PALING YARDS WIND FARM

Noise Impact Assessment

Prepared for:

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Level 8, 80 Mount Street
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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Tract Consultants (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
640.30153-R01-v1.3	4 August 2023	Gustaf Reutersward	Jim Antonopoulos	Gustaf Reutersward
640.30153-R01-v1.2	1 December 2022	Gustaf Reutersward	Jim Antonopoulos	Gustaf Reutersward
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EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR Consulting) has completed a noise impact assessment of the proposed Palings Yard Wind Farm. The methodology and criteria used in the assessment are supported by the South Australia Environmental Protection Authority (SA EPA) *Environment Noise Guidelines for Wind Farms* (2003), World Health Organisation (WHO) limits and *Interim Construction Noise Guideline* (ICNG), NSW *Noise Policy for Industry* (NPfI) and the NSW *Road Noise Policy* (RNP).

The Project is located approximately 60 km north of Goulburn and 35 km north-east of Crookwell, in NSW, and is to be located on the landholdings known as 'Mingary Park', 'Middle Station', 'Hilltop' and 'Paling Yards' which comprise a total of approximately 4,600 hectares. The Project also contains a transmission line corridor located across nine parcels of land to the north-east of the site. The site is situated in the Central Tablelands of NSW.

The Project proposes a wind farm with a total capacity of approximately 287 MW and 47 wind turbine generators (WTGs) each with a total height of up to 240 m (blade tip height).

The base layout presented in this report is a 47 WTG layout and considers a General Electric – Cypress 158 – 6.1 MW model. This model WTG, like most modern turbines, is able to be operated in a multiple of reduced noise modes, whereby through an adaptive management measure the turbines normal operation can be altered by increasing its pitch angle and reducing the speed of rotation of the blades and lowering its noise emission.

The predicted noise levels of the base layout where all WTG's operated at their full noise emission level (107 dBA Sound Power Level) indicates that:

- Non-involved receptors 3 and 4 marginally exceed the minimum SA EPA Guideline criteria of 35 dBA.
- Project-involved receptors 6A, 7, 7A, 8, 8A, 9, 9A and 9B, exceed the WHO criteria of 45 dBA.

An iterative predictive noise optimisation procedure was undertaken in which up to 16 WTG's, closest to those receptors where exceedances were predicted, were placed into a reduced Noise Management Mode (NMM 104 and NMM 101). The Mitigated Layout was shown to meet the relevant criteria at all receptors. It is expected that a more nuanced mitigated operations plan will be developed during detailed design that considers specific conditions.

Noise predictions for the transformer substation location options indicate that the minimum night-time NSW NPfI limit will be met at all receptors.

No significant noise impacts are anticipated for amenity and/or passive recreational uses within the Abercrombie National Park based on a comparison of the predicted noise levels against appropriate noise guideline levels from the *NPfI*.

Construction noise has been predicted for a number of key activities to all nearby receptors; a number of these are deemed 'noise affected' under the NSW ICNG. In order to ensure all appropriate measures are being taken to manage construction noise, a more detailed construction management plan should be developed by the proponent. This document will provide detailed guidance on various noise mitigation strategies for the construction stage.

Vibration impacts from key construction activities have been assessed and the 'worst case' scenarios modelled were found to be acceptable.

EXECUTIVE SUMMARY

Construction traffic noise impact has been assessed and the 'worst case' maximum construction traffic scenario would comply to the NSW RNP requirements, due to the typically large setback of dwellings from the road network. Night-time deliveries are unlikely to cause sleep disturbance based on predicted maximum noise levels.

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR Consulting), has been engaged by Tract Consultants Pty Ltd (Tract) on behalf of Global Power Generation Australia (GPG) as the acoustical consultants for the proposed Paling Yards Wind Farm.

This report describes the methodology and findings of the Noise Impact Assessment (NIA) for the proposed Paling Yards Wind Farm forming part of the Environmental Impact Assessment for the proposed project.

Detailed in this report are the main aspects of the proposed wind farm project, the acoustic criteria, the background noise measurements and the predicted noise levels at all potentially impacted receptors from the operation of the proposed wind farm. It also addresses the acoustic impact of the wind farm during the construction phase, including blasting and transportation noise.

1.1 Wind Farm Assessment Methodology

1.1.1 Acceptability Limit Criteria

The methodology and acceptability limit criteria that have been applied to this study are based upon

- NSW Planning and Environment's *Wind Energy: Noise Assessment Bulletin for State Significant Wind Energy Development* - 2016 (NSW Bulletin), and
- South Australian EPA *Wind farms – environmental noise guidelines* – 2009 (SA Guideline)

The principal acceptability limit criteria is that the wind farm $L_{eq,(10\ min)}$ noise should not exceed the greater of an amenity limit of 35 dBA or the pre-existing background noise, $L_{90,(10\ min)}$ by more than 5 dBA (for any given wind speed).

The project requirements and wind farm acceptability limit criteria are discussed in more detail in **Section 3.2**.

1.1.2 Wind Farm Noise Level Prediction

The noise emission model used in this study to predict wind farm noise levels at sensitive receptors is based on ISO 9613-2:1996 as implemented in the SoundPLAN computer noise model. The model predicts noise levels through spherical spreading and includes the effect of air absorption (as per ISO 9613), ground attenuation and shielding, with adaptions in accordance with the Institute of Acoustics *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise - 2013* (IOA Guide).

Predicted L_{Aeq} noise levels were calculated based upon sound power levels determined in accordance with the recognised standard IEC-61400-11:2002 *(Wind Turbine Generator Systems - Part 11: Acoustic Noise Measurement Techniques)*, where available, for the wind range 4 to 15 m/s.

The noise character of Wind Turbine Generator (WTG) noise emissions is also assessed for any special audible characteristics, such as tonality or low frequency content, which would be deemed more annoying or offensive. If sufficient characteristics such as tonality are identified then the predicted noise level would be penalised by the addition of 5 dBA. It should be noted that the characteristic noise level modulation of WTGs, commonly referred to as 'swish', is considered to be a fundamental part of wind farm noise and is taken into account by the SA EPA Guideline assessment procedure.

1.1.3 Ambient Noise Monitoring

In order to establish the intrusive noise limit, background noise monitoring is required to establish the pre-existing ambient noise environment as a function of wind speed. As wind speed increases the ambient noise level at most receptors generally also increases as natural sources such as wind in trees begin to dominate. The variation of background noise with wind speed is usually quite site specific and related to various physical characteristics such as topographic shielding and the extent and height of exposed vegetation.

Noise monitoring is completed for a period of approximately 2 weeks and correlated to synchronous wind speed and direction data measured at the wind farm monitoring mast. The captured data is screened for validity, with data monitored during periods of rain or where the average wind speed at the microphone position likely exceeded 20 m/s (hub height) being discarded from the data set. Other data that was obviously affected by external noise sources (eg pond pumps, grass mowing, birds at dawn, frogs etc) was also removed from the data set. A regression analysis of all valid data is used to determine a line of 'best fit' from which the noise limit is established.

1.1.4 Assessment Procedure

In general, the assessment procedure contains the following steps:

1 Predict and plot the L_{Aeq} 35 dBA noise level contour from the wind farm under reference conditions. Receptors outside the contour are considered to be within acceptable wind farm noise levels.

2 Establish the pre-existing background noise level at each of the relevant assessment receptors within the L_{Aeq} 35 dBA noise level contour through background noise monitoring.

3 Predict wind farm noise levels at all relevant assessment receptors for the wind range from cut-in of the WTG to approximately 15 m/s (at hub height).

4 Assess the acceptability of wind farm noise at each relevant assessment receiver to the established limits.

In addition, where the assessment of a receptor has predicted unacceptable wind farm noise levels, a process of noise mitigation and alternative wind farm layouts is considered and Steps 3 and 4 are repeated until an acceptable arrangement is developed.

A brief explanation and description of the acoustic terminology used in this report is included in **Appendix D.**

2 Project Description

The Project is located approximately 60 km north of Goulburn and 35 km north-east of Crookwell, in NSW. To the west lies the Abercrombie River National Park and to the east is Mount Werong State Forest.

The Project is to be located on the landholdings known as 'Mingary Park', 'Middle Station', 'Hilltop' and 'Paling Yards' which comprise a total of approximately 4,600 hectares. The Project also contains a transmission line corridor located across nine parcels of land to the north-east of the site. The site is situated in the Central Tablelands of NSW.

A State Significant Development (SSD) application will be made for the Project to the NSW Department of Planning and Environment (DPE).

The Project proposes a wind farm with a total capacity of approximately 287 MW and will have a total operational life of 30 years. At this stage, the construction of the Project is planned for commencement in early 2023 with a timeframe of 22 months.

The wind farm will include the following elements:

- Approximately 47 wind turbines with a total height of 240 m (blade tip height);
- Three wind monitoring masts, fitted with various instruments such as anemometers, wind vanes, temperature gauges and other electrical equipment;
- Obstacle lighting to selected turbines (if required);
- Wind farm substation and approximately 9.0 km of overhead powerline of up to 500 kV;
- Removal of native vegetation and additional vegetation planting to provide screening (as required);
- Upgrade to existing local road infrastructure and internal unsealed tracks;
- Temporary batching plant to supply concrete.

2.1 Characteristics of the Site

The proposed project site incorporates four landowners. A noise assessment has been carried out for all dwellings within 10 kilometres of a turbine under SA EPA Guidelines.

For project involved receptor locations who have agreements with GPG, a noise assessment has been carried out under WHO Guidelines to ensure there is no unreasonable impact on amenity.

Topographically, the proposed site runs along a plateau, bisected by Goulburn Oberon Rd. This plateau is approximately 800 m to 1000 m above sea level. The surrounding district is primarily used for agricultural (grazing) purposes with areas surrounding project site covered in native vegetation.

The Abercrombie River is to the south of the project site and plateaus in a steep gully. The Abercrombie National Park broadly adjoins the proposed wind farm to the west and south. The National Park includes two campground areas, a network of 4WD tracks, and no marked hiking trails.

Prevailing winds are easterlies and westerlies. The district receives approximately 700 mm – 800 mm of rainfall annually

All receptors surrounding the proposed Wind Farm site have an ambient background noise environment that is determined by pre-dominantly natural sources which are largely wind influenced.

2.2 Receptor Locations

Receptors are situated on either side of Goulburn-Oberon Rd (Also known as Abercrombie Rd) and are predominantly to the south-west, south, as well as a cluster on a plateau to the east of the wind turbines.
The assessment locations include all dwellings located within 10 km of a proposed WTG. **Table 1** lists all the receptors, the distance from the nearest proposed WTG and their project involved status.

Figure 1 shows the nearby receptor dwellings assessed for the project and indicative turbine positions are shown in pink.

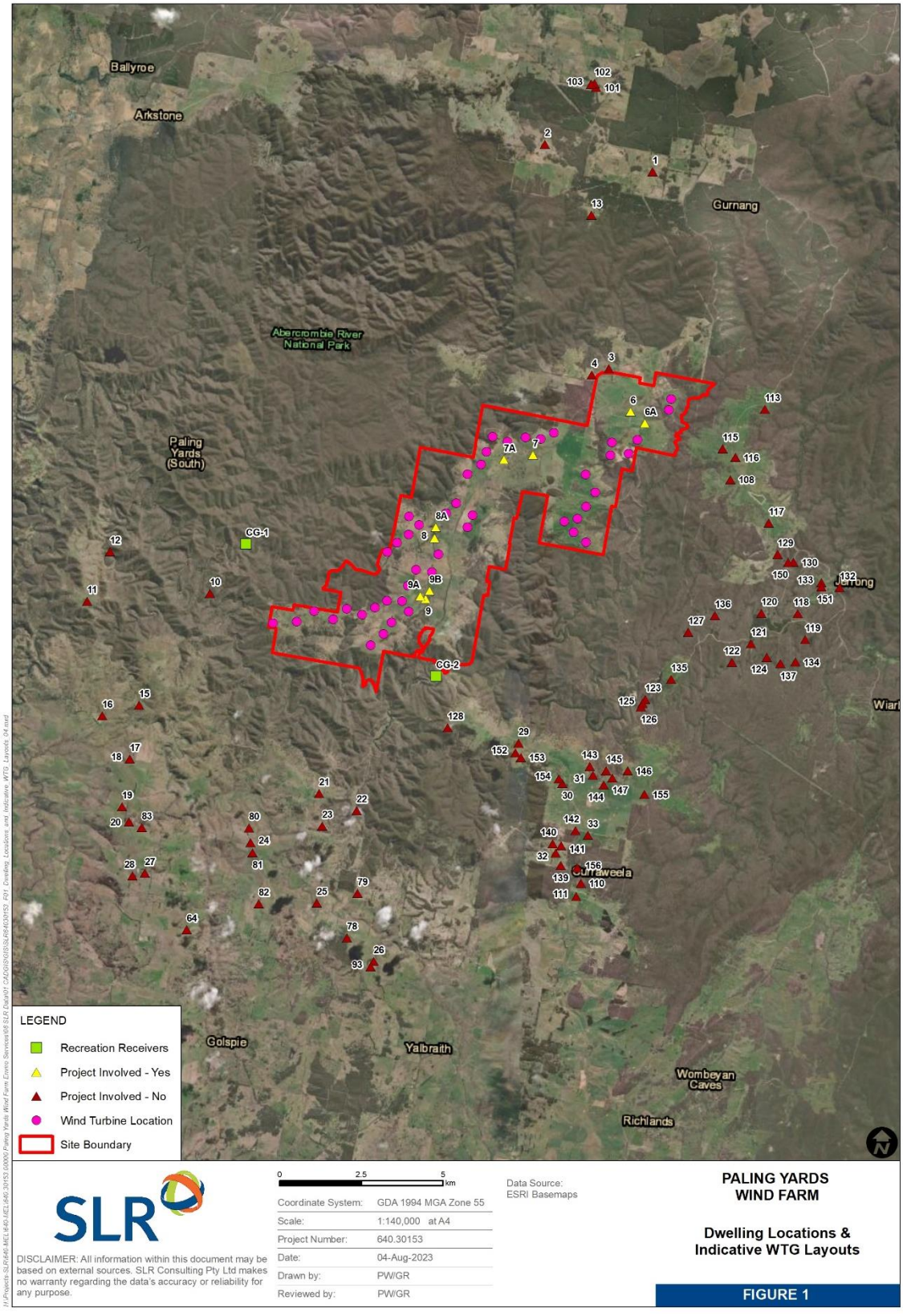
Table 1 Receptor locations

Receptor ID	UTM X	UTM Y	Distance to nearest WTG, km	Project involved?
1	759405	6228581	7.0	no
3	756117	6229424	8.7	no
4	758075	6222553	2.1	no
6	758737	6221235	0.9	yes
6A	759167	6220887	0.6	yes
7	755747	6219917	0.5	yes
7A	754860	6219774	0.6	yes
8	752734	6217366	0.5	yes
8A	752774	6217698	0.5	yes
9	752472	6215504	0.7	yes
9A	752296	6215591	0.5	yes
9B	752585	6215759	0.6	yes
10	745867	6215676	2.1	no
11	742110	6215435	5.7	no
12	742810	6216952	5.5	no
13	757536	6227258	6.2	no
15	743699	6212243	4.8	no
16	742579	6211925	5.9	no
17	743419	6210597	6.0	no
18	743419	6210597	6.0	no
19	743178	6209144	7.3	no
20	743387	6208682	7.5	no
21	749214	6209545	4.8	no
22	750359	6209023	5.1	no

Receptor ID	UTM X	UTM Y	Distance to nearest WTG, km	Project involved?
23	749303	6208555	5.7	no
24	747108	6208037	6.8	no
25	749139	6206191	8.1	no
26	750876	6204401	9.7	no
27	743874	6207106	8.6	no
28	743497	6207027	8.9	no
29	755306	6211087	5.2	no
30	756650	6209854	7.1	no
31	757587	6210098	7.1	no
32	756449	6207725	8.5	no
33	757432	6208264	8.8	no
64	745157	6205377	9.7	no
78	750061	6205127	9.0	no
79	750378	6206494	7.6	no
80	747059	6208491	6.3	no
81	747173	6207737	7.1	no
82	747358	6206173	8.6	no
83	743789	6208501	7.4	no
93	750789	6204233	9.9	no
101	757683	6231167	9.8	no
102	757632	6231283	10.0	no
103	757525	6231265	10.0	no
108	761796	6219158	2.8	no
110	757217	6206799	9.7	no
111	757070	6206397	9.9	no
113	762845	6221306	2.9	no
115	761552	6220096	2.0	no
116	761945	6219840	2.5	no
117	762965	6217831	4.6	no
118	763846	6215051	6.8	no
119	764076	6214260	7.3	no
120	762741	6215066	5.8	no
121	762417	6214136	5.9	no
122	761840	6213562	5.8	no
123	759186	6212424	5.1	no
124	762904	6213720	6.6	no
125	759102	6212302	5.2	no
126	759054	6212194	5.3	no

Receptor ID	UTM X	UTM Y	Distance to nearest WTG, km	Project involved?
127	760498	6214491	4.2	no
128	753141	6211562	3.4	no
129	763234	6216864	5.5	no
130	763718	6216627	6.0	no
131	768841	6225269	9.6	no
132	765129	6215849	7.5	no
133	764575	6216002	7.1	no
134	763784	6213570	7.4	no
135	759978	6213043	4.9	no
136	761312	6214998	4.5	no
137	763323	6213521	7.0	no
139	756604	6207337	8.9	no
140	756351	6208005	8.2	no
141	756619	6207950	8.5	no
142	757054	6208406	8.4	no
143	757492	6210376	6.9	no
144	757918	6209812	7.4	no
145	757987	6210251	7.0	no
146	758646	6210245	7.1	no
147	758178	6210022	7.3	no
150	763557	6216624	5.9	no
151	764574	6215874	7.1	no
152	755215	6210789	5.4	no
153	755381	6210652	5.6	no
154	756546	6209997	6.9	no
155	759163	6209521	7.9	no
156	757098	6207268	9.3	no
CG-1	746968	6217193	2.5	-
CG-2	752783	6213101	2.1	-

