five receiver sites in the vicinity of the proposed wind farm have been measured at the site continuously over a period of over three weeks in accordance with the SA EPA 2009 Wind Farm Noise Guidelines. The background noise levels (and therefore criteria) at each site are scaled to a 10m reference wind speed height for analysis against the SA EPA 2003 noise guidelines. This is performed using the same shear used in WTG sound power calculations and therefore give a more accurate picture of what sound levels to expect at residences in certain wind conditions compared to developing a criteria using a hub height reference.

The noise model was run for the maximum power WTG setting, with both ISO9613 and Concawe prediction algorithms. The model was run for the worst case wind conditions for the range of wind speeds from 3 to 12 ms^{-1} (at 10m AGL). At the time of modelling, the turbine type for the FCWF project has not been determined; however, the GE 2.5xl wind turbine generator was selected as the indicative wind turbine for this analysis.

The predicted levels were assessed in accordance with the SA EPA *"Environmental Noise Guidelines: Wind Farms 2003"*. The predicted L_{Aeq} noise levels, for worst case wind conditions range up to 42dB(A); however, this noise level is below the background noise + 5dB(A) criteria and is therefore in compliance. These predicted levels at maximum WTG power setting achieve the appropriate criteria for all relevant receivers with the exception for small exceedances (0.5dB) at three relevant properties at $6ms^{-1}$ and $7ms^{-1}$ wind speeds. These noise levels will be reduced by operating four wind turbines in a noise reduction mode such that SA EPA noise limits are achieved at all residence locations

Noise levels at the nearby non-relevant receivers, do not exceed the WHO guidelines for sleep disturbance, and therefore comply with the selected criteria.

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1. INTRODUCTION

This report outlines a noise impact assessment of the proposed Flyers Creek Wind Farm (FCWF) development near Blayney, New South Wales. Noise modelling was performed to determine the noise generated by a proposed 44 Wind Turbine Generator layout on the site.

The likely noise impact of the proposed wind farm configuration is predicted for a range of operational and wind scenarios using a noise model and accepted noise propagation algorithms.

Predicted noise levels are assessed against the 2003 SA EPA *"Environmental Noise Guidelines : Wind Farms"* (Ref [1]) as specified in the Durector General's Requirements for the Environmental Assessment.

2. REFERENCES

[1] "*Wind Farms: Environmental Noise Guidelines*", SA Environment Protection Authority, SA Government, Dec 2003.

[2] "*Wind Farms: Environmental Noise Guidelines*", SA Environment Protection Authority, SA Government, July 2009 (ISBN 978-1-876562-43-9).

[3] Concawe Report No. 4/81: "*The propagation of noise from petroleum and petrochemical complexes to neighbouring communities*", Manning C.J., 1981

[4] International Standard ISO 9613 *Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation,* 1996

[5] *Background Noise Monitoring Report, Flyers Creek Wind Farm,* Vipac Document No. 50B-08-0089-TRP-771535-0, Vipac Engineers & Scientists, 7 June 2010

[6] WTG layout for Flyers Creek Wind Farm provided by Aurecon 24 November 2010

[7] *"Guidelines for Community Noise"*, World Health Organization (WHO), Geneva, Switzerland, 1999.

[8] GE Commercial Documentation for WTG Systems GE 2.5xl – 50Hz & 60Hz Product Acoustic Specifications

[9] GE Commercial Documentation for WTG Systems GE 2.5xl – 50Hz & 60Hz Product Acoustic Specifications – Noise Reduced Operations According to IEC61400-11

[10] IEC 61400-11, Ed. 2.1 "Wind Turbine Generator Systems – Part 11: Acoustic noise measurement techniques", 2006-11.

3. NOISE CRITERIA GUIDELINES

The primary criteria to be used for wind farm developments in New South Wales are provided in the 2003 SA EPA *"Environmental Noise Guidelines : Wind Farms"* [Ref :[1]].

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

The EPA guidelines [Ref : [1]] also state that all noise measurements are to be taken outdoors at 1.2 to 1.5 metres above the ground and within 20 metres of a noise sensitive premises (and at least 5m from any major reflecting surface). The background noise monitoring survey should be carried out (for representative sensitive or relevant receivers within 1.5km of the wind farm) over a period of at least 2 weeks to ensure the

collection of at least 2000 valid data points. All wind speed measurements are to be taken at, or adjusted to, 10m AGL.

In addition, in accordance with the EPA guidelines, an adjustment of 5dB(A) should be added if tonality, impulsiveness or low frequency components are present in the noise generated by the wind farm.

The criteria for this proposed wind farm (for relevant receivers) are determined from the background noise measurements at the site (see section 5). Corrections for the influence of wind-induced background noise are determined from the application of regression techniques described in [Ref : [1]] and [Ref : [5]].

For non-relevant receivers (associated with the wind farm), the World Health Organisation (WHO) criterion level for unreasonable interference or sleep disturbance is applicable [Ref :[7]].

A glossary of acoustic terminology is provided in Appendix A.

4. PROJECT AND SITE DESCRIPTION

The proposed wind farm near Blayney is situated in proximity of Universal Transverse Mercator (UTM) reference 6,290,000 m S, 692,000 m E (Zone 55H). Note that the coordinate system used throughout is UTM WGS84, which is essentially the same as GDA 94 (MGA).

The general area of the wind farm site comprises a mix of pasture and open farming properties. The aspect of the landscape is open, with significant hills and occasional trees and other obstructions. The area is classified as 'General rural' under the Blaney Local Environmental Plan.

The wind farm configuration will consist of up to 44 Wind Turbine Generators (WTGs).

At the time of modelling, the turbine model for the Flyers Creek Wind Farm project has not been selected, however the GE 2.5xl WTG was selected to be the indicative turbine for this analysis.

5. BACKGROUND NOISE MEASUREMENTS AND CRITERIA

The existing environment is defined from background noise monitoring that has been carried out within the vicinity of the proposed site and is detailed in Ref [5].

There are approximately 100 residential premises (receivers) within 3 km of the proposed wind farm of which 70 are relevant receivers and 30 wind farmers that lease part or all of their properties for the proposed wind farm. The nearest associated dwelling (non-relevant) is approximately 800m away from the nearest FCWF wind turbine, and the nearest non-associated (relevant) dwelling is approximately 1.1km away from the nearest FCWF wind turbine. The receivers are listed, with details, in Appendix C. The non-relevant residences associated with the wind farm ("windfarmers", with wind turbines on their properties) are also noted in Appendix C.

The background noise levels at five receiver sites in the vicinity of the proposed wind farm have been measured (Ref [5]) continuously over a period of over three weeks in accordance with [2]:

- R012
- R025
- R027
- R078
- R089

The noise criteria at residences in the vicinity of the Flyers Creek Wind Farm which did not have background noise monitoring undertaken were matched to background noise from a similar site which has had a background noise survey. A number of factors determine the selection of which criteria to apply to each location, however some of the main factors are outlined below:

- Similarity of the ambient acoustic environment at a receiver location to one or more of the five background noise measurement sites which may be affected by:
    - Degree of exposure to winds
    - Type and amount of vegetation at residence location
    - Other mechanical sources, pumps, generators, windmill etc.
    - Domestic farm animals located near the residence
    - Resident activities

It is not possible to be definitive on all of these items as they vary over time. However, the maximum variation between the four monitored sites utilised for non-logged neighbours is approximately 3 dB at wind speeds between 3 and 12ms^{-1}. Therefore, the background noise levels at the four background monitoring sites used for non-logged receivers was quite consistent. This exercise aims to identify the representative site that is most similar to a specific neighbour residence location.

The applied criteria for non-logged relevant receivers is outlined in Table 5-1.

Table 5-1: Representative background sites with similar noise criteria

Background monitoring site	Sites considered to have a similar background noise characteristic
R012	R001, R003, R004, R005, R007, R008, R009, R010, R011, R012, R013, R014, R015, R016, R017, R021, R051, R052, R057, R058, R071, R073, R074, R075, R079, R085, R086, R087, R088, R102, R106, R107, R095, R109, R51B, R022, R112, R126, R128, R129, R130, R131, R132, R158
R025	R023, R024, R025, R029, R030, R033, R034, R041, R042, R043, R080, R082, R083, R084, R098, R114, R115, R116, R137, R152
R027	R020, R026, R027, R028, R035, R036, R037, R044, R045, R091, R092, R093, R094, R096, R117, R118, R119, R120, R121, R122, R123, R124, R125, R127, R138, R139, R140, R141, R142, R143, R144, R145, R146, R153, R154, R155, R156, R157
R078	R002, R046, R047, R048, R049, R050, R054, R055, R056, R072, R076, R077, R078, R090, R099, R100, R101, R108, R110, R111, R133, R134, R136, R147, R148, R149, R150, R151
R089	R089

The results of the analysis of the noise and wind monitoring are given in Ref [5]. These monitoring results have been performed in compliance with (Ref [2]). From these results we have observed that there is small disparity between day time and night time results.

A recommended wind farm noise compliance level at each of the five monitored sites and the rest of the sites has been based on the background noise levels measured. The noise criterion levels at each wind speed (10mAGL) from Ref [5] are as follows:

Table 5-2: Resultant noise criteria for each site at 78.6m AGL reference

	Wind speed ms^{-1} (at 76m AGL)									
Monitored Site	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
R012	35.0	35.0	35.5	36.5	38.0	39.0	40.0	41.0	41.5	42.5
R025	35.0	35.0	35.0	35.0	36.0	37.0	38.0	39.0	40.0	40.5
R027	35.0	35.0	35.0	35.0	35.0	36.5	37.5	39.0	40.0	41.0
R078	35.0	35.0	35.0	35.0	35.0	36.0	37.5	39.5	41.0	43.5
R089	39.0	40.5	41.5	43.0	44.0	45.0	46.5	47.5	48.5	50.0

We note, that the wind turbine sound power measurements for the reference turbine GE2.5XL are taken with reference to 10m AGL, therefore an adjusted criteria for 10m AGL referenced wind speed is given in Table 5-3. This adjustment was performed using the equation and method outlined in IEC 61400-11, which is used for calculating a reference height (10m) wind speed from Hub height wind speed (Equation 7 given in [10]). Furthermore, the method in which sound power levels are determined uses wind speed taken at Hub height, and then adjusted using this wind speed reference height scaling process. Although assessing the background noise (and therefore setting criteria) against Hub height wind speeds is a small deviation from the 2003 SA EPA Wind Farm Noise Guidelines (and is not a deviation from the current 2009 SA EPA Wind Farm Noise Guidelines), in essence, this method is using 10m wind speed criteria (derived from Hub height) against 10m reference sound power data, which also is derived from Hub Height, using the same scaling equation. If noise criteria were based on measurements paired with 10m AGL meteorological mast height (i.e. not scaled), the assessment will still be carried out using sound power data derived from hub height wind speed. In this case, the wind shear on site may be different than what has been assumed in the derived sound power level calculations, giving erroneous results when comparing a 10m reference (measured) wind speed criteria, to a 10m (derived) wind speed sound power level. If the same shear is used (using same scaling equation as in this case), then the wind shear components effectively cancel out, and therefore give a more accurate indication of the sound levels expected at residences in given wind conditions.

In essence, the SA EPA 2009 Wind Farm Noise Guidelines follow this method (using hub height wind speed reference), changing from the 2003 Wind Farm Noise Guidelines 10m reference method after careful deliberation and collective experience. Therefore we have provided criteria which are *based* on hub height wind speed (but *derived* to 10m wind speed, as with sound power levels) to give the most accurate noise assessment in relation to the wind speed experienced on site.

As the conversion from hub height wind speed to a reference height of 10m AGL gives non-integer wind speeds (and the supplied IEC 61400 sound power data is in integer wind speeds), a linear interpolation of the criteria has been performed on the scaled wind speed (from hub height to 10m AGL) to obtain criteria for integer wind speeds.

Table 5-3: Resultant noise criteria for each site at 10m AGL reference

	Wind speed ms^{-1} (at 10m AGL)						
Monitored Site	**3**	**4**	**5**	**6**	**7**	**8**	**9**
R012	35	36	38	39.5	40.5	41.5	42.5
R025	35	35	36	37.5	38.5	40	40.5
R027	35	35	35	37	38.5	40	41
R078	35	35	35	36.5	39	41.5	43.5
R089	40.5	42.5	44	45.5	47	48.5	50

The residences with wind turbines on their properties (identified as "Wind Farmers" in Appendix C) are not relevant receivers and the above criteria are not applicable. Predicted levels are provided for these sites and referenced to the World Health Organisation (WHO) relevant guideline level of 45 dB(A) [Ref: [7]].

6. NOISE MODEL

Both Concawe and ISO9163 noise propagation algorithms were used in this assessment. An accurate Predictive Noise Model has been constructed using the validated and accepted Concawe algorithm ([Ref: [3]]) for noise propagation in different meteorological conditions, with a ground absorption factor set to partially reflective (30% reflective, with ground factor set to G=0.7). The standard ISO9613 algorithm [Ref : [4]] was also used, with a ground absorption factor set to fully reflective (100% reflective, G set to 0.0). The noise model has been constructed using the widely recognised SoundPLAN proprietary software package.

The algorithms used in the model take into account the likely effects of atmospheric absorption, ground absorption/reflection, diffraction and attenuation by topographic features, screening effect of barriers and the propagation effect of wind speed and direction. The accuracy of the noise model is likely to be at least ± 2 dB(A).

The layout presented to be modelled consisted of 44 WTG's. This layout is represented graphically in Appendix B, and in tabular format in Appendix D.

