Appendix C

Noise Assessment and Pre-Construction Wind Turbine Noise Assessment

MARSHALL DAY Acoustics

NORMANVILLE ENERGY PARK
ENVIRONMENTAL NOISE ASSESSMENT

Rp 001 R03 20221016 | 12 May 2025

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EXECUTIVE SUMMARY

This report presents the results of an environmental noise assessment for the Normanville Energy Park, which is proposed to be developed by WestWind Energy Development Pty Ltd (proponent).

The assessment is based on the proposed wind farm comprising 17 multi-megawatt wind turbines and a transformer station.

The planning application for the wind farm seeks approval to develop wind turbines with a maximum tip height of up to 280 m. The actual wind turbine which would be used at the site would be determined at a later stage in the project, after the planning approval has been granted. The final selection would be based on a range of design requirements including achieving compliance with the planning permit noise limits at surrounding noise sensitive locations (receivers). In advance of a final selection, this assessment considers 3 candidate wind turbine models that are representative of the size and type of wind turbine which could be used at the site. For this purpose, the Vestas V172-7.2MW, Vestas V162-6.8MW and GE 6.0-164 models, all modelled with a hub height of 150 m, have been nominated by the proponent.

Operational noise from the proposed wind turbines has been assessed in accordance with the New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808), as required by the Victorian Department of Transport and Planning publication *Planning Guidelines for Development of Wind Energy Facilities* dated September 2023 and the *Environment Protection Regulations 2021*. The operational wind farm noise assessment considers the base (minimum) noise limits determined in accordance with NZS 6808, accounting for the land zoning of the area.

Manufacturer specification data for the candidate wind turbine models have been used as the basis for the assessment. The specification documents provide noise emission data in accordance with the international standard referenced in NZS 6808. The noise emission data is consistent with the range of values expected for comparable types of multi megawatt wind turbine models that are being considered for the site.

The noise emission data has been used with international standard ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2) to predict the level of noise expected to occur at neighbouring receivers. The ISO 9613-2 standard has been applied using well-established input choices and adjustments, based on research and international guidance, that are specific to wind farm noise assessment.

The results of the noise modelling demonstrate that the predicted noise levels for the proposed wind turbine layout and candidate wind turbine models achieve the base noise limits determined in accordance with NZS 6808 at all neighbouring receivers.

Consideration was also given to the potential cumulative noise considerations of the proposed Cannie and Meering West wind farm developments. The assessment demonstrates that the cumulative noise considerations are not relevant to the interface with the proposed Cannie Wind Farm. In relation to the proposed Meering West Wind Farm, there is significant scope within the limits to accommodate the potential noise contribution of the proposed turbines.

The assessment has also considered operational noise for the transformer station proposed to be located approximately 3.9 km to the north of the wind farm, adjacent to the approved Koorangie Energy Storage System.

The *Environment Protection Regulations 2021* (EP Regulations) require operational noise of the transformer station to be assessed in accordance with EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, dated May 2021 (Noise Protocol). The assessment demonstrates that the transformer station can be designed and operated to achieve the noise limits determined in accordance with the Noise Protocol, including consideration of other existing and approved industry developments in the area.

As required by the *Environment Protection Act 2017,* consideration was also given to the general environmental duty.

The noise assessment therefore demonstrates that the proposed Normanville Energy Park can be designed and developed to achieve Victorian policy requirements.

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1.0 INTRODUCTION

WestWind Energy Development Pty Ltd (proponent) is proposing to develop a wind farm known as Normanville Energy Park (Project) within the Gannawarra Shire region of Victoria, approximately 14 km west of Kerang.

This report presents the results of an assessment of operational wind turbine noise in accordance with the New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808), as required by the *Environment Protection Regulations 2021* (EP Regulations) and the Victorian Department of Transport and Planning publication *Planning Guidelines for Development of Wind Energy Facilities* dated September 2023 (Victorian Wind Energy Guidelines).

Operational noise of the proposed transformer station is assessed in accordance with EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* dated May 2021 (Noise Protocol), as required by the EP Regulations. The general environment duty, introduced by the *Environment Protection Act 2017* (EP Act), must also be considered.

The wind farm noise assessment presented in this report is based on:

- operational noise limits determined in accordance with NZS 6808 and the Noise Protocol, accounting for local land zoning
- predicted noise levels for the proposed wind turbines, based on the proposed site layout and 3 candidate turbine models that are representative of the size and type of turbine that the planning application seeks consent for
- predicted operational noise levels for the proposed transformer station, based on empirical noise emission data
- a comparison of the predicted noise levels with the applicable base noise limits determined in accordance with NZS 6808 and the Noise Protocol.

Acoustic terminology used in this report is presented in Appendix A. For simplicity, the term *noise sensitive receiver* (receiver) is used throughout this report when referring to any location where an assessment of noise is required. However, the details and types of receivers which must be considered are specific to the source of noise being assessed.

2.0 PROJECT DESCRIPTION

The wind farm is proposed to comprise:

- up to 17 wind turbines
- a transformer station.

The coordinates of the proposed wind turbines and transformer station are tabulated in Appendix B.

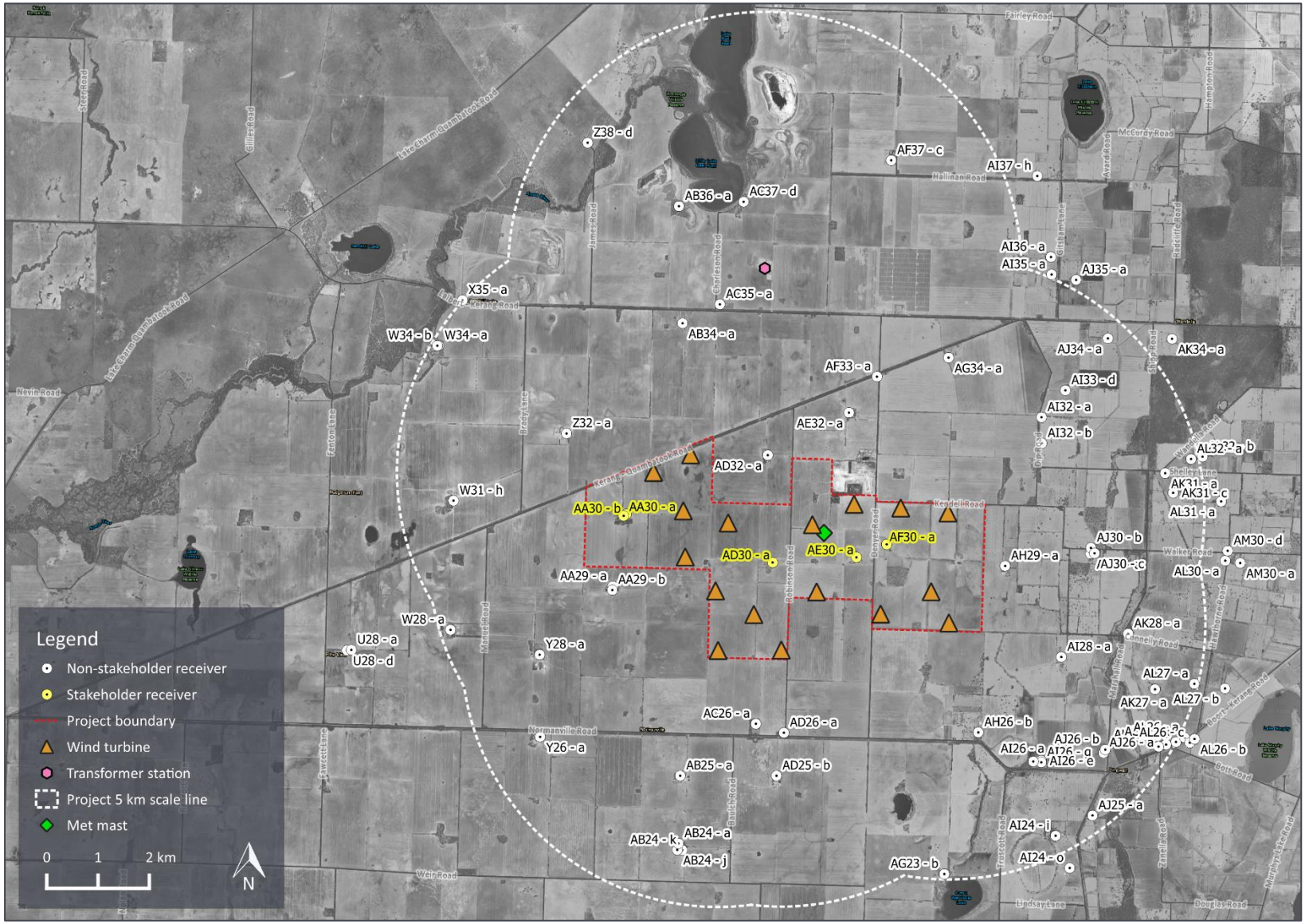
The proponent is seeking consent for a wind farm comprising wind turbines extending to a tip height of up to 280 m. Three candidate wind turbine models that are representative of the size and type of wind turbine which could be used at the site have been nominated by the proponent with rotor diameters ranging between 162 and 172 m. The assessment is based on a turbine hub height of 150 m for all candidate turbine models. Further details of the candidate wind turbine models are presented in Section 6.2.

A total of 58 receivers, located within 5 km of the proposed wind turbines and transformer station, have been considered in this noise assessment. This includes 5 receivers within the Project boundary where a noise agreement is in place or proposed between the landowners and the proponent (subsequently referred to as *stakeholder receivers* herein).

The coordinates of the receivers are tabulated in Appendix C.

A site layout plan illustrating the wind turbine layout, transformer station and receivers is provided in Figure 1.

Figure 1: Proposed wind turbine layout, transformer station and receivers



3.0 VICTORIAN LEGISLATIONS AND GUIDELINES

The following publications are relevant to the assessment of operational noise from proposed wind farm developments in Victoria:

- *Environment Protection Act 2017*
- *Environment Reference Standard*
- *Environment Protection Regulations 2021*
- Victorian Department of Transport and Planning publication *Planning Guidelines for Development of Wind Energy Facilities* dated September 2023
- New Zealand Standard 6808:2010 *Acoustics – Wind farm noise*
- EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* dated May 2021.

Details of the guidance and noise limits provided by these publications are provided below. Victorian guidelines that are relevant to the assessment are also briefly outlined in Section 3.7.

3.1 Environment Protection Act 2017

The *Environment Protection Act 2017* (EP Act) provides the overarching legislative framework for the protection of the environment in Victoria.

The EP Act establishes a general environmental duty to minimise the risks of harm to human health or the environment from pollution or waste, including noise related amenity impacts, so far as reasonably practicable.

The EP Act also prohibits the emission of unreasonable noise from commercial and industrial trade premises. Specifically, the EP Act states that:

> *A person must not, from a place or premises that are not residential premises—*
>
> *(a) emit an unreasonable noise; or*
>
> *(b) permit an unreasonable noise to be emitted*

Under the EP Act, unreasonable noise means noise that:

> *(a) is unreasonable having regard to the following—*
>
> *(i) its volume, intensity or duration;*
>
> *(ii) its character;*
>
> *(iii) the time, place and other circumstances in which it is emitted;*
>
> *(iv) how often it is emitted;*
>
> *(v) any prescribed factors; or*
>
> *(b) is prescribed to be unreasonable noise:*

Further information about noises that are prescribed to be unreasonable are separately defined in regulations made under the EP Act (see next section).

3.2 Environment Protection Regulations 2021

The *Environment Protection Regulations 2021* (the EP Regulations) give effect to the EP Act by establishing prescriptive requirements for a range of environmental considerations including noise.

The EP Regulations specify noise requirements such as assessment procedures, the types of receivers to be assessed and different time periods which must be accounted for in the assessment. Importantly, the requirements of the EP Regulations are specific to the type of noise generating activity being assessed. For example, the types of receivers which must be considered when assessing commercial and industrial noise sources are called *noise sensitive areas*. Conversely, the procedure specified in the EP Regulations for assessing wind turbine noise requires consideration of receivers called *noise sensitive locations*. While noise sensitive areas and noise sensitive locations are broadly similar, there are slight differences between the two which relate to the types of receivers which must be considered and the specific locations where the noise limits apply.

Part 5.3 Division 5 of the EP Regulations nominates NZS 6808 as the relevant standard for assessing operational wind turbine noise in Victoria, establishes a range of provisions and obligations for the assessment and management of wind turbine noise.

Specifically, the EP Regulations outline the following:

- Noise agreements

  An owner or operator of a wind energy facility may enter into a written agreement with a landowner to modify the noise limits.

  If a noise agreement is made after 1 November 2021, an increased base noise limit of 45 dB L_{A90} would apply. If a noise agreement was made prior to 1 November 2021, the noise limit can be modified as specified in the noise agreement.

- Wind energy facility operators' duties

  Regulation 131C establishes a duty to manage and review wind turbine noise by taking all applicable actions set in Division 5 of the EP Act.