Figure 1 Dwelling Locations and Indicative WTG Layout



2.3 Proposed WTG model

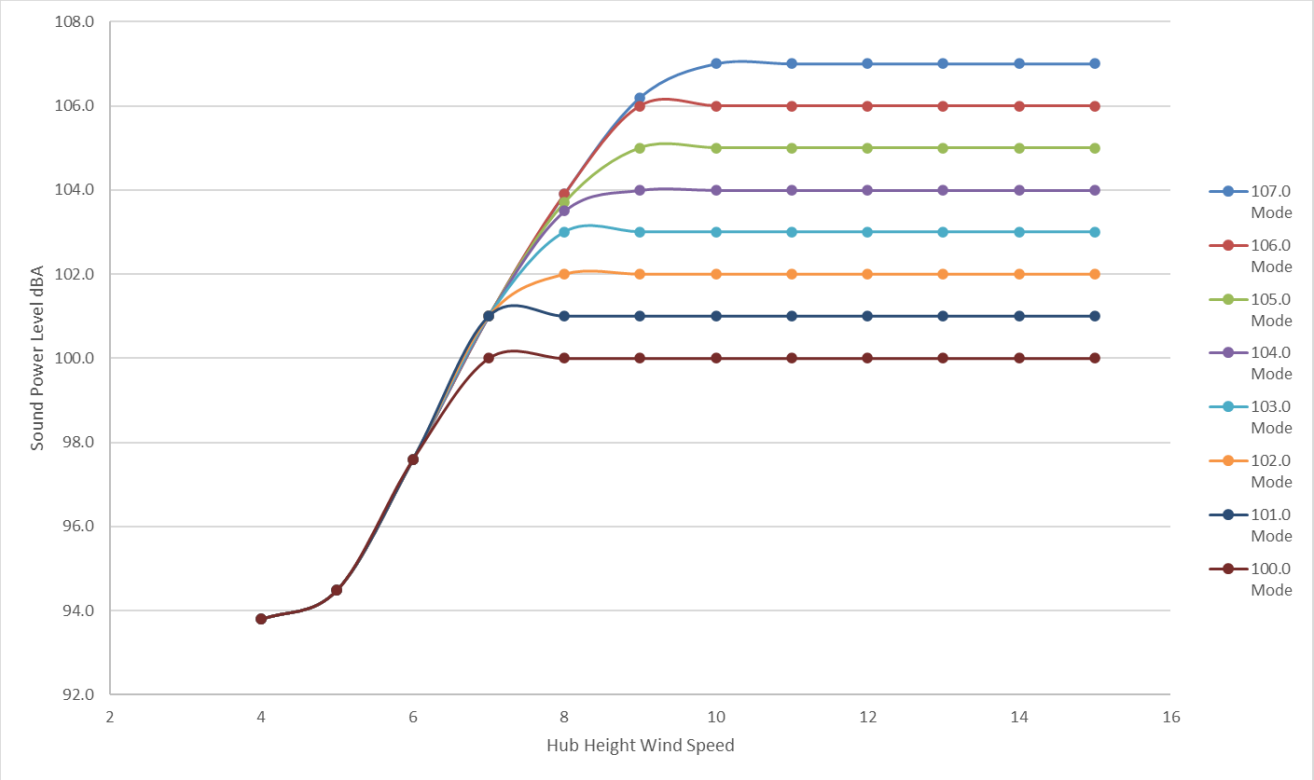
The WTG manufacturer and model has not yet been finalised, and accordingly it is necessary to evaluate the wind farm based on a typical turbine model that may comprise a layout. The base layout presented in this report is a 47 WTG layout, the considered WTG model is the General Electric – Cypress 158 – 6.1MW.

This model WTG, like most modern turbines, is able to be operated in a multiple of reduced noise modes, whereby through an adaptive management measure the turbines normal operation can be altered by increasing its pitch angle and reducing the speed of rotation of the blades. Noise emissions for the proposed WTG have been provided by the manufacturer, with the standard operational mode maximum sound power level of 107 dBA and other noise reduced operation modes shown in **Figure 2**. Detailed noise test results for the GE 158 WTG in accordance with IEC61400-11 are not currently available, however, it has been assumed that the turbine will have no penalizable tonal characteristics. Confirmation of the tested tonal audibility data $\Delta L_{A,k}$ values should be provided by the manufacturer prior to construction. **Table 2** summarises the relevant turbine input data used for noise level prediction.

Table 2 WTG details

WTG Parameter	
Make, model	General Electric, Cypress 158
Rated power	6.1 MW
Rotor diameter	158 m
Hub height	151 m
Cut-in wind speed	3 m/s
'Standard Mode' Sound Power Level, $L_{WA\ Vref\ 10\ m/s\ HH}$	107 dBA

Figure 2 WTG Sound Power Level



2.4 Proposed Wind Farm Layout

A tabulated listing of WTG coordinates for the layout is included in **Table 3.** Should an alternative selection or turbine type or layout be finalised then a revised noise impact assessment prediction will be completed.

Table 3 Proposed Wind Farm Layout

Turbine Number	Easting UTM-X	Northing UTM-Y
PY-1	750790.7	6214083.1
PY-2	751180.8	6214432.9
PY-3	751425.0	6214787.1
PY-4	751941.7	6215114.6
PY-5	747801.1	6214761.2
PY-6	748519.7	6214803.3
PY-7	749054.8	6215129.1
PY-8	749637.9	6214879.5
PY-9	750046.0	6215202.9
PY-10	750521.2	6215025.3
PY-11	750915.0	6215238.1
PY-12	751277.3	6215444.2
PY-13	751742.9	6215430.5

Turbine Number	Easting UTM-X	Northing UTM-Y
PY-25	753741.3	6217698.6
PY-26	753904.4	6218068.6
PY-27	753741.4	6219320.4
PY-28	754161.6	6219611.9
PY-29	754331.1	6220009.3
PY-30	754518.2	6220469.6
PY-31	754969.8	6220320.2
PY-32	755526.9	6220445.7
PY-33	755987.8	6220402.6
PY-34	756386.4	6220593.1
PY-35	757375.3	6217236.9
PY-36	756991.8	6217538.1
PY-37	756710.9	6217869.8

Turbine Number	Easting UTM-X	Northing UTM-Y
PY-14	751924.4	6215913.3
PY-15	752167.2	6216398.8
PY-16	752654.5	6216324.8
PY-17	752852.1	6216862.8
PY-18	751295.5	6216935.1
PY-19	751591.8	6217222.5
PY-20	751942.3	6217474.1
PY-21	751952.9	6218024.6
PY-22	752263.9	6217765.2
PY-23	753090.5	6218123.5
PY-24	753402.1	6218432.0

Turbine Number	Easting UTM-X	Northing UTM-Y
PY-38	757116.8	6217956.8
PY-39	757375.8	6218320.9
PY-40	757655.8	6218768.4
PY-41	757359.7	6219304.8
PY-42	758118.0	6219898.1
PY-43	758168.3	6220296.9
PY-44	758672.1	6219951.1
PY-45	758947.7	6220373.9
PY-46	759907.2	6221289.5
PY-47	759979.2	6221613.6

3 Legislation & Guidelines

3.1 SEARS

The New South Wales (NSW) Government Department of Planning has issued information on the Planning Secretary's Environmental Assessment Requirements (SEARs) into the Environmental Impact Statement (EIS). With respect to noise and vibration the requirements are as per below.

Noise and Vibration – the EIS must assess:

- wind turbine noise in accordance with the *NSW Wind Energy: Noise Assessment Bulletin* (EPA/DPE, 2016);
- noise generated by ancillary infrastructure in accordance with the *NSW Noise Policy for Industry* (EPA, 2017);
- construction noise under the *Interim Construction Noise Guideline* (DECC, 2009);
- traffic noise under the *NSW Road Noise Policy* (DECCW, 2011);
- vibration under the *Assessing Vibration: A Technical Guideline* (DECC, 2006); and
- assess the noise impacts on amenity/recreational use of the Abercrombie National Park (including walking tracks, campgrounds and lookouts) considering the *NSW Noise Policy for Industry* (EPA, 2017).

NSW *Wind Energy: Noise Assessment Bulletin* (NSW Noise Bulletin) provides proponents of wind energy projects and the community with advice about how noise impacts are assessed for large-scale wind energy development projects that are State Significant Development (SSD). The NSW Government has adopted the 2009 South Australian EPA document *Wind farms – environmental noise guidelines* (SA EPA Guideline) which forms the basis of the regulatory noise standard and assessment.

3.2 SA EPA Guideline

The SA EPA Guideline recommends the following noise criteria for new wind farms,

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

The Guideline also provides information on measuring the background noise levels, locations and requirements on the number of valid data points to be obtained and the methodology for excluding invalid data points. It also outlines the process for determining lines of best fit for the background data, and determination of the noise limit.

The Guideline explicitly states that the "swish" or normal modulation noise from wind turbines is a fundamental characteristic of such turbines; however, it specifies that tonal or annoying characteristics of turbine noise should be penalised.

A 5 dBA penalty should be applied to the measured noise level if an "authorised" officer or an acoustical engineer determines that tonality is an issue and that tonality should be assessed in a way acceptable to the EPA. The NSW Noise Bulletin provides guidance as to appropriate tonality assessment methodology.

The Guideline does not provide an assessment for the potential of low frequency noise or infrasound, but it does state that recent turbine designs do not appear to generate significant levels of infrasound, as the earlier turbine models did. The NSW Noise Bulletin provides guidance as to an appropriate low frequency assessment methodology.

The Guideline accepts that wind farm developers commonly enter into agreements with private landowners in which they are provided compensation. The guideline is intended to be applied to premises that do not have an agreement with the wind farm developer. This does not absolve the obligations of the wind farm developer entirely as appropriate action can be taken under the *Environmental Protection Act* if a development 'unreasonably interferes' with the amenity of an area. The guideline lists that there is unlikely to be unreasonable interference if:

- a formal agreement is documented between the parties
- the agreement clearly outlines to the landowner the expected impact of the noise from the wind farm and its effect on the landowner's amenity
- the likely impact of exposure will not result in adverse health impacts (e.g. the level does not result in sleep disturbance)

The proponent has discussed the possible noise implications of the proposed turbine layout with the involved residents whose property the turbines would be located on and will enter into agreements with these parties.

3.3 World Health Organisation (WHO) Guidelines

Where noise levels at project-involved residences do not comply with the SA EPA Guidelines, the proponent intends to enter into agreements with the owners of those residences to achieve noise criteria in accordance with World Health Organisation (WHO) Guidelines. The proponent will apply those guidelines as necessary to ensure that the project does not result in an 'unreasonable interference' with the amenity or cause any adverse health effects at those residences.

The WHO publication '*Guidelines for Community Noise'- 1999* identifies the main health risks associated with noise and derives acceptable environmental noise limits for various activities and environments.

The appropriate guideline limits are listed in **Table 4** below**.**

Table 4 WHO Guideline values for environmental noise in specific environments

Specific Environment	Critical Health Effect(s)	L_{eq} (dBA)	Time base (hours)	L_{Max} (dBA, Fast)
Outdoor living area	Serious Annoyance, daytime & evening Moderate annoyance, daytime & evening	55 50	16 16	- -
Dwelling indoors Inside bedrooms	Speech Intelligibility & moderate annoyance, daytime & evening Sleep disturbance, night-time	35 30	16 8	 45
Outside bedrooms	Sleep disturbance – window open, night-time	45	8	60

For the assessment of project involved residences the adopted external criteria of 45 dBA or the level given by the SA EPA Guideline criteria, where higher, will be adopted.

Effectively this becomes 45 dBA or background + 5 dBA, whichever is the higher.

3.4 NSW Noise Policy for Industry (NPfI)

The NSW *Noise Policy for Industry* (NPfI) was released in 2017 and sets out the requirements for the assessment and management of operational noise from industry in NSW. The NPfI will apply to noise emissions from operational plant such as the proposed substations.

3.4.1 Industrial Noise Trigger Levels

The NPfI defines how to determine 'trigger levels' for noise emissions from industrial developments. Where a development is likely to exceed the trigger levels at existing noise sensitive receivers, feasible and reasonable noise management measures are required to be considered to reduce the impacts.
There are two types of trigger levels – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses:

- The **intrusiveness** of an industrial noise source is generally considered acceptable if the L_{Aeq} noise level of the source, measured over a period of 15-minutes, does not exceed the representative background noise level by more than 5 dB. Intrusive noise levels are only applied to residential receivers. For other receiver types, only the amenity levels apply.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended **amenity** levels specified in the NPfI for that particular land use.

Intrusive and amenity noise levels are not used directly as regulatory limits. They are used to assess the potential impact of noise, assess feasible and reasonable mitigation options, and subsequently determine achievable noise requirements.

The NPfI provides guidance on assigning residential receiver amenity noise categories based on the site-specific features, the details relevant to rural category are shown in **Table 5**.

Table 5 Residential Receiver Amenity

Category	Typical Planning Land Use Zoning	Typical Existing Background Noise Levels (RBL)	Description
Rural	RU1 – primary production RU2 – rural landscape RU4 – primary production small lots R5 – large lot residential E4 – environmental living	Daytime <40 dBA Evening <35 dBA Night <30 dBA	**Rural** – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Note: Where background noise levels are higher than those presented due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.

3.4.2 Project Noise Trigger Levels

The trigger levels for industrial noise from the project are summarised in **Table 6**. The Project Noise Trigger Levels (PNTL) are the most stringent of the intrusiveness and amenity trigger level for each period and are highlighted below. Note that the '*hotels, motels, caretakers' quarters, holiday accommodation, permanent caravan parks*' receiver location / type is used for the two nearby campgrounds and the '*passive recreation*' receiver location / type is used for recreational areas within the National Park.

Table 6 Project Noise Trigger Levels

Receiver Location/ Type	Period	Amenity Noise Level L_{Aeq} (dBA)	RBL[1,3] (dBA)	Project Noise Trigger Levels $L_{aeq(15minute)}$ (dBA)	
				Intrusiveness	Amenity[2]
Rural residential	Day	50	<40	45	50
	Evening	45	<35	40	45
	Night	40	<30	35	40
Hotels, motels, caretakers' quarters, holiday accommodation, permanent caravan parks	Day	55	-	-	55
	Evening	50	-	-	50
	Night	45	-	-	45
Area specifically reserved for passive recreation (e.g. national park)	When in use	50	-	-	50

Note 1: RBL = Rating Background Level.
Note 2: The recommended amenity noise levels have been used as the project amenity noise levels as there are no other sources of industrial noise present or likely to be introduced.
Note 3: The NPfI minimum RBL value has been used due to the measured RBL being lower than the minimum value.

3.4.3 Modifying Factors

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, intermittency or dominant low-frequency content. The NpfI specifies the following modifying factors, shown in **Table 7**, which are to be applied where annoying characteristics are present. The corrections are to be added to the noise level at the receiver before comparison with the Project Noise Trigger Levels.

Table 7 NpfI Modifying Factors

Factor	Assessment/Measurement	When to Apply	Correction[1]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by the levels defined in the NpfI.	5 dB[2]

Factor	Assessment/Measurement	When to Apply	Correction[1]
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements	Measure/assess source contribution C and A weighted $L_{eq,t}$ levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and the level to which the thresholds defined in the Npfl are exceeded.	2 or 5 dB[2]
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level	The source noise heard at the receiver varies by more than 5 dB and the intermittent nature of the noise is clearly audible. The intermittency correction is not intended to be applied to changes in noise level due to meteorology.	5 dB[3]
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated.	Maximum correction of 10 dB[2] (excluding duration correction)

Note 1: Corrections to be added to the measured or predicted levels.
Note 2: Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.
Note 3: Adjustment to be applied to night-time only.

3.5 Construction Noise Guidelines

The Department of Environment, Climate Change and Water (DECCW) issued the "*Interim Construction Noise Guideline"* in July 2009. The main objectives of the guideline are stated in Section 1.3, a portion of which is presented below:

- promote a clear understanding of ways to identify and minimise noise from construction works.
- focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts.
- encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours.

The guideline sets out Noise Management Levels (NMLs) at residences, and how they are to be applied, as presented in **Table 8**. This approach intends to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

Table 8 Noise at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{aeq(15minute)}$[1]	How to Apply
Recommended standard hours: Monday to Friday 7.00 am to 6.00 pm	Noise affected > RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{aeq(15minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. 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.

Time of Day	Management Level $L_{aeq(15minute)}$[1]	How to Apply
Saturday 8.00 am to 1.00 pm No work on Sundays or public holidays	Highly noise affected >75 dBA	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 proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.
Outside recommended standard hours	Noise affected > RBL + 5 dBA	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 dBA above the noise affected level, the proponent should negotiate with the community.

Note 1: Noise levels apply at the property boundary that is most exposed to construction noise. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence.

3.6 Vibration Guidelines

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). Of these considerations, the human comfort limits are the most stringent. Therefore, for occupied buildings, if compliance with human comfort limits is achieved, it will follow that compliance will be achieved with the building damage objectives.

3.6.1 Human Comfort

The DECCW's *Assessing Vibration: A Technical Guideline* provides acceptable values for continuous and impulsive vibration based upon guidelines contained in BS 6472–1992, *Evaluation of human exposure to vibration in buildings (1–80 Hz)*.

Both preferred and maximum vibration limits are defined for various locations and are shown in **Table 9**, with the preferred night-time PPV criteria of 0.2 mm/s being the most relevant to the project.

Table 9 Preferred and maximum values for continuous and impulsive vibration

Location	Assessment period[1]	Preferred values RMS acceleration m/s²		Maximum values RMS acceleration m/s²		Peak Velocity PPV mm/s	
		z-axis	x- and y-axes	z-axis	x- and y-axes	Preferred	Maximum
Continuous vibration							
Critical areas[2]	Day- or night-time	0.0050	0.0036	0.010	0.0072	0.14	0.28
Residences	Daytime	0.010	0.0071	0.020	0.014	0.28	0.56
	night-time	0.007	0.005	0.014	0.010	0.20	0.40
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028	0.56	1.1
Workshops	Day- or night-time	0.04	0.029	0.080	0.058	1.1	2.2
Impulsive vibration							
Critical areas[2]	Day- or night-time	0.0050	0.0036	0.010	0.0072	0.14	0.28
Residences	Daytime	0.30	0.21	0.60	0.42	8.6	17.0
	night-time	0.010	0.0071	0.020	0.014	2.8	5.6
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92	18.0	36.0
Workshops	Day- or night-time	0.64	0.46	1.28	0.92	18.0	36.0

Note1: Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am

Note 2: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above. Stipulation of such criteria is outside the scope of this policy, and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472–1992

These limits relate to a long-term (16 hours for daytime), continuous exposure to vibration sources. Where vibration is intermittent, a higher level of vibration is typically acceptable.