The model incorporates the proposed locations of WTG arrays at a hub height of 85m above the ground level which will be the hub height should the GE 2.5xl turbine model be selected for the project.

The WTG sound power data is given in Appendix E. The sound power output, measured at 10m AGL (in accordance with IEC 61400-11), of the selected turbine at 8m/s (at 10m AGL) is 105.0dB(A).

There was limited published data from the manufacturers outlining any detectable tones or any other significant characteristics such as impulsiveness, modulation or low frequency components in the sound power spectrum. We note that a preliminary report for the GE turbines show that tone at 7m/s wind speed which has a $\Delta L_{a,k}$ of 0.82. Additionally, we are aware that GE are actively working on eliminating any measureable tonality in their 2.5MW turbine, and at the time of installation, tonality may not be present in the near field of the WTG. Additionally, this tone (measured in the near field) is likely to attenuate, and be masked by background noise effects at the nearest residential receiver (and therefore not audible, and penalty should not be set). We note that this will need to be assessed once the wind farm is constructed, or tests on this selected WTG type show adequate attenuation of this tone in the far field (distances greater than 500m from the WTG). Otherwise, these noise predictions presented in this report provide a conservative estimate. The proponent has advised that they will not select a turbine that exhibits tonality characteristics as defined by the EPA SA guidelines.

We note that the turbine selection is indicative only, and may change as the project develops. The proponent is aware that if a different WTG model is selected for the project, remodelling and further acoustic assessment will be required.

The psycho-acoustic response or annoyance levels to a new noise source is subjective and will vary from person to person but is unlikely to be significant with wind farm noise and particularly so with increasing separation distance between the turbines and the residences. Current wind turbine designs are not a significant source of low frequency noise or infrasound – even nearby (less than 500m), any infrasound is well below the threshold of human perception and would not cause health effects.

6.1. Noise Predictions

We note that both Concawe and ISO9613 algorithms have been used to predict noise levels at receiver locations surrounding the wind farm. We present ISO9613 levels, as these give slightly higher noise levels at the receivers, and therefore making the noise model slightly more conservative.

The noise model was run for the maximum power setting for all of the WTGs at the integer wind speeds (at 10m AGL). The model was run with these sound power settings for ISO9613 and wind-affected propagation conditions from 3 to 12 ms^{-1}. It was found that when run with WTGs at maximum power setting, the noise levels at three receivers were slightly exceeding their respective criteria by up to 0.5dB at wind speeds of 6ms^{-1} and 7ms^{-1} (at 10m AGL) and therefore selected turbines were modelled using a lower power setting (and therefore a lower sound power level). The sound power levels for the derating modes for the selected GE turbines are given in Appendix F.

Table 6-1 provides a summary of the predicted noise reduction operation mode scheme at each wind speed for the noise levels at the selected residences to be below the selected criteria.

Table 6-1: Wind Turbine Derating Scheme

Wind Speed @10m AGL (@85m AGL), ms^{-1}	Turbines affected	Noise Reduced Operation Mode
5.5 – 6.5 (7.7 – 9.1)	WTG 16	NRO100
	WTG 18	NRO100
6.5 – 7.5 (9.1 – 10.4)	WTG 04	NRO102
	WTG 05	NRO102
	WTG18	NRO100

The noise levels at the relevant receivers after these noise mitigation options have been employed are outlined in Table 6-2

Predicted L_{Aeq} noise levels (rounded to the nearest 0.5 dB(A)) have been determined for all relevant and non-relevant receivers and are tabulated in Table 6-2 and Table 6-3 respectively for integer wind speeds. The criterion level which would be applicable is also given in the table. The relevant World Health Organisation (WHO) guideline level of 45 dB(A) for unreasonable interference or sleep disturbance [Ref :[7]] is also given in the table for non-relevant receivers.

Table 6-2: Predicted Noise Levels (L_{Aeq} dB(A)) for Relevant Sites at Different Wind Speeds Using ISO9613 Meteorological Conditions G = 0.0.

Relevant Receiver	Wind Speed ms^{-1} (at 10m AGL)									
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
Criteria set: R012 - Errowanbang										
Criteria	35.0	36.0	38.0	39.5	40.5	41.5	42.5			
R001	21.5	24.5	27.5	30.5	33.0	33.0	33.0	33.0	33.0	33.0
R005	23.0	26.0	29.0	32.0	34.5	34.5	34.5	34.5	34.5	34.5
R007	12.5	15.5	18.5	21.5	24.0	24.0	24.0	24.0	24.0	24.0
R008	11.5	14.5	17.5	20.5	23.0	23.0	23.0	23.0	23.0	23.0
R009	23.0	26.0	29.0	32.0	34.5	34.5	34.5	34.5	34.5	34.5
R010	25.0	28.0	31.0	34.0	36.5	36.5	36.5	36.5	36.5	36.5
R011	24.0	27.0	30.0	33.0	35.5	35.5	35.5	35.5	35.5	35.5
R012	23.5	26.5	29.5	32.5	35.0	35.0	35.0	35.0	35.0	35.0

Relevant Receiver	Wind Speed ms^{-1} (at 10m AGL)									
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
R013	23.5	26.5	29.5	32.5	35.0	35.0	35.0	35.0	35.0	35.0
R015	20.0	23.0	26.0	29.0	31.5	31.5	31.5	31.5	31.5	31.5
R016	21.0	24.0	27.0	30.0	33.0	33.0	33.0	33.0	33.0	33.0
R017	22.0	25.0	28.0	31.0	33.5	33.5	33.5	33.5	33.5	33.5
R057	25.0	28.0	31.0	34.0	36.5	36.5	36.5	36.5	36.5	36.5
R058	14.5	17.5	20.5	23.5	26.0	26.0	26.0	26.0	26.0	26.0
R073	21.5	24.5	27.5	30.5	33.5	33.5	33.5	33.5	33.5	33.5
R075	23.0	26.0	29.0	32.0	34.5	34.5	34.5	34.5	34.5	34.5
R085	22.5	25.5	28.5	31.5	34.0	34.0	34.0	34.0	34.0	34.0
R087	21.0	24.0	27.0	30.0	33.0	33.0	33.0	33.0	33.0	33.0
R095	25.5	28.5	31.5	34.5	37.0	37.0	37.0	37.0	37.0	37.0
R102	24.0	27.0	30.0	33.0	35.5	35.5	35.5	35.5	35.5	35.5
R106	21.0	24.0	27.0	30.0	32.5	32.5	32.5	32.5	32.5	32.5
R107	21.0	24.0	27.0	30.0	32.5	32.5	32.5	32.5	32.5	32.5
R109	11.0	14.0	17.0	20.0	22.5	22.5	22.5	22.5	22.5	22.5
R112	17.5	20.5	23.5	26.5	29.5	29.5	29.5	29.5	29.5	29.5
R126	22.5	25.5	28.5	31.5	34.0	34.0	34.0	34.0	34.0	34.0
R128	18.5	21.5	24.5	27.5	30.0	30.0	30.0	30.0	30.0	30.0
R129	22.0	25.0	28.0	31.0	33.5	33.5	33.5	33.5	33.5	33.5
R130	21.0	24.0	27.0	30.0	32.5	32.5	32.5	32.5	32.5	32.5
R131	13.0	16.0	19.0	22.0	25.0	25.0	25.0	25.0	25.0	25.0
R132	20.5	23.5	26.5	29.5	32.0	32.0	32.0	32.0	32.0	32.0
R158	22.5	25.5	28.5	31.5	34.0	34.0	34.0	34.0	34.0	34.0
Criteria set: R025 - Bromley										
Criteria	35.0	35.0	36.0	37.5	38.5	40.0	40.5			
R023	27.5	30.5	33.5	36.5	38.0	39.0	39.0	39.0	39.0	39.0
R025	25.0	28.0	31.0	34.0	36.5	36.5	36.5	36.5	36.5	36.5
R029	14.5	17.5	20.5	23.5	26.0	26.0	26.0	26.0	26.0	26.0
R030	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R031	15.5	18.5	21.5	24.5	27.5	27.5	27.5	27.5	27.5	27.5
R033	15.5	18.5	21.5	24.5	27.0	27.0	27.0	27.0	27.0	27.0
R034	14.5	17.5	20.5	23.5	26.0	26.0	26.0	26.0	26.0	26.0
R041	16.0	19.0	22.0	25.0	27.5	27.5	27.5	27.5	27.5	27.5
R042	12.0	15.0	18.0	21.0	24.0	24.0	24.0	24.0	24.0	24.0
R043	23.5	26.5	29.5	32.5	35.0	35.0	35.0	35.0	35.0	35.0
R080	20.5	23.5	26.5	29.5	32.0	32.0	32.0	32.0	32.0	32.0
R082	21.5	24.5	27.5	30.5	33.0	33.0	33.0	33.0	33.0	33.0
R083	13.0	16.0	19.0	22.0	24.5	24.5	24.5	24.5	24.5	24.5
R084	15.0	18.0	21.0	24.0	26.5	26.5	26.5	26.5	26.5	26.5
R098	16.0	19.0	22.0	25.0	27.5	27.5	27.5	27.5	27.5	27.5
R114	12.0	15.0	18.0	21.0	23.5	23.5	23.5	23.5	23.5	23.5

Relevant Receiver	Wind Speed ms^{-1} (at 10m AGL)									
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
R115	18.5	21.5	24.5	27.5	30.0	30.0	30.0	30.0	30.0	30.0
R116	18.0	21.0	24.0	27.0	29.5	29.5	29.5	29.5	29.5	29.5
R137	14.0	17.0	20.0	23.0	25.5	25.5	25.5	25.5	25.5	25.5
R152	13.5	16.5	19.5	22.5	25.0	25.0	25.0	25.0	25.0	25.0
Criteria set: R027 - Willow Creek East										
Criteria	35.0	35.0	35.0	37.0	38.5	40.0	41.0			
R020	19.0	22.0	25.0	28.0	30.5	30.5	30.5	30.5	30.5	30.5
R027	22.5	25.5	28.5	31.5	34.0	34.0	34.0	34.0	34.0	34.0
R028	22.5	25.5	28.5	31.5	34.0	34.0	34.0	34.0	34.0	34.0
R035	9.5	12.5	15.5	18.5	21.0	21.0	21.0	21.0	21.0	21.0
R036	15.5	18.5	21.5	24.5	27.5	27.5	27.5	27.5	27.5	27.5
R037	19.0	22.0	25.0	28.0	30.5	30.5	30.5	30.5	30.5	30.5
R044	26.0	29.0	32.0	35.0	38.0	38.0	38.0	38.0	38.0	38.0
R045	21.0	24.0	27.0	30.0	33.0	33.0	33.0	33.0	33.0	33.0
R091	16.0	19.0	22.0	25.0	27.5	27.5	27.5	27.5	27.5	27.5
R092	13.0	16.0	19.0	22.0	24.5	24.5	24.5	24.5	24.5	24.5
R093	11.0	14.0	17.0	20.0	23.0	23.0	23.0	23.0	23.0	23.0
R094	20.0	23.0	26.0	29.0	31.5	31.5	31.5	31.5	31.5	31.5
R096	20.5	23.5	26.5	29.5	32.0	32.0	32.0	32.0	32.0	32.0
R117	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R118	13.5	16.5	19.5	22.5	25.0	25.0	25.0	25.0	25.0	25.0
R119	11.5	14.5	17.5	20.5	23.5	23.5	23.5	23.5	23.5	23.5
R120	16.0	19.0	22.0	25.0	27.5	27.5	27.5	27.5	27.5	27.5
R121	14.5	17.5	20.5	23.5	26.0	26.0	26.0	26.0	26.0	26.0
R122	14.0	17.0	20.0	23.0	25.5	25.5	25.5	25.5	25.5	25.5
R123	10.0	13.0	16.0	19.0	21.5	21.5	21.5	21.5	21.5	21.5
R124	10.0	13.0	16.0	19.0	21.5	21.5	21.5	21.5	21.5	21.5
R125	11.5	14.5	17.5	20.5	23.0	23.0	23.0	23.0	23.0	23.0
R127	9.5	12.5	15.5	18.5	21.0	21.0	21.0	21.0	21.0	21.0
R138	11.0	14.0	17.0	20.0	22.5	22.5	22.5	22.5	22.5	22.5
R139	10.5	13.5	16.5	19.5	22.0	22.0	22.0	22.0	22.0	22.0
R140	15.5	18.5	21.5	24.5	27.0	27.0	27.0	27.0	27.0	27.0
R141	14.5	17.5	20.5	23.5	26.0	26.0	26.0	26.0	26.0	26.0
R142	9.5	12.5	15.5	18.5	21.0	21.0	21.0	21.0	21.0	21.0
R143	3.0	6.0	9.0	12.0	15.0	15.0	15.0	15.0	15.0	15.0
R144	12.5	15.5	18.5	21.5	24.5	24.5	24.5	24.5	24.5	24.5
R145	13.0	16.0	19.0	22.0	24.5	24.5	24.5	24.5	24.5	24.5
R146	12.5	15.5	18.5	21.5	24.5	24.5	24.5	24.5	24.5	24.5
R153	6.0	9.0	12.0	15.0	18.0	18.0	18.0	18.0	18.0	18.0
R154	4.5	7.5	10.5	13.5	16.0	16.0	16.0	16.0	16.0	16.0
R155	3.0	6.0	9.0	12.0	14.5	14.5	14.5	14.5	14.5	14.5