  Regulation 131CA establishes a duty to comply with the noise limit (or the alternative monitoring point criterion if wind turbine noise is being assessed at an alternative monitoring point) determined in accordance with NZS 6808 and any applicable noise agreement.

  Providing that the operator of a wind farm complies with the requirements of regulations 131C and 131CA, their duty with respect to the general environmental duty under the EP Act has been addressed.

Details of the types of receivers to be assessed, the noise limits and the technical procedures for assessing compliance with the noise limits are separately defined in NZS 6808 (see further information in Section 3.4).

In accordance with the EP Regulations, noise levels from a wind farm are prescribed to be *unreasonable* for the purposes of the EP Act, if they exceed the relevant applicable noise limits.

3.3 Victorian Wind Energy Guidelines

The Victorian Department of Transport and Planning publication *Planning Guidelines for Development of Wind Energy Facilities* dated September 2023 (Victorian Wind Energy Guidelines) provide advice to responsible authorities, proponents and the community about suitable sites to locate wind energy facilities and to inform planning decisions about a wind energy facility proposal. The Victorian Wind Energy Guidelines set out:

- *a framework to provide a consistent and balanced approach to the assessment of wind energy projects across the state;*
- *a set of consistent operational performance standards to inform the assessment and operation of a wind energy facility project;*
- *guidance as to how planning permit application requirements might be met; and*
- *a framework for the regulation of wind turbine noise.*

Section 4.3.2 of the Victorian Wind Energy Guidelines outlines the application requirements for a wind energy facility. Specifically, the following written reports must be submitted to address potential noise impacts:

- *A pre-construction (predictive) noise assessment report prepared by a suitably qualified and experienced acoustician that:*
  - *reports on a pre-construction (predictive) noise assessment conducted following New Zealand Standard NZS6808:2010, Acoustics – Wind Farm Noise*
  - *provides an assessment of whether the proposed wind energy facility will comply with the noise limit for that facility*
  - *where the proposed wind energy facility will be the subject of a wind turbine noise agreement under the Environment Protection Regulations 2021, specifies the premises of the relevant landowner (including any particular buildings) to which the agreement relates and provides an assessment of whether the proposed wind energy facility will comply with the modified noise limit for that facility specified in the agreement*
  - *is prepared on the basis that the relevant noise standard will be the New Zealand Standard NZS6808:2010, Acoustics – Wind Farm Noise and includes an assessment of whether a high amenity noise limit is applicable under Section 5.3 of the standard.*
- *A report prepared by an environmental auditor appointed under Part 8.3 of the Environment Protection Act 2017 that verifies whether or not the pre-construction (predictive) noise assessment was conducted under New Zealand Standard NZS6808:2010, Acoustics – Wind Farm Noise*

Section 5 the Victorian Wind Energy Guidelines outlines the key criteria for evaluating the planning merits of a wind energy facility. The following guidance is provided in Section 5.1.2 for the assessment of noise levels from proposed new wind farm developments:

> *A wind energy facility must comply with the noise limits in the New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (the Standard).* […]
>
> *The Standard specifies a general 40 decibel limit (40 d B LA90(10mins)) for wind energy facility sound levels outdoors at noise sensitive locations, or that the sound level should not exceed the background sound level by more than five decibels (referred to as 'background sound level +5 dB'), whichever is the greater.*
>
> *Noise sensitive locations are defined in the Standard as, "The location of a noise sensitive activity, associated with a habitable space or education space in a building not on a wind farm site", and include:*
>
> - *any part of land zoned predominantly for residential use*
> - *residential land uses included in the accommodation group at clause 73.03, Land use terms of the VPP and all planning schemes*
> - *education and child care uses included in the child care centre group and education centre group at clause 73.03 of the of the VPP and all planning schemes.* […]
>
> *A 45-decibel limit is recommended for stakeholder dwellings. A stakeholder dwelling is a dwelling located on the same land as the wind energy facility, or one that has an agreement with the wind energy facility to exceed the noise limit.*
>
> *Under Section 5.3 of the Standard, a 'high amenity noise limit' may be justified in special circumstances. All wind energy facility applications must be assessed using Section 5.3 of the Standard to determine whether a high amenity noise limit is justified for specific locations, following procedures outlined in 5.3.1 of the Standard. Guidance can be found on this issue in the VCAT determination for the Cherry Tree Wind Farm.*[1]
>
> *Measurement and compliance assessment methods are set out in the Standard. The assessment must be made without relying on noise reduction operation modes to achieve compliance.*

Based on the above, receivers within the Project boundary and/or with a noise agreement are referred to herein as 'stakeholder receivers'.

[1] *Cherry Tree Wind Farm v Mitchell Shire Council* (2013)

Clause 73.03 of the Victoria Planning Provisions (VPP), as referenced above, defines *Accommodation* as *land used to accommodate persons* and lists the following uses:

- *Camping and caravan park*
- *Corrective institution*
- *Dependent person's unit*
- *Dwelling*
- *Group accommodation*
- *Host farm*
- *Residential aged care facility*
- *Residential building*
- *Residential village*
- *Retirement village*

Consideration must also be given to whether a high amenity noise limit is warranted to reflect special circumstances at specific locations.

3.4 NZS 6808

New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808) provides methods for the prediction, measurement, and assessment of sound from wind turbines. The following sections provide an overview of the objectives of NZS 6808 and the key elements of the standard's assessment procedures.

3.4.1 Objectives

The foreword of NZS 6808 provides guidance about the objectives of the noise limits outlined within the standard:

> *Wind farm sound may be audible at times at noise sensitive locations, and this Standard does not set limits that provide absolute protection for residents from audible wind farm sound. Guidance is provided on noise limits that are considered reasonable for protecting sleep and amenity from wind farm sound received at noise sensitive locations.*

The *Outcome Statement* of NZS 6808 then goes on to provide information about the objective of the standard in a planning context:

> *This Standard provides suitable methods for the prediction, measurement, and assessment of sound from wind turbines. In the context of the* [New Zealand] *Resource Management Act, application of this Standard will provide reasonable protection of health and amenity at noise sensitive locations.*

Section C1.1 of the standard provides further information about the intent of the standard, which is:

> [...] *to avoid adverse noise effects on people caused by the operation of wind farms while enabling sustainable management of natural wind resources.*

Based on the objectives outlined above, NZS 6808 addresses health and amenity considerations at noise sensitive locations by specifying noise limits which are to be used to assess wind farm noise.

3.4.2 Noise sensitive locations

The provisions of NZS 6808 are intended to protect noise sensitive locations (also generally referred to as *receivers* herein) that existed before the development of a wind farm. Noise sensitive locations are defined by the Standard as:

> *The location of a noise sensitive activity, associated with a habitable space or education space in a building not on the wind farm site. Noise sensitive locations include:*
>
> *(a) Any part of land zoned predominantly for residential use in a district plan;*
>
> *(b) Any point within the notional boundary of buildings containing spaces defined in (c) to (f);*
>
> *(c) Any habitable space in a residential building including rest homes or groups of buildings for the elderly or people with disabilities …*
>
> *(d) Teaching areas and sleeping rooms in educational institutions …*
>
> *(e) Teaching areas and sleeping rooms in buildings for licensed kindergartens, childcare, and day-care centres; and*
>
> *(f) Temporary accommodation including in hotels, motels, hostels, halls of residence, boarding houses, and guest houses.*
>
> *In some instances holiday cabins and camping grounds might be considered as noise sensitive locations. Matters to be considered include whether it is an established activity with existing rights.*

For the purposes of an assessment according to the Standard, the notional boundary is defined as:

> *A line 20 metres from any side of a dwelling or other building used for a noise sensitive activity or the legal boundary where this is closer to such a building.*

NZS 6808 was prepared to provide methods of assessment in the statutory context of New Zealand. Specifically, NZS 6808 notes that in the context of the New Zealand *Resource Management Act 1991* (RMA), application of the Standard will provide reasonable protection of health and amenity at noise sensitive locations. This is an important point of context, as the RMA states:

> *(3)(a)(ii): A consent authority must not, when considering an application, have regard to any effect on a person who has given written approval to the application.*

Based on the above definitions and statutory context, the NZS 6808 noise limits only apply to the assessment of wind turbine noise levels at receivers other than stakeholder receivers, as defined in Section 3.3 (i.e. the noise limits determined in accordance with NZS 6808 only apply at receivers that are outside the wind farm boundary and are not subject to a noise agreement).

3.4.3 Noise limit

Section 5.2 *Noise limit* of NZS 6808 defines acceptable noise limits as follows:

> *As a guide to the limits of acceptability at a noise sensitive location, at any wind speed wind farm sound levels ($L_{A90(10\ min)}$) should not exceed the background sound level by more than 5 dB, or a level of 40 dB $L_{A90(10\ min)}$, whichever is the greater.*

This arrangement of limits requires the noise associated with a wind farm to be restricted to a permissible margin above background noise, except in instances when both the background and source noise levels are low. In this respect, the noise limits indicate that it is not necessary to continue to adhere to a margin above background when the background noise levels are below the range of 30-35 dB L_{A90}.

As detailed in the preceding section, the NZS 6808 noise limits do not apply to stakeholder receivers.

The noise limits specified in NZS 6808 apply to the combined wind turbine noise level of all wind farms influencing the environment at a receiver. Specifically, section 5.6.1 states:

> *The noise limits* […] *should apply to the cumulative sound level of all wind farms affecting any noise sensitive location.*

3.4.4 High amenity

Section 5.3.1 of NZS 6808 states that the base noise limit of 40 dB L_{A90} detailed in the previous section is *appropriate for protection of sleep, health, and amenity of residents at most noise sensitive locations*. It goes on to note that the application of a high amenity noise limit may require additional consideration:

> […] *In special circumstances at some noise sensitive locations a more stringent noise limit may be justified to afford a greater degree of protection of amenity during evening and night-time. A high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area, for example where evening and night-time noise limits in the plan for general sound sources are more stringent than 40 dB $L_{Aeq(15\ min)}$ or 40 dBA L_{10}. A high amenity noise limit should not be applied in any location where background sound levels, assessed in accordance with section 7, are already affected by other specific sources, such as road traffic sound.*

The definition of the high amenity noise limit provided in NZS 6808 is specific to New Zealand planning legislation and guidelines. A degree of interpretation is therefore required when determining how to apply the concept of high amenity in Victoria.

In accordance with Section 5.3 of NZS 6808, if a high amenity noise limit is justified, wind farm noise levels (L_{A90}) during evening and nigh-time periods should not exceed the background noise level (L_{A90}) by more than 5 dB or 35 dB L_{A90}, whichever is the greater. The standard recommends that this reduced noise limit would typically apply for wind speeds below 6 m/s at hub height. A high amenity noise limit is not applicable during the daytime period.

The method for assessing the applicability of the high amenity noise limit, detailed in NZS 6808, is a two-step approach as follows:

1. Determination of whether the planning guidance for the area warrants consideration of a high amenity noise limit

   First and foremost, for a high amenity noise limit to be considered, the land zoning of a receiver must promote a higher degree of acoustic amenity.

2. Evaluation of whether a high amenity noise limit is justified

   Following the guidance presented in C5.3.1, if the planning guidance for the area warrants consideration of a high amenity noise limit, and the receiver is located within the predicted 35 dB L_{A90} noise contour, then a calculation should be undertaken to determine whether background noise levels are sufficiently low.

3.4.5 Special audible characteristics

Section 5.4.2 of NZS 6808 requires the following:

> *Wind turbine sound levels with special audible characteristics (such as tonality, impulsiveness and amplitude modulation) shall be adjusted by arithmetically adding up to +6dB to the measured level at the noise sensitive location.*

Notwithstanding this, the standard requires that wind farms be designed with no special audible characteristics at nearby residential properties while concurrently noting in Section 5.4.1 that:

> […] *as special audible characteristics cannot always be predicted, consideration shall be given to whether there are any special audible characteristics of the wind farm sound when comparing measured levels with noise limits.*

NZS 6808 emphasises assessment of special audible characteristics during the post-construction measurement phase of a project. An indication of the potential for tonality to be a characteristic of the noise emission from the assessed wind turbine model is sometimes available from tonality audibility assessments conducted as part of manufacturer wind turbine noise emission testing. However, this data is frequently not available at the planning stage of an assessment.

3.5 Noise Protocol

EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (Noise Protocol) sets noise limits that apply to commercial, industrial and trade premises and entertainment venues in Victoria. Compliance with the noise limits is mandatory under the EP Act.

The proposed transformer station is considered as 'commercial, industrial and trade premises' (CIT premises) under the EP Act.

The Noise Protocol specifies noise limits that are used to assess whether a noise is prescribed to be unreasonable in accordance with the EP Regulations. The noise limits apply at a 'noise sensitive area', which is defined in Section 4 of the EP Regulations as being *within 10 metres of the outside of the external walls* of buildings including dwellings, hotels, schools. In rural areas only, noise sensitive areas also include land within the boundaries of tourist establishments, campgrounds, and caravan parks.

The procedures for setting noise limits are defined separately for urban and rural areas. However, in both cases, the noise limits are defined by considering the land zoning in the area and the noise environment of the receiver. The noise limits are defined separately for day, evening and night periods.