3.6.2 Building Damage

In regard to potential building damage, the German Standard DIN4150 recommends a limit of 10 mm/s PPV within any building and the British Standard BS7385: Part 2 – 1993 sets a limit within buildings which depends upon the vibration frequency, but is as low as 7.5 mm/s PPV (at 4.5 Hz). For the purposes of ensuring a reasonable factor of safety, a conservative limit of approximately 5 mm/s PPV has been applied for this project.

3.7 Road Traffic Noise

The NSW *Road Noise Policy* (RNP) was published by the NSW Department of Environment, Climate Change and Water (DECCW) in March 2011 and addresses the assessment of road traffic noise arising from new or redeveloped roads as well as new traffic-generating developments.

The road traffic noise criteria presented in the policy are based on the functional categories of the subject roads. The functional categories are as follows:

→ Arterial roads (including freeways) carrying predominantly through-traffic from one region to another, forming principal avenues of communication for urban traffic movements.

→ Sub-arterial roads connecting the arterial roads to areas of development and carrying traffic from one part of a region to another. They may also relieve traffic on arterial roads in some circumstances.

→ Local roads, which are the subdivisional roads within a particular developed area. These are used solely as local access roads

For this project, traffic associated with the construction stage has the potential to increase noise levels on existing arterial and local roads during the day (no night period construction proposed). As such, the relevant traffic noise criteria, as provided in Table 3 of the NSW RNP, are provided in **Table 10** below.

Table 10 Road Traffic Noise Criteria

Type of Development	Criteria	
	Day 7am – 10pm (dBA)	Where Criteria are Already Exceeded
Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{aeq(15hour)}$ 60 dBA	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2 dBA.
Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{aeq(1hour)}$ 55 dBA	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2 dBA.

When considering potential for sleep disturbance the NSW RNP states that:

> *Maximum internal noise levels below 50-55 dBA are unlikely to awaken people from sleep*

and

One or two noise events per night, with maximum internal levels of 65-70 dBA are not likely to affect health and wellbeing significantly.

3.8 Abercrombie National Park

Under the SEARS the potential noise impacts to the Abercrombie National Park are required to be assessed with consideration of the *NPfI*.

The regions of Abercrombie National Park which are adjacent to the project area include two campground areas, a network of 4WD tracks, and no marked hiking trails. On this basis the assessment will centre on the potential impact of project noise on passive recreation to the campground areas only

Table 6 provides the NPfI amenity noise level for *Area specifically reserved for passive recreation (e.g. national park)* as L_{Aeq} of 50 dBA for periods when in use.

Furthermore, considering the use of campgrounds as places to sleep the NPfI provides the category of *Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks* with a recommended amenity noise level 5 dBA above that for a residence in the relevant noise amenity area and time of day. Effectively this becomes L_{Aeq} of 45 dBA during the night period.

It should be noted that the *NPfI* explicitly excludes wind farm noise as per Section 1.5, which for the purposes of this assessment is taken as meaning wind turbine noise and as such a formal assessment of substation noise against *NPfI* for passive recreational uses of Abercrombie National Park is appropriate. Notwithstanding the significant distance from the closest substation to the campgrounds, a discussion on the specific criterion method used for the substation noise is described in **Section 3.4**.

Notwithstanding that wind turbine noise is explicitly excluded from the *NPfI*, the relevant amenity criteria from the *NPfI* has been chosen to facilitate a comparative evaluation of the potential impact of wind turbine noise, however it should be noted that these are not intended to be adopted as noise compliance limits.

4 Existing Environment

The project is located in a remote region which is relatively sparsely populated and predominantly made up of broad acreage farming with grazing and some limited cropping activity. The main transport arterial being Abercrombie Road only carries relatively sporadic traffic.

All receptors surrounding the proposed Wind Farm site have an ambient background noise environment that is determined by pre-dominantly natural sources, including those which are wind influenced such as wind noise in foliage.

4.1 Baseline surveys

To quantify the existing ambient noise environment baseline noise monitoring was conducted at 5 reference receptor locations in the project area between 11th April 2022 and 3rd June 2022.

The monitoring campaign included periods of rain, which were removed from the analysed data set.

Furthermore, at most locations it was evident that extended periods were affected by elevated high frequency noise because of frogs or insects, which due to these being considered seasonally influenced and unlikely a permanent feature of the ambient noise environment, were removed from the data set using a best practice 1/3 octave band screening method described below:

> Individual ten (10) minute measurement samples that are likely to have been affected by high frequency extraneous noise shall be identified and filtered from the analysis when the following conditions are satisfied:
>
> - The highest A-weighted one-third octave band noise level occurs at a frequency above than 1 kHz; and
> - The identified one-third octave band A-weighted noise level is greater than a level of 20 dB L_{A90} and is within 5 dB of the overall A-weighted noise level for the ten (10) minute sample in question.

At each location, noise monitoring equipment was placed in the vicinity of the residence, at a location that would be exposed to future WTG noise. Consideration was given to avoiding other potential sources of extraneous noise and the position of the monitoring equipment was documented with photographs.

The baseline surveys utilised noise monitoring equipment that meets the sound level meter requirements of IEC 61672-1:2002 – Class 1, with low noise floor (Bruel & Kjaer : Type 2250) with current NATA calibration and they utilised high performance microphone wind socks (150 mm diameter). Each site also included a local weather station, which was used to evaluate local rainfall and local wind speed to assist in the screening of valid data. Pre and post survey acoustic calibrations were completed on-site.

Reference wind speed was derived by two methods

- PY5 met mast: an 80 m AGL, with hub height wind speed provided by GPG, derived from the logarithmic law shear profile and the data collected from the mast.
- Light Detection and Ranging (LIDAR) unit determined wind speed at 151 m AGL. For some periods of the survey the LIDAR was unable to resolve wind speed due to rain or fog.

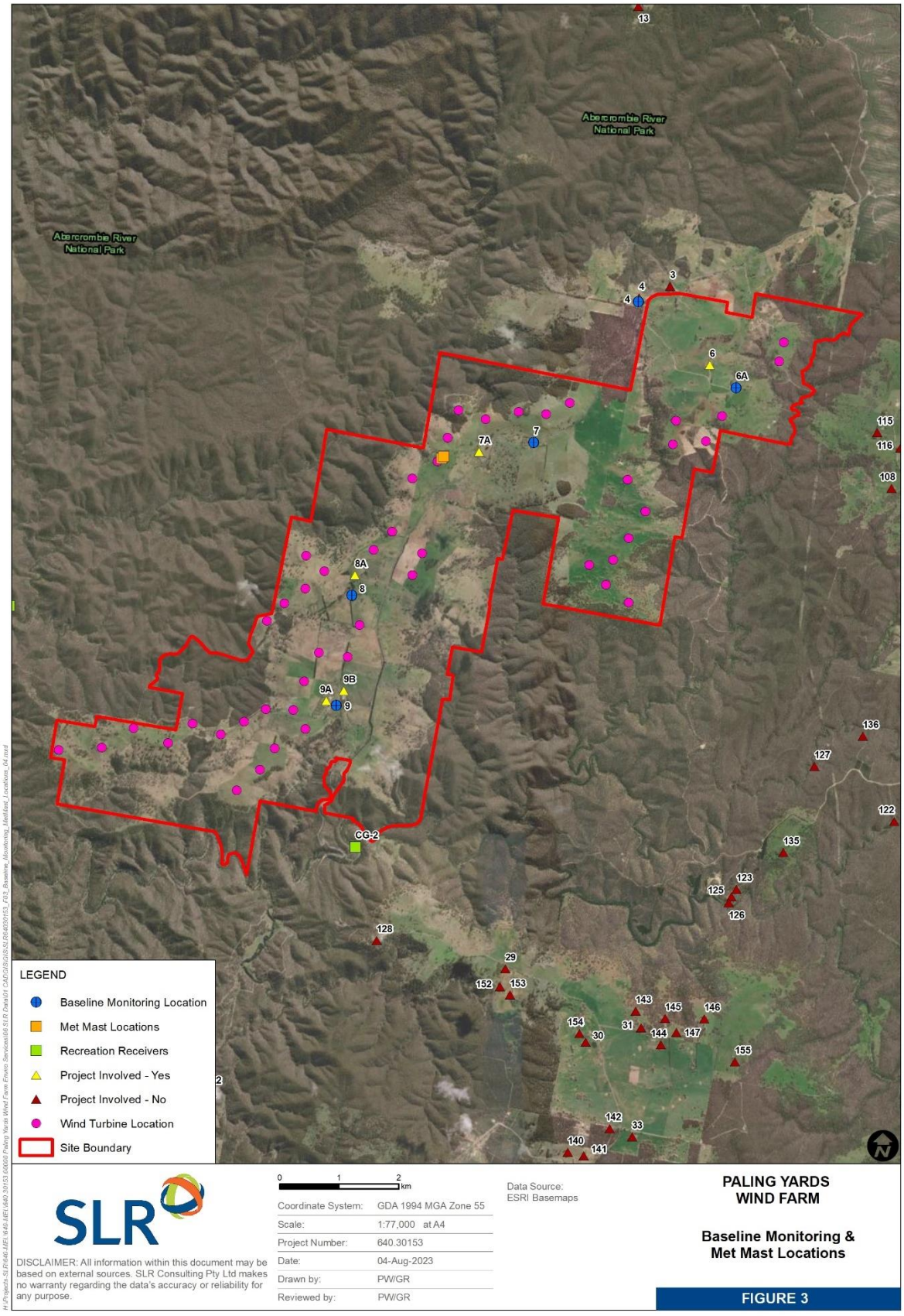
A consolidated wind data set from the above was used and from this the local noise data was then correlated to the 151 m AGL wind speed.

4.2 Measurement Locations

The locations for the background noise measurements were selected by SLR Consulting on the basis of preliminary predicted WTG noise levels as well as proximity and similarity to other receptors.

The monitoring locations are shown in **Figure 3**.

Figure 3 Baseline monitoring locations



4.3 Measurement Details

The measurement location, monitoring period, and serial number of the noise loggers for all testing are summarised in **Table 11** along with the number of valid data points for each location.

The SA EPA Guideline recommends a set of approximately 2,000 valid data points. Any data points adversely affected by periods of rain or extraneous noise were excluded.

The measured background noise levels (L_{A90}) are then plotted against the hub height wind speed to obtain a background versus wind speed characteristic. The line of best fit for the data set is then determined, as required by the SA EPA Guideline, using a third order (cubic) polynomial.

Table 11 Measurement details for each Location

Measurement Location	Measurement Period	Noise Logger Model # Serial number	Total No. of monitoring intervals	No. of valid data points
Loc 4	12/4/22 – 11/5/22	B&K 2250 #3007014	4205	2496
Loc 6A	4/5/22- 28/5/22	B&K 2250 #3008630 WS1081 WS8	3385	2630
Loc 7	12/4/22 – 31/5/22	B&K 2250L #3003632 Vaisala N2340035	6007	2992
Loc 8	11/4/22 – 11/5/22	B&K 2250 #3011836 Vaisala N2430028	4311	1916
Loc 9	11/4/22 – 3/6/22	B&K 2250 #3011919 Vaisala N1430787	4333	2443

The baseline noise monitoring survey locations are pictured along with data and results which are detailed fully in **Appendix B**.

5 Operational Noise Criteria

5.1 Wind Turbine Noise

The assessment of the acceptability of wind farm noise was undertaken at all assessment residential receptors (located within 10 km of a WTG) using the noise limit set in SA EPA Guidelines. Dwellings further than this distance are deemed to comply if dwellings closer to turbines comply with the SA EPA noise limit. The two campgrounds identified as areas specifically reserved for passive recreation are assessed to the *NPfI* amenity criterion.

The proponent GPG intends to enter into noise agreements with some project involved residences prior to construction. Under the SA EPA Guidelines these residences are not required to comply to the 35 dBA or 'background + 5 dBA' limits. However, it is necessary to ensure that the project does not result in an 'unreasonable interference' with the amenity of these areas or cause any adverse health effects. Therefore for the assessment of project involved residences the adopted external criteria of 45 dBA (as per the WHO Guideline) or the level given by the SA EPA Guideline criteria, where higher, will be adopted. Effectively this becomes 45 dBA or background + 5 dBA, whichever is the higher.

Table 12 WTG noise criteria summary

Project involved status	Minimum criteria	Background criteria
no (residential)	35 dBA	Background + 5 dBA
yes	45 dBA	Background + 5 dBA

Owing to the relatively low levels of background noise determined by the baseline noise monitoring, detailed in **Appendix B**, the minimum criteria outlined in **Table 12** will generally apply.

For recreational / amenity uses within the Abercrombie National Park, the *NPfI* has been used to assess the noise impacts. **Table 13** presents a summary of the guideline noise levels for the purposes of this assessment.

Table 13 Guideline Noise Levels within Abercrombie National Park

Receiver Location/ Type	Period	Guideline Noise Levels $L_{Aeq(15minute)}$
Campgrounds	Day	55 dBA
	Evening	50 dBA
	Night	45 dBA
Passive recreation	When in use	50 dBA

5.2 Substation Noise

Substation noise is evaluated against the NSW *Noise Policy for Industry* (NPfI).

Owing to the relatively low levels of background noise determined by the baseline noise monitoring, detailed in **Appendix B**, it has been assumed that the minimum Rating Background Level (RBL) will apply for all residential receptors and hence the Project Noise Trigger Levels will be determined by the intrusiveness considerations. The Project Noise Trigger Levels for the campgrounds have been assessed against the amenity noise level.

Table 14 Substation noise criteria summary

Receiver Location/ Type	Period	Project Noise Trigger Levels $L_{Aeq(15minute)}$
Rural residential	Day	45 dBA
	Evening	40 dBA
	Night	35 dBA
Hotels, motels, caretakers' quarters, holiday accommodation, permanent caravan parks	Day	55 dBA
	Evening	50 dBA
	Night	45 dBA
Passive recreation	When in use	50 dBA

6 Operational Assessment

6.1 Introduction

A three-dimensional SoundPLAN computer noise model was used to predict L_{Aeq} noise levels from all WTG's at all surrounding residential dwellings within 10km if a turbine.

The ISO 9613 noise model incorporates a 'hard ground' assumption and includes one-third octave band calculated effects for air absorption, ground attenuation and topographic shielding with amendments in accordance with the Institute of Acoustics (IoA) *Good Practice Guide on Wind Turbine Noise*.

It is noted that ISO 9613 equations predict for average downwind propagation conditions and also hold for average propagation under a well-developed moderate ground-based temperature inversion.

The estimated accuracy of the prediction model is approximately ±3 dBA.

6.2 Wind Turbine Noise

6.2.1 Predicted Wind Turbine Noise Levels - 47 WTG base layout

The wind farm noise levels from the proposed 47 WTG base layout was calculated for a hub height wind condition of 10 m/s and listed in **Table 15**. The predicted noise contour plot is presented in **Figure 4.**

Furthermore, noise levels from the proposed wind farm 47 WTG layout were calculated for all integer wind speeds in the range of 4 m/s to 15 m/s (hub height) at all surrounding assessment receivers within 2.5 km of a WTG. For ease of presentation, the assessment has been grouped in 5 zones, where each zone includes receptors which have been grouped together based on their proximity and similarity to locations where baseline noise monitoring was undertaken. The assessment graphs are depicted in **Appendix C1** and show the predicted WTG operational noise levels, baseline noise regression curve and SA EPA Guideline noise criteria.

Table 15 Predicted WTG Noise Level (dBA) – 47 WTG Base Layout

Receptor ID	WTG noise dBA	Complies with minimum criteria ? 35/45 dBA
1	21.1	Y
3	35.2	N
4	36	N
6 *	42.5	Y
6A *	45.1	Y
7 *	46.8	N
7A *	47.4	N
8 *	48	N
8A *	48.3	N
9 *	46.8	N
9A *	48.5	N
9B *	47.1	N
10	31.6	Y
11	24.5	Y
12	23	Y
13	26	Y
15	22.5	Y
16	24	Y
17	24	Y
18	24	Y
19	22.3	Y
20	22.1	Y
21	28.5	Y
22	27.2	Y
23	26.5	Y
24	24.8	Y
25	20.9	Y
26	20.9	Y
27	18.9	Y
28	20.4	Y