Relevant Receiver	Wind Speed ms^{-1} (at 10m AGL)									
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
R156	5.5	8.5	11.5	14.5	17.5	17.5	17.5	17.5	17.5	17.5
Criteria set: R078 - House										
Criteria	35.0	35.0	35.0	36.5	39.0	41.5	43.5			
R046	24.5	27.5	30.5	33.5	36.0	36.0	36.0	36.0	36.0	36.0
R047	21.0	24.0	27.0	30.0	32.5	32.5	32.5	32.5	32.5	32.5
R048	24.0	27.0	30.0	33.0	35.5	35.5	35.5	35.5	35.5	35.5
R072	24.5	27.5	30.5	33.5	36.0	36.0	36.0	36.0	36.0	36.0
R077	27.5	30.5	33.5	36.0	38.5	39.0	39.0	39.0	39.0	39.0
R078	28.0	31.0	34.0	36.0	38.5	39.5	39.5	39.5	39.5	39.5
R090	26.5	29.5	32.5	35.5	38.0	38.0	38.0	38.0	38.0	38.0
R099	26.0	29.0	32.0	35.0	37.5	37.5	37.5	37.5	37.5	37.5
R100	23.0	26.0	29.0	32.0	34.5	34.5	34.5	34.5	34.5	34.5
R101	18.5	21.5	24.5	27.5	30.0	30.0	30.0	30.0	30.0	30.0
R108	26.5	29.5	32.5	35.5	38.0	38.0	38.0	38.0	38.0	38.0
R110	16.5	19.5	22.5	25.5	28.0	28.0	28.0	28.0	28.0	28.0
R111	15.5	18.5	21.5	24.5	27.0	27.0	27.0	27.0	27.0	27.0
R133	19.5	22.5	25.5	28.5	31.0	31.0	31.0	31.0	31.0	31.0
R134	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R136	13.5	16.5	19.5	22.5	25.0	25.0	25.0	25.0	25.0	25.0
R147	11.5	14.5	17.5	20.5	23.0	23.0	23.0	23.0	23.0	23.0
R148	15.0	18.0	21.0	24.0	26.5	26.5	26.5	26.5	26.5	26.5
R149	2.5	5.5	8.5	11.5	14.0	14.0	14.0	14.0	14.0	14.0
R150	9.5	12.5	15.5	18.5	21.0	21.0	21.0	21.0	21.0	21.0
R151	14.0	17.0	20.0	23.0	25.5	25.5	25.5	25.5	25.5	25.5
Criteria set: R089 - House										
Criteria	40.5	42.5	44.0	45.5	47.0	48.5	50.0			
R089	29.5	32.5	35.5	38.5	41.0	41.0	41.0	41.0	41.0	41.0

Table 6-3: Predicted Noise Levels (L_{Aeq} dB(A)) for Non-Relevant Sites at Different Wind Speeds Using ISO9613 Meteorological Conditions G = 0.0.

Non Relevant Receiver	Wind Speed ms^{-1} (at 10m AGL)									
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
Criteria	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
R002	27.0	30.0	33.0	36.0	39.0	39.0	39.0	39.0	39.0	39.0
R003	32.0	35.0	38.0	41.0	43.5	43.5	43.5	43.5	43.5	43.5
R004	30.0	33.0	36.0	39.0	41.5	41.5	41.5	41.5	41.5	41.5
R014	30.5	33.5	36.5	39.5	42.0	42.0	42.0	42.0	42.0	42.0
R021	28.5	31.5	34.5	37.5	40.0	40.0	40.0	40.0	40.0	40.0
R022	29.0	32.0	35.0	38.0	41.0	41.0	41.0	41.0	41.0	41.0
R024	26.0	29.0	32.0	35.0	37.5	37.5	37.5	37.5	37.5	37.5

Non Relevant Receiver	Wind Speed ms^{-1} (at 10m AGL)									
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
R026	23.5	26.5	29.5	32.5	35.0	35.0	35.0	35.0	35.0	35.0
R049	29.0	32.0	35.0	38.0	40.5	40.5	40.5	40.5	40.5	40.5
R050	31.0	34.0	37.0	40.0	43.0	43.0	43.0	43.0	43.0	43.0
R051	29.0	32.0	35.0	38.0	41.0	41.0	41.0	41.0	41.0	41.0
R052	29.0	32.0	35.0	38.0	41.0	41.0	41.0	41.0	41.0	41.0
R054	30.5	33.5	36.5	39.5	42.0	42.0	42.0	42.0	42.0	42.0
R055	27.5	30.5	33.5	36.5	39.5	39.5	39.5	39.5	39.5	39.5
R056	29.5	32.5	35.5	38.5	41.5	41.5	41.5	41.5	41.5	41.5
R071	30.0	33.0	36.0	39.0	42.0	42.0	42.0	42.0	42.0	42.0
R074	27.0	30.0	33.0	36.0	38.5	38.5	38.5	38.5	38.5	38.5
R076	30.0	33.0	36.0	39.0	41.5	41.5	41.5	41.5	41.5	41.5
R079	32.5	35.5	38.5	41.5	44.0	44.0	44.0	44.0	44.0	44.0
R086	25.5	28.5	31.5	34.5	37.0	37.0	37.0	37.0	37.0	37.0
R088	27.0	30.0	33.0	36.0	38.5	38.5	38.5	38.5	38.5	38.5
R51B	29.5	32.5	35.5	38.5	41.0	41.0	41.0	41.0	41.0	41.0

As shown in Table 6-2 above, compliance with the noise criteria can be achieved at all residences by operating four wind turbines in noise reduction mode for a specific wind speed range of 1 – 2 m/s. This sort of specific derating scheme of the wind turbine generation, and thereby the acoustic levels, is easily accomplished using existing control software in modern wind turbines. Should this wind turbine be selected for the Flyers Creek project, the noise reduction mode necessary to meet the noise criteria will be confirmed during compliance testing of the wind farm project after construction.

Colour noise contour plots have been generated for the maximum power setting (at $8ms^{-1}$ at 10m AGL)wind speed for ISO9613 and CONCAWE wind propagation scenarios), covering the surrounding area. These are shown in Appendix I.

6.2. Model accuracy

We acknowledge that the 95% confidence level of the ISO9613 model used in the SoundPLAN program under high propagation conditions may be in the order of ± 4 to 5 dB(A):

- The ISO9613 set with fully reflective ground factor (G = 0.0) algorithm model in combination with the capabilities of the recognised SoundPLAN software offer an accurate estimate of environmental noise levels and, importantly, provides estimated wind effects on noise propagation.
- The Concawe set with 30% reflective ground factor (G = 0.7) algorithm model in combination with the capabilities of the recognised SoundPLAN software offer an accurate estimate of environmental noise levels and, importantly, provides estimated wind effects on noise propagation.
- In South Australia and elsewhere, the use of the Concawe model has been validated for its application to wind farms. Post-compliance data and information suggests that the model provides reasonably accurate (and slightly conservative) predictions of wind farm noise levels.
- The noise prediction model for the FCWF assumes a steady or uniform wind field; however, this does not happen in reality and therefore the real noise propagation from the installed turbine array is likely to be less than that modelled, and the model is therefore likely to be slightly conservative.
- A number of conservative assumptions are built into both models such as assuming each residence is downwind from every turbine, which, of course, would require the wind to be blowing from different directions at the same time which is nearly impossible.

- For the above reasons, the Concawe or ISO9613 model should incorporate enough built-in conservatism to account for any possible inaccuracies.
- We note that the results for both Concawe and ISO9613 algorithms for this project have given similar results (a difference of 0.3dB), and both can be relied on as being accurate.

7. NOISE IMPACT ASSESSMENT

We note that the criteria are met at all relevant receiver sites (with Wind Turbine Derating Scheme in place, as outlined in Table 6-1). Additionally the noise levels at the non-relevant receivers meet the relevant World Health Organisation (WHO) guideline level of 45 dB(A) for unreasonable interference or sleep disturbance [Ref :[7]].

Therefore, operation of the wind farm with four wind turbines (WTG 4, 5, 16 and 18) in noise reduction mode is predicted to satisfy the noise criteria at every residence for all wind speeds.

It is noted that the proponent will select a turbine that will ensure noise compliance is achieved and that further noise modeling may be required if the selected model differs from that assessed in this report.

7.1. Substation Noise

The proposed substation is to consist of two 33kV/132kV transformers each rated up to 80MVA. The two proposed 33kV/132kV (80MVA) transformers are indicated to have a conservative sound power level of 94 dB(A). Based on these figures a combined conservative sound power level of 97dB(A) is expected for the substation.
The proposed Flyers Creek Wind Farm substation is approximately 1,200 metres from the nearest residential receivers. Review of potential noise levels at the closest (based on the conservative 97dB(A) sound power level) indicates that the predicted noise level from the substation at the receivers is likely to be about 30dB(A), which is much lower than worst case wind turbine levels, and up to 32dB(A) in certain 'worst case' meteorological conditions. However, the maximum loading and noise generation from the substation will occur during periods of strong winds and associated high background noise levels of over 40 dB(A).

Due to the distance between the substation and the receivers the 100Hz frequency component of transformer noise is not expected to be significant at the receiver locations.

7.2. Construction Noise

We note that the assessment of noise from construction of the wind turbines and roads etc for associated infrastructure is not governed by the Environmental Noise Guidelines : Wind Farms; rather, the guidelines laid out in the NSW DECC's Interim Construction Noise Guideline are applicable to construction noise.

The NSW DECC Construction Noise Guideline provides the following noise criteria :

Construction period	**Criterion dB(A)**
Within Acceptable Construction Hours	$L_{Aeq,15min}$ <= background L_{A90} + 10
Outside Acceptable Construction Hours	$L_{Aeq,15min}$ <= background L_{A90} + 5

Table 7-1: Construction noise criteria

Acceptable construction hours are defined below:

Day	**Acceptable construction times**
Monday to Friday	7:00 am to 6:00pm
Saturday	8:00 am to 1:00pm

Table 7-2: **Construction time restrictions**

The construction programme is likely to occur over a 12 month period. Due to the distributed nature of the development, noise impacts at turbine locations will progress across the wind farm site. Therefore, the extent

of significant construction in any one area is likely to be less than 3 months (and the erection time for individual turbines being only a matter of days).

With most construction activities occurring on weekdays and only during normal working hours, the potential for sleep disturbance to occur is reduced, and the evening and night time amenity of residents in the vicinity of the construction activities being unaffected by those activities.

Regarding the impact of traffic noise, we anticipate that existing roads will be utilised as far as possible, minimising the time and cost of constructing additional infrastructure and reducing the impact of temporary road construction on residential locations. The short-term increase in heavy vehicle movement may be noticeable to residences along the existing roads utilised during construction.

Construction activities will include: site preparation/establishment, earthworks/excavation, foundation works and structural/construction works. The following table provides indicative short-term noise levels which may be experienced at varying distances from typical items of equipment used for construction activities:

Predicted Typical Construction Noise Levels dB(A) (L_{Aeq})				
Equipment	**Distance from equipment**			
	500m	**1000m**	**1500m**	**2000m**
Compactor	45-52	38-45	33-40	29-36
Concrete mixer truck	35-44	28-37	23-32	<30
Concrete pump	<30	<30	<30	<30
Crane	46-50	39-41	34-36	30-32
Crushing Plant	45-52	38-45	33-40	29-36
Front End Loader/Dozer	46-50	39-41	34-36	30-32
Excavator	42-46	35-39	30-34	26-30
Grader	42-46	35-39	30-34	26-30
Piling	44-49	37-42	32-37	28-33
Roller	<30	<30	<30	<30

Table 7-3: Predicted Typical Construction Noise Levels dB(A)

The following average day time background (L_{A90}) noise levels were measured during the noise monitoring period of the FCWF project, with the corresponding criteria:

Construction Noise Criteria			
Location	**Average Background Noise Level L_{A90} dB(A)**	**Construction Noise Criterion Level L_{Aeq} dB(A)**	**Average Daytime Ambient Noise Level L_{Aeq} dB(A)**
R012	35	45	44
R025	33	43	41
R027	40	50	52
R078	33	43	46
R089	40	50	51

Table 7-4: Construction Noise Criterion Levels dB(A)

As distances from the nearest turbine to each relevant receiver are all greater than 1000m, the noise criteria for construction noise is likely to be achieved at all relevant residences. Some 'windfarmer' residences within 1000m of the construction activities may be exposed to short term noise levels which may exceed this criterion. We note however that the average L_{Aeq} noise levels measured on site are approximately at the same level as the construction noise criterion level. Therefore, if construction noise meets the stipulated criterion, the noticeable effect at each receiver will be negligible (as noise levels will be similar to existing measured noise levels).

Where multiple plant is likely to be used, we have assumed the following scenarios with their total conservative expected noise levels given in Table 7-5.

Construction Type	**Units Used / Activities**	**Maximum Expected Noise Levels (dB(A)) at the nearest relevant receiver**
WTG Erection	Crane, Concrete Truck, Front End Loader	43dB(A)
Road Preparation	Grader, Roller, Compactor	45dB(A)
WTG foundation preparation	Excavator, Piling	42dB(A)

Table 7-5: Expected Worst Case Noise Levels From Construction Activities

With Table 7-5 in mind, the relevant receivers will have noise from construction activities meet or slightly exceed the noise criteria by up to approximately 1-2dB, and the likely number of relevant residences affected by construction noise (relevant residences less than 1.5km) would be approximately 8.

However, as the construction of either the appropriate infrastructure or the turbines themselves are not confined to a single location for any significant length of time, the actual exposure of any given residence to any construction noise is only for a limited time period (possibly as short as a few weeks depending on construction activity).

We note also that construction noise levels at residences in the vicinity of the proposed Flyers Creek Wind Farm are likely to be within the general rise-and-fall of ambient noise levels experienced at the residences.