In contrast to NZS 6808 and Part 5.3 Division 5 of the EP Regulations, the Noise Protocol does not differentiate between stakeholder and non-stakeholder receivers.

The measurement and analysis procedures outlined in the Noise Protocol include adjustments which are to be applied to noise that is characterised by audible tones, impulses or intermittency. Further details of the noise limits applicable to the Project are provided in Section 7.1.

3.6 Environment Reference Standard

The *Environment Reference Standard* (ERS) is a legislative instrument made under the EP Act which sets out environmental values for ambient sound that are sought to be achieved and maintained in Victoria and standards to support those values. The indicators and objectives within the standard provide a benchmark for comparing desired outcomes to the actual state of the environment, and a basis for assessing actual and potential risks to the environmental values.

The ERS is an environmental benchmark. It brings together a collection of environmental values, indicators and objectives that describe environmental and human health outcomes to be achieved or maintained in the whole or in parts of Victoria. These values, indicators and objectives are used to assess and report on changing environmental conditions by providing a reference point for decision makers to consider whether a proposal or activity is consistent with the environmental values identified in the ERS. The ERS also allows decision makers to evaluate potential impacts on human health and the environment that may result from a proposal or activity. The ERS does not specify requirements that must be met by environmental managers or other duty holders.

The ERS is primarily relevant for aspects of the environment that are not the subject of prescriptive regulation. These aspects include the noise from commercial premises and construction activities in natural areas, or the additional noise from public roads as a result of traffic associated with commercial activities.

Further, in the situations where the ERS is a relevant consideration, it is important to note that the ERS is not a compliance standard. Specifically, the values listed within the ERS are not prescribed noise limits, nor are they design criteria for proposed development.

Indicators and objectives within the ERS are generally not relevant considerations where they relate to an aspect of the environment that is the subject of prescriptive regulation. For example, the ambient sound indicators and objectives will not be relevant when considering noise from wind turbines at noise sensitive areas, as defined in the EP Regulations. This is because noise in these circumstances is regulated by specific provisions and noise limits in the EP Regulations and the associated NZS 6808.

The environmental values presented in the ERS and a description of each is provided in Table 1.

Table 1: Environmental values of the ambient sound environment

Environmental value	Description of environmental value
Sleep during the night	An ambient sound environment that supports sleep during the night
Domestic and recreational activities	An ambient sound environment that supports recreational and domestic activities in a residential setting
Normal conversation	An ambient sound environment that allows for normal conversation indoors without the need to raise voices
Child learning and development	An ambient sound environment that supports cognitive development and learning in children
Human tranquillity and enjoyment outdoors in natural areas	An ambient sound environment that allows for the appreciation and enjoyment of the environment for its natural condition and the restorative benefits of tranquil soundscapes in natural areas
Musical entertainment	An ambient sound environment that recognises the community's demand for a wide range of musical entertainment.

The ERS land use categories and their descriptions are provided in Table 2.

Table 2: Land use categories for the ambient sound environment

Land use category	General description	Planning zones
Category I	An urban form with distinctive features or characteristics of taller buildings, high commercial and residential intensity and high site coverage.	Industrial Zone 1 (IN1Z) Industrial Zone 2 (IN2Z) Port Zone (PZ) Road 1 Zone (RDZ1) Capital City Zone (CCZ) Docklands Zone (DZ)
Category II	Medium rise building form with a strong urban or commercial character. Typically contains mixed land uses including activity centres and larger consolidated sites, and an active public realm.	Industrial Zone 3 (IN3Z) Commercial 1 Zone (C1Z) Commercial 2 Zone (C2Z) Commercial 3 Zone (C3Z) Activity Centre Zone (ACZ) Mixed Use Zone (MUZ) Road 2 Zone (RDZ2)
Category III	Lower rise building form including lower density residential development and detached housing typical of suburban residential settings or in towns of district or regional significance.	Residential Growth Zone (RGZ) General Residential Zone (GRZ) Neighbourhood Residential Zone (NRZ) Urban Floodway Zone (UFZ) Public Park and Recreation Zone (PPRZ) Urban Growth Zone (UGZ) [1]
Category IV	Lower density or sparse populations with settlements that include smaller hamlets, villages and small towns that are generally unsuited for further expansion. Land uses include primary industry and farming.	Low Density Residential Zone (LDRZ) Township Zone (TZ) Rural Living Zone (RLZ) Green Wedge A Zone (GWAZ) Rural Conservation Zone (RCZ) Public Conservation and Resource Zone (PCRZ) Green Wedge Zone (GWZ) Farming Zone (FZ) Rural Activity Zone (RAZ)
Category V	Unique combinations of landscape, biodiversity and geodiversity. These natural areas typically provide undisturbed species habitat and enable people to see and interact with native vegetation and wildlife.	Natural areas are classified as land within Category V irrespective of the planning zones that apply to that land.
Category I, II, III or IV depending on surrounding land uses and the intent of the specific planning zone (which may have a diversity of uses) as specified in a schedule to the planning zone		Comprehensive Development Zone (CDZ) Priority Development Zone (PDZ) Special Use Zone (SUZ) Public Use Zone (PUZ)

1 Urban Growth Zone (UGZ) is a Category III land use until the relevant precinct structure plan is adopted, at which time the approved land uses will determine the land use category.

The ERS indicators and objectives relevant to each land use category are described in Table 3.

Table 3: Indicators and objectives for the ambient sound environment

Land use category	Indicators	Objectives
Category I	Outdoor $L_{Aeq,8h}$ from 2200 hrs to 0600 hrs	55 dB L_{Aeq}
	Outdoor $L_{Aeq,16hr}$ from 0600 hrs to 2200 hrs	60 dB L_{Aeq}
Category II	Outdoor $L_{Aeq,8h}$ from 2200 hrs to 0600 hrs	50 dB L_{Aeq}
	Outdoor $L_{Aeq,16hr}$ from 0600 hrs to 2200 hrs	55 dB L_{Aeq}
Category III	Outdoor $L_{Aeq,8h}$ from 2200 hrs to 0600 hrs	40 dB L_{Aeq}
	Outdoor $L_{Aeq,16hr}$ from 0600 hrs to 2200 hrs	50 dB L_{Aeq}
Category IV	Outdoor $L_{Aeq,8h}$ from 2200 hrs to 0600 hrs	35 dB L_{Aeq}
	Outdoor $L_{Aeq,16hr}$ from 0600 hrs to 2200 hrs	40 dB L_{Aeq}
Category V	Qualitative	A sound quality that is conducive to human tranquillity and enjoyment, having regard to the ambient natural soundscape

Natural areas are a land-use category for which the ERS details desired outcomes in terms of noise level to be achieved or maintained in Victoria. The ERS defines natural areas as national parks, state parks, state forests, nature conservation reserves and wildlife reserves.

3.7 Related Victorian guidelines

To support the application and use of the legislation and guidance summarised in the preceding sections, a range of Victorian publications provide additional advice on matters of interpretation and technical assessment requirements. These publications include:

- EPA Publication 1992 *Guide to the Environment Reference Standard,* dated June 2021
- EPA Publication 1996 *Noise guideline – assessing low frequency noise,* dated June 2021
- EPA Publication 1997 *Technical guide: Measuring and analysing industry noise and music noise,* dated June 2021
- EPA Publication 2061 *Wind Energy Facility Turbine Noise Regulation Guidelines* [2]
- EPA-DTP Publication 3011 *Wind Energy Facility Turbine Noise – Technical Guideline* (Technical Guideline).

These guidelines are non-statutory documents which provide detailed advice for a broad range of technical considerations. Relevant aspects of these guidelines are referenced where appropriate in this assessment.

[2] At the date of preparation of this report, EPA Publication 2061 is not available as a version controlled formal document. This report is based on the EPA webpage version of this publication, last updated on 26 January 2024.

4.0 ASSESSMENT METHOD

4.1 Overview

Based on the legislation and guidelines outlined in Section 3.0, assessing the operational noise levels of the Project involves:

- assessing background noise levels at noise sensitive locations around the wind farm
- assessing the land zoning of the Project site and surrounding areas
- establishing suitable noise limits accounting for background noise levels and land zoning
- predicting the level of noise expected to occur as a result of the proposed wind turbines and transformer station
- assessing whether the Project can achieve the requirements of Victorian policy and guidelines by comparing the predicted noise levels to the noise limits
- recommending reasonably practicable measures to minimise the risk of noise impact as a result of noise from the transformer station
- assessing the potential for cumulative noise effects as a result of Project and other existing and proposed developments in the surrounding area.

4.2 Background noise levels

In accordance with the Victorian Wind Energy Guidelines and NZS 6808, background noise level information is used for setting noise limits for both the wind turbine component and transformer station of a project. However, in rural areas where wind farms are typically developed, the background noise level data is most relevant to the assessment of the wind turbines. This is due to the need to consider the changes in background noise levels and wind turbine noise levels for different wind conditions.

In accordance with the Victorian Wind Energy Guidelines and NZS 6808, background noise level information is used for setting noise limits for the wind turbine component of a wind farm project.

The procedures for determining background noise levels are defined in NZS 6808. The first step in assessing background noise levels involves determining whether background noise measurements are warranted. For this purpose, Section 7.1.4 of the standard provides the following guidance:

> *Background sound level measurements and subsequent analysis to define the relative noise limits should be carried out where wind farm sound levels of 35 dB $L_{A90(10\,min)}$ or higher are predicted for noise sensitive locations, when the wind turbines are at 95% rated power. If there are no noise sensitive locations within the 35 dB $L_{A90(10\,min)}$ predicted wind farm sound level contour then background sound level measurements are not required.*

The initial stage of a background noise monitoring program in accordance with NZS 6808 therefore comprises:

- preliminary wind turbine noise predictions to identify all receivers where predicted noise levels are higher than 35 dB L_{A90}
- identification of selected receivers where background noise monitoring should be undertaken prior to development of the wind farm, if required.

If required, the surveys involve measurements of background noise levels at receivers, and simultaneous measurement of wind speeds at the site of the proposed wind farm. The survey typically extends over a period of several weeks to enable a range of wind speeds and directions to be measured.

The results of the survey are then analysed to determine the trend between the background noise levels and site wind speeds at the proposed hub height of the wind turbines. This trend defines the value of the background noise for the different wind speeds in which the wind turbines will operate. At the wind speeds when the background noise level is above 35 dB L_{A90} (or 30 dB L_{A90} in special circumstances where high amenity limits apply), the background noise levels are used to set the noise limits for the wind farm.

4.3 Noise predictions

Operational wind turbine noise levels are predicted using:

- noise emission data for the wind turbines and transformer station
- a 3D digital model of the site and the surrounding environment
- international standards used for the calculation of environmental sound propagation.

The method selected to predict noise levels is International Standard ISO 9613-2: 1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2). The prediction method is consistent with the guidance provided by NZS 6808 and has been shown to provide a reliable method of predicting the typical upper levels of the wind turbine noise expected to occur in practice.

The method is generally applied in a comparable manner to both wind turbine and transformer station noise levels. For example, for both types of sources, equivalent ground and atmospheric conditions are used for the calculations. However, when applied to wind turbine noise, additional and specific input choices apply, as detailed below.

Key elements of the noise prediction method are summarised in Table 4. Further discussion of the method and the calculation choices is provided in Appendix F

Table 4: Noise prediction elements

Detail	Description
Software	Proprietary noise modelling software SoundPLANnoise version 9.0
Method	International Standard ISO 9613-2:1996 *Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation* (ISO 9613-2). For wind turbine predictions, adjustments to the ISO 9613-2 method are applied on the basis of the guidance contained in the UK Institute of Acoustics publication *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* (the UK Institute of Acoustics guidance). The adjustments are applied within the SoundPLANnoise modelling software and relate to the influence of terrain screening and ground effects on sound propagation. Specific details of adjustments are noted below and are discussed in Appendix F.