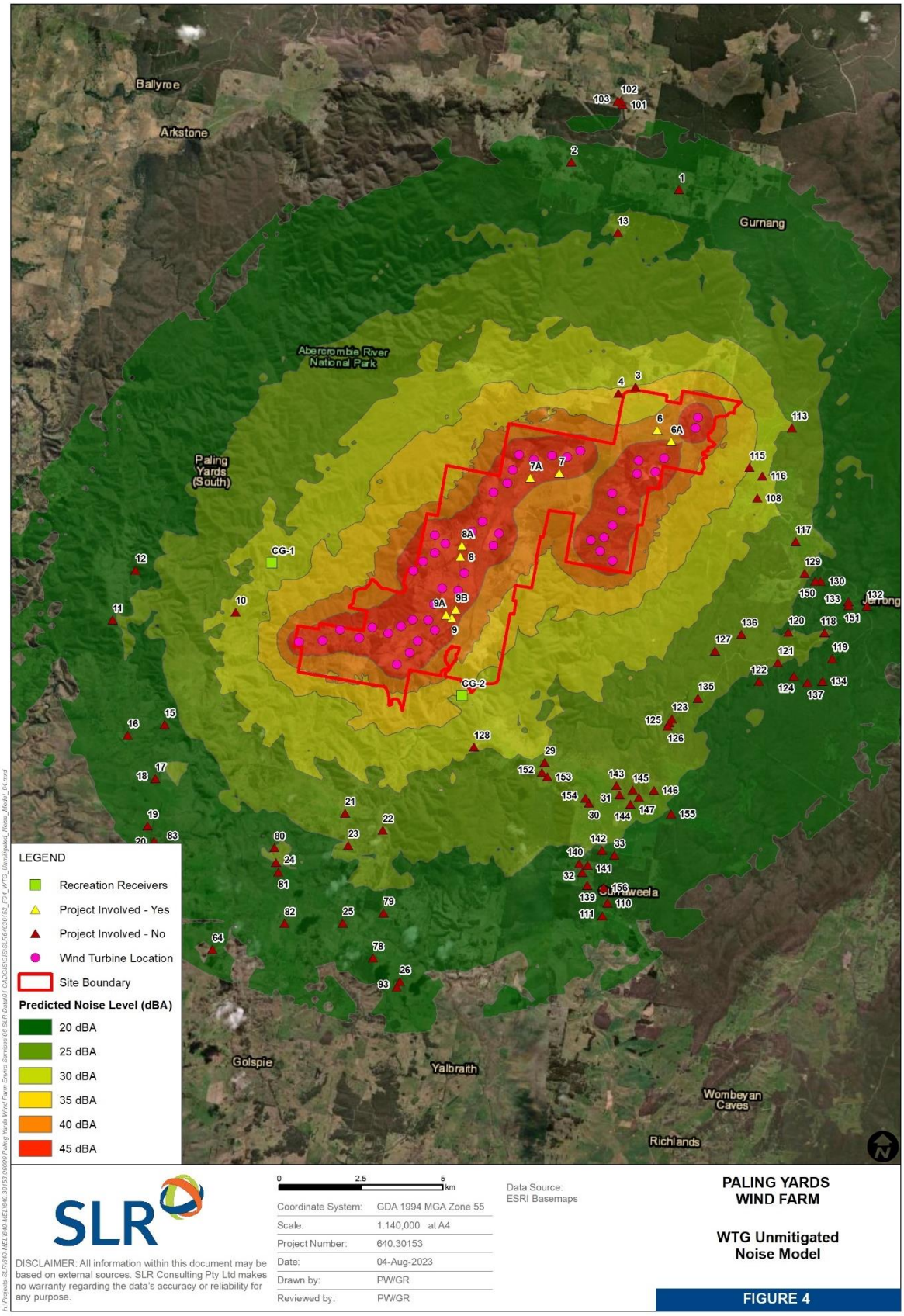
Receptor ID	WTG noise dBA	Complies with minimum criteria ?
108	32.8	Y
110	22.2	Y
113	30.2	Y
115	34.9	Y
116	32.7	Y
117	28.7	Y
118	25.2	Y
119	23.8	Y
120	26.2	Y
121	25.6	Y
122	23.8	Y
123	25.9	Y
124	23	Y
125	26.3	Y
126	25.1	Y
127	26.4	Y
128	32.5	Y
129	27.1	Y
130	23.8	Y
132	21.4	Y
133	23	Y
134	22.3	Y
135	26.2	Y
136	27.4	Y
137	22.3	Y
139	21.9	Y
140	24.8	Y
141	22.7	Y
142	24.9	Y
143	27	Y

Receptor ID	WTG noise dBA	Complies with minimum criteria ? 35/45 dBA
29	29.6	Y
30	26.9	Y
31	26.6	Y
32	24.3	Y
33	24.6	Y
64	19.7	Y
78	21.8	Y
79	22	Y
80	25.3	Y
81	24.4	Y
82	21.7	Y
83	22.3	Y
93	20.7	Y
CG-2**	35.3	-

Receptor ID	WTG noise dBA	Complies with minimum criteria ?
144	26	Y
145	26.5	Y
146	26	Y
147	26.1	Y
150	24	Y
151	23	Y
152	29.1	Y
153	28.8	Y
154	27.2	Y
155	24.9	Y
156	21.6	Y
CG-1**	30.8	-

Note: * Denotes a project involved receptor
** Denotes camping ground
Shaded cell indicates a predicted exceedance of the relevant minimum criteria 35 dBA or 45 dBA for project involved

Figure 4 Predicted Noise Contour Map – 47 WTG Base Layout, v_{HH}=10m/s, L_{Aeq}



6.2.2 Wind Farm Noise Assessment- 47 WTG base layout

A predictive assessment for the 47 WTG base layout at a wind speed of 10 m/s (hub height), which represents the highest noise emission, was undertaken against the minimum noise criteria of 35 dBA for project uninvolved receivers and 45 dBA for project involved receivers at all assessment receivers located within 10 km of a turbine. Dwellings further than this distance are deemed to comply if dwellings closer to turbines comply with the SA EPA noise limit.

The results presented in **Table 15** indicate that

- Non-involved receptors 3 and 4 marginally exceed the minimum 35 dBA SA EPA Guideline criteria.
- Project-involved receptors 6A, 7, 7A, 8, 8A, 9, 9A and 9B, exceed the minimum 45 dBA WHO criteria

The assessment graphs depicted in **Appendix C** for all surrounding assessment receivers within 2.5 km of a WTG detail the predicted noise for all integer wind speeds in the range of 4 m/s to 15 m/s (hub height) and indicate that due to the relatively low levels of background noise the criteria at these properties would be defined by the relevant (non-involved or project involved) minimum noise limit defined by SA EPA Guideline Criteria and WHO, e.g. those receptors identified above as exceeding the minimum noise limit.

Notwithstanding that the predictions are considered to provide a conservatively high estimate, it is necessary to show that through application of adaptive management that sufficient mitigation of noise emissions can be applied in order to meet the relevant noise limits at the above receptors.

The predicted noise levels at the two campgrounds (CG-01 and CG-02) are well below the 45 dBA night time noise level from the *NPfI* that is applicable for places to sleep in the category of *Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks.* Furthermore, the predicted noise level at the two campgrounds are well below the 50 dBA noise level from the *NPfI* that is applicable to *areas specifically reserved for passive recreation (e.g. national park).*

6.2.3 Mitigation Layout

Modern wind farms are generally able to apply a noise curtailment strategy to their operations. This can typically include;

- Sector Management (SM) - where individual turbines are switched off during certain meteorological conditions such as particular wind speed and directions (or 'sectors'). This method is usually implemented when a particular combination of wind speeds and directions results in markedly higher noise levels at a receptor or the development of Special Audible Characteristics (SACs). Sector Management is controlled by the operator of the Wind Farm through the SCADA system as the conditions arise, just as turbines are turned on and off to respond to changing wind conditions on site to maximise the power output of the Wind Farm. SM is therefore best considered a reactive mitigation and best not relied upon as a basis for establishing compliance during the planning and approval process

- Noise Management Mode (NMM) - which is a firmware-locked operation mode of the WTG whereby the speed of the rotor is reduced to lessen the sound power generated by the blades. This is set by the turbine manufacturer and is fixed for each WTG. The WTG effectively becomes a fixed variant of the standard model, with a lower sound power output at higher wind speeds. Conservative noise modelling sometimes predicts a small exceedance of the criteria, for which NMM is employed to show that the criteria can be met. If post-construction measurements demonstrate that the wind farm already complies and that additional mitigation is not required then the firmware is not installed and the reduced noise mode is never used. Alternatively, if additional mitigation is required then the manufacturer will change firmware settings within each WTG to activate the reduced noise mode. The WTG then operates according to the lower sound power curve settings. NMM is therefore used for establishing predictive compliance (if necessary) during the planning and approval process as using a WTG in NMM is akin to selecting a WTG model with a lower sound power level.

The considered WTG model (GE 158 – 6.1MW) has the ability to apply varying levels of Noise Management Mode, with the maximum sound power level being 107 dBA and progressively decremented to 100 dBA as depicted in **Figure 2**. An iterative predictive noise optimisation procedure was undertaken in which the WTG's closest to those receptors where exceedances were predicted were placed into NMM 104 and NMM 101 operation, which reduces the sound power output of those turbines compared to standard Mode 107 operation.

Table 16 shows a list of all WTGs and their mode for the mitigated scenario.

Table 16 Mitigated Turbine Layout

Turbine Name	Type
PY-4	101 NMM
PY-13	104 NMM
PY-14	101 NMM
PY-15	101 NMM
PY-16	104 NMM
PY-17	101 NMM
PY-20	101 NMM
PY-21	101 NMM

Turbine Name	Type
PY-22	101 NMM
PY-23	104 NMM
PY-29	101 NMM
PY-31	101 NMM
PY-32	104 NMM
PY-33	104 NMM
PY-34	101 NMM
PY-45	104 NMM

The predicted noise levels for the mitigated layout at the reference wind speed are shown in **Table 17**. The predicted noise contour plot is presented in **Figure 5.**

Table 17 Predicted Noise Levels – Mitigated Turbine Layout – Leq dBA

Receptor ID	Wind farm noise dBA	Complies with minimum criteria ? 35/45 dBA
1	19.9	Y
3	34.2	Y
4	34.8	Y
6 *	41.6	Y
6A *	43.9	Y

Receptor ID	Wind farm noise dBA	Complies with minimum criteria ? 35/45 dBA
108	32.2	Y
110	21	Y
113	29.6	Y
115	34.5	Y
116	32.1	Y

Receptor ID	Wind farm noise dBA	Complies with minimum criteria ? 35/45 dBA
7 *	44.1	Y
7A *	44.8	Y
8 *	44.2	Y
8A *	44.7	Y
9 *	43.2	Y
9A *	44.6	Y
9B *	43.5	Y
10	31.3	Y
11	23.6	Y
12	22	Y
13	24.7	Y
15	21.7	Y
16	23.1	Y
17	23.2	Y
18	23.2	Y
19	21.5	Y
20	21.2	Y
21	27.6	Y
22	26.2	Y
23	25.5	Y
24	23.9	Y
25	19.9	Y
26	19.8	Y
27	18	Y
28	19.5	Y
29	28.3	Y
30	25.7	Y
31	25.5	Y
32	23.2	Y
33	23.4	Y
64	18.7	Y
78	20.8	Y
79	20.9	Y
80	24.5	Y
81	23.5	Y
82	20.7	Y
83	21.4	Y

Receptor ID	Wind farm noise dBA	Complies with minimum criteria ? 35/45 dBA
117	28	Y
118	24.4	Y
119	22.9	Y
120	25.4	Y
121	24.8	Y
122	23	Y
123	24.8	Y
124	22.2	Y
125	25.4	Y
126	24.2	Y
127	25.7	Y
128	31.3	Y
129	26.3	Y
130	23.1	Y
132	20.5	Y
133	22.3	Y
134	21.3	Y
135	25.4	Y
136	26.8	Y
137	21.5	Y
139	20.8	Y
140	23.6	Y
141	21.6	Y
142	23.8	Y
143	25.9	Y
144	24.9	Y
145	25.4	Y
146	24.9	Y
147	25	Y
150	23.3	Y
151	22.3	Y
152	27.9	Y
153	27.5	Y
154	26	Y
155	23.8	Y
156	20.4	Y
CG-1 **	30.2	Y

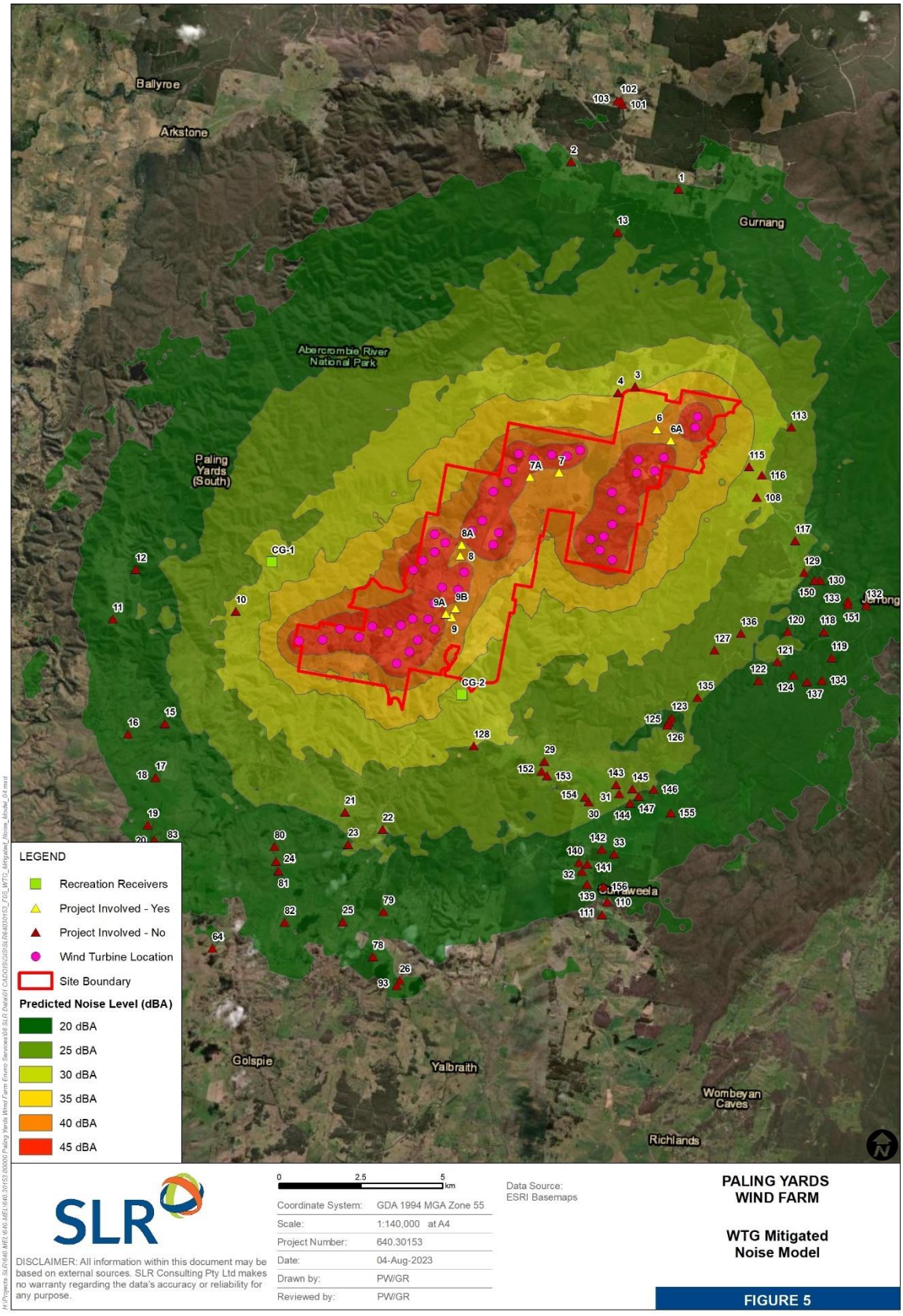
Receptor ID	Wind farm noise dBA	Complies with minimum criteria ? 35/45 dBA
93	19.6	Y
CG-2 **	34.0	Y

Receptor ID	Wind farm noise dBA	Complies with minimum criteria ? 35/45 dBA

Note: * Denotes a project involved receptor
** Denotes camping ground

The mitigated layout (if required) is shown to comply at all receptors at all wind speeds

Figure 5 Predicted Noise Contour Map – 47 WTG Mitigated Turbine Layout, v_{HH}=10m/s, L_{Aeq}



6.3 Substation Noise

The appropriate noise criteria for Substation Noise are provided in *NSW NPfI* (See **Section 3.4** and **Section 5.2**). Noise from the substation will be assessed separately from the wind farm.

Two 180 MVA transformers are proposed for the collector transformer facility and a single 320 MVA transformer is proposed for the switching station. Two alternative location options (refer to West Option and East Option below) are being considered for the switching station. The proposed location of the substations are shown in the construction layout plan in **Appendix D.**

Australian Standard AS 60076 Part 10 2009: *"Power Transformers – Determination of sound levels"* indicates that each 180 MVA transformer may produce sound power levels up to 106 dBA and that the 320 MVA transformer may produce sound power levels up to 109 dBA. The dominant frequency of such transformers is 100 Hz.

Proposed locations for substations are shown in **Table 18**. Note that two options for the collector substation are listed. The two substation options have been modelled.

Table 18 Proposed Substation Locations

Name	Type	Easting	Northing
Collector Station	2 x 180 MVA	753800	6218160
Switching Station West Option	1 x 320 MVA	759515	6222100
Switching Station East Option	1 x 320 MVA	760650	6222150

Noise predictions for transformer substations have been made using ISO 9601 algorithm. The results of the two options are presented in **Table 19** and **Table 20** for the nearest receptor locations, with all transformers operating simultaneously, and compared to the minimum night-time NSW NPfI criterion.

Table 19 Predicted Switching Substation and Collector Substation Noise – West Option

Location	Predicted Noise Level, Leq dBA	Minimum RBL (Night), dBA	Noise Limit (Intrusive Criteria), dBA	Complies
3	18	30	35	Yes
4	25	30	35	Yes
6	33	30	35	Yes
6A	32	30	35	Yes
7	26	30	35	Yes
7A	31	30	35	Yes
8	27	30	35	Yes
8A	28	30	35	Yes
9	19	30	35	Yes
9A	19	30	35	Yes

Location	Predicted Noise Level, Leq dBA	Minimum RBL (Night), dBA	Noise Limit (Intrusive Criteria), dBA	Complies
9B	19	30	35	Yes
115	22	30	35	Yes
116	19	30	35	Yes

Table 20 Predicted Switching Substation and Collector Substation Noise – East Option

		NSW Industrial Noise Policy Assessment		
Location	Predicted Noise Level, Leq dBA	Minimum RBL (Night)	Noise Limit (Intrusive Criteria)	Complies
3	20	30	35	Yes
4	20	30	35	Yes
6	26	30	35	Yes
6A	27	30	35	Yes
7	26	30	35	Yes
7A	31	30	35	Yes
8	27	30	35	Yes
8A	28	30	35	Yes
9	19	30	35	Yes
9A	19	30	35	Yes
9B	19	30	35	Yes
115	13	30	35	Yes
116	<10	30	35	Yes

Table 19 and **Table 20** show compliance with the minimum noise criteria set out in the *NPfI* at all locations.

7 Assessment of Construction Noise & Vibration

7.1 Project Construction Noise

The *Interim Construction Noise Guidelines* (DECCW, 2009) define Noise Management Levels (NMLs) at residences, and how they are to be applied, (See **Section 3.5**).

A number of key construction activities associated with the building of wind farm infrastructure have been evaluated, including;

- construction of access roads,
- establishment of turbine tower foundations and electrical substation,
- digging of trenches to accommodate underground power cables,
- erection of turbine towers and assembly of WTG's.

The equipment required to complete the above tasks will typically include;

- excavator/grader, bulldozer, dump trucks, vibratory roller
- bucket loader, rock breaker, drill rig, excavator/grader, bulldozer, dump truck, flat bed truck, concrete truck
- cranes, fork lift, and various 4WD and service vehicles.