Vibration levels generated from construction machinery (including vibration from construction traffic movements) are likely to be below the threshold of detection, and therefore not material, at residences. Given the locations and distances of the residences there are not likely to be any vibration sensitive receivers. Blasting activities are not likely to occur during construction at this site and any piling activities may cause some noticeable short-term or distant low frequency noise events.

Therefore, construction noise and vibration is not anticipated to cause significant detrimental effect to the amenity of the residences in the vicinity of the wind farm during construction.

We note that it is not uncommon for exemption from environmental noise policies to be sought, and granted, for construction noise, however this should not be viewed as an evasion of responsibility to minimise the acoustic impact of construction activities.

7.3. Transmission Line Noise

Transmission line noise (due to corona or Aeolian noise) is not significant or potentially annoying at short distances (distances greater than 100m) from the lines, and is therefore not likely to be an issue at any residences. Aeolian noise, the noise caused by high wind through the lines, increases as the wind speed increases, therefore elevated noise levels created by airflow around the transmission lines will be present in only very high wind speeds (greater than $20ms^{-1}$), where wind induced background noise will be dominant. Corona discharge noise will only be present in high humidity conditions (such as periods of rainfall or fog), and will only be significant or distracting near the power line---within 100 metres. As the 132kV line is not proposed to be this close to any residences, corona discharge noise will not be issue.

APPENDIX A GLOSSARY OF ACOUSTIC TERMINOLOGY

dB(A) A unit of measurement, decibels(A), of sound pressure level which has its frequency characteristics modified by a filter ("A-weighted") so as to more closely approximate the frequency response of the human ear.

L_{10} The noise level which is equalled or exceeded for 10% of the measurement period. L_{10} is an indicator of the mean maximum noise level, and is used in Australia as the descriptor for intrusive noise [usually in dB(A)]. Nominal measurement period is usually 15 minutes.

L_{90} The noise level which is equalled or exceeded for 90% of the measurement period. L_{90} or L_{95} is an indicator of the mean minimum noise level, and is used in Australia as the descriptor for background or ambient noise [usually in dB(A)].

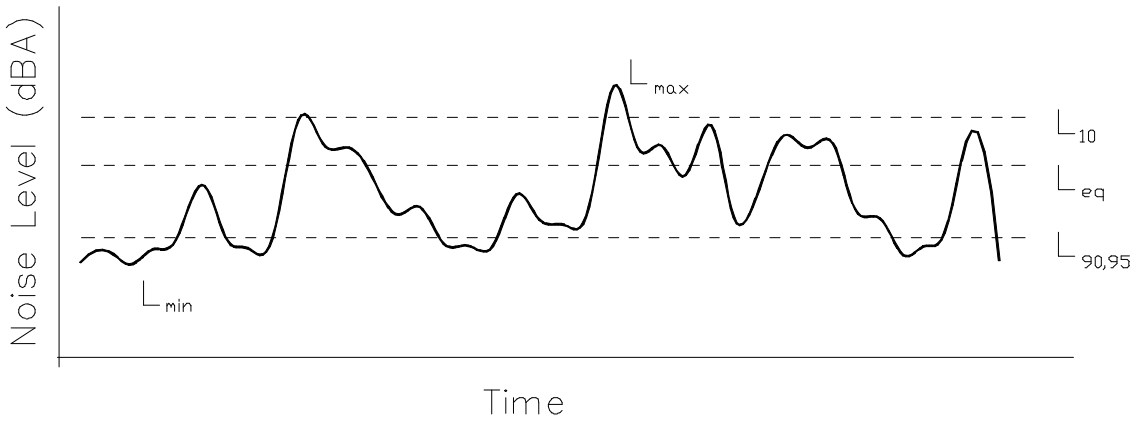
L_{eq} The equivalent continuous noise level for the measurement period, weighted for duration and intensity. L_{eq} is an indicator of the average noise level [in dB(A)].

L_{max} The maximum noise level for the measurement period [usually in dB(A)].

L_{peak} The maximum numerical noise level, usually unweighted, attained during the measurement period [usually in dB(Z), or formerly as dB(lin)].

SEL The single event Sound Exposure Level is the equivalent A-weighted sound level which, if it lasted for one second, would produce the same sound energy as the actual event [in dB(A)].

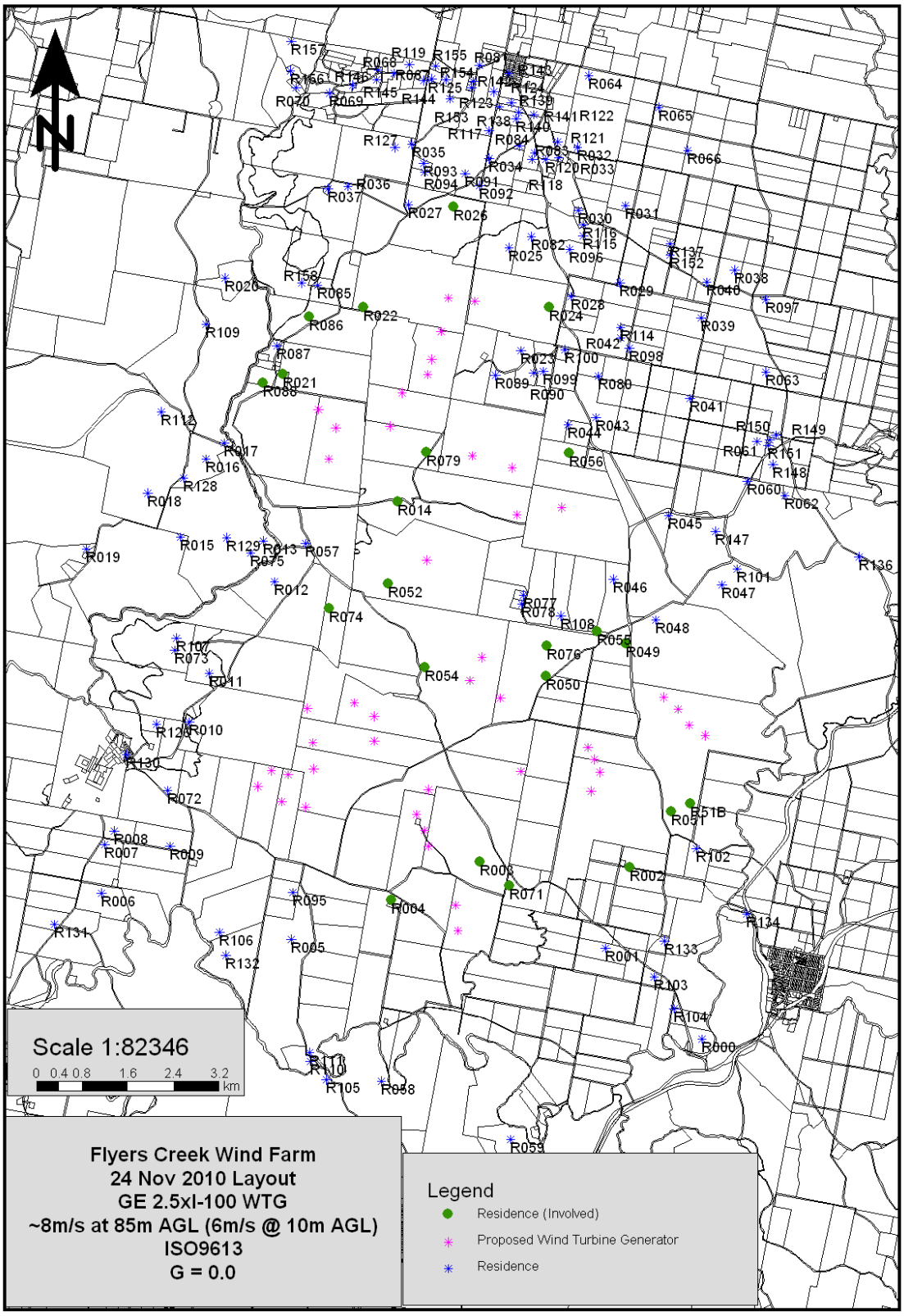
$\Delta L_{a,k}$ Tonal Audibility of Wind Turbine Generators (in dB), as defined by IEC61400-11:2002+A12006. Levels above 0dB are generally considered to be audible



Note: *The subjective response or reaction to changes in noise levels can be described as follows:*

A 3 dB(A) change in sound pressure level is just perceptible to the average human ear; a 5 dB(A) increase is quite noticeable and a 10 dB(A) increase is typically perceived as a doubling in loudness.

APPENDIX B LAYOUT MAP OF FLYERS CREEK WIND FARM


N
Scale 1:82346
0 0.4 0.8 1.6 2.4 3.2 km
Flyers Creek Wind Farm
24 Nov 2010 Layout
GE 2.5xl-100 WTG
~8m/s at 85m AGL (6m/s @ 10m AGL)
ISO9613
G = 0.0
Legend
Residence (Involved)
Proposed Wind Turbine Generator
Residence

APPENDIX C LIST AND DETAILS OF RESIDENTIAL PREMISES NEAR WIND FARM.

Name	Easting	Northing	Dist. to nearest WTG (m)	Closest WTG	Wind Farmer
R000 - Stokefield	697170	6277991	4677	WTG37	No
R001 - Hillcrest	695480	6279583	2601	WTG37	No
R002 - Haverton	695919	6280995	1504	WTG42	Yes
R003 - Glen Ayr	693290	6281079	869	WTG36	Yes
R004 - Lochewen	691740	6280418	1116	WTG36	Yes
R005 - Glenarvon	689988	6279727	2336	WTG31	No
R006 - Tettenhall	686673	6280542	3310	WTG29	No
R007 - Glendale	686729	6281398	2860	WTG29	No
R008 - Rockdale	686895	6281635	2626	WTG29	No
R009 - Sunnyview	687863	6281361	1865	WTG29	No
R010 - Hill View	688196	6283545	1655	WTG29	No
R011 - Rhondda Villa	688548	6284390	1816	WTG24	No
R012 - Errowanbang	689697	6285992	2284	WTG24	No
R013 - Old Errowanbang	689493	6286700	1839	WTG12	No
R014 - Willow Park	691859	6287385	1132	WTG17	Yes
R015 - Stockton	688049	6286778	2925	WTG12	No
R016 - Meribah Cottage	688498	6288144	2140	WTG12	No
R017 - Triangle Park	688810	6288422	1753	WTG10	No
R018 - Meribah	687479	6287542	3215	WTG12	No
R019 - South Log	686400	6286566	4520	WTG12	No
R020 - North West	688821	6291307	2825	WTG10	No
R021 - Rembo	689845	6289617	868	WTG10	Yes
R023 - Towradgee	693998	6290034	1190	WTG04	No
R024 - Windella	694504	6290794	1321	WTG04	Yes
R025 - Bromley	693794	6291840	1113	WTG04	No
R026 - Thrushley	692827	6292548	1598	WTG03	Yes
R027 - Willow Creek East	692030	6292590	1783	WTG03	No
R028 - Hillview	694887	6290992	1701	WTG04	No
R029 - Fairview	695725	6291229	2558	WTG04	No
R030 - Vermont	695003	6292497	2414	WTG04	No
R031 - Strathfield	695822	6292571	3117	WTG04	No
R032 - Loloma	694991	6293599	3241	WTG04	No
R033 - Dogwind	694654	6293413	2905	WTG04	No
R034 - Westerham	693441	6293402	2509	WTG04	No
R035 - Timaru	692095	6293649	2772	WTG03	No
R036 - Willow Creek	690975	6292913	2636	WTG03	No
R037 - Braithwaite	690622	6292862	2850	WTG03	No
R038 - Carlingford	697744	6291449	4589	WTG04	No
R039 - Hillview	697156	6290613	3979	WTG04	No
R040 - The Cottage	697253	6291238	4079	WTG04	No
R041 - Crenvor	696957	6289196	2936	WTG15	No
R042 - Euronga	695744	6290256	2637	WTG04	No
R043 - Bellevue	695308	6288867	1680	WTG15	No
R044 - Willow Dale	694827	6288747	1233	WTG14	No
R045 - Castle Hill	696576	6287157	1861	WTG15	No
R046 - Bulwarra	695613	6286034	1544	WTG15	No