Detail	Description
Source characterisation	Each source of operational noise is modelled as a point source of sound. The total sound of the component of the wind farm being modelled (i.e. the wind turbines) is then calculated on the basis of simultaneous operation of all elements (e.g. all wind turbines) and summing the contribution of each. To model the wind turbine component of the wind farm, the following specific procedures are noted: • Calculations of wind turbine to receiver distances and average sound propagation heights are made on the basis of the point source being located at the position of the hub of the wind turbine. • Calculations of terrain related screening are made on the basis of the point source being located at the maximum tip height of each wind turbine. Further discussion of terrain screening effects is provided below.
Terrain data	10 m resolution within the site and surrounds, based on elevation contours *NMEP_EL_CONTOUR_v19-04,* supplied by the proponent on 24 February 2023.
Terrain effects (wind turbine-specific procedures)	Adjustments for the effects of terrain are determined and applied on the basis of the UK Institute of Acoustics guidance and research outlined Appendix F. • Valley effects: +3 dB is applied to the calculated noise level of a wind turbine when a significant valley exists between the wind turbine and calculation point. A significant valley is determined to exist when the actual mean sound propagation height between the wind turbine and calculation point is 50 % greater than would occur if the ground were flat. • Terrain screening effects: only calculated if the terrain blocks line of sight between the maximum tip height of the wind turbine and the calculation point. The value of the screening effect is limited to a maximum value of -2 dB. The Project is located in a relatively flat area characterised by little variations in ground elevation between the wind turbines and surrounding receivers. Based on comparison of predicted noise levels with and without terrain elevation data included, calculated terrain effects range between -0.1 dB and +0.2 dB for receivers within 5 km of the proposed wind turbines. For reference purposes, the ground elevations at the wind turbines and receivers are tabled in Appendix B and Appendix C respectively. The topography of the site is depicted in the elevation map provided in Appendix D.
Ground conditions	Ground factor of G = 0.5 on the basis of the UK Institute of Acoustics guidance and research outlined in Appendix F. The ground around the site corresponds to acoustically soft conditions (G = 1) according to ISO 9613-2. The adopted value of G = 0.5 assumes that 50 % of the ground cover is acoustically hard (G = 0) to account for variations in ground porosity and provide a cautious representation of ground effects.

Detail	Description
Atmospheric conditions	Temperature 10°C / relative humidity 70 % / atmospheric pressure: 101.325 kPa These represent conditions which result in relatively low levels of atmospheric sound absorption. The calculations are based on sound speed profiles which increase the propagation of sound from each wind turbine to each receiver, whether as a result of thermal inversions or wind directed toward each calculation point.[3]
Receiver heights	1.5 m above ground level, expect for wind turbine predictions. 4 m above ground level for wind turbine noise predictions. A discussion of the receiver height is provided Appendix F and indicates that a 1.5 m height remains appropriate for the calculation of wind turbine noise levels, based on the results of extensive wind farm noise monitoring at wind farm projects around Australia and international guidance that contemporary wind farm noise modelling methods are based on. However, the Technical Guideline sets out a much more conservative assessment approach based on recommended default modelling parameters which include a 4 m calculation height. While the Technical Guideline does indicate that other input parameters (i.e. other than the default values) may be suitable where appropriately justified, following consultations with the independent environmental auditor, the Proponent has elected to present predicted noise levels based on 4 m receiver heights for the simplicity of aligning with the default modelling parameters described in the Technical Guideline. The predicted noise levels presented in this report will therefore overestimate wind farm noise levels by approximately 2 dB.

[3] The sound speed profile defines the rate of change in the speed of sound with increasing height above ground

4.4 Cumulative effects

The potential for cumulative noise effects is evaluated by:

- identifying other existing and potential developments in the area around the Project
- identifying receivers where there is the potential for cumulative noise from the Project and other developments
- assessing the predicted wind turbine noise levels of the Project at the identified receivers to determine whether:
  - the Project could contribute to total wind turbine noise levels above the limits in the vicinity of other exiting wind farms
  - there is a margin below the noise limits to accommodate other potential wind farm developments
- assessing the predicted transformer station noise levels of the Project at the identified receivers to determine whether:
  - the Project would contribute to total industry noise levels above the limits in the vicinity of other existing commercial, industry and trade premises
  - there is a margin below the noise limits to accommodate other potential wind farm developments.

5.0 EXISTING NOISE ENVIRONMENT

Selection of background noise monitoring locations was based on wind turbine noise being modelled with the receiver heights set at 1.5 m, as presented in earlier revisions of this report.

The results indicated that the highest predicted noise levels, using the V172-7.2MW candidate wind turbine model, were between 35 and 40 dB L_{A90} for 5 non-stakeholder receivers. In accordance with NZS 6808, background noise monitoring is therefore required to be undertaken at selected receivers.

The updated noise modelling results with the receiver heights set at 4.0 m are subsequently presented in Section 6.4 and indicate another 2 non-stakeholder receivers being located within the 35 dB L_{A90} noise contour using the V172-7.2MW (AD26 – a to the south and AE32 – a to the north).

It is noted that consent to undertake background noise monitoring was not granted at 3 of the 5 non-stakeholder receivers where wind turbine noise levels where predicted higher than 35 dB L_{A90}. As such, 2 alternative monitoring locations were selected:

- proxy location representative of AA29 – a and AA29 – b, to the east of the wind farm. This location is referenced as *AA29 – a (proxy)*.
- receiver AD26 – a, approximately 575 m to the west southwest of AC26 – a

For community engagement purposes, the proponent has also requested that additional, voluntary, noise monitoring be undertaken at 2 other non-stakeholder receivers, AE32 – a and Y28 – a (the original modelling based on 1.5 m receiver heights indicated predicted noise levels are below 35 dB L_{A90} at both of these receivers for all candidate turbines).

Based on the above, background noise monitoring was carried out in accordance with NZS 6808 at 6 locations from 4 June to 19 July 2024.

The noise monitoring, analysis procedures and results are detailed in the Background Noise Report.[4] The data presented in Table 5 and Table 6 summarise the background noise levels determined in accordance with NZS 6808 for the all-time and night-time periods, respectively.

The data in these tables is provided for the key wind speeds relevant to the assessment of wind farm noise. The results for all surveyed wind speeds are illustrated in the graphical data provided for each receiver in the appendices of the Background Noise Report.

Table 5: Background noise levels, dB L_{A90} - All-time period

Location	Hub height wind speed, m/s [1]									
	3	4	5	6	7	8	9	10	11	12
AA29 - a (proxy)	17.9	19.8	21	21.7	21.9	21.8	21.5	21.1	20.9	20.8
AD26 - a	20.7	23.4	25.2	26.2	26.7	26.7	26.5	26.2	26.1	26.2
AD32 - a	20.7	22.9	24.4	25.2	25.5	25.5	25.4	25.2	25.1	25.4
AE32 - a	21.5	23	23.9	24.3	24.4	24.3	24.2	24.1	24.2	24.7
AH29 - a	20.8	23.5	25.2	26.1	26.4	26.3	25.9	25.5	25.3	25.3
Y28 - a	22.6	25.1	26.7	27.7	28.2	28.3	28.2	28	27.9	27.9

1 150 m above ground level at 750,161 E, 6,037,605 N (GDA2020 MGA zone 54)

[4] MDA Report Rp 002 20221016 *Normanville Energy Park - Background noise monitoring*, dated 20 November 2024

Table 6: Background noise levels, dB L_{A90} - Night period

Location	Hub height wind speed, m/s [1]									
	3	4	5	6	7	8	9	10	11	12
AA29 - a (proxy)	- [2]	- [2]	- [2]	- [2]	- [2]	- [2]	- [2]	16.8	16.9	17.4
AD26 - a	- [2]	- [2]	- [2]	- [2]	- [2]	19.4	19.5	19.8	20.4	21.4
AD32 - a	- [2]	- [2]	- [2]	- [2]	- [2]	18.6	18.6	18.8	19.3	20.3
AE32 - a	- [2]	- [2]	- [2]	- [2]	- [2]	- [2]	21.5	21.4	21.6	22.3
AH29 - a	- [2]	- [2]	- [2]	- [2]	- [2]	- [2]	19.6	19.5	19.8	20.6
Y28 - a	- [2]	- [2]	- [2]	- [2]	- [2]	20.6	21.1	21.8	22.7	23.8

1 150 m above ground level at 750,161 E, 6,037,605 N (GDA2020 MGA zone 54)

2 Regression lines indicate an increase of background noise levels as hub height wind speed decreases. As this feature is deemed to be an artifact of the regression analysis process due to the large scatter of points at low hub height wind speeds, the regression lines have been truncated at their lowest values.

6.0 WIND TURBINE ASSESSMENT

6.1 Noise limits

6.1.1 High amenity

In accordance with NZS 6808, an assessment is required for all receivers located within the predicted 35 dB L_{A90} contour to determine whether a high amenity noise limit may be justified. As detailed in Section 3.4.4, this is based on a two-step approach comprising:

1. A land zoning review to determine whether the planning guidance for the area warrants consideration of a high amenity noise limit. If it does, then the second step should be considered
2. A review of the relationship between the background noise levels and predicted noise levels, using the calculation set out in clause C5.3.1.

Based on the predicted noise level contours presented in Section 6.4, and the zoning map for the area presented in Appendix E, receivers within the predicted 35 dB L_{A90} contour are located within the Farming Zone (FZ) .

Following guidance from the VCAT determination for the Cherry Tree Wind Farm, as required by the Victorian Wind Energy Guidelines, the areas within the Farming Zone do not warrant consideration of the high amenity noise limit. Similar guidance concerning the Farming Zone is provided in EPA Publication 2061 *Wind Energy Facility Turbine Noise Regulation Guidelines* which indicates that the high amenity noise limit should not apply to the Farming Zone.[5]

Based on the above, the high amenity noise limit is not justified for the proposed wind farm.

6.1.2 Stakeholder receivers

The definition of noise sensitive locations in NZS 6808 specifically excludes stakeholder receivers located within a wind farm site boundary. The discussion earlier in this report in Section 3.4.2 also provides details of the statutory context of NZS 6808, and indicates the method is not intended to be applied to stakeholder receivers outside the site boundary where a noise agreement exists between the occupants and the proponent of the development.

However, consistent with the Victorian Wind Energy Guidelines, regulation 131B of the EP Regulations specifies a noise limit of 45 dB L_{A90} or background noise (L_{A90}) + 5 dB, whichever is the greater, for stakeholder receivers outside of the wind farm boundary where a noise agreement between the owner or operator of a wind energy facility and a landowner is made on or after 1 November 2021.

Further, consistent with the Victorian Wind Energy Guidelines, it is recommended that wind turbine noise levels not exceed a reference level of 45 dB L_{A90} or background noise (L_{A90}) +5 dB at stakeholder receivers within the Project boundary.

The proponent advised that noise agreements are currently in place or proposed between the landowners and the proponent at 5 receivers within the Project boundary, as presented in Figure 1 of Section 2.0. There are no stakeholder receivers outside of the Project boundary.

[5] At the date of preparation of this report, EPA Publication 2061 is not available as a version controlled formal document. This report is based on the EPA Victoria webpage version of this publication, last updated on 26 Jan 2024.

6.1.3 Applicable noise limits

Accounting for the conclusions of the assessment of high amenity detailed in Section 6.1.1, the preliminary applicable noise limits are detailed in Table 7.

Table 7: Applicable noise limits, dB L_{A90}

Receiver status	Noise limit
Non-stakeholder	40 dB or background L_{A90} + 5 dB, whichever is the greater
Stakeholder with a noise agreement	45 dB or background L_{A90} + 5 dB, whichever is the greater
Stakeholder within the Project boundary	Not applicable Reference level of 45 dB or background L_{A90} + 5 dB, whichever is the greater

Background noise levels presented in Table 5 and Table 6 of Section 5.0 are below 35 dB L_{A90} at all available wind speeds. As such, the wind farm has been conservatively assessed at non-stakeholder receivers using the relevant base (minimum) noise limits of 40 dB L_{A90}.

6.2 Candidate wind turbine models

The final wind turbine model for the site would be selected after a tender process to procure the supply of wind turbines. The final selection would be based on a range of design requirements including achieving compliance with any planning permit noise limits at surrounding receivers and the requirements of the EP Regulations.

Accordingly, to assess the proposed wind farm at this stage in the project, it is necessary to consider a candidate wind turbine model that is representative of the size and type of wind turbines being considered. The purpose of the candidate wind turbine is to assess the viability of achieving compliance with the applicable noise limits, based on noise emission levels that are typical of the size of wind turbines being considered for the site.

For this assessment, the proponent has nominated 3 candidate wind turbine models as detailed in Table 8, with a hub height of 150 m.

These models are variable speed wind turbines, with the speed of rotation and the amount of power generated by the wind turbines being regulated by control systems which vary the pitch of the wind turbine blades (the angular orientation of the blade relative to its axis).

This assessment has been based on the wind turbines operating in an unconstrained mode of generation (i.e. without noise reduced operating modes) and with blade serrations. Blade serrations are now routinely used to reduce wind turbine noise emissions, and it is understood that their use is now the market standard for wind turbines being offered in the Australian market.

Details of the assessed candidate wind turbine are provided in Table 8.

Table 8: Selected candidate wind turbine model

Item	V172-7.2MW	V162-6.8MW	GE 6.0-164
Make	Vestas	Vestas	General Electric (GE)
Model	V172	V162	Cypress 6.0-164
Rated power	7.2 MW	6.8 MW	6.0 MW
Operating mode	PO7200 [1]	PO6800 [2]	-
Rotor diameter	172 m	162 m	164 m
Blade serrations	Yes	Yes	Yes
Cut-in wind speed (hub height)	3 m/s	3 m/s	3 m/s
Cut-out wind speed (hub height)	25 m/s	25 m/s	25 m/s

1 'PO7200' is a manufacturer designation which indicates a Power Optimisation mode to achieve a power output of 7,200 kW – this is an unconstrained mode of operation (i.e. without noise reduction)

2 'PO6800' is a manufacturer designation which indicates a Power Optimisation mode to achieve a power output of 6,800 kW – this is an unconstrained mode of operation (i.e. without noise reduction)

The proponent advised that the proposed candidate turbine models can operate at hub heights ranging from 150 m to 180 m. A sensitivity analysis demonstrated that a hub height of 150 m resulted in the highest predicted noise levels at receivers, by up to 0.3 dB. As such, a hub height of 150 m has been used to assess wind turbine noise levels for all candidate turbine models.