The Operational noise of a temporary concrete batching plant to facilitate foundation construction have also been assessed. The proposed location of the batching plant is shown in the construction layout plan in **Appendix D.**

Based on information contained within the Traffic Assessment (ref: 640.30153.00010-R01-v2.6-20221115), it is assumed that up to two trucks will be batching at any one time. Other plant and equipment that have been assumed to be on site as a worst-case scenario are:

- front end loader
- material conveying system
- cement silo dust extraction fans
- concrete mix trucks loading under silos
- concrete mix trucks slumping
- batch hopper
- concrete mix truck idling
- concrete mix truck moving slowly on site
- concrete mix truck at washout
- bulk material truck delivery and unloading

The estimated construction period is anticipated to be 22 months, with civil works expected to span approximately 12 to 15 months, however, due to the large area of the wind farm site, intensive works will be located within close proximity to individual residential receivers for only relatively short and intermittent periods of time.

It is anticipated that most construction will occur during standard construction hours and it is therefore considered appropriate that construction noise levels up to 10 dBA above the RBL's would be acceptable. Construction noise levels greater than 10 dBA above RBL could be considered as 'noise affected' as defined by the DECCW guidelines. At levels greater than 75 dBA receptors would be considered 'highly noise affected' by construction noise as defined by the Guidelines.

7.2 Ambient Background Noise Levels

Ambient baseline noise levels were measured at five locations and after filtering out extraneous noise (frogs) they were found to be generally low. As wind farm baseline monitoring is completed using 10 minute intervals as opposed to the 15 minute interval period used by the NPfI, no post processing of RBLs was completed, however, a conservative approach has been taken by adopting the NSW NPfI minimum RBL of 35 dBA for standard day time hours and minimum RBL of 30 dBA for the night-time period.

7.3 Noise Modelling Parameters

In order to calculate the noise levels at the various noise sensitive receiver locations from construction equipment associated with the project, a SoundPLAN computer noise model was developed.

The model predicts noise levels by taking into account such factors as the source sound power levels and locations of sources and receivers, distance attenuation, ground absorption, air absorption and shielding attenuation, as well as meteorological conditions, including wind effects. The noise model was configured to use prediction algorithms in accordance with the ISO 9613 prediction methodology which allows for conservative 'worst case' meteorological propagation conditions.

Sound power levels used to derive the predicted construction noise were based on typical data sourced from the SLR Consulting noise source database. Computer noise models of typical construction scenarios were developed which included all anticipated mobile equipment for the activity operating simultaneously at full load. To examine the possible worst case construction noise impacts for all nearby receivers, four different construction scenarios were modelled at each turbine location and the highest noise levels for each receiver predicted. These are:

- Construction of Access Roads
- Establishment of Turbine Foundations
- Trench Excavation
- WTG Erection and Assembly
- Concrete batch plant

Table 21 presents the typical sound power levels of equipment for each scenario.

Table 21 Typical Construction Equipment

Scenario	Equipment	Sound Power Level, dB L_{Aeq}
Construction of Access Roads	Grader	120
Establishment of Turbine Foundations	Rock Breaker	126
Trench Excavation	Excavator	113
WTG Erection and Assembly	Crane	113
Concrete batch plant	All plant/equipment and deliveries	117

7.4 Construction Noise Assessment

The operations that may potentially occur at night are:

- the erection of WTG's by large cranes, as low wind conditions are preferable while the towers are being erected, and
- batching plant operations in the early morning so that construction elsewhere can start at 7 am.

The three remaining construction scenarios are expected to occur during standard hours (day-time).

Table 22 shows the predicted construction level for all receivers and the minimum applicable noise limit for standard hours period (intrusive criteria) and for the out of hours night period. Only receptors are included where construction noise levels are predicted to be greater than 10 dBA.

Locations where the predicted noise levels exceed the NML (45 dBA) for construction during standard hours (day-time) are highlighted orange.

Locations where the predicted noise levels are above the NML (35 dBA) for works occurring out of hours in the night period are highlighted in red.

Table 22 Predicted Construction Noise Levels

	Construction Activity						
Location	Construction of Access Roads	Establishment of Turbine Tower Foundations	Trench Excavation	WTG Erection & Assembly	Batching Plant	Standard Hours Limit, $L_{eq, 15min}$ dBA	OOHW Limit, $L_{eq, 15min}$ dBA
3	36	42	29	29	<10	45	35
4	37	43	30	30	<10	45	35
6	47	53	40	40	<10	45	35
6A	50	56	43	43	<10	45	35
7	52	58	45	45	37	45	35
7A	51	57	44	44	41	45	35
8	50	56	43	43	46	45	35
8A	52	58	45	45	49	45	35
9	49	55	42	42	35	45	35
9A	51	57	44	44	35	45	35
9B	50	56	43	43	36	45	35
10	36	42	29	29	<10	45	35
15	<10	10	<10	<10	<10	45	35
21	24	30	17	17	<10	45	35
115	37	43	30	30	<10	45	35
116	34	40	27	27	<10	45	35
117	25	31	18	18	<10	45	35
125	33	39	26	26	<10	45	35
127	19	25	12	12	<10	45	35
128	31	37	24	24	<10	45	35
136	24	30	17	17	<10	45	35
L	24	30	17	17	<10	45	35

A total of 9 receptors are deemed potentially 'noise affected' by the NSW Interim Construction Noise Guideline (ICNG) during activities including access road construction and WTG foundation civil works. The same nine receptors are potentially impacted were WTG erection and assembly to occur outside of standard construction hours. All nine properties are project involved.

Five of the project involved receptors are potentially impacted by concrete batch plant operations were they to commence prior to 7 am.

No locations exceed the 'highly noise affected' 75 dBA NML.

7.4.1 Mitigation for Construction Noise

The ICNG recommend that where residences are deemed 'noise affected', that work practices and mitigation measures deemed feasible and reasonable should be applied. Possible mitigation measures may include:

- Scheduling construction works for less critical times of day
- Using alternative, quieter equipment
- Noise controls including temporary walls/earth berms and exhaust silencers
- Keeping the community informed about upcoming works in the area
- Detailed tracking regarding complaints about construction noise, including how each complaint was addressed.

A detailed construction noise management plan will be developed closer to the construction of the wind farm to ensure that all reasonable steps are taken to reduce noise from construction sources, and that appropriate community engagement occurs with respect to construction noise.

7.5 Construction Vibration Assessment

Vibration generated by construction has the potential to impact on occupants (human comfort) and structures (building damage) as detailed in **Section 3.6**

The activities and equipment with the potential to generate the highest levels of ground vibration are the operation of vibratory rollers during construction of access roads and the operation of any rock breakers during establishment of turbine tower foundations. Typical vibration levels from these sources are presented in **Table 23**.

Table 23 Typical Vibration Emission Levels from Construction Plant

Activity	**Minimum limit PPV mm/s**		Vibration Level, **PPV** mm/s at Distance			
	human comfort	**building damage**	**10m**	**20m**	**30m**	**100m**
4-Tonne Vibratory Roller	0.2	7.5	2.0 - 2.4	0.4 - 1.2	0.2 - 0.8	<0.2
Hydraulic Hammer (30t)	0.2	7.5	3	1.5	1.0	<0.5

It is evident that given the large distances between receptors and structures where construction works are likely to be undertaken (greater than 500 m, refer to **Appendix C**), the building damage and human comfort vibration criteria will easily be met during construction.

7.6 Traffic Noise

Traffic generated by the project during its construction phase has been evaluated in *Paling Yards Wind Farm Traffic Impact Assessment* prepared by SLR Consulting Pty Ltd, dated 13 July 2022.

The assessment completed some traffic volume tube counts on Abercrombie Road in the vicinity of the project site and found existing traffic was approximately 25 vehicles per hour during the peak.

The traffic report anticipates that daily traffic generation of approximately of 20 trips per day could be expected from the project during the construction phase, with approximately 7 trips during the peak hour.

The projected increase in road traffic noise levels on all local roads may potentially be greater than 2 dBA during peak construction periods, however, road traffic noise levels are anticipated to comply with the *Road Noise Policy* (RNP) target for a local road of daytime $L_{Aeq(1\ hour)}$ = 55 dBA at setback distances of greater than 50 m. We note that being a rural farming community that most receptors are at much greater setback distances from the road and therefore will easily meet the RNP requirement.

7.7 Night-time deliveries

There could potentially be deliveries of equipment scheduled for out of hours, necessitated by traffic congestion considerations and safe passage of heavy vehicle convoys or especially long loads. Night-time traffic has the potential to cause sleep disturbance to residential receivers along the route.

Preliminary calculations indicate that maximum noise levels at a residence approximately 50 metres from the road as a result of a heavy vehicle pass-by would be in the range 45-55 dBA. Assuming a 10 dBA transmission loss through an open window this would result in 35 to 45 dBA inside.

The NSW RNP states that:

> *Maximum internal noise levels below 50-55 dBA are unlikely to awaken people from sleep*

and

> *One or two noise events per night, with maximum internal levels of 65-70 dBA are not likely to affect health and wellbeing significantly.*

In order to further minimise potential noise impacts associated with night-time deliveries some potential measures to be considered are:

- Prior notification of affected public where night-time convoys are scheduled
- Restricted use of exhaust/engine brakes in built up areas

8 Conclusion

8.1 Wind Farm Noise

Noise from the proposed Palings Yard Wind Farm using a layout of 47 WTGs (GE158 – 6.1MW) has been predicted. The predicted noise levels were assessed against the relevant criteria prescribed by the SA EPA Guideline and World Health Organisation (WHO) goals where appropriate.

The predicted noise levels of the base layout where all WTG's operated at their full noise emission level (107 dBA Sound Power Level) indicates that:

- Non-involved receptors 3 and 4 marginally exceed the minimum SA EPA Guideline criteria of 35 dBA.
- Project-involved receptors 6A, 7, 7A, 8, 8A, 9, 9A and 9B, exceed the WHO criteria of 45 dBA.
- No significant noise impacts are anticipated for amenity and/or passive recreational uses within the Abercrombie National Park based on a comparison of the predicted noise levels against appropriate noise guideline levels from the *NPfI*.

An iterative predictive noise optimisation procedure was undertaken in which up to 16 WTG's, closest to those receptors where exceedances were predicted, were placed into a reduced Noise Management Mode (NMM 104 and NMM 101), which reduces the sound power output of those turbines compared to standard NMM 107 operation. The Mitigated Layout was shown to meet the relevant criteria at all receptors.

8.2 Substation Noise

Noise predictions for the transformer and substation location options indicate that the minimum night-time NSW *NPfI* limit will be met at all receptors.

8.3 Construction Noise and Vibration

Construction noise has been predicted for a number of key activities to all nearby receptors; a number of these are deemed 'noise affected' under the NSW Interim Construction Noise Guidelines.

In order to ensure all appropriate measures are being taken to manage construction noise, a more detailed construction management plan should be developed by the proponent. This document will provide detailed guidance on various noise mitigation strategies for the construction stage.

Vibration impacts from key construction activities have been assessed and the 'worst case' scenarios modelled were found to be acceptable.

Construction traffic noise impact has been assessed and the 'worst case' maximum construction traffic scenario would comply to the NSW RNP requirements, due to the typically large setback of dwellings from the road network. Night-time deliveries are unlikely to cause sleep disturbance based on predicted maximum noise levels.

Appendix A:

Glossary

Glossary

Term	Description
'A' weighted	A frequency adjustment which represents how humans hear sounds.
ABL	Assessment Background Level. The single-figure background level representing each assessment period (day, evening and night). Defined in the *Noise Policy for Industry*.
Ambient noise level	The all-encompassing sound associated with an environment or area.
Background creep	The incremental increase in background noise levels over time as new developments are built in an area.
dB	Decibel
dBA	'A' weighted decibel
DW	The weighted level difference between two rooms, that is, the on-site sound insulation between two spaces.
Facade affected	A monitoring location which is influenced by facade reflections. Measurements at facades are typically taken at a distance of 1 m away and the measured noise level generally regarded as being +2.5 dB higher than 'free field'.
Free field	A monitoring location where the microphone is positioned sufficiently far from nearby surfaces for the measured data to not be influenced by reflected noise.
Hz	Hertz
Impulsive noise	Noise with a high peak of short duration, or sequence of peaks.
Intermittent noise	Noise which varies in level with the change in level being clearly audible
L_{90} , L_{10}, etc.	Statistical exceedance levels, where LN is the sound pressure level exceeded for N% of a given measurement period.
L_{AE} (or SEL)	Sound Exposure Level. This is the constant sound level that has the same amount of energy in one second as the original noise event.
LA_{eq}	The 'A' weighted equivalent noise level. It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.
L_{Amax}	The A' weighted maximum sound pressure level of an event.
Term	Description
Low frequency	Noise containing energy in the low frequency range.
L_P or SPL	Sound Pressure Level
Lw or SWL	Sound Power Level
Noise logger	A self-contained, battery powered item of equipment that is used to measure noise levels over several days.
Noise reduction	The difference in sound pressure level between any two areas.
NR noise rating	Single number evaluation of the background noise level in a space. The NR level is typically around 5 to 6 dB below the 'A' weighted noise level.
Octave-band	A frequency band where the highest frequency is twice the lowest frequency.
Offensive noise	Noise that is considered harmful or which interferes unreasonably with affected receivers.
PNTL	Project Noise Trigger Levels. Target noise levels for a particular noise generating development.
RBL	Rating Background Level. The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period. Defined in the *Noise Policy for Industry*.
Steady state noise	Noise which remains relatively constant in level over time, as opposed to time-varying noise which fluctuates over time.
Time weighting	Sound level meters can be set to 'fast' or 'slow' response. 'Fast' corresponds to a 125 ms time constant and 'slow' corresponds to a 1 second time constant.
Tonality	Noise containing a prominent frequency.
Transmission loss (or sound transmission loss or sound reduction index)	A test which rates the sound transmission properties of a wall, floor or roof construction.

Appendix B:

Baseline Noise Monitoring

Location 4

Location 4 is a non-involved receptor located to the north-east of the proposed wind farm, approximately 2 km from the nearest WTG. The monitoring location is shown in **Figure 6**.

Figure 6 Location 4 measurement location

Looking North

Looking East

Looking South

Looking West

★ Measurement

☆ Receptor

The results of the background noise monitoring showing the LA90 data points, excluded data points due to rain and high frequency extraneous noise (frogs) and regression line of best fit and criteria curve are shown in **Figure 7**

Figure 7 Location 4 - Background Noise Measurements

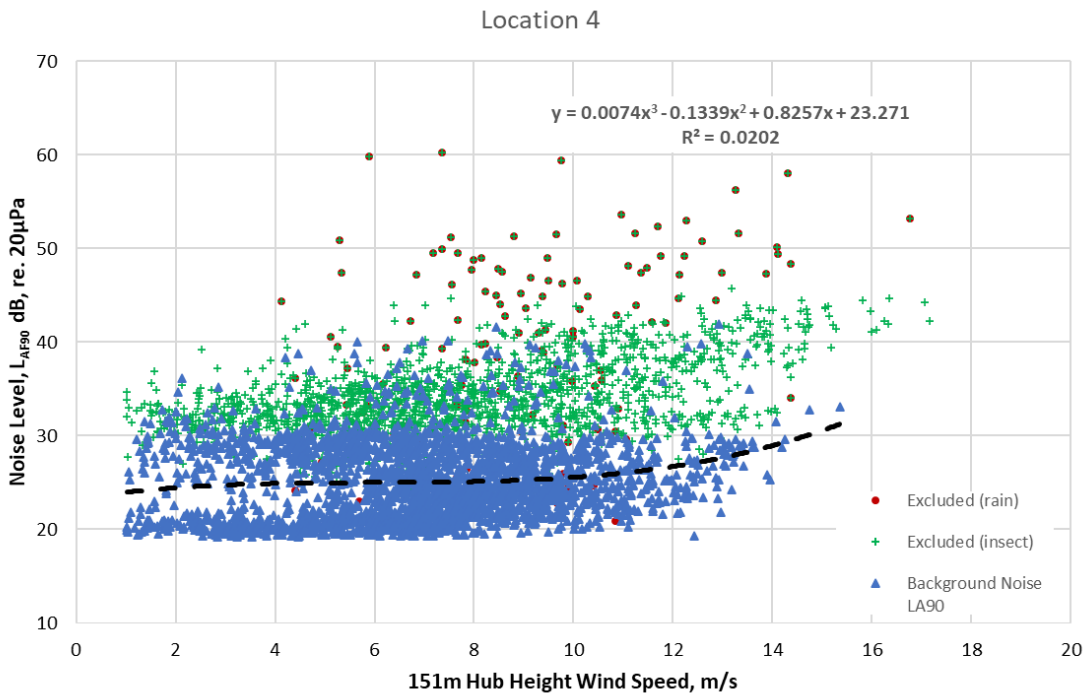
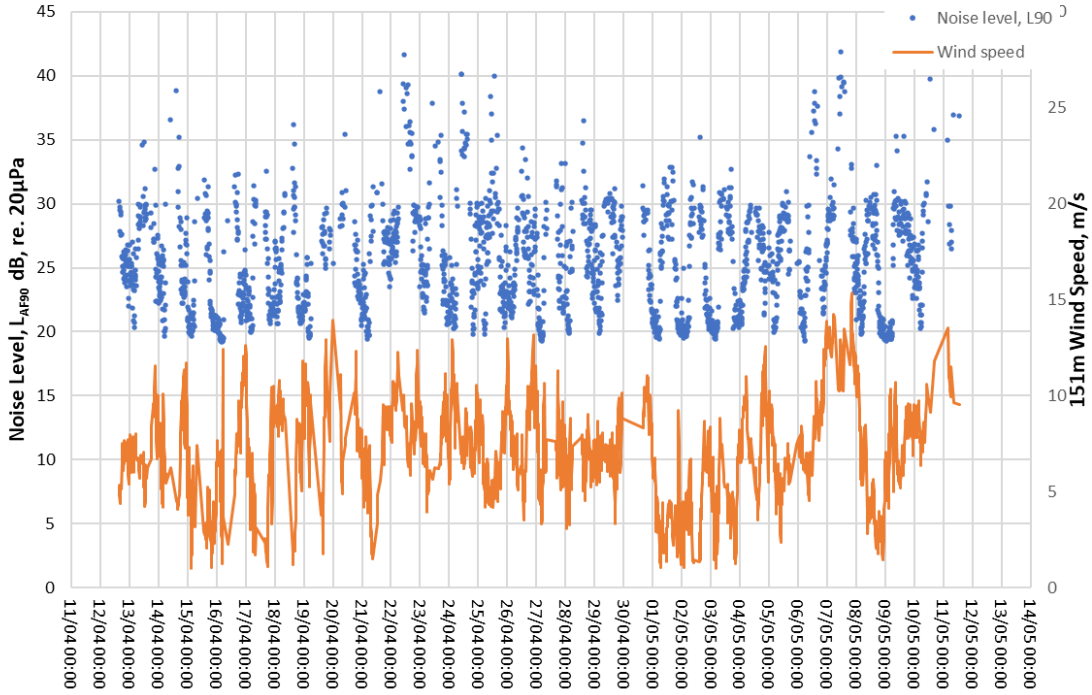


Figure 8 Time history of measured LA90,10-min at Location 4



Location 6A

Location 6A is a project-involved receptor, currently an unoccupied cottage, located within the north-eastern portion of the proposed wind farm, approximately 500 m from the nearest WTG. The monitoring location is shown in **Figure 6**.