Name	Easting	Northing	Dist. to nearest WTG (m)	Closest WTG	Wind Farmer
R047 - Weston	697517	6285936	2220	WTG43	No
R048 - Fairbanks	696357	6285318	1359	WTG43	No
R049 - Wattlecomb	695841	6284902	1142	WTG43	Yes
R050 - Nullawonga	694452	6284339	901	WTG20	Yes
R051 - Beulah Park	696637	6281968	1430	WTG41	Yes
R052 - Carramar	691683	6285950	792	WTG17	Yes
R054 - Hillcrest	692331	6284482	805	WTG19	Yes
R055 - House	695336	6285112	1629	WTG43	Yes
R056 - Cooramilla	694850	6288242	957	WTG15	Yes
R057 - School	690243	6286658	1532	WTG12	No
R058 - Ridge End	691558	6277254	2959	WTG37	No
R059 - House	693818	6276240	3767	WTG37	No
R060 - Carradowns	697959	6287754	3272	WTG15	No
R061 - Caithness	698124	6288446	3593	WTG15	No
R062 - Tralee	698615	6287506	3900	WTG15	No
R063 - Long View	698286	6289654	4276	WTG15	No
R064 - Sunnyside	695193	6294854	4428	WTG04	No
R065 - Greenbank	696414	6294288	4674	WTG04	No
R066 - Ferndale	696920	6293544	4570	WTG04	No
R067 - Karinya	691781	6294883	4045	WTG03	No
R068 - Mirraweena	691505	6294942	4175	WTG03	No
R069 - Narrawong	690656	6294539	4147	WTG03	No
R070 - Warrengong	690073	6294640	4549	WTG03	No
R071 - Platt	693808	6280666	1014	WTG36	Yes
R072 - House	687821	6282338	1583	WTG29	No
R073 - Braeburn	687953	6284796	2520	WTG24	No
R074 – House	690651	6285519	1699	WTG21	Yes
R075 – House	689275	6286492	2138	WTG12	No
R076 - House	694469	6284864	1171	WTG18	Yes
R077 - House	694049	6285751	1312	WTG18	No
R078 - House	694012	6285598	1166	WTG18	No
R079 - House	692359	6288256	789	WTG13	Yes
R080 - House	695362	6289589	2197	WTG14	No
R082 - House	694183	6292036	1506	WTG04	No
R083 - House	694241	6293494	2794	WTG04	No
R084 - House	693969	6293621	2825	WTG04	No
R085 - House	690447	6291187	2179	WTG10	No
R086 - House	690308	6290617	1617	WTG10	Yes
R087 - House	689734	6290127	1335	WTG10	No
R088 - House	689502	6289460	1062	WTG10	Yes
R089 - House	693550	6289600	1146	WTG06	No
R090 - House (empty)	694219	6289645	1629	WTG04	No
R091 - House	693030	6293126	2193	WTG03	No
R092 - House	693277	6292929	2025	WTG04	No
R093 - House	692306	6293308	2395	WTG03	No
R094 - House	692314	6293160	2247	WTG03	No
R096 - House	694850	6291802	1888	WTG04	No
R097 - House	698279	6290936	5092	WTG04	No

Name	Easting	Northing	Dist. to nearest WTG (m)	Closest WTG	Wind Farmer
R098 - House	695904	6290084	2838	WTG04	No
R099 - House	694392	6289672	1723	WTG04	No
R100 - House	694772	6290052	1799	WTG04	No
R101 - House	697785	6286217	2595	WTG43	No
R102 - House	697065	6281327	1987	WTG46	No
R103 - House	696332	6279079	3434	WTG42	No
R104 - House	696683	6278525	4026	WTG37	No
R105 - House	690596	6277280	3482	WTG37	No
R106 - House	688728	6279860	2536	WTG30	No
R107 - House	687977	6285007	2592	WTG24	No
R108 - House	694704	6285394	1570	WTG18	No
R095	690018	6280556	1509	WTG31	No
R109 - Brendan Kilby	688500	6290500	2466	WTG10	No
R51B	696967	6282107	1228	WTG46	Yes
R022 - Wallaby	691254	6290797	1420	WTG05	Yes
R110 - House	690318	6277598	3452	WTG37	No
R111 - House	690304	6277759	3358	WTG37	No
R112	687709	6288967	2754	WTG10	No
R114	695751	6290438	2605	WTG04	No
R115	695087	6292048	2216	WTG04	No
R116	695091	6292246	2328	WTG04	No
R117	693441	6293890	2995	WTG04	No
R118	694196	6293386	2677	WTG04	No
R119	692045	6295040	4145	WTG03	No
R120	694438	6293383	2774	WTG04	No
R121	694640	6293698	3146	WTG04	No
R122	694220	6294171	3424	WTG04	No
R123	693138	6294634	3702	WTG03	No
R124	693533	6294569	3679	WTG04	No
R125	692443	6294799	3857	WTG03	No
R126	687625	6283504	2086	WTG29	No
R127	691799	6293599	2807	WTG03	No
R128	688104	6287804	2556	WTG12	No
R129	688852	6286757	2259	WTG12	No
R130	687105	6282971	2365	WTG29	No
R131	685837	6280004	4304	WTG29	No
R132	688837	6279448	2874	WTG30	No
R133	696510	6279699	2927	WTG42	No
R134	697944	6280180	3210	WTG46	No
R136	699920	6286420	4119	WTG46	No
R137	696604	6291909	3560	WTG04	No
R138	693623	6294311	3433	WTG04	No
R139	693835	6294380	3534	WTG04	No
R140	693913	6294091	3266	WTG04	No
R141	693957	6294212	3395	WTG04	No
R142	693165	6294750	3821	WTG03	No
R143	693788	6294889	4028	WTG04	No
R144	692299	6294767	3839	WTG03	No

Name	Easting	Northing	Dist. to nearest WTG (m)	Closest WTG	Wind Farmer
R145	691475	6294777	4027	WTG03	No
R146	691058	6294683	4091	WTG03	No
R147	697406	6286869	2719	WTG15	No
R148	698405	6288043	3760	WTG15	No
R149	698465	6288564	3954	WTG15	No
R150	698346	6288483	3816	WTG15	No
R152	696605	6291705	3509	WTG04	No
R151	698324	6288379	3764	WTG15	No
R081	693283	6295029	4112	WTG03	No
R158	690162	6291224	2237	WTG10	No
R153	692763	6294447	3494	WTG03	No
R154	692694	6294781	3828	WTG03	No
R155	692513	6295017	4070	WTG03	No
R156	689967	6294937	4853	WTG03	No
R157	689987	6295452	5274	WTG03	No

It should be noted the following residences, outside the project boundary and counted as relevant receivers, are actually owned by ‘windfarmers’ in the project:

R001

R028

R031

R035

R046

R072

R075

APPENDIX D LIST AND DETAILS OF PROPOSED WIND TURBINE GENERATORS

Proposed Wind Turbine Generators (WTGs)		
WTG No.	**Easting**	**Northing**
WTG03	692738	6290953
WTG04	693188	6290906
WTG05	692610	6290375
WTG06	692438	6289879
WTG07	692375	6289621
WTG08	691922	6289293
WTG09	691710	6288716
WTG10	690463	6289008
WTG11	690764	6288686
WTG12	690638	6288139
WTG13	693146	6288195
WTG14	693850	6287994
WTG15	694720	6287294
WTG16	693932	6287163
WTG17	692356	6286368
WTG18	693315	6284663
WTG19	693106	6284262
WTG20	693633	6283962
WTG21	691091	6283878
WTG22	691440	6283635
WTG23	691436	6283205
WTG24	690258	6283778
WTG25	690357	6283178
WTG26	690381	6282714
WTG27	689933	6282625
WTG28	689635	6282686
WTG29	689403	6282413
WTG30	689820	6282149
WTG31	690231	6282050
WTG32	692382	6282353
WTG33	692173	6281920
WTG34	692320	6281639
WTG35	692379	6281358
WTG36	692852	6280328
WTG37	692897	6279893
WTG38	694007	6282678
WTG39	695178	6283099
WTG40	695285	6282880
WTG41	695383	6282655
WTG42	695229	6282331
WTG43	696494	6283966
WTG44	696745	6283761
WTG45	696940	6283488
WTG46	697221	6283308

APPENDIX E SOUND POWER SPECTRUM OF THE GE 2.5XL WIND TURBINE GENERATOR

Wind Speed ms^{-1} (at 10m AGL)	63Hz	125 Hz	250 Hz	500 Hz	1kHz	2kHz	4kHz	8kHz	Total - dB(A)
3	75	82	88	88	87	73	76	59	93
4	78	85	91	91	90	76	79	62	96
5	81	88	94	94	93	79	82	65	99
6	84	91	97	97	96	82	85	68	102
7	87	93	99	100	98	95	87	71	105
8	87	93	99	100	98	95	87	71	105
9	87	93	99	100	98	95	87	71	105
10	87	93	99	100	98	95	87	71	105
11	87	93	99	100	98	95	87	71	105
12	87	93	99	100	98	95	87	71	105

(noise spectra in dB (flat) Overall is A-weighted total) taken from GE Commercial Documentation for WTG Systems GE 2.5xl – 50Hz & 60Hz Product Acoustic Specifications

APPENDIX F NOISE REDUCED OPERATIONS FOR GE 2.5XL WTG SPECIFICATION

Wind speed at V_{10m} [m/s]	Normal Operation $L_{WA,k}$ Apparent Sound Power Level [dB]	NRO 104	NRO 103	NRO 102	NRO 101	NRO 100
3	≤ 93	93	93	93	93	93
4	≤ 96	96	96	96	96	96
5	≤ 99	99	99	99	99	99
6	≤ 102	102	102	101.5	100.8	99.8
7	≤ 104.5	103.8	102.8	102	101	100
8	≤ 105	104	103	102	101	100
9	≤ 105	104	103	102	101	100
10	≤ 105	104	103	102	101	100
11- cut out	≤ 105	104	103	102	101	100

$L_{WA,k}$ indicates apparent sound power level per IEC 61400-11 standard measured in dB, A-weighted 10 base logarithmic value of apparent sound power level value relative to reference acoustic power level of 10^{-12} W.

Table 1: Normal operations and noise reduced operations, GE 2.5xl-100 wind turbine, GE 48.7 type blade (100 m rotor) product apparent sound power level at wind speed V_{10m}

The **nominal acoustic performances** for GE 2.5xl-100 wind turbine being specified at **95 % rated electrical power** per IEC 61400-11 shall be:

- The **Normal Operations** (NO) apparent sound power level $L_{WA,k}$ ≤ **105.0 dBA** at 95 % rated electrical power per IEC 61400-11
- The **Noise Reduced Operations H-NRO 104** apparent sound power level $L_{WA,k}$ ≤ **104.0 dBA** at 95 % rated electrical power per IEC 61400-11
- The **Noise Reduced Operations H-NRO 103** apparent sound power level $L_{WA,k}$ ≤ **103.0 dBA** at 95 % rated electrical power per IEC 61400-11
- The **Noise Reduced Operations H-NRO 102** apparent sound power level $L_{WA,k}$ ≤ **102.0 dBA** at 95 % rated electrical power per IEC 61400-11
- The **Noise Reduced Operations H-NRO 101** apparent sound power level $L_{WA,k}$ ≤ **101.0 dBA** at 95 % rated electrical power per IEC 61400-11
- The **Noise Reduced Operations H-NRO 100** apparent sound power level $L_{WA,k}$ ≤ **100.0 dBA** at 95 % rated electrical power per IEC 61400-11
- Tonal audibility $\Delta L_{a,k}$ < **4 dB** at 95 % rated electrical power per IEC 61400-11