It is our understanding that the final hub height of the selected wind turbine model may differ slightly. However, the magnitude of the potential changes is expected to be minor and inconsequential with respect to predicted noise levels at receivers, as demonstrated by the sensitivity analysis. Irrespective, revised noise modelling would be conducted for the final turbine layout, model selection and hub height to verify compliance. The results of the revised noise modelling would be documented in the noise management plan required under regulation 131E of the EP Regulations.

6.3 Wind turbine noise emissions

6.3.1 Sound power levels

The noise emissions of the wind turbines are described in terms of the sound power level for different wind speeds. The sound *power* level is a measure of the total sound energy produced by each wind turbine and is distinct from the sound *pressure* level which depends on a range of factors such as the distance from the wind turbine.

Sound power level data for the candidate wind turbine models, including sound frequency characteristics, has been sourced from the manufacturers' documents listed in Table 9.

Table 9: Candidate wind turbine model specification documents

Candidate model	Document No.	Date	Title
V172-7.2MW	0128-4336_00	30 Jun 2022	*Third octave noise emission – EnVentus V172-7.2 MW 50/60 Hz*
V162-6.8MW	0111-1246_03	13 Jan 2023	*Third octave noise emission EnVentus™ V162-6.8MW 50/60 Hz*
GE 6.0-164	0082273 Rev: 2	16 Mar 2021	*Technical Documentation Wind Turbine Generator Systems Cypress 6.0-164 - 50Hz - Product Acoustic Specifications According to IEC 61400-11*

Based on the data sourced from the manufacturer's documentation, the noise modelling undertaken for this assessment involved conversion of third octave band levels to octave band levels (where applicable), and adjustment by addition of +1.0 dB at each wind speed to provide a margin for typical values of test uncertainty.

The overall A-weighted sound power levels (including the +1.0 dB addition) as a function of hub height wind speed are presented in Table 10. These represent the total noise emissions of each candidate wind turbine model, including the secondary contribution of ancillary plant associated with each wind turbine (e.g. cooling fans).

The sound frequency characteristics for each candidate wind turbine model were sourced from the manufacturer's specification documents. The reference spectra used as the basis for this assessment are tabulated in Table 11 and correspond to the highest overall sound power level tabulated in Table 10, considering low frequency content.

Table 10: Sound power levels versus hub height wind speed, dB L_{WA}

	Hub height wind speed, m/s											
Candidate model	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**≥15**
V172-7.2MW	95.6	96.2	99.6	103.2	106.6	107.9	107.9	107.9	107.9	107.9	107.9	107.9
V162-6.8MW	95.0	95.0	96.0	99.3	102.5	104.3	104.3	104.4	104.8	105.1	105.3	105.5
GE 6.0-164	94.8	96.7	100.2	103.5	105.7	107.7	108.0	108.0	108.0	108.0	108.0	108.0

Table 11: Octave band sound power levels, dB L_{WA}

	Octave band centre frequency, Hz									
Candidate model	**31.5**	**63**	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**	**8,000**	**Total**
V172-7.2MW[1]	79.4	91.5	99.2	102.3	102.5	100.8	96.2	88.5	77.7	107.9
V162-6.8MW[2]	76.0	88.5	96.4	99.7	100.2	98.7	94.2	86.7	76.0	105.5
GE 6.0-164[3]	79.8	89.1	94.6	99.1	101.7	103.3	101.1	93.6	77.8	108.0

1 Based on octave band levels at 12 m/s

2 Based on octave band levels at 15 m/s

3 Based on octave band levels at 10 m/s

These sound power levels are also illustrated in Appendix H.

Review of available sound power data for a range of wind turbine models has shown that there is not a clear relationship between wind turbine size, or power output, and the noise emission characteristics of a given wind turbine model. In practice, the overall noise emissions of a wind turbine are dependent on a range of factors, including the wind turbine size and power output, and other important factors such as the blade design and rotational speed of the wind turbine.

While wind turbine sizes and power ratings of contemporary wind turbines have increased, the noise emissions of the wind turbines are comparable to, or lower than, previous generations of wind turbines. This is a result of design improvements which include measures to reduce the speed of rotation of the wind turbines and enhanced blade design features such as serrations for noise control.

6.3.2 Special audible characteristics

Special audible characteristics relate to potential tonality, amplitude modulation and impulsiveness of a wind turbine.

Information concerning potential tonality is often limited at the planning stage of a wind farm, and test data for tonality is presently unavailable for the selected candidate wind turbine models. However, the occurrence of tonality in the noise of contemporary multi-megawatt wind turbine designs is unusual. This is supported by evidence of operational wind farms in Australia which indicates that the occurrence of tonality at receivers is atypical.

Amplitude modulation and impulsiveness are not able to be predicted, however the evidence of operational wind farms in Australia indicates that their occurrence is limited and atypical.

Given the above, adjustments for special audible characteristics have not been applied to the predicted noise levels presented in this assessment. This is consistent with the recommendations of the Technical Guideline which states that it is not necessary to apply a penalty for special audible characteristics during the prediction of wind farm noise levels.

Notwithstanding this, the subject of special audible characteristics would be addressed in subsequent assessment stages for the project, following approval of the wind farm, and again following construction of the wind farm.

6.4 Predicted noise levels

This section of the report presents the predicted noise levels of the wind farm at surrounding receivers.

Sound levels in environmental assessment work are typically reported to the nearest integer to reflect the practical use of measurement and prediction data. However, in the case of wind farm layout design, significant layout modifications may only give rise to fractional changes in the predicted noise level. This is a result of the relatively large number of sources influencing the total predicted noise level, as well as the typical separating distances between the wind turbine locations and surrounding assessment positions. It is therefore necessary to consider the predicted noise levels at a finer resolution than can be perceived or measured in practice. It is for this reason that the levels presented in this section are reported to one decimal place.

Noise levels from the proposed wind farm have been predicted using the sound power level data detailed in Section 6.3.1 for the selected candidate wind turbine models and are summarised in Table 12 for the hub height wind speed which results in the highest predicted noise levels for each candidate wind turbine model. Only receivers where predictions are higher than 30 dB L_{A90} are included.

The locations of the predicted 30, 35, 40 and 45 dB L_{A90} noise contours are illustrated in Figure 2 to Figure 4, for the hub height wind speed which results in the highest predicted noise levels for each candidate wind turbine model.

Predicted noise levels for each integer wind speed are tabulated in Appendix G and for all receivers within 5 km of a wind turbine.

Table 12: Highest predicted noise level at receivers with predicted levels 30 dB L_{A90} or above

Receiver	V172-7.2MW	V162-6.8MW	GE 6.0-164
Non-stakeholder receivers			
AA29 - a	36.9	34.4	35.3
AA29 - b	36.8	34.2	35.1
AB25 - a	31.3	28.7	29.1
AB34 - a	31.1	28.5	28.8
AC26 - a	36.7	34.2	35.1
AC35 - a	30.0	27.4	27.6
AD25 - b	32.4	29.8	30.2
AD26 - a	35.7	33.2	33.9
AD32 - a	38.9	36.4	37.4
AE32 - a	35.6	33.0	33.7
AF33 - a	32.8	30.2	30.7
AG34 - a	30.6	28.0	28.2
AH26 - b	32.2	29.6	30.0
AH29 - a	37.4	34.9	35.9
AI28 - a	31.5	28.9	29.4
AI32 - a	30.4	27.8	28.1

Receiver	V172-7.2MW	V162-6.8MW	GE 6.0-164
AI32 - b	31.5	28.9	29.3
AJ30 - a	30.6	28.0	28.3
AJ30 - b	30.6	27.9	28.2
AJ30 - c	30.4	27.7	28.0
Y28 - a	30.3	27.6	27.8
Z32 - a	33.5	30.9	31.6
Stakeholder receivers within the Project boundary			
AA30 - a	40.7	38.2	39.5
AA30 - b	40.3	37.8	39.1
AD30 - a	43.2	40.7	42.0
AE30 - a	42.9	40.4	41.7
AF30 - a	43.3	40.8	42.2

The following can be concluded from Table 12:

- The predicted wind turbine noise levels are below the applicable base noise limit of 40 dB at all non-stakeholder receivers by at least 1.1 to 2.6 dB, depending on the candidate wind turbine model.
- The predicted wind turbine noise levels are below the reference base noise level of 45 dB at all stakeholder receivers within the Project boundary by at least 1.7 to 2.8 dB, depending on the candidate wind turbine model.