Figure 9 Location 6A measurement location

Looking North

Looking East

Looking South

Looking West

Measurement

Receptor

The results of the background noise monitoring showing the LA90 data points, excluded data points due to rain and high frequency extraneous noise (frogs) and regression line of best fit and criteria curve are shown in **Figure 10**.

Figure 10 Location 6A - Background Noise Measurements

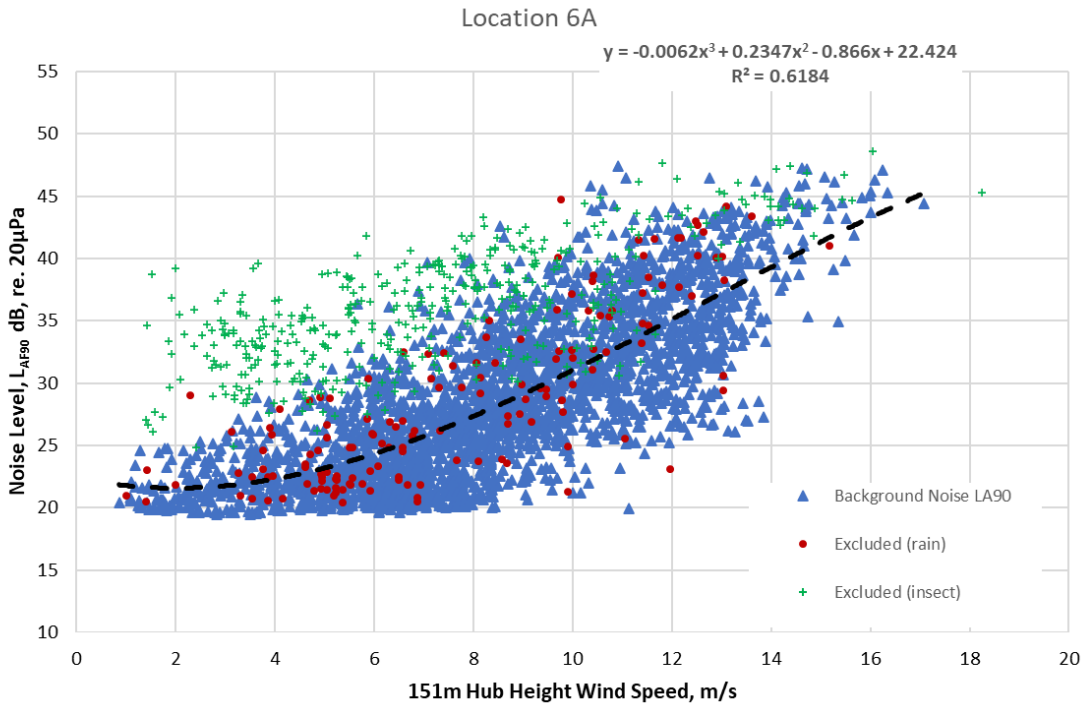
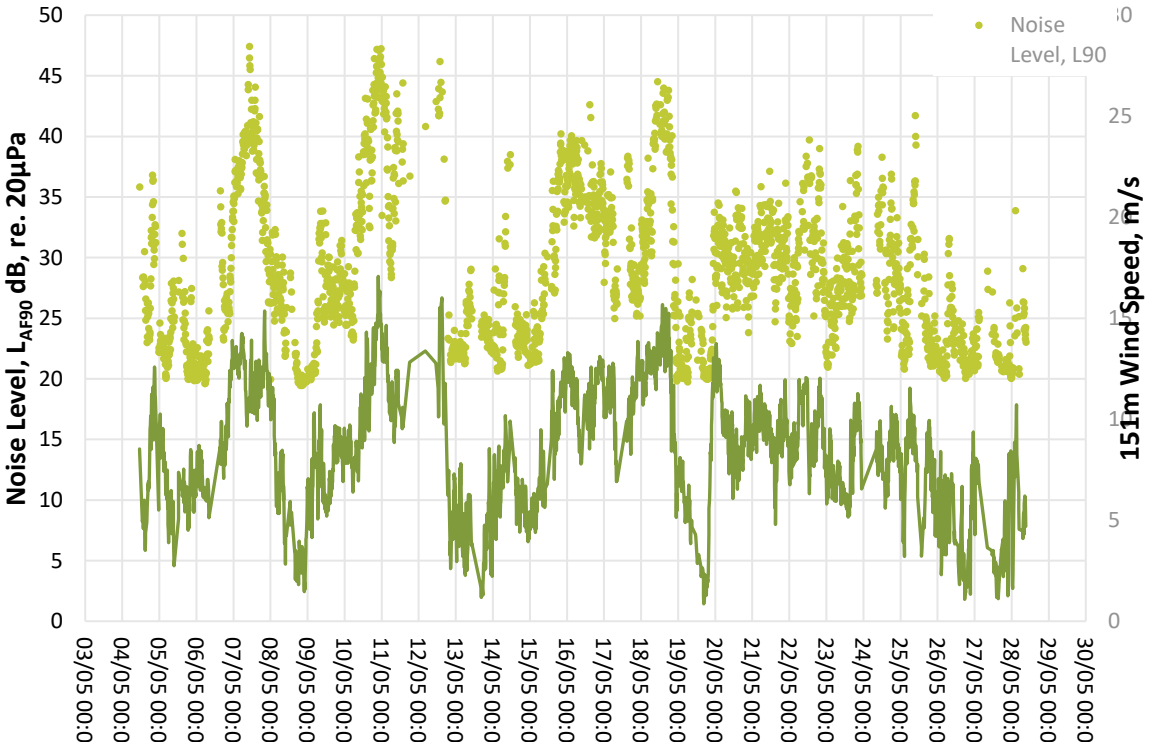


Figure 11 Time history of measured $L_{A90,10\text{-}min}$ at Location 6A



Location 7

Location 7 is a project-involved receptor, located within the northern portion of the proposed wind farm, approximately 500 m from the nearest WTG. The monitoring location is shown in **Figure 12**.

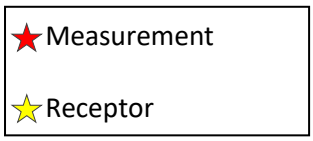
Figure 12 Location 7 measurement location

Looking North

Looking East

Looking South

Looking West



The results of the background noise monitoring showing the LA90 data points, excluded data points due to rain and high frequency extraneous noise (frogs) and regression line of best fit and criteria curve are shown in **Figure 13**.

Figure 13 Location 7 - Background Noise Measurements

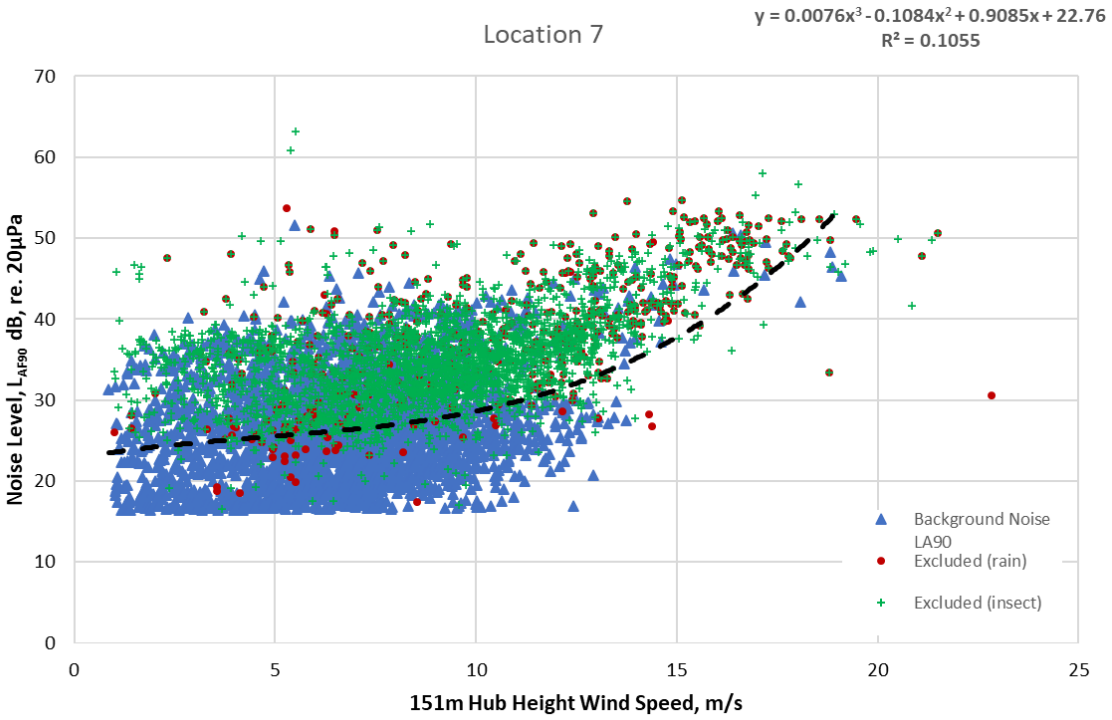
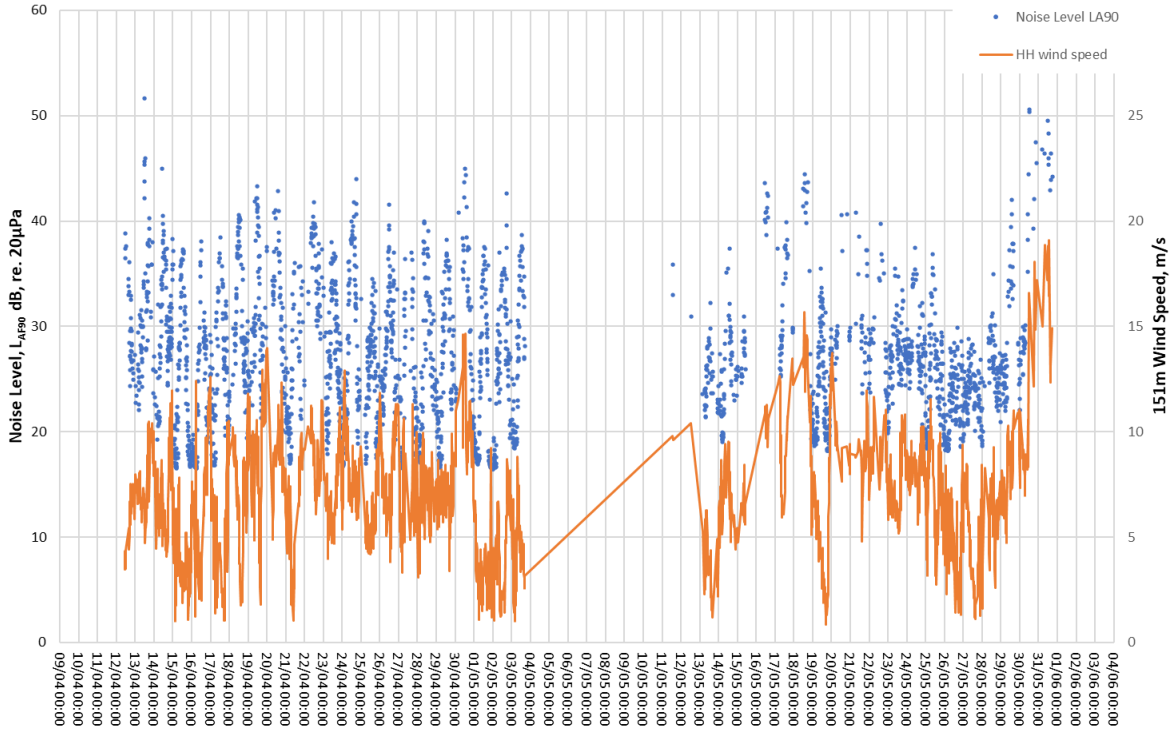


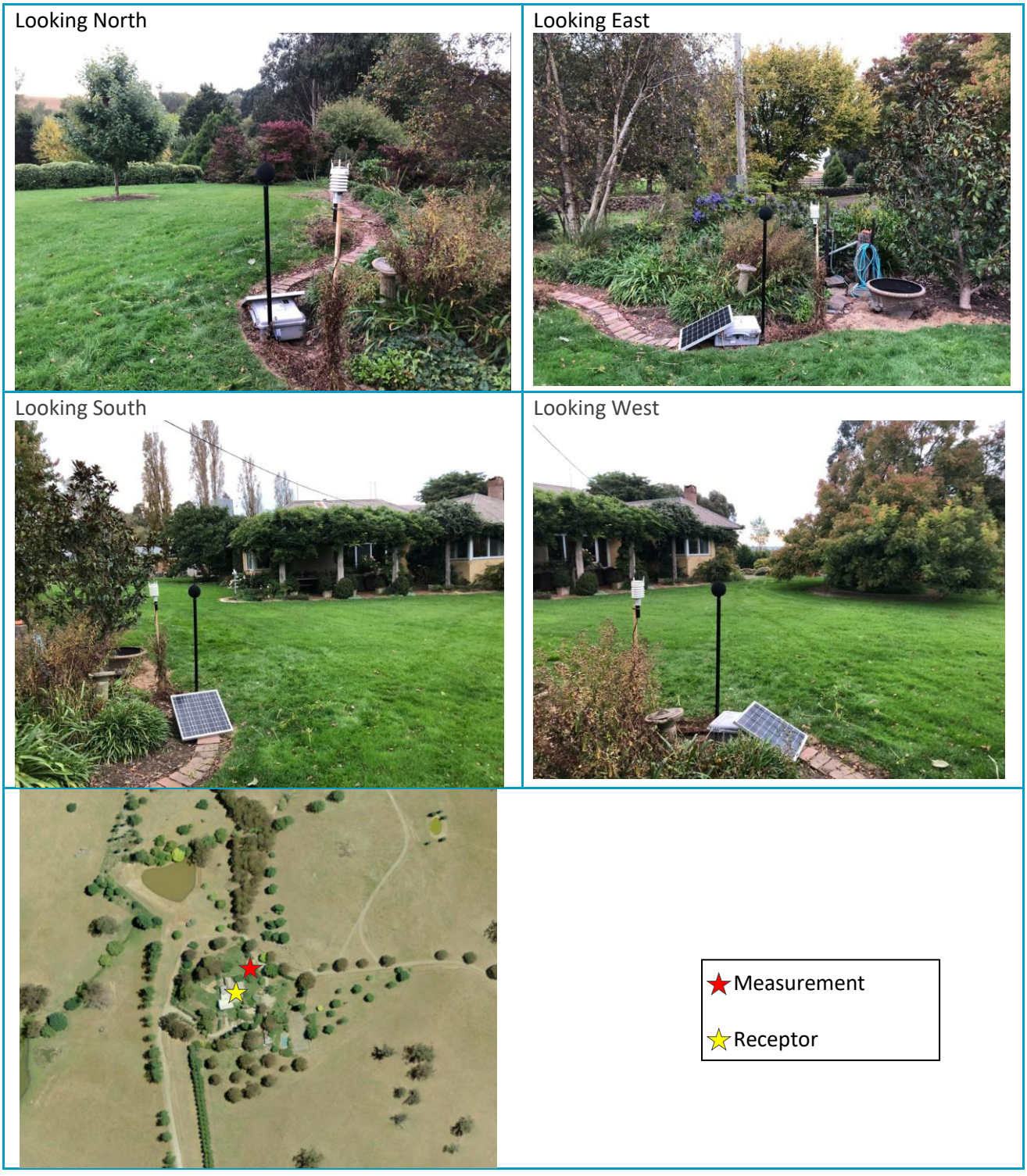
Figure 14 Time history of measured LA90,10-min at Location 7



Location 8

Location 8 is a project-involved receptor, located within the northern portion of the proposed wind farm, approximately 500 m from the nearest WTG. The monitoring location was selected to be sufficiently far from domestic noise sources as well as a garden fish / frog pond, and is shown in **Figure 15**.

Figure 15 Location 8 measurement location



The results of the background noise monitoring showing the LA90 data points, excluded data points due to rain and high frequency extraneous noise (frogs) and regression line of best fit and criteria curve are shown in **Figure 16**.