APPENDIX G PREDICTED NOISE LEVELS USING CONCAWE METEOROLOGICAL CONDITION STANDARD (AFTER NOISE DERATING IS APPLIED

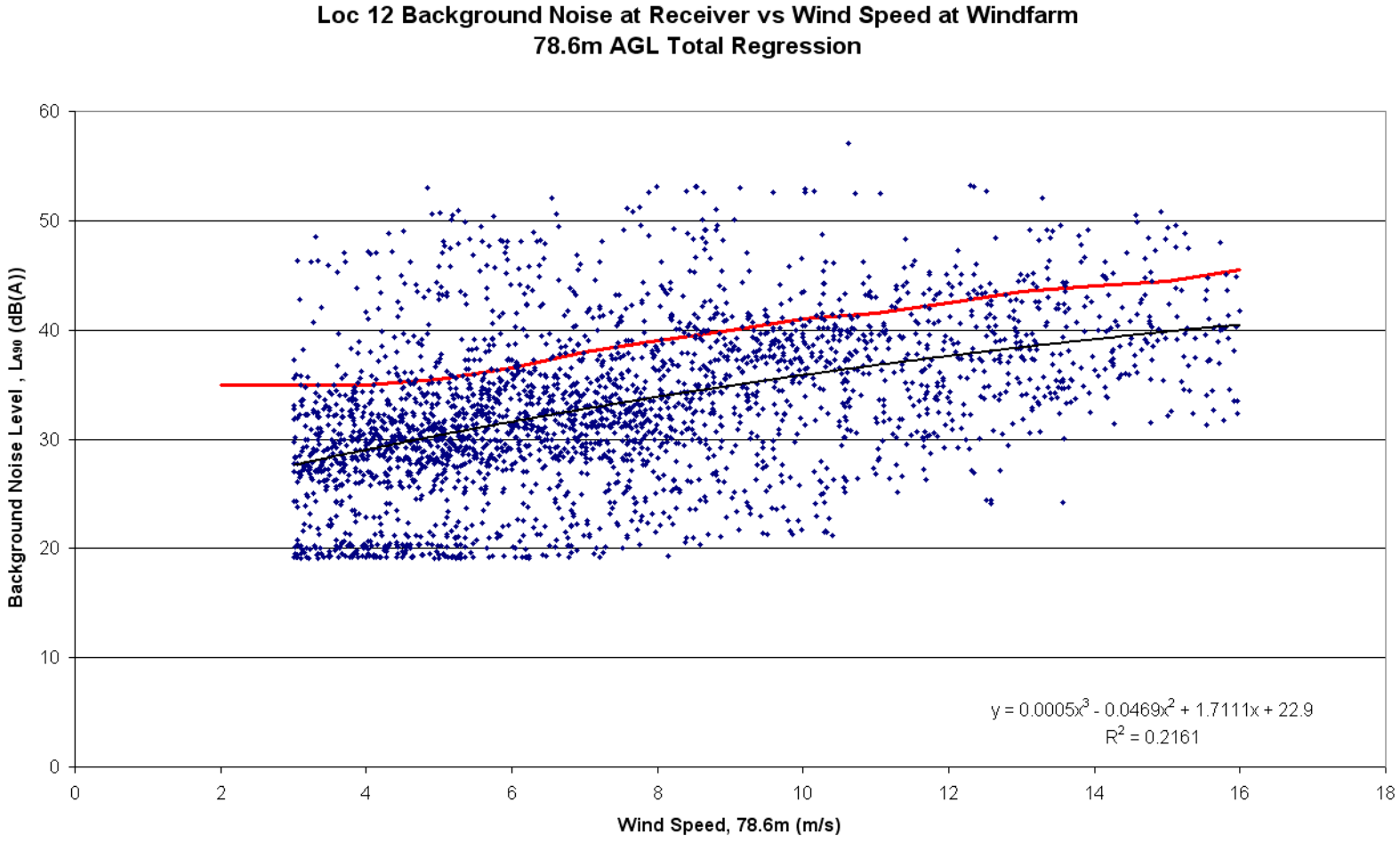
Relevant Receiver	Wind Speed ms^{-1} (at 10m AGL)									
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
Criteria set: R012 - Errowanbang										
Criteria	35.0	36.0	38.0	39.5	40.5	41.5	42.5			
R001	19.5	22.5	25.5	28.5	31.0	31.0	31.0	31.0	31.0	31.0
R005	21.5	24.5	27.5	30.5	33.0	33.0	33.0	33.0	33.0	33.0
R007	16.5	19.5	22.5	25.5	28.0	28.0	28.0	28.0	28.0	28.0
R008	17.5	20.5	23.5	26.5	29.0	29.0	29.0	29.0	29.0	29.0
R009	22.0	25.0	28.0	31.0	34.0	34.0	34.0	34.0	34.0	34.0
R010	24.5	27.5	30.5	33.5	36.5	36.5	36.5	36.5	36.5	36.5
R011	23.5	26.5	29.5	32.5	35.5	35.5	35.5	35.5	35.5	35.5
R012	22.5	25.5	28.5	31.5	34.0	34.0	34.0	34.0	34.0	34.0
R013	22.0	25.0	28.0	31.0	33.5	33.5	33.5	33.5	33.5	33.5
R015	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R016	20.0	23.0	26.0	29.0	31.5	31.5	31.5	31.5	31.5	31.5
R017	22.0	25.0	28.0	31.0	33.5	33.5	33.5	33.5	33.5	33.5
R057	24.0	27.0	30.0	33.0	35.5	35.5	35.5	35.5	35.5	35.5
R058	13.5	16.5	19.5	22.5	25.0	25.0	25.0	25.0	25.0	25.0
R073	20.0	23.0	26.0	29.0	31.5	31.5	31.5	31.5	31.5	31.5
R075	21.0	24.0	27.0	30.0	32.5	32.5	32.5	32.5	32.5	32.5
R085	22.5	25.5	28.5	31.5	34.0	34.0	34.0	34.0	34.0	34.0
R087	23.5	26.5	29.5	32.5	35.0	35.0	35.0	35.0	35.0	35.0
R095	25.5	28.5	31.5	34.5	37.5	37.5	37.5	37.5	37.5	37.5
R102	23.0	26.0	29.0	32.0	34.5	34.5	34.5	34.5	34.5	34.5
R106	20.0	23.0	26.0	29.0	31.5	31.5	31.5	31.5	31.5	31.5
R107	19.5	22.5	25.5	28.5	31.0	31.0	31.0	31.0	31.0	31.0
R109	13.5	16.5	19.5	22.5	25.0	25.0	25.0	25.0	25.0	25.0
R112	15.5	18.5	21.5	24.5	27.5	27.5	27.5	27.5	27.5	27.5
R126	21.5	24.5	27.5	30.5	33.0	33.0	33.0	33.0	33.0	33.0
R128	17.5	20.5	23.5	26.5	29.0	29.0	29.0	29.0	29.0	29.0
R129	20.0	23.0	26.0	29.0	31.5	31.5	31.5	31.5	31.5	31.5
R130	19.5	22.5	25.5	28.5	31.0	31.0	31.0	31.0	31.0	31.0
R131	9.5	12.5	15.5	18.5	21.0	21.0	21.0	21.0	21.0	21.0
R132	18.5	21.5	24.5	27.5	30.0	30.0	30.0	30.0	30.0	30.0
R158	21.5	24.5	27.5	30.5	33.0	33.0	33.0	33.0	33.0	33.0
Criteria set: R025 - Bromley										
Criteria	35.0	35.0	36.0	37.5	38.5	40.0	40.5			
R023	27.5	30.5	33.5	36.5	38.0	39.0	39.0	39.0	39.0	39.0
R025	25.5	28.5	31.5	34.5	37.0	37.0	37.0	37.0	37.0	37.0
R029	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R030	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R031	13.5	16.5	19.5	22.5	25.0	25.0	25.0	25.0	25.0	25.0

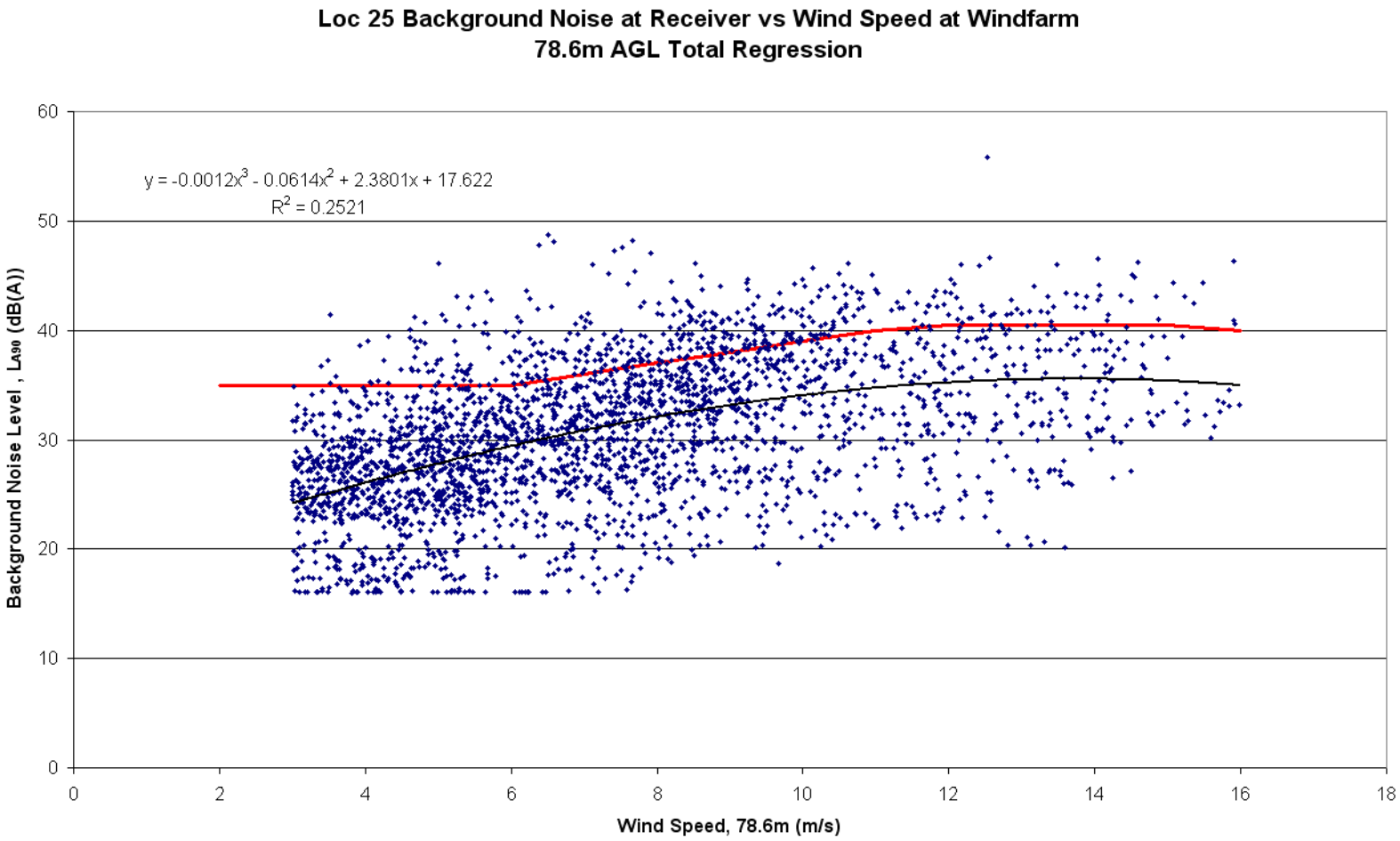
Relevant Receiver	Wind Speed ms^{-1} (at 10m AGL)									
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
R033	14.5	17.5	20.5	23.5	26.0	26.0	26.0	26.0	26.0	26.0
R034	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R041	15.0	18.0	21.0	24.0	27.0	27.0	27.0	27.0	27.0	27.0
R042	18.5	21.5	24.5	27.5	30.0	30.0	30.0	30.0	30.0	30.0
R043	23.5	26.5	29.5	32.5	35.0	35.0	35.0	35.0	35.0	35.0
R080	21.5	24.5	27.5	30.5	33.0	33.0	33.0	33.0	33.0	33.0
R082	22.5	25.5	28.5	31.5	34.0	34.0	34.0	34.0	34.0	34.0
R083	15.0	18.0	21.0	24.0	26.5	26.5	26.5	26.5	26.5	26.5
R084	15.0	18.0	21.0	24.0	26.5	26.5	26.5	26.5	26.5	26.5
R098	18.5	21.5	24.5	27.5	30.0	30.0	30.0	30.0	30.0	30.0
R114	18.0	21.0	24.0	27.0	29.5	29.5	29.5	29.5	29.5	29.5
R115	18.5	21.5	24.5	27.5	30.0	30.0	30.0	30.0	30.0	30.0
R116	17.5	20.5	23.5	26.5	29.5	29.5	29.5	29.5	29.5	29.5
R137	12.0	15.0	18.0	21.0	24.0	24.0	24.0	24.0	24.0	24.0
R152	13.0	16.0	19.0	22.0	24.5	24.5	24.5	24.5	24.5	24.5
Criteria set: R027 - Willow Creek East										
Criteria	35.0	35.0	35.0	37.0	38.5	40.0	41.0			
R020	16.5	19.5	22.5	25.5	28.0	28.0	28.0	28.0	28.0	28.0
R027	21.5	24.5	27.5	30.5	33.0	33.0	33.0	33.0	33.0	33.0
R028	22.0	25.0	28.0	31.0	33.5	33.5	33.5	33.5	33.5	33.5
R035	16.0	19.0	22.0	25.0	27.5	27.5	27.5	27.5	27.5	27.5
R036	17.5	20.5	23.5	26.5	29.0	29.0	29.0	29.0	29.0	29.0
R037	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R044	26.0	29.0	32.0	35.0	37.5	37.5	37.5	37.5	37.5	37.5
R045	20.5	23.5	26.5	29.5	32.0	32.0	32.0	32.0	32.0	32.0
R091	16.5	19.5	22.5	25.5	28.0	28.0	28.0	28.0	28.0	28.0
R092	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R093	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R094	18.5	21.5	24.5	27.5	30.0	30.0	30.0	30.0	30.0	30.0
R096	20.0	23.0	26.0	29.0	31.5	31.5	31.5	31.5	31.5	31.5
R117	14.5	17.5	20.5	23.5	26.0	26.0	26.0	26.0	26.0	26.0
R118	15.5	18.5	21.5	24.5	27.0	27.0	27.0	27.0	27.0	27.0
R119	8.5	11.5	14.5	17.5	20.0	20.0	20.0	20.0	20.0	20.0
R120	15.0	18.0	21.0	24.0	26.5	26.5	26.5	26.5	26.5	26.5
R121	13.0	16.0	19.0	22.0	25.0	25.0	25.0	25.0	25.0	25.0
R122	12.0	15.0	18.0	21.0	23.5	23.5	23.5	23.5	23.5	23.5
R123	11.0	14.0	17.0	20.0	22.5	22.5	22.5	22.5	22.5	22.5
R124	11.0	14.0	17.0	20.0	22.5	22.5	22.5	22.5	22.5	22.5
R125	10.0	13.0	16.0	19.0	21.5	21.5	21.5	21.5	21.5	21.5
R127	15.5	18.5	21.5	24.5	27.5	27.5	27.5	27.5	27.5	27.5
R138	12.5	15.5	18.5	21.5	24.0	24.0	24.0	24.0	24.0	24.0