Figure 2: Highest predicted noise level contours – V172-7.2MW

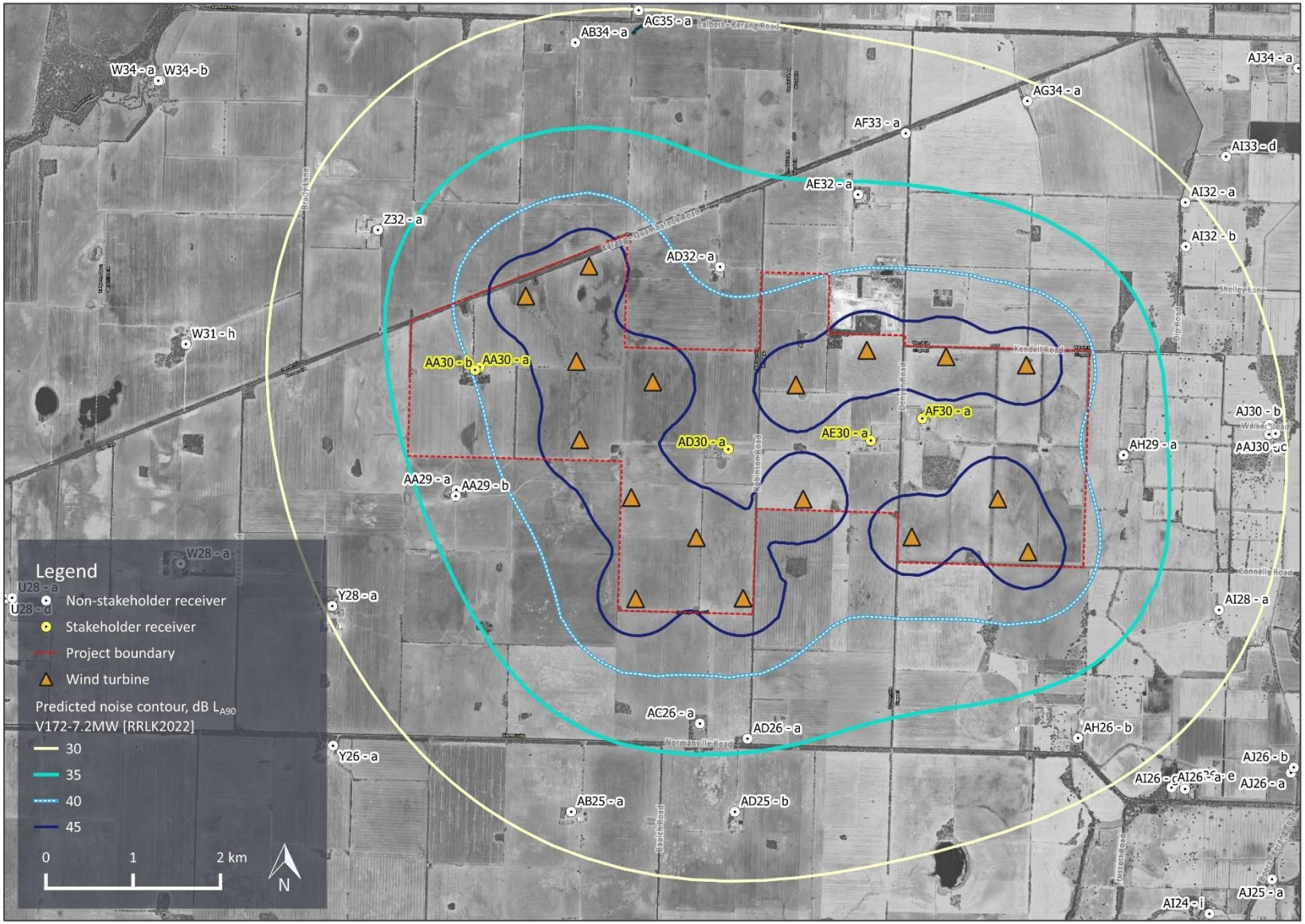


Figure 3: Highest predicted noise level contours – V162-6.8MW

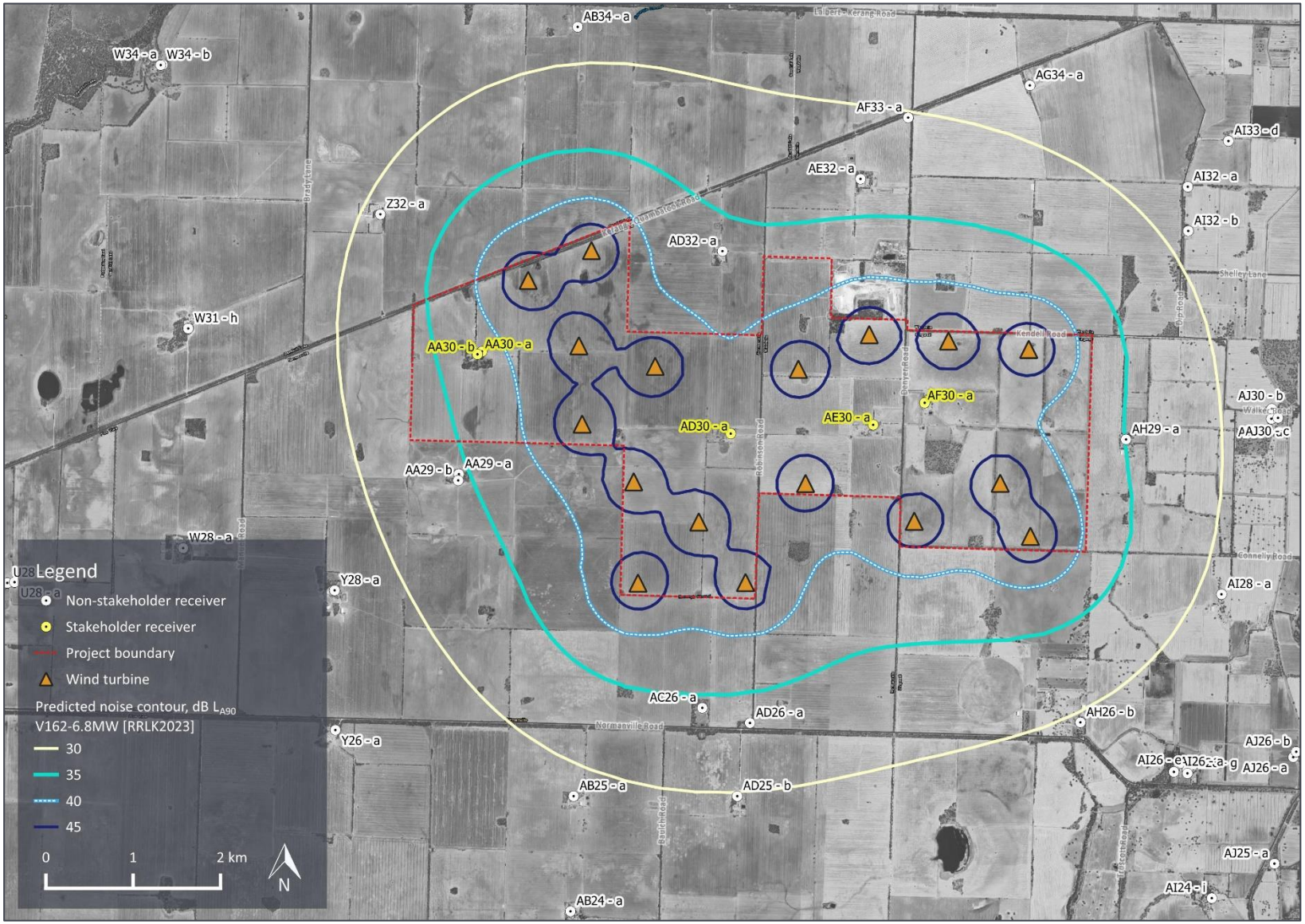


Figure 4: Highest predicted noise level contours – GE 6.0-164

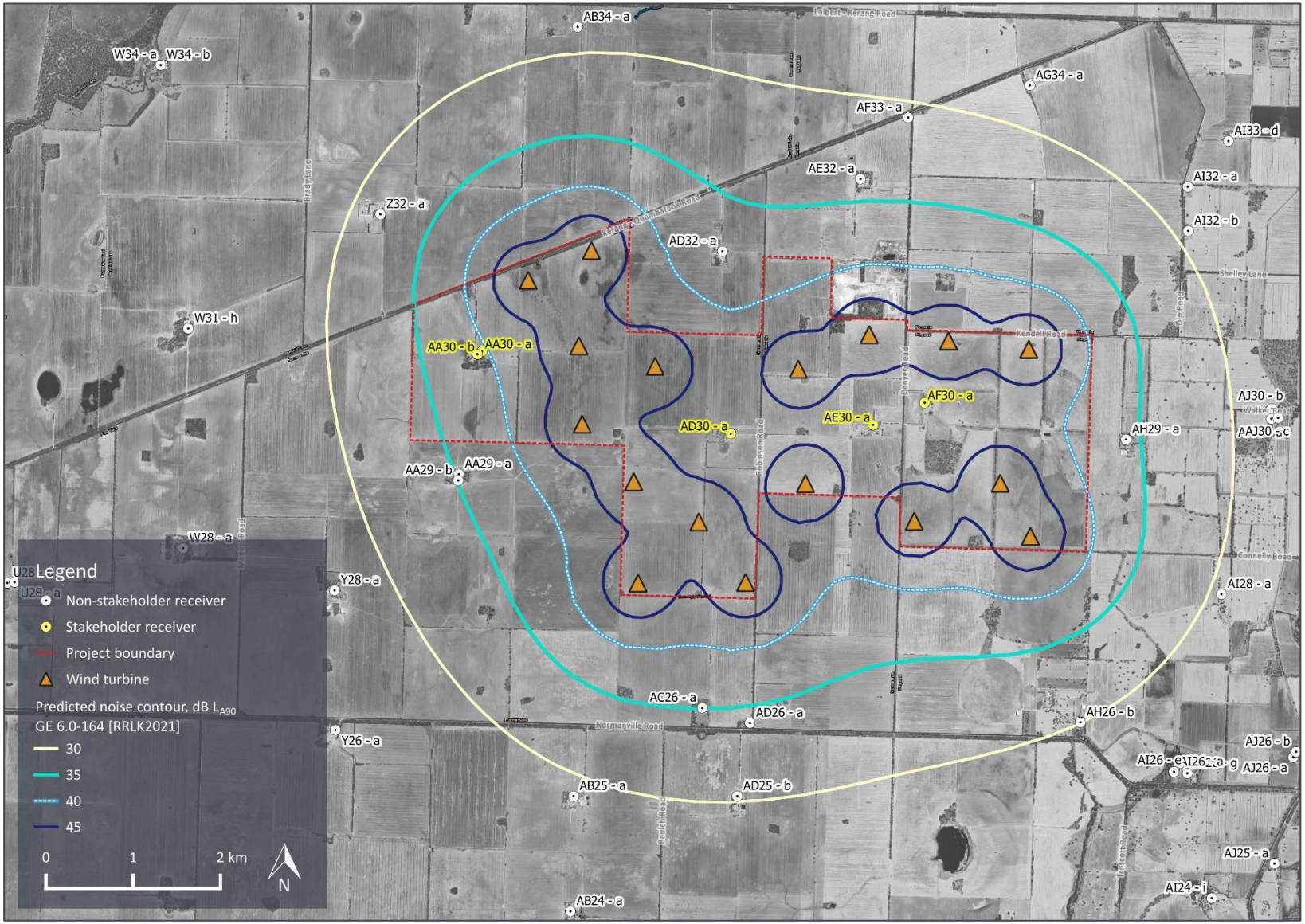
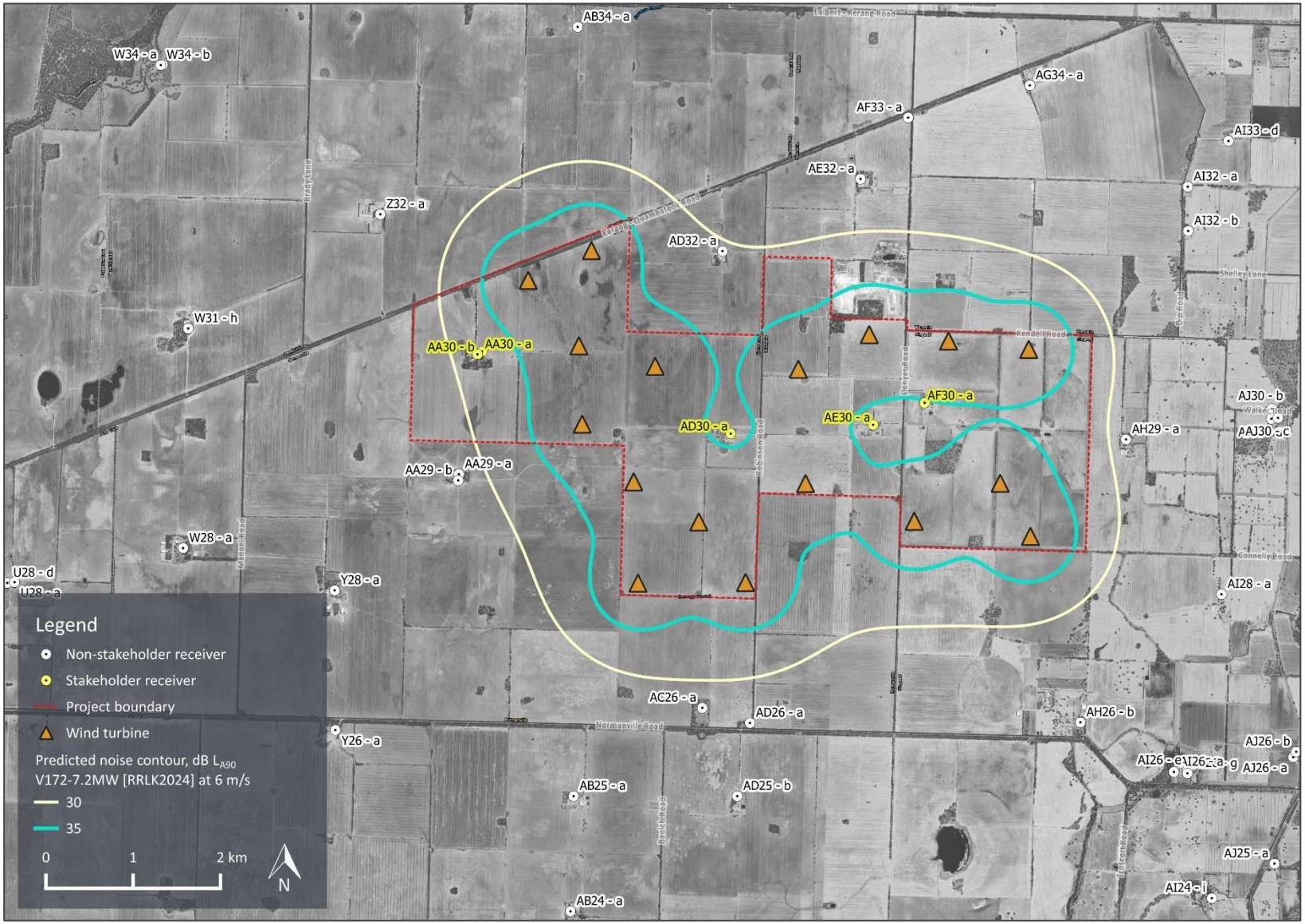


Figure 5: Predicted noise level contours at hub height wind speed of 6 m/s – V172-7.2MW



6.5 High amenity sensitivity analysis

High amenity considerations for the Project are formally assessed in Section 6.1.1. The conclusion of this assessment, based on all applicable guidance, is that the high amenity noise limit is not justified for the Project.

The objective of the sensitivity analysis presented herein is to gauge whether the application of high amenity limits would have any relevance to the design and operation of the Project, irrespective of whether or not high amenity noise limits are justified.

The key finding of the sensitivity analysis is that the modelling results indicate that the predicted noise levels at all non-stakeholder receivers are below the high amenity limit for the candidate wind turbine model resulting in the highest predicted levels (V172—7.2MW). Specifically, the predicted noise levels are below 35 dB L_{A90} for wind speeds up to 6 m/s inclusive (EPA Publication 2061 specifies this is the highest wind speed for applying high amenity limits).

These results are evident in the tabulated predicted noise levels presented in Appendix G.

In addition, the location of the predicted 35 dB L_{A90} noise contour is illustrated in Figure 5, corresponding to the hub height wind speed of 6 m/s for the V172-7.2MW. It can be seen from Figure 5 that the predicted wind turbine noise levels at a hub height wind speed of 6 m/s are below the high amenity noise limit of 35 dB L_{A90} at all non-stakeholder receivers by 4.5 dB or more. Accordingly, in addition to the high amenity limits not being considered applicable, their application would be inconsequential to the operational noise management of the Project.

6.6 Cumulative assessment

The nearest existing operational wind farm identified from online public sources is the Coonooer Bridge Wind Farm, located over 80 km southwest of the Project. Due to the large separating distance, cumulative noise is not a relevant consideration with respect to existing operational wind farm projects.