Figure 16 Location 7 - Background Noise Measurements

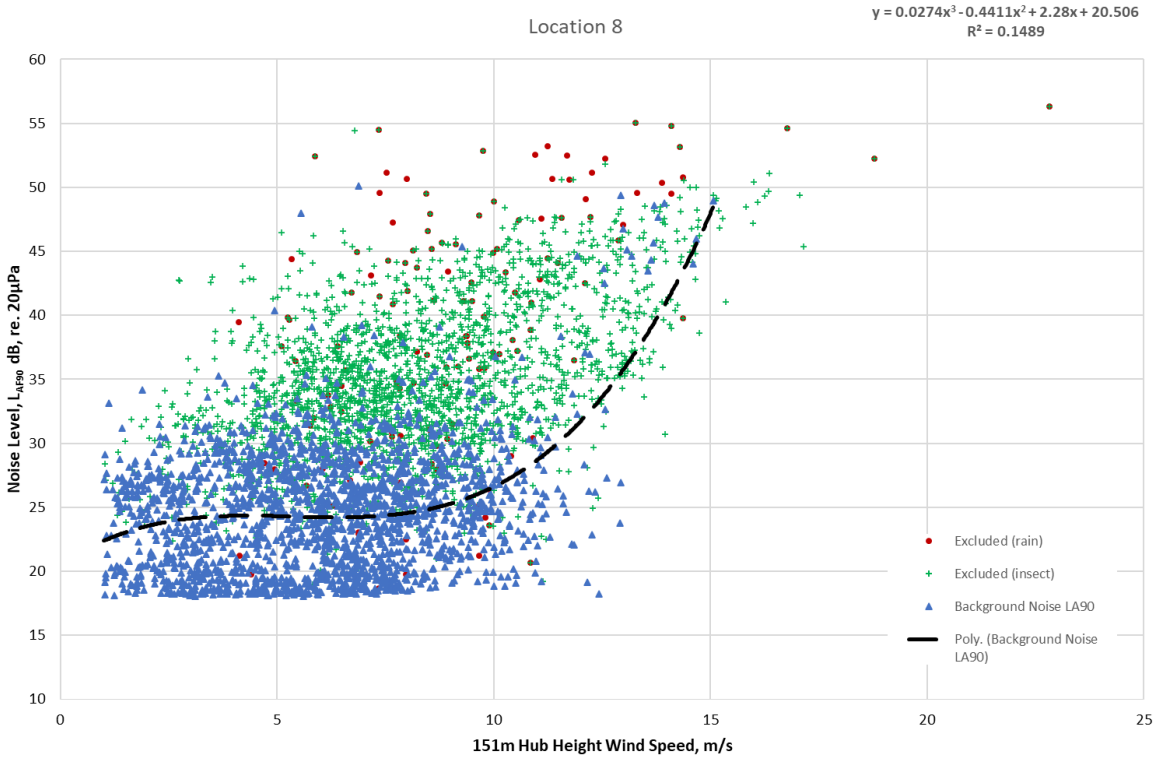
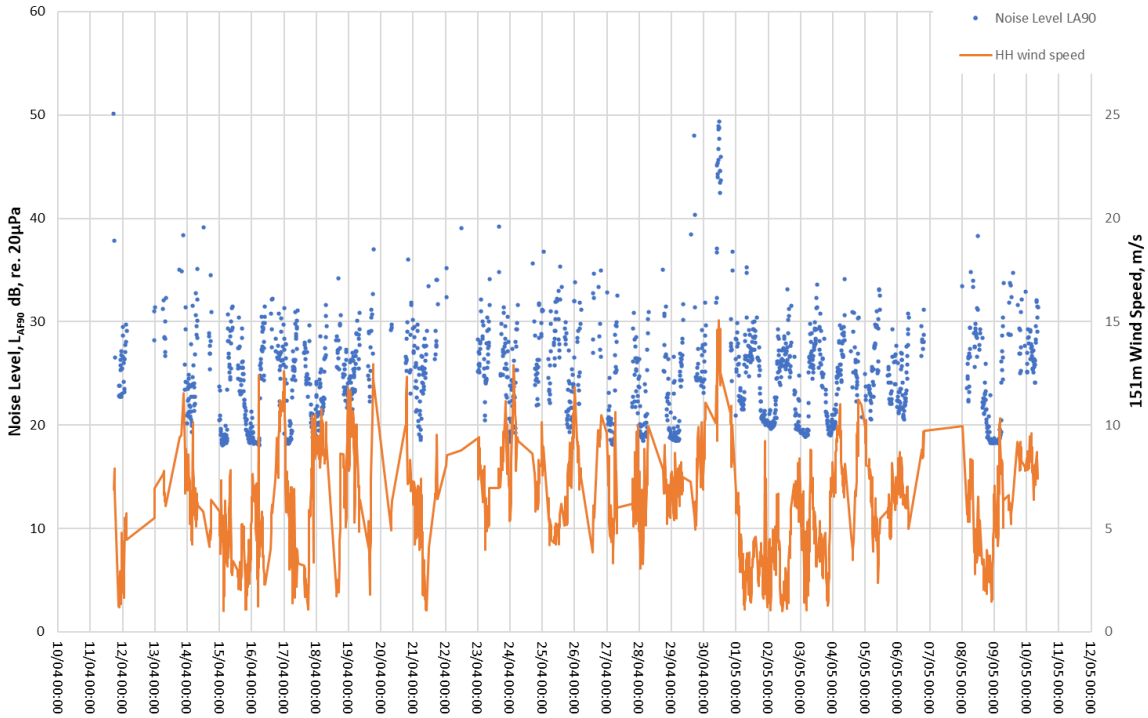


Figure 17 Time history of measured $L_{A90,10\text{-}min}$ at Location 7



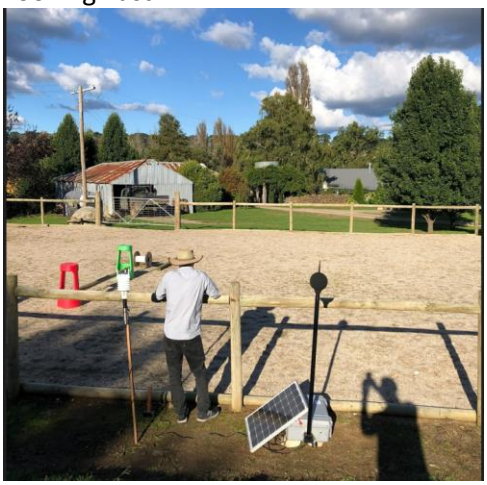
Location 9

Location 9 is a project-involved receptor, located within the northern portion of the proposed wind farm, approximately 500 m from the nearest WTG. The monitoring location was selected as it was midway between two dwellings and sufficiently far from a garden water feature and pump to not influence noise. The location is shown in **Figure 18**.

Figure 18 Location 9 measurement location

Looking North

Looking East



Looking South

Looking West

★ Measurement

☆ Receptor

The results of the background noise monitoring showing the LA90 data points, excluded data points due to rain and high frequency extraneous noise (frogs) and regression line of best fit and criteria curve are shown in **Figure 19**.

Figure 19 Location 9 - Background Noise Measurements

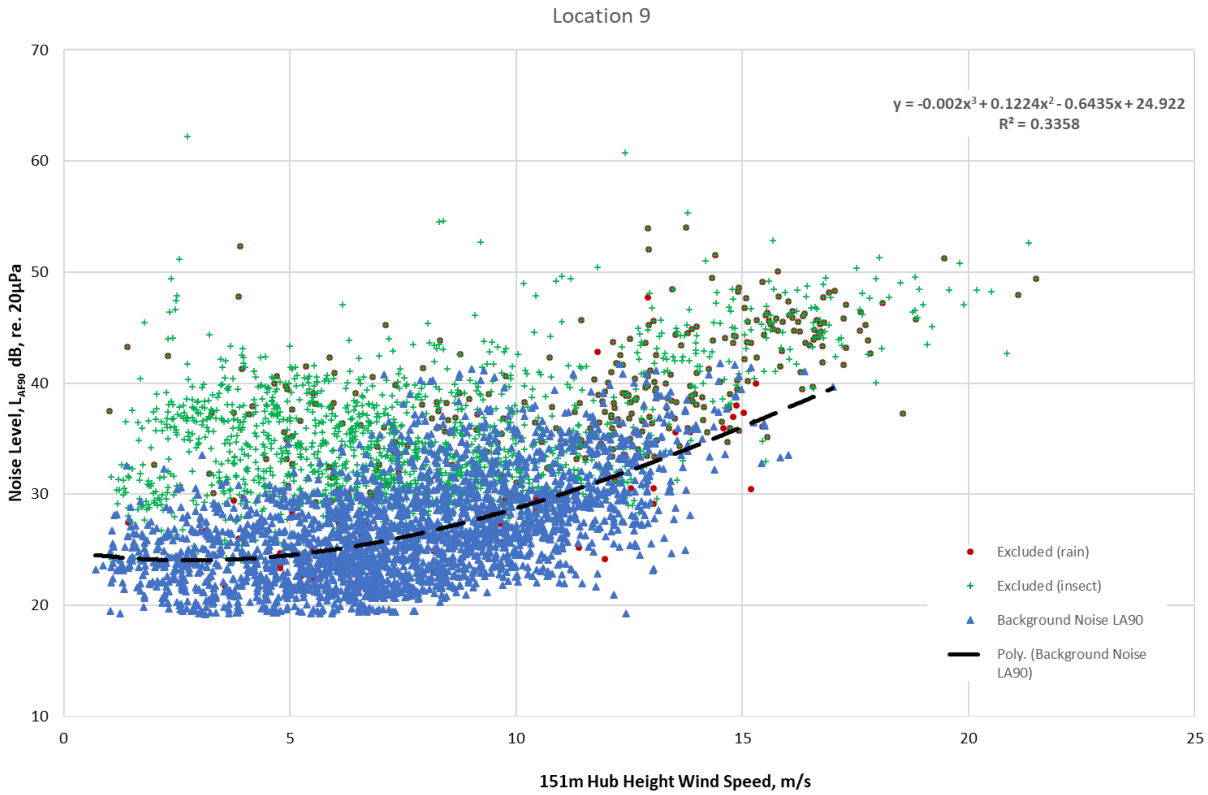
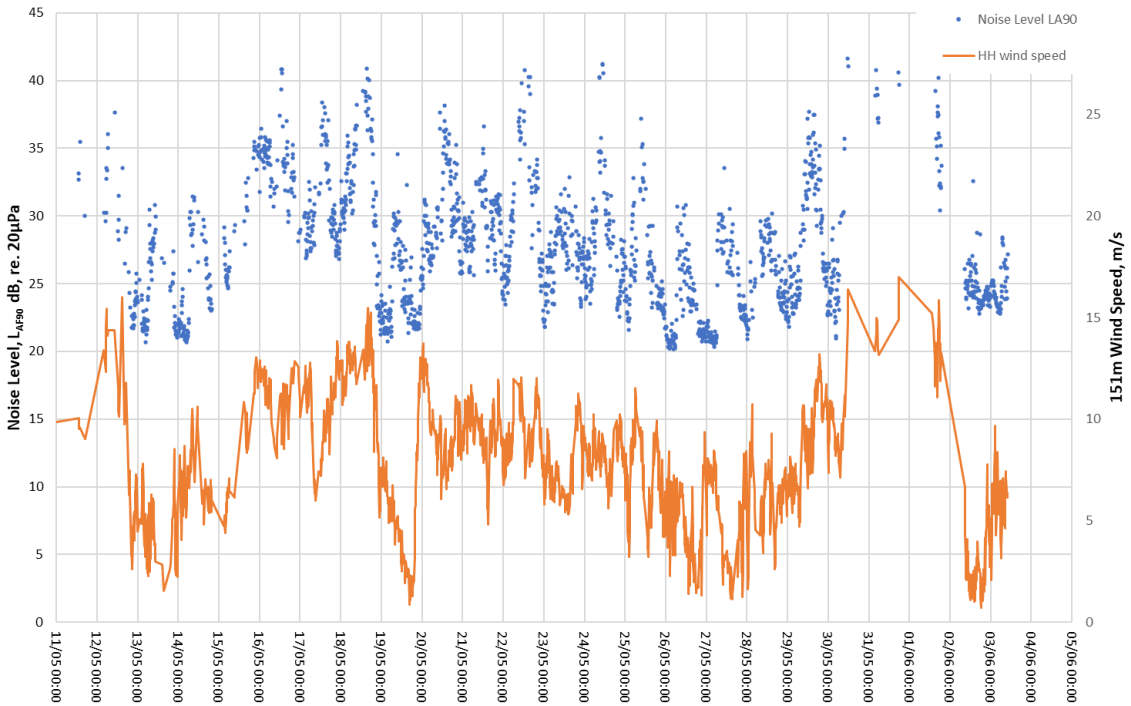
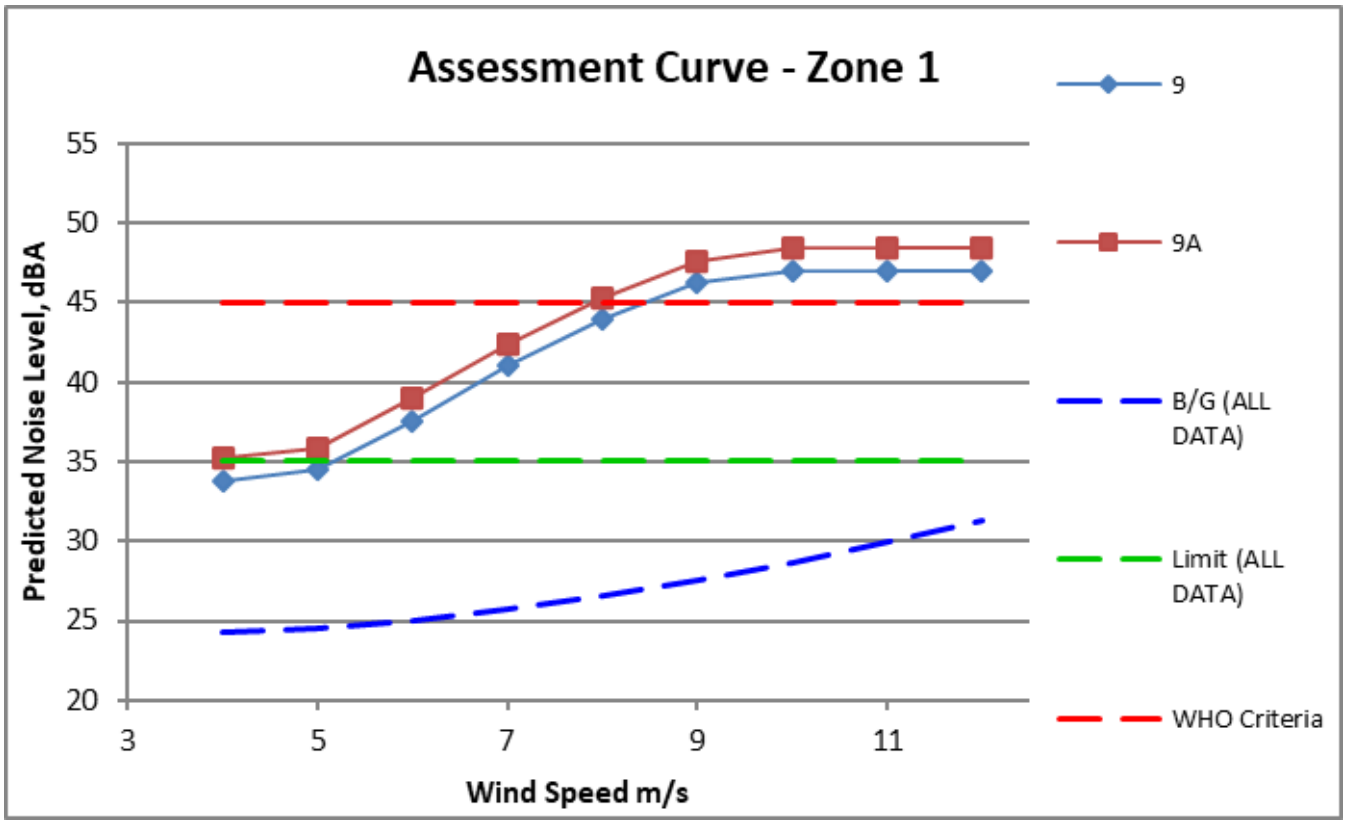


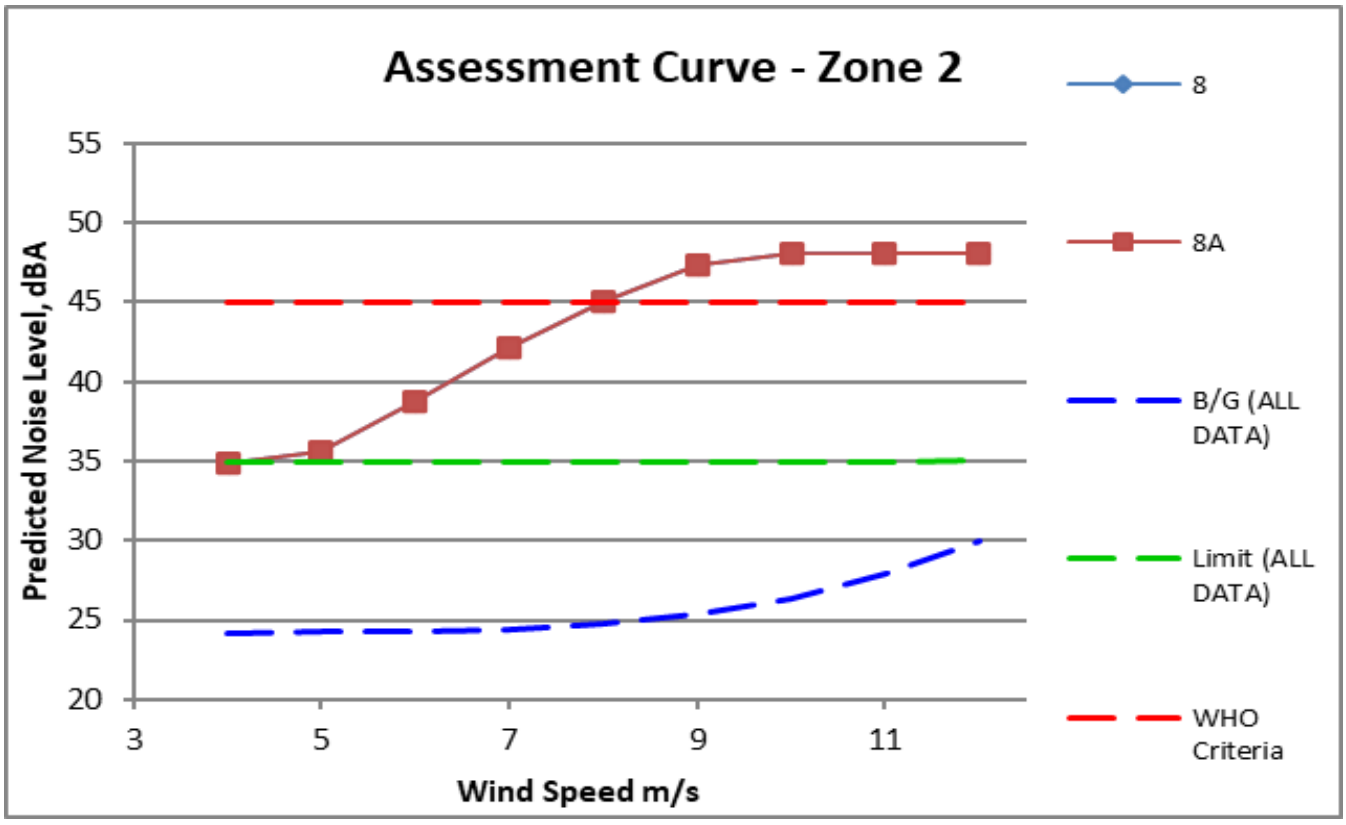
Figure 20 Time history of measured $L_{A90,10\text{-min}}$ at Location 9