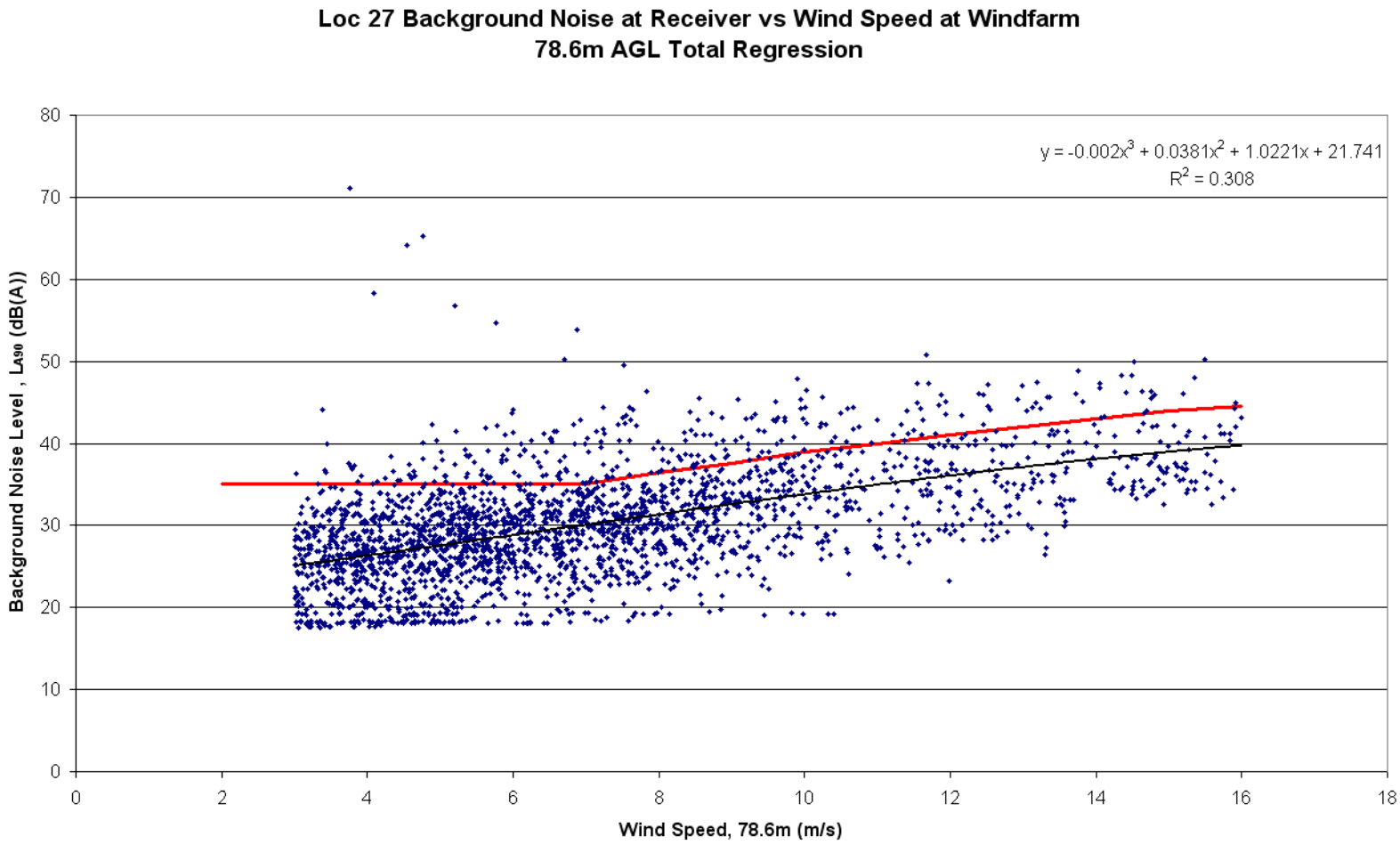
Relevant Receiver	Wind Speed ms^{-1} (at 10m AGL)									
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
R139	12.0	15.0	18.0	21.0	23.5	23.5	23.5	23.5	23.5	23.5
R140	13.0	16.0	19.0	22.0	24.5	24.5	24.5	24.5	24.5	24.5
R141	12.5	15.5	18.5	21.5	24.0	24.0	24.0	24.0	24.0	24.0
R142	10.0	13.0	16.0	19.0	21.5	21.5	21.5	21.5	21.5	21.5
R143	9.0	12.0	15.0	18.0	20.5	20.5	20.5	20.5	20.5	20.5
R144	10.0	13.0	16.0	19.0	22.0	22.0	22.0	22.0	22.0	22.0
R145	9.5	12.5	15.5	18.5	21.0	21.0	21.0	21.0	21.0	21.0
R146	9.0	12.0	15.0	18.0	21.0	21.0	21.0	21.0	21.0	21.0
R153	11.5	14.5	17.5	20.5	23.0	23.0	23.0	23.0	23.0	23.0
R154	7.5	10.5	13.5	16.5	19.0	19.0	19.0	19.0	19.0	19.0
R155	8.5	11.5	14.5	17.5	20.0	20.0	20.0	20.0	20.0	20.0
R156	1.5	4.5	7.5	10.5	13.5	13.5	13.5	13.5	13.5	13.5
Criteria set: R078 - House										
Criteria	35.0	35.0	35.0	36.5	39.0	41.5	43.5			
R046	24.0	27.0	30.0	33.0	35.5	35.5	35.5	35.5	35.5	35.5
R047	20.0	23.0	26.0	29.0	31.5	31.5	31.5	31.5	31.5	31.5
R048	25.0	28.0	31.0	34.0	36.5	36.5	36.5	36.5	36.5	36.5
R072	24.0	27.0	30.0	33.0	35.5	35.5	35.5	35.5	35.5	35.5
R077	27.5	30.5	33.5	36.0	38.5	39.0	39.0	39.0	39.0	39.0
R078	27.5	30.5	33.5	35.5	38.0	39.0	39.0	39.0	39.0	39.0
R090	26.0	29.0	32.0	35.0	38.0	38.0	38.0	38.0	38.0	38.0
R099	25.5	28.5	31.5	34.5	37.0	37.0	37.0	37.0	37.0	37.0
R100	22.0	25.0	28.0	31.0	34.0	34.0	34.0	34.0	34.0	34.0
R101	18.5	21.5	24.5	27.5	30.0	30.0	30.0	30.0	30.0	30.0
R108	26.0	29.0	32.0	35.0	37.5	37.5	37.5	37.5	37.5	37.5
R110	13.0	16.0	19.0	22.0	25.0	25.0	25.0	25.0	25.0	25.0
R111	13.5	16.5	19.5	22.5	25.0	25.0	25.0	25.0	25.0	25.0
R133	17.5	20.5	23.5	26.5	29.0	29.0	29.0	29.0	29.0	29.0
R134	15.5	18.5	21.5	24.5	27.5	27.5	27.5	27.5	27.5	27.5
R136	10.5	13.5	16.5	19.5	22.0	22.0	22.0	22.0	22.0	22.0
R147	17.0	20.0	23.0	26.0	28.5	28.5	28.5	28.5	28.5	28.5
R148	11.5	14.5	17.5	20.5	23.0	23.0	23.0	23.0	23.0	23.0
R149	4.0	7.0	10.0	13.0	15.5	15.5	15.5	15.5	15.5	15.5
R150	9.5	12.5	15.5	18.5	21.0	21.0	21.0	21.0	21.0	21.0
R151	10.5	13.5	16.5	19.5	22.0	22.0	22.0	22.0	22.0	22.0
Criteria set: R089 - House										
Criteria	40.5	42.5	44.0	45.5	47.0	48.5	50.0			
R089	29.5	32.5	35.5	38.5	41.0	41.0	41.0	41.0	41.0	41.0

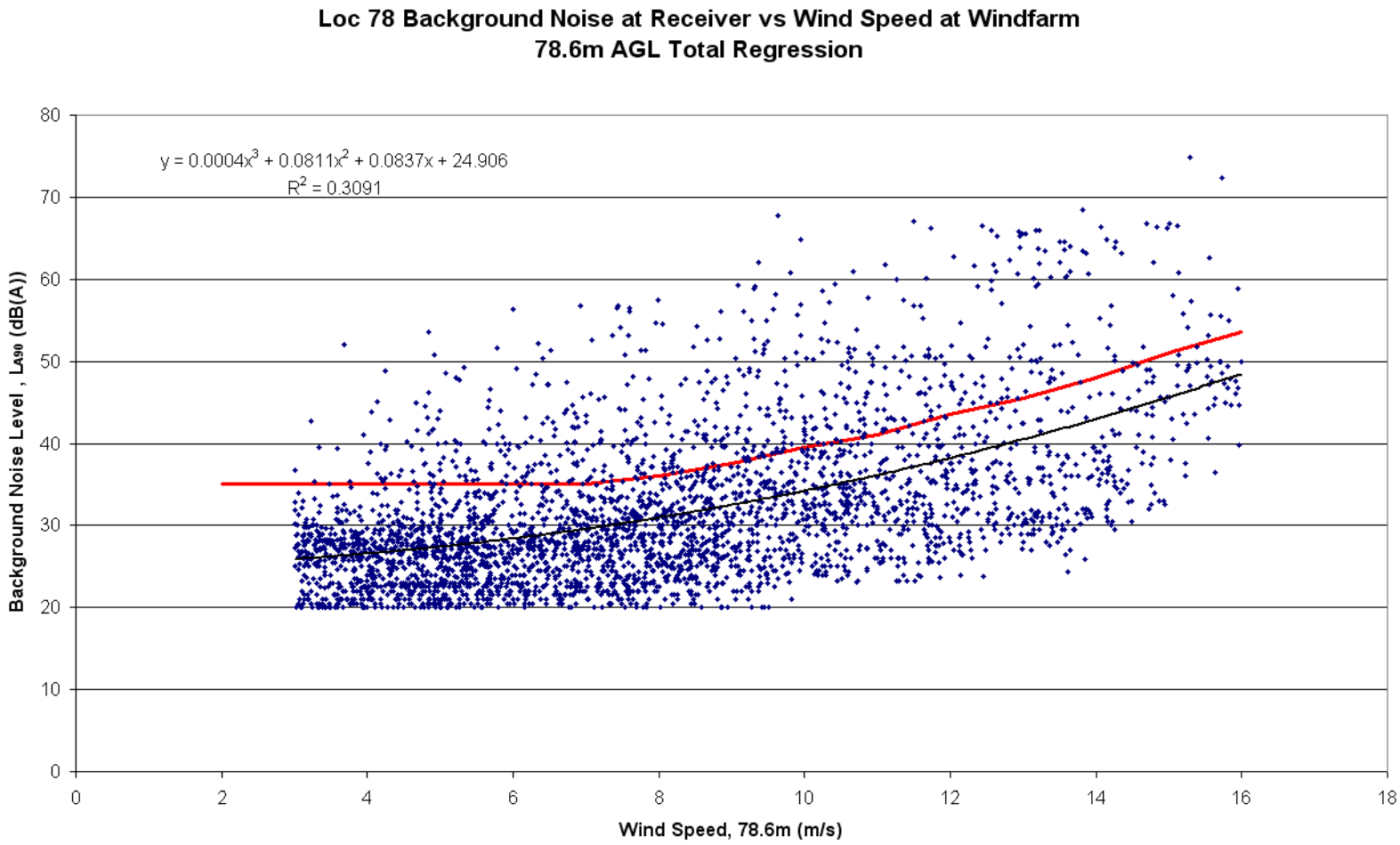
Non Relevant Receiver	Wind Speed ms^{-1} (at 10m AGL)									
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
Criteria	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
R002	26.5	29.5	32.5	35.5	38.0	38.0	38.0	38.0	38.0	38.0
R003	32.5	35.5	38.5	41.5	44.0	44.0	44.0	44.0	44.0	44.0
R004	30.5	33.5	36.5	39.5	42.5	42.5	42.5	42.5	42.5	42.5
R014	30.5	33.5	36.5	39.5	42.0	42.0	42.0	42.0	42.0	42.0
R021	29.5	32.5	35.5	38.5	41.0	41.0	41.0	41.0	41.0	41.0
R022	29.0	32.0	35.0	38.0	40.5	40.5	40.5	40.5	40.5	40.5
R024	26.5	29.5	32.5	35.5	38.0	38.0	38.0	38.0	38.0	38.0
R026	24.5	27.5	30.5	33.5	36.0	36.0	36.0	36.0	36.0	36.0
R049	29.0	32.0	35.0	38.0	40.5	40.5	40.5	40.5	40.5	40.5
R050	31.5	34.5	37.5	40.5	43.5	43.5	43.5	43.5	43.5	43.5
R051	29.0	32.0	35.0	38.0	41.0	41.0	41.0	41.0	41.0	41.0
R052	29.5	32.5	35.5	38.5	41.5	41.5	41.5	41.5	41.5	41.5
R054	32.0	35.0	38.0	41.0	43.5	43.5	43.5	43.5	43.5	43.5
R055	27.5	30.5	33.5	36.5	39.0	39.0	39.0	39.0	39.0	39.0
R056	30.0	33.0	36.0	39.0	42.0	42.0	42.0	42.0	42.0	42.0
R071	30.0	33.0	36.0	39.0	42.0	42.0	42.0	42.0	42.0	42.0
R074	27.5	30.5	33.5	36.5	39.0	39.0	39.0	39.0	39.0	39.0
R076	30.0	33.0	36.0	39.0	41.5	41.5	41.5	41.5	41.5	41.5
R079	33.0	36.0	39.0	42.0	44.5	44.5	44.5	44.5	44.5	44.5
R086	26.0	29.0	32.0	35.0	37.5	37.5	37.5	37.5	37.5	37.5
R088	28.0	31.0	34.0	37.0	39.5	39.5	39.5	39.5	39.5	39.5
R51B	29.0	32.0	35.0	38.0	41.0	41.0	41.0	41.0	41.0	41.0