The nearest identified potential wind farm developments in the vicinity of the Project are:

- Cannie Wind Farm: a proposed development located just over 10 km to the west-northwest of the Project. A referral for the development was submitted to the Department of Transport and Planning (DTP) under the *Victorian Environmental Effects Act (1978)* in 2024. The referral outlines a proposed development consisting of up to 174 wind turbines, BESS and associated infrastructure.
- Meering West Wind Farm: a proposed development directly to the south of the Project. The development is in the early stages of planning and, to our knowledge, formal submissions or applications for the development have not yet been made.

The site boundaries of these proposed wind farm developments were sourced from public references and are illustrated in Figure 6 with the layout of Project.

Details of the turbine layouts and predicted noise levels of the proposed Cannie Wind Farm are not available. However, at a separation distance of over 10 km between the Project and the proposed Cannie Wind Farm, cumulative wind turbine noise levels are not a material consideration. Specifically, the predicted noise levels of the Project would be very low at receivers nearest to the proposed Cannie Wind Farm (below 20 dB) and would not affect compliance outcomes for the proposed Cannie Wind Farm. Conversely, the predicted noise levels of the proposed Cannie Wind Farm are also expected to be very low (less than 30 dB and likely below 20 dB) at receivers nearest to the Project and would therefore have no bearing on the compliance outcomes for the Project.

In relation to the proposed Meering West Wind Farm, the development boundary is directly adjacent to the Project, and cumulative noise is likely to be a relevant consideration for receivers to the south of the Project. Given the proposed Meering West Wind Farm is in the early stages of development, turbine layouts and predicted noise levels are not yet available. However, given the advanced and public status of the Project, the developers of the Meering West Wind Farm would need to factor the Project in its design development. In particular, a planning application for the proposed Meering West Wind Farm would need to include noise modelling which demonstrates that the predicted cumulative wind turbine noise levels of the Project and the proposed Meering West Wind Farm are within the noise limits determined in accordance with NZS 6808. In this respect, the predicted noise levels at all receivers around the Project are compliant with the minimum applicable limit by a margin which can practically accommodate an additional contribution from a neighbouring development. For example, at locations to the south of the Project which are nearest to the proposed Meering West Wind Farm, the Project is predicted to comply with minimum applicable limit by a margin of at least 3 dB. This means that even if the Meering West Wind Farm was planned in a way that resulted in comparable predicted noise levels at these receivers, the total combined noise level of the two projects would still be below the minimum applicable limit by a clear margin. This supports that cumulative noise considerations can be practically managed at the interface of the Project and the Meering West Wind Farm, but the subject would need to be addressed as part of the planning application process for the Meering West Wind Farm.

The above findings are also applicable to a scenario in which all 3 projects were subsequently approved and developed. This is based on the:

- clear margins of compliance at all receivers around the Project
- large separating distance between the Project and the proposed Cannie Wind Farm
- neighbouring developments being oriented in different directions from the Project.

Figure 6: Project turbine layout (with highest predicted noise contours) and site boundaries of the proposed Meering West and Cannie wind farms

7.0 TRANSFORMER STATION ASSESSMENT

7.1 Noise limits

The procedure for determining the noise limits according to the Noise Protocol depends on whether the noise source or the receivers are located in a rural or urban area.

The procedure for rural areas, applicable for the subject site, is based on determining the zone levels according to the land zoning of the area in which the noise source and receivers are located. These zone levels are then adjusted, where appropriate, for a range of factors.

The zone levels are determined on the basis of the transformer station and surrounding receivers both being located on land designated as Farming Zone (FZ) (see land zoning map in Appendix E).

Considering that the land zoning is continuous between the transformer station and the receivers, a distance adjustment is not applicable.

Adjustments for 'background relevant areas' are not warranted in this instance, as the background noise levels during the relevant assessment conditions for the transformer station (i.e. low wind speeds) are expected to be relatively low; adjustments for background noise levels are therefore not warranted in this instance.

Based on the above and considering that the transformer station would be defined in the Victorian Planning Provisions as a *utility*, the noise limits applicable at the nearest receivers, are summarised in Table 13. These noise limits apply to the cumulative noise of all industry premises which contribute to noise levels at the receivers.

Table 13: Noise Protocol time periods and noise limits, dB ENL[6]

Period	Day of week	Start time	End time	Noise limit
Day	Monday- Saturday	0700 hrs	1800 hrs	45
Evening	Monday- Saturday	1800 hrs	2200 hrs	39
	Sunday, Public holidays	0700 hrs	2200 hrs	
Night	Monday-Sunday	2200 hrs	0700 hrs	34

[6] The effective noise level (ENL) of commercial or industrial noise determined in accordance with the Noise Protocol. This is the L_{Aeq} noise level over a half-hour period, adjusted for the character and duration of the noise. Character adjustments may be made for tonality, intermittency, and impulsiveness.

7.2 Transformer noise emissions

The high voltage (HV) transformer and any associated cooling equipment would be the main sources of noise located within the transformer station.

At this stage in the project, specific details of the transformer make and model are yet to be determined, however, the proponent has indicated that a single 150 MVA transformer would be representative.

In the absence of measured sound power level data for a specific transformer model, reference has been made to the standard maximum method for estimating overall transformer sound power levels for a given power rating described in AS 60076-10:2009.[7]

Octave band spectral data for each transformer was then estimated by applying Bies & Hansen corrections from Table 11.27 (*Location 1a for outdoor transformer noise*) to the determined overall sound power level.[8]

Sound power levels used for the assessment of operational noise from the transformer stations are detailed in Table 14. Data is provided as un-weighted (linear) octave band spectra and A-weighted overall sound power level.

Table 14: Sound power levels for transformer station equipment items, dB L_W

Item	Octave band centre frequency, Hz							
	63	125	250	500	1,000	2,000	4,000	L_{WA}
HV transformer (150 MVA)	99	101	96	96	90	85	80	96

7.3 Predicted noise levels

Predicted noise levels have been determined on the basis of:

- the indicative equipment noise emission data detailed in Section 7.2
- the ISO 9613-2 noise prediction method described in Section 4.3.

An adjustment of +2 dB has then been applied to the predicted noise levels to account for the potential tonal characteristics of transformer noise. The relevance and magnitude of the adjustment in practice is dependent on several variables. This is discussed below.

The predicted noise level from the transformer station at the nearest receiver (AC35 - a), located approximately 1.1 km to the southwest, is 23 dB ENL (including the +2 dB adjustment for potential tonality).

The predicted effective noise levels are below the day, evening and night noise limits set out in Table 13 by at least 11 dB.

[7] AS 60076-10:2009 *Power transformers – Part 10: Determination of sound levels*

[8] Bies, & Hansen, C. H. (2009). *Engineering noise control: theory and practice (Fourth edition.).* p. 601

The following contextual notes are provided:

- A +2 dB adjustment for tonality has been assumed at all receivers in order to provide a conservative assessment. The predicted effective noise levels are very low and would be comparable to or less than background noise levels in many instances. The adjustment for tonality may therefore not be applicable if the tonal character of the transformer station is not detectable at the receiver.
- Conversely, in the unlikely event that the character of the noise warranted a larger adjustment of +5 dB (the maximum potential adjustment, which would only be triggered in the event that the selected transformer was tonal and the tonal character was prominent at the receiver), compliance would still be achieved.

These results indicate that the proposed transformer station associated with the Project is capable of being designed and operated such that the applicable noise limits are achieved.

Notwithstanding the above, the predicted noise levels should be reviewed at the time when the Project design and equipment selection are finalised, accounting for manufacturer noise emission data.

It should be noted that compliance with the limit does not infer compliance with the general environmental duty under the EP Act. Further discussion is provided in Section 9.0.

7.4 Cumulative assessment

The nearest existing operational industry in the vicinity of the Project are:

- Gannawarra Solar Farm: a 50 MW solar farm located just over 2 km to the east of the Project's transformer station.
- Gannawarra BESS: a 25 MW / 50 MWh BESS integrated with the Gannawarra Solar Farm.

Both projects were commissioned in 2018.

The following approved industry developments in the vicinity of the Project were identified:

- Koorangie BESS: an approved 185MW / 370MWh BESS located directly adjacent to the northwest of the Project's transformer station. The Koorangie BESS is currently in construction and scheduled to commence operation in 2025.
- Gannawarra Solar Farm – Stage 2: an expansion of the existing Gunnarwara Solar Farm on land surrounding the site of the Project's transformer station. Construction of this development is yet to commence.

Noise related information for the existing and approved industry in the area was not available to reference in this assessment. However, under the EP Act, the combined total noise levels of these developments must comply with the noise limits determined in accordance with the Noise Protocol. The applicable noise limits are the values outlined earlier in Section 7.1.

Guidance for the assessment of cumulative industry noise levels is provided in EPA Publication 1997 *Technical Guide: Measuring and analysing industry and music noise* dated June 2021. Specifically, section 3.3 of EPA Publication 1997 provides guidance for the assessment of noise from multiple premises in a range of situations. The relevant guidance is reproduced below.

Proposed new industry or extension of existing premises in rural areas

In rural areas, new industry plant or operations should be designed so that their emissions are less than the noise limits.

Circumstances for which the equal sharing principle applies for new industry developments include:

- *where there is existing industry impacting on noise sensitive areas sites*
- *where there are multiple small commercial, industrial or trade premises.*

The contribution of the proposed development should then be abated to meet, for each period of the day, a level set below the relevant noise limit by 10 x log10(N) decibels, where N is the total number of existing and likely contributing industrial plant installations (refer Table 2).

Otherwise, a future-proofing approach should be adopted in areas where there is a likelihood of further industrial growth, as is the case for:

- *industrial premises in an Industrial 1 zone (IN1Z) or in an Industrial 2 zone (IN2Z), with at least two other allotments in the same zoned piece of land*
- *industrial premises on an allotment greater than 10 ha in any zone where expansion is likely.*

The contribution from an individual site to the noise within noise sensitive areas in rural areas should be no greater than the noise limit minus five decibels (for each period of the day). This 5 dB reduction from the noise limit is provided on the presumption of three premises in the industrial zone will ultimately affect the noise sensitive areas. Where there is a high potential for industry development, to prevent the combined noise from exceeding the noise limits as more industries are developed over time, a lower level may be required.

Both the equal sharing principle and future-proofing approach are relevant in this instance.

The equal sharing principle returns the most stringent limit allocations for each site, being the total noise limits (day, evening and night) minus 7 dB. This is based on a total of 5 contributing sites, consisting of the Project's transformer station and the 4 existing and approved industry developments. Treating the sites separately results in the lowest limits for the Project's transformer station, and the highest collective allocation for the neighbouring developments (i.e. the sum of the individual allocations for the neighbouring developments). The result is an equal sharing principle night-time noise limit of 27 dB ENL.

However, there is separate guidance in EPA Publication 1997 to indicate that the equal sharing principle may be too simplistic in complex situations where the amount of noise each individual premises contributes to the cumulative noise within sensitive areas varies to a large degree. EPA Publication 1997 notes the following examples where this may be the case:

- there is a large diversity in the size or nature of the industries affecting noise sensitive
- the distance from each individual premises to the noise sensitive area varies
- the practicability of noise control varies greatly between the different premises.

The above factors are relevant here. For these situations, EPA Publication 1997 states:

Rather than applying the equal sharing principle, noise reductions achievable from each site need to be investigated to obtain a suitable outcome. It may then be relevant to adopt individual criteria that give regard to the circumstances of each premises.

Accounting for the above, and recognising the larger scale of existing and approved neighbouring developments, there is merit in considering the suitability and viability of a more stringent limit allocation for the Project's transformer station than suggested by the equal sharing principle.

In this respect, the highest predicted noise level indicated in Section 7.3 for the Project's transformer station is 23 dB ENL (including the +2 dB adjustment for potential tonality). This result relates to a single receiver which is nearest to the Project's transformer station. The predicted noise levels will be lower, and generally significantly lower, at other receivers around the Project. This indicates that, as well as complying with the overall cumulative noise limit, the highest predicted noise level is below the equal sharing principle allocation of 27 dB ENL by a margin of 4 dB. Further, as the predicted noise level is more than 10 dB below the cumulative noise limit, the predicted contribution of the Project's transformer station is negligible with respect to compliance. For example, if all other neighbouring industry were operating at a combined noise level approaching the cumulative noise limit, the contribution of the Project's transformer station to the total noise level would be less than half a decibel and would be inconsequential to the compliance outcomes.

These findings support that the Project's transformer station is not expected to be a material contributor to cumulative industry noise at surrounding receivers. However, in recognition of the scale of existing and approved industry, the Project's transformer station should be designed to the lowest noise level which can be achieved by implementing all reasonably practicable measures in accordance with the GED under the EP Act. The specific limit allocation for the Project's substation would need to be assessed during the detailed design stage of the Project, accounting for the status and available noise data for the neighbouring developments at the time. A provisional design target equal to the cumulative noise limits minus 10 dB is recommended in the interim. This equates to a night period limit value of 24 dB ENL which the noise modelling indicates is achievable.