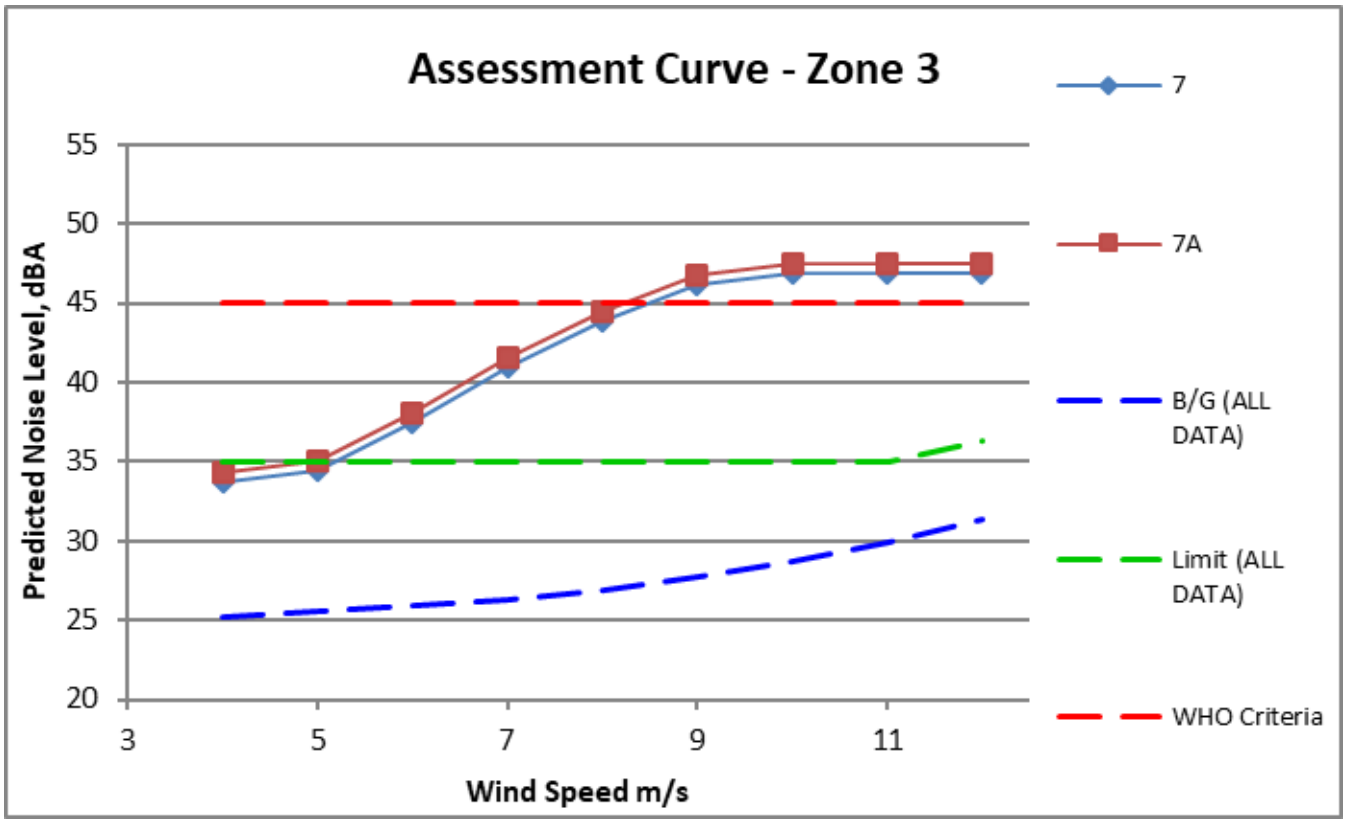


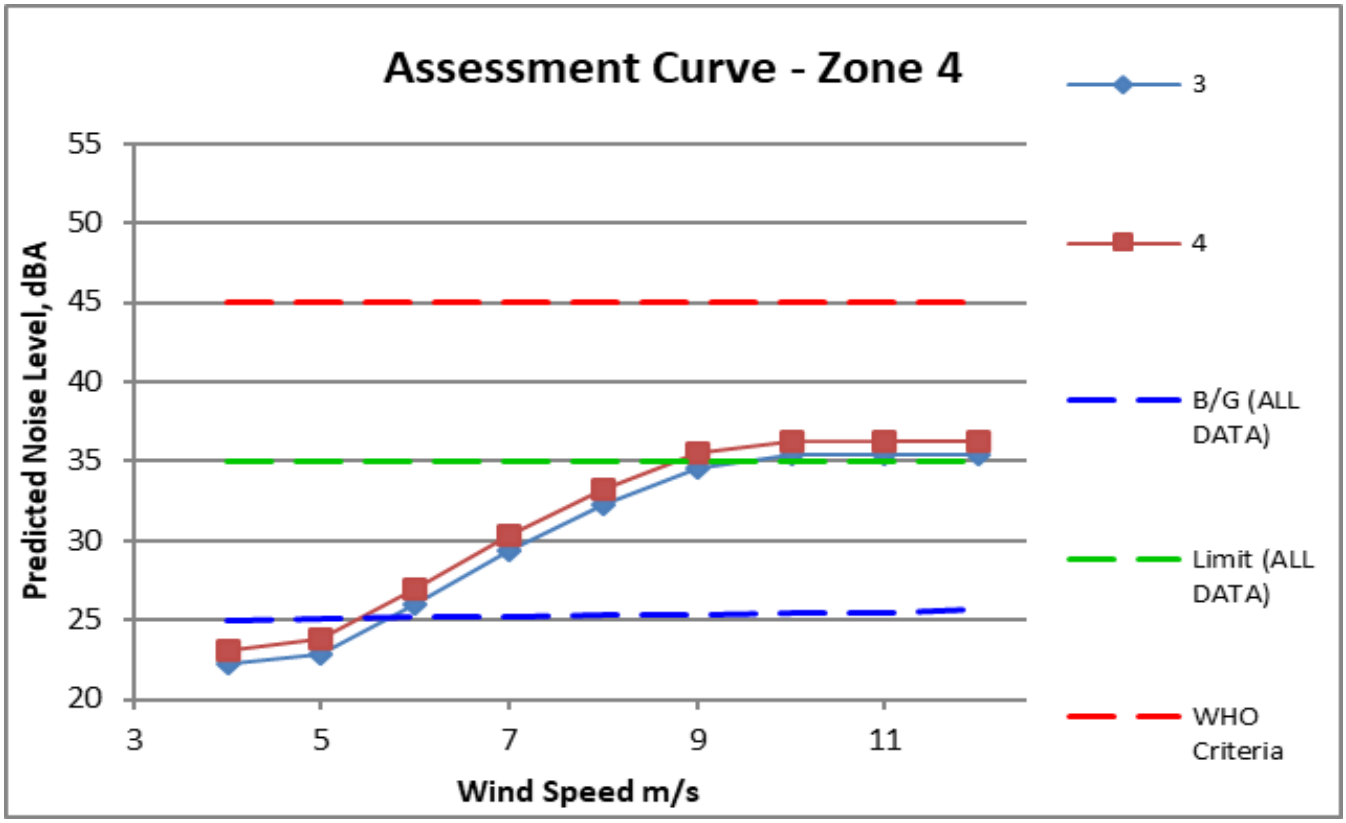
Appendix C:

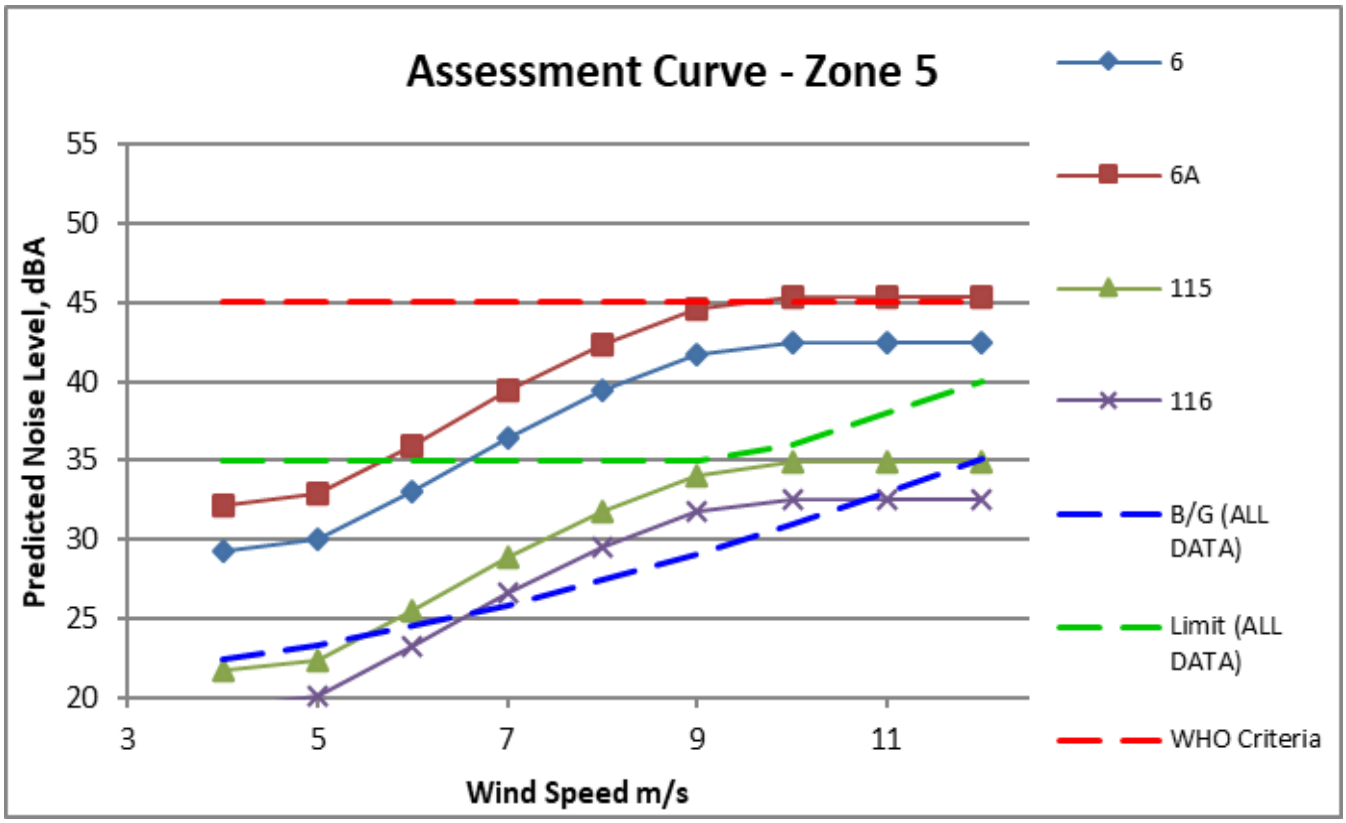
Noise Assessment Graphs – 47 WTG base layout


Assessment Curve - Zone 1
Predicted Noise Level, dBA
55
50
45
40
35
30
25
20
3
5
7
9
11
Wind Speed m/s
9
9A
B/G (ALL DATA)
Limit (ALL DATA)
WHO Criteria


Assessment Curve - Zone 2
Predicted Noise Level, dBA
55
50
45
40
35
30
25
20
3
5
7
9
11
Wind Speed m/s
8
8A
B/G (ALL DATA)
Limit (ALL DATA)
WHO Criteria

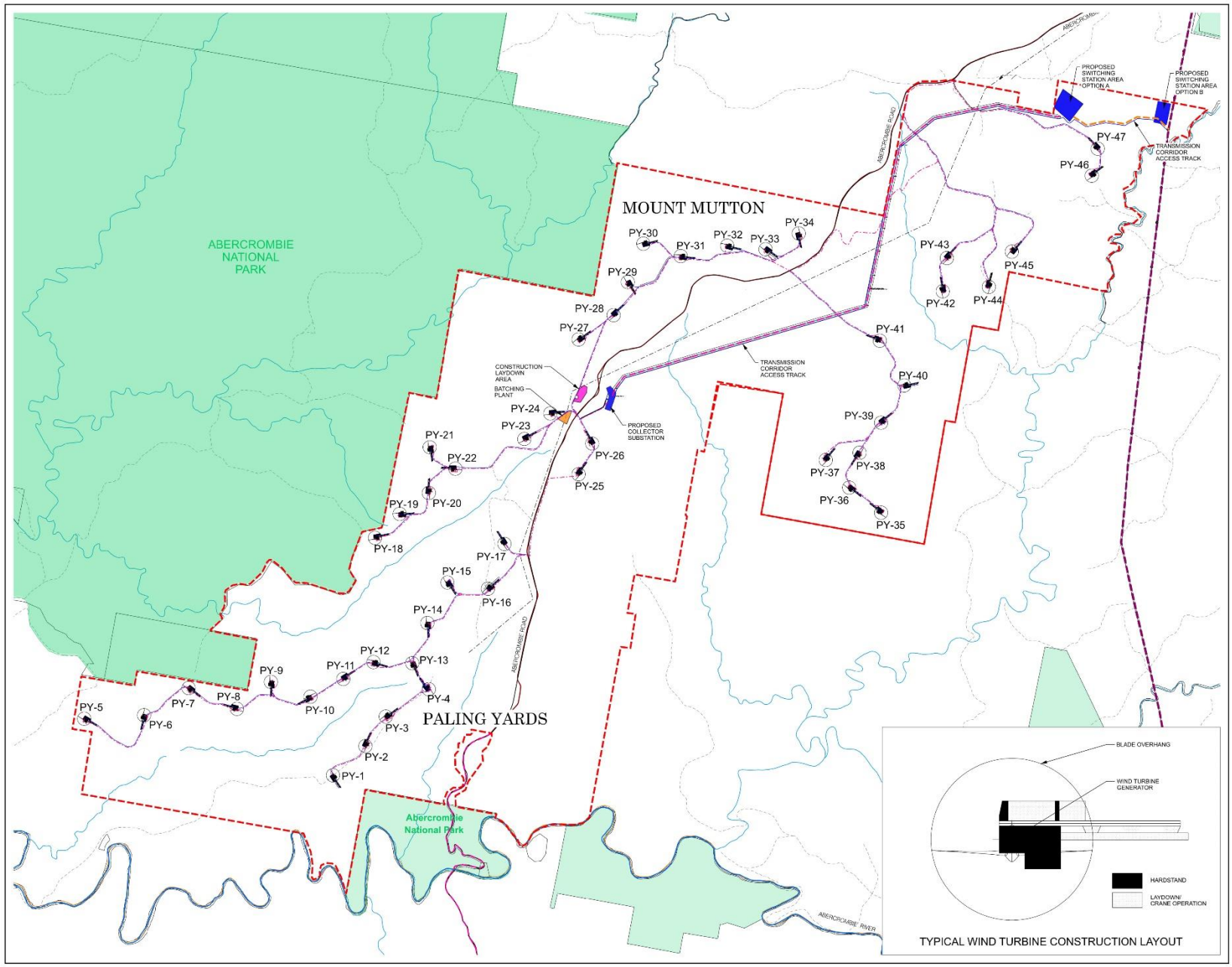

Assessment Curve - Zone 3
Predicted Noise Level, dBA
55
50
45
40
35
30
25
20
3
5
7
9
11
Wind Speed m/s
7
7A
B/G (ALL DATA)
Limit (ALL DATA)
WHO Criteria


Assessment Curve - Zone 4
Predicted Noise Level, dBA
55
50
45
40
35
30
25
20
3
5
7
9
11
Wind Speed m/s
3
4
B/G (ALL DATA)
Limit (ALL DATA)
WHO Criteria


Assessment Curve - Zone 5
Predicted Noise Level, dBA
55
50
45
40
35
30
25
20
3
5
7
9
11
Wind Speed m/s
6
6A
115
116
B/G (ALL DATA)
Limit (ALL DATA)
WHO Criteria

Appendix D:

Construction Plan Layout



GENERAL NOTES

1. DO NOT SCALE DRAWINGS. FIGURED DIMENSIONS HAVE PREFERENCE OVER SCALED DIMENSIONS.
2. ANY DISCREPANCIES MUST BE REPORTED IMMEDIATELY TO THE SUPERINTENDENT.
3. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE DETAILS, SPECIFICATIONS AND ENGINEERING DOCUMENTS.
4. LOCATE AND PROTECT ALL UNDERGROUND SERVICES PRIOR TO ANY EXCAVATION. MAKE GOOD ALL DAMAGE TO EXISTING WORKS CAUSED BY THE ACTIVITY OF THESE WORKS.
5. THESE DRAWINGS ARE TO BE PRINTED IN COLOUR.

LEGEND

- Parcel
- Proposed Site Boundary
- Township
- Proposed WTG Location
- Proposed Access Track
- Proposed Transmission Line Access Track
- Proposed Construction Laydown Area
- Proposed Batching Plant
- National Park
- River / Creek

TRANSMISSION LINES

- 500KV Power Transmission
- Proposed 500KV Extension
- Proposed 132KV Transmission
- Proposed 33KV Reticulation
- Proposed Substation
- Rural Distribution Line
- 33kV Distribution Line Proposed

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRN	CHKD
A	PRELIMINARY	28.11.22	D.S.	L.S.
B	PRELIMINARY	23.1.23	D.S.	L.S.
C	PRELIMINARY	05.05.23	D.S.	L.S.

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PROJECT
PALING YARDS WIND FARM

CLIENT
GLOBAL POWER GENERATION AUSTRALIA PTY LTD

DRAWING TITLE
PRELIMINARY CONSTRUCTION PLAN

DRAWING NUMBER	REVISION
220-0052-00-P-02-2D09	C

DRAWN	CHECKED	APPROVED	DATE
D.S.	L.S.	L.S.	05.05.23

SCALE 1:20000 @ A1
0 200 400 1000m

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