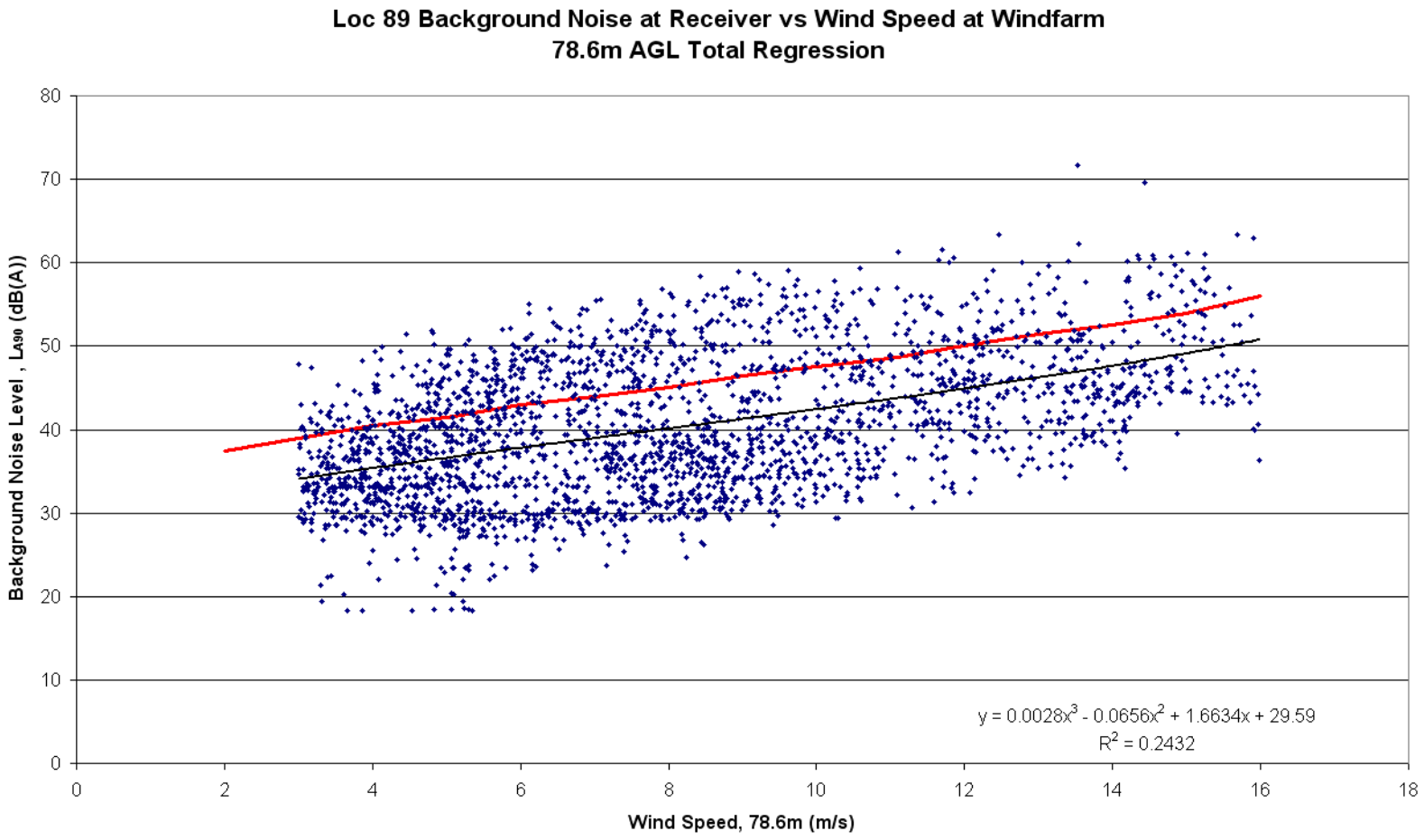
APPENDIX H BACKGROUND NOISE MONITORING MEASUREMENTS


Loc 12 Background Noise at Receiver vs Wind Speed at Windfarm
78.6m AGL Total Regression
Background Noise Level , La90 (dB(A))
Wind Speed, 78.6m (m/s)
y = 0.0005x3 - 0.0469x2 + 1.7111x + 22.9
R2 = 0.2161
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14
16
18

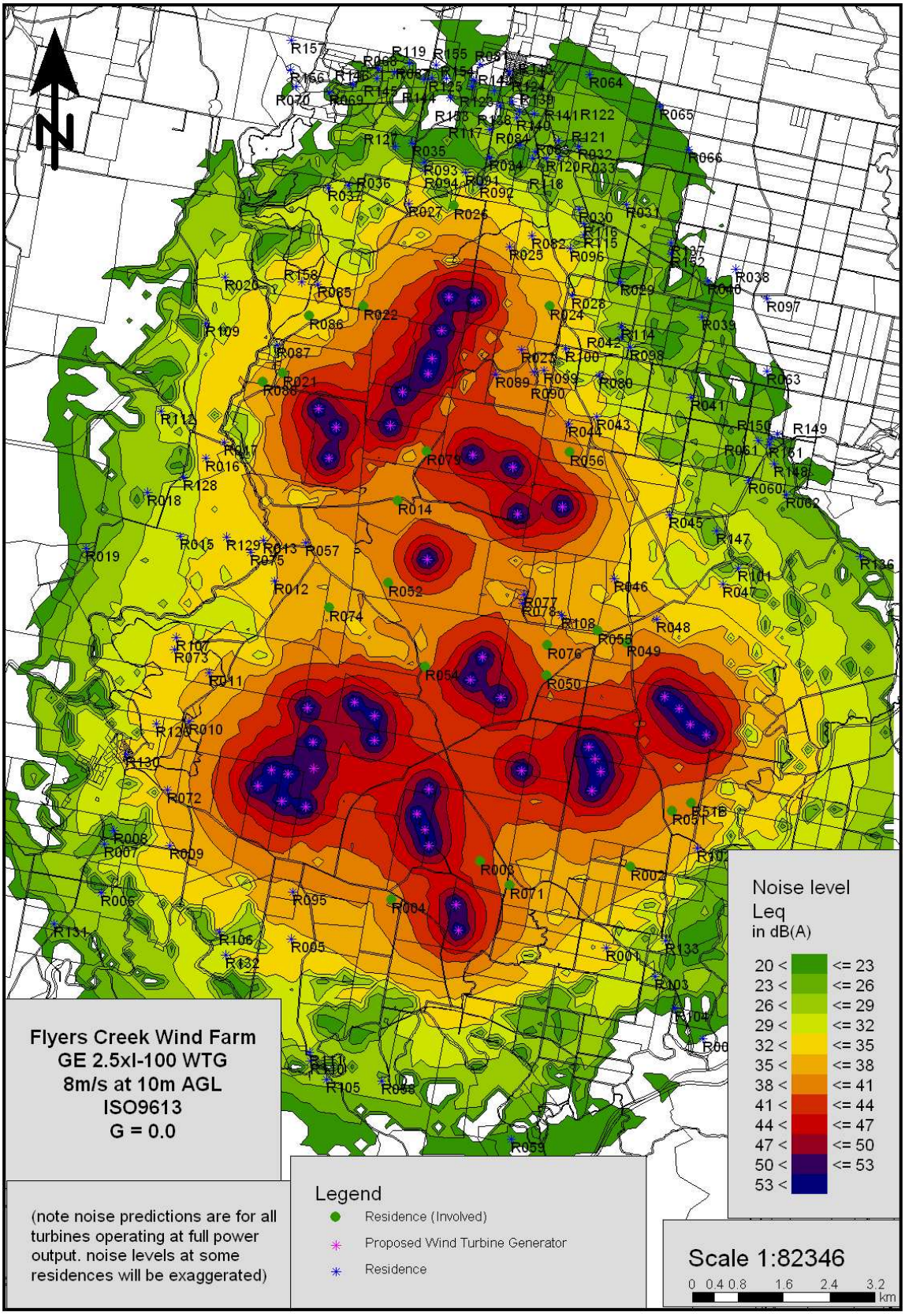

Loc 25 Background Noise at Receiver vs Wind Speed at Windfarm
78.6m AGL Total Regression
y = -0.0012x3 - 0.0614x2 + 2.3801x + 17.622
R2 = 0.2521
Background Noise Level , LA90 (dB(A))
Wind Speed, 78.6m (m/s)
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14
16
18

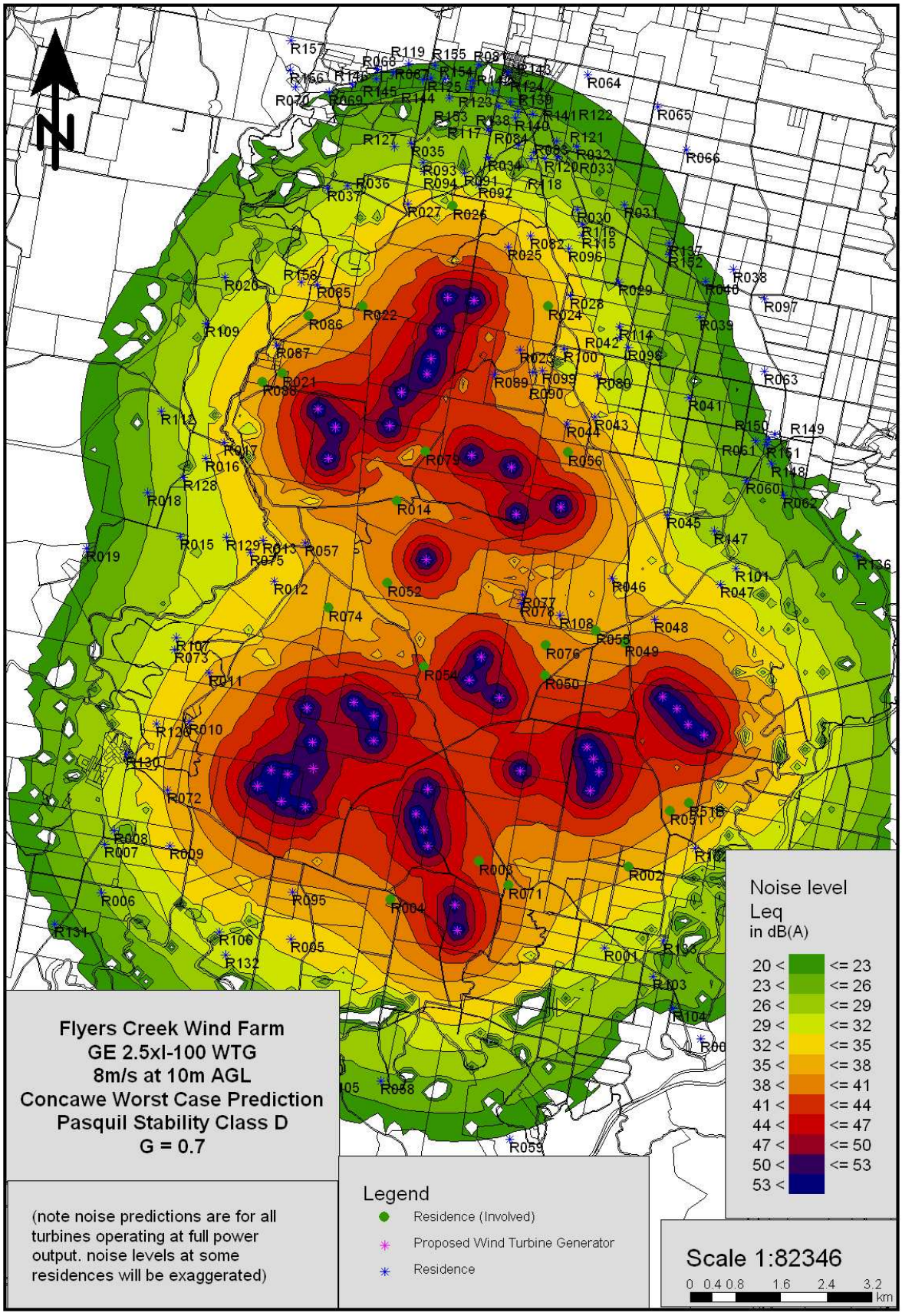

Loc 27 Background Noise at Receiver vs Wind Speed at Windfarm
78.6m AGL Total Regression
y = -0.002x3 + 0.0381x2 + 1.0221x + 21.741
R2 = 0.308
Background Noise Level , LA90 (dB(A))
Wind Speed, 78.6m (m/s)
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14
16
18


Loc 78 Background Noise at Receiver vs Wind Speed at Windfarm
78.6m AGL Total Regression
y = 0.0004x3 + 0.0811x2 + 0.0837x + 24.906
R2 = 0.3091
Background Noise Level , LA90 (dB(A))
Wind Speed, 78.6m (m/s)
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14
16
18


Loc 89 Background Noise at Receiver vs Wind Speed at Windfarm
78.6m AGL Total Regression
Background Noise Level , LA90 (dB(A))
Wind Speed, 78.6m (m/s)
y = 0.0028x3 - 0.0656x2 + 1.6634x + 29.59
R2 = 0.2432
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14
16
18

APPENDIX I COLOUR NOISE CONTOUR PLOTS FOR THE MAXIMUM POWER SETTING FOR ISO9613 AND CONCAWE $8MS^{-1}$ (10 10M AGL) WIND PROPAGATION SCENARIOS FOR PROVIDED WTG LAYOUT


N
Flyers Creek Wind Farm
GE 2.5xl-100 WTG
8m/s at 10m AGL
ISO9613
G = 0.0
(note noise predictions are for all turbines operating at full power output. noise levels at some residences will be exaggerated)
Legend
Residence (Involved)
Proposed Wind Turbine Generator
Residence
Noise level
Leq
in dB(A)
20 < <= 23
23 < <= 26
26 < <= 29
29 < <= 32
32 < <= 35
35 < <= 38
38 < <= 41
41 < <= 44
44 < <= 47
47 < <= 50
50 < <= 53
53 <
Scale 1:82346
0 0.4 0.8 1.6 2.4 3.2
km


Flyers Creek Wind Farm
GE 2.5xl-100 WTG
8m/s at 10m AGL
Concawe Worst Case Prediction
Pasquil Stability Class D
G = 0.7
(note noise predictions are for all turbines operating at full power output. noise levels at some residences will be exaggerated)
Legend
Residence (Involved)
Proposed Wind Turbine Generator
Residence
Noise level
Leq
in dB(A)
20 < <= 23
23 < <= 26
26 < <= 29
29 < <= 32
32 < <= 35
35 < <= 38
38 < <= 41
41 < <= 44
44 < <= 47
47 < <= 50
50 < <= 53
53 <
Scale 1:82346
0 0.4 0.8 1.6 2.4 3.2
km