Figure 7: Project transformer station and other existing and approved developments

8.0 ENVIRONMENTAL REFERENCE STANDARD

The Environmental Reference Standard (ERS) is a relevant consideration for natural areas located in the vicinity of the Project and is addressed in this section.

8.1 Identified natural areas

Natural areas are a land-use category for which the ERS details desired outcomes in terms of noise level to be achieved or maintained in Victoria. The ERS defines natural areas as national parks, state parks, state forests, nature conservation reserves and wildlife reserves.

To provide an indication of the proximity of natural areas to the Project, reference has been made to the land zoning of the surrounding area. Specifically, areas zoned as PCRZ and PPRZ, have been identified, where the ERS may be relevant. For the Project, the identified natural areas within 5 km are:

- Wandella Nature Conservation Reserve, approximately 4.2 km northeast of the Project
- Little Lake Bael, approximately 4.6 km north of the Project
- Great Spectacle Lake, approximately 4.8 km south of the Project.

8.2 Guidance on noise in natural areas

Clause 7 of the ERS sets out the environmental values for the ambient sound environment that are to be achieved or maintained in Victoria. The ERS also sets out the indicators and objectives to support those values. The environmental value relevant to natural areas and the indicator to support this value is contained in Table 15.

Table 15: Environmental values of the ambient sound environment

Environmental value	Description of environmental value
Human tranquillity and enjoyment outdoors in natural areas	An ambient sound environment that allows for the appreciation and enjoyment of the environment for its natural condition and the restorative benefits of tranquil soundscapes in natural areas

8.3 Project noise levels in natural areas

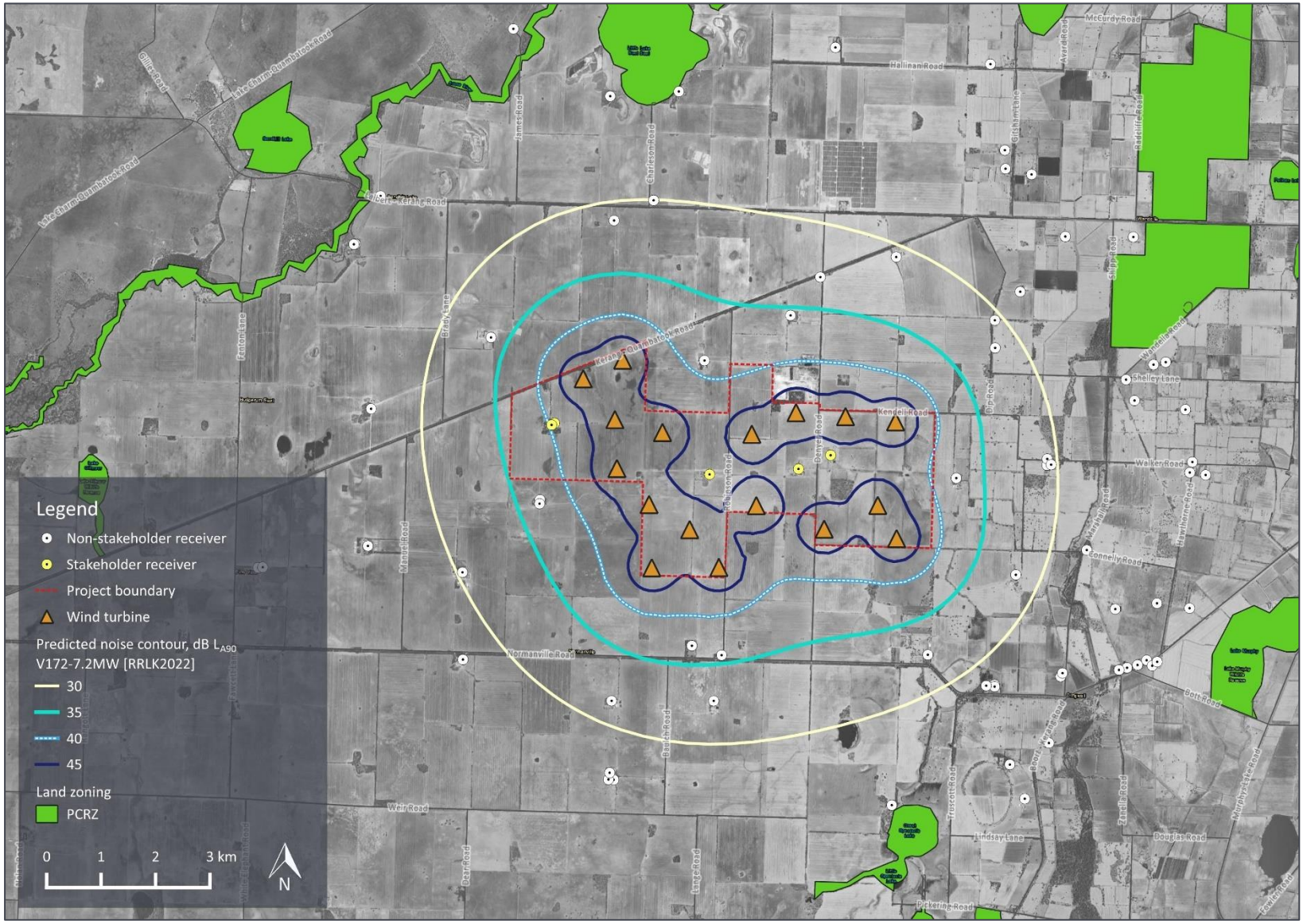
With respect to operational noise of the Project in natural areas, the primary consideration is noise from wind turbines. In contrast, the extent of natural areas potentially affected by the proposed transformer station is relatively limited.

The highest operational wind turbine noise levels from the Project within the nearest natural areas are predicted to be between 20 dB and 25 dB L_{A90}. These levels are likely to be similar or lower than existing background noise levels. This should be reviewed in more detail once background noise levels in the vicinity of the Project site are known. The distribution of wind turbine noise levels in the vicinity of the identified natural areas is presented in Figure 8 for the candidate turbine model resulting in the highest predicted noise levels (V172-7.2MW).

The potential for the environmental value of *human tranquillity and enjoyment outdoors in natural areas* to be affected by noise is dependent on the audibility of the noise. Audibility of the Project in the identified natural areas will be highly dependent on a range of factors, including:

- Proximity, scale and operating conditions of the project
- extent of the identified natural areas
- natural background noise sources (e.g., vegetation, fauna, etc.)
- anthropogenic background noise sources (e.g., road traffic, farming and forestry activities, etc.)
- wind conditions (e.g., wind speed and wind direction).

Figure 8: Identified natural areas in the vicinity of the Project including highest predicted wind turbine noise contours



9.0 RECOMMENDED NOISE MANAGEMENT MEASURES

Providing that the operator of a wind energy facility complies with the requirements of regulation 131C of the EP Regulations, their obligations with respect to the general environmental duty (GED) under the EP Act will be addressed with regard to wind turbine noise.

Specifically, the operator of the facility must:

- ensure that wind turbine noise complies with NZS 6808
- implement all applicable actions under Division 5.3 of the EP Regulations to manage and review wind turbine noise from the facility, including:
  - preparation of a noise management plan
  - conducting noise compliance testing when the wind farm begins operating
  - preparing annual compliance statements
  - conducting verification wind turbine noise monitoring every 5 years.

In addition to the above, the following noise management measures should be implemented as part of the subsequent stages of development:

- The transformer equipment should be specified and selected to achieve noise emissions not exceeding the empirical values specified in AS 60076-10.

  The transformer equipment will need to be designed accounting for the cumulative noise of other existing and approved industry developments. The specific limit allocation in accordance with the Noise Protocol will need to be assessed during detailed design. However, a provisional design target equal to the cumulative noise limits minus 10 dB is recommended in the interim (this equates to a provisional limit allocation of 24 dB ENL for night-time for the Project's transformer station).
- Preparation of a detailed noise assessment by a qualified acoustic consultant, prior to construction, addressing:
  - the final wind turbine selection and layout
  - the final location and equipment selection for the transformer station
  - compliance with the applicable noise limits at surrounding receivers.
  - recommendation of reasonably practicable noise mitigation measures to minimise the risk of harm from noise associated with the transformer station, as required under the EP Act.
- Development of reasonably practicable construction noise mitigation and management measures to be documented in a construction environmental management plan, prior to construction.

10.0 SUMMARY

An assessment of operational wind turbine noise for the proposed Normanville Energy Park has been carried out in accordance with NZS 6808, as required by the Victorian Wind Energy Guidelines and the EP Regulations. The assessment is based on the proposed wind farm layout comprising up to 17 multi-megawatt wind turbines and the proposed transformer station.

Noise modelling was based on based on 3 candidate wind turbine models which have been selected by the proponent as being representative of the size and type of wind turbines which could be used at the site.

The results of the modelling demonstrate that the proposed wind turbines are predicted to achieve compliance with the applicable noise limits determined in accordance with NZS 6808 for all selected candidate wind turbine models. Consideration was also given to the potential cumulative noise considerations of the proposed Cannie and Meering West wind farm developments. The assessment demonstrates that the cumulative noise considerations are not relevant to the interface with the proposed Cannie Wind Farm. In relation to the proposed Meering West Wind Farm, cumulative wind turbine noise is a relevant consideration at the interface to the south of the Project. However, the predicted wind turbine noise levels associated with the Project are well below the minimum applicable noise limits at this interface. Accordingly, there is significant scope within the limits to accommodate the potential noise contribution of the proposed Meering West Wind Farm.

Noise limits applicable to the transformer station have also been determined in accordance with the Noise Protocol. Noise modelling based on empirical data for the transformer station indicates that the noise limits can be achieved, including consideration of other existing and approved industry developments in the area.

Consideration was also given to the general environmental duty, as required by the EP Act.

The noise assessment therefore demonstrates that the proposed Normanville Energy Park can be designed and developed to achieve the relevant Victorian noise requirements.

APPENDIX A GLOSSARY AND ABBREVIATIONS

Term	Definition	Abbreviation
Amplitude modulation	Sound that is characterised by a rhythmic and higher than normal rise and fall in sound level at regular intervals.	-
A-weighting	A method of adjusting sound levels to reflect the human ear's varied sensitivity to different frequencies of sound.	See discussion below this table.
A-weighted 90th centile	The A-weighted pressure level that is exceeded for 90 % of a defined measurement period. It is used to describe the underlying background sound level in the absence of a source of sound that is being investigated, as well as the sound level of steady, or semi steady, sound sources.	L_{A90}
A-weighted average noise level	The equivalent continuous (time-averaged) A-weighted sound level.	L_{Aeq}
Decibel	The unit of sound level.	dB
EPA	Environment Protection Authority Victoria	-
EP Act	*Environment Protection Act 2017*	-
EP Regulations	*Environment Protection Regulations 2017*	-
Hertz	The unit for describing the frequency of a sound in terms of the number of cycles per second.	Hz
Impulsiveness	Sound that is characterised by a distinct and very rapid rise in sound level (e.g. a car door closing or the impact sound of a hammer)	-
ISO 9613-2	ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*	-
Noise sensitive area	A location where the noise of commercial, industry or trade premises is assessable in accordance with the *Environment Protection Regulations 2017*.	Receiver
Noise sensitive location	A location where wind turbine noise is assessable in accordance with the *Environment Protection Regulations 2017* and NZS 6808, excluding stakeholder receivers.	Receiver
NZS 6808	New Zealand Standard 6808:2010 *Acoustics – Wind farm noise*	-
Octave Band	A range of frequencies. Octave bands are referred to by their logarithmic centre frequencies, these being 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz for the audible range of sound.	-
Receiver	Any location where an assessment of noise levels is required in accordance with a regulatory requirement or government guideline. The term is used interchangeably when referring to noise sensitive areas as defined in the *Environment Protection Regulations 2017*, noise sensitive locations as defined in NZS 6808, and the types of locations which require consideration under the Environment Reference Standard.	-
Sound power level	A measure of the total sound energy emitted by a source, expressed in decibels.	L_W
Sound pressure level	A measure of the level of sound expressed in decibels.	L_p

Term	Definition	Abbreviation
Special audible characteristics	A term used to define a set group of Sound characteristics that increase the likelihood of adverse reaction to the sound. The characteristics comprise tonality, impulsiveness, and amplitude modulation.	SAC
Stakeholder receiver	Receivers that are located within the Project boundary and/or receivers where a noise agreement between the land owner and the proponent would apply in relation to wind turbine noise.	-
Tonality	A characteristic to describe sounds which are composed of distinct and narrow groups of audible sound frequencies (e.g. whistling or humming sounds).	-

The basic quantities used within this document to describe noise adopt the conventions outlined in ISO 1996-1:2016 *Acoustics - Description measurement and assessment of environmental noise – Basic quantities and assessment procedures*. Accordingly, all frequency weighted sound pressure levels are expressed as decibels (dB) in this report. For example, sound pressure levels measured using an "A" frequency weighting are expressed as dB L_A. Alternative ways of expressing A-weighted decibels such as dBA or dB(A) are therefore not used within this report unless as a direct quote of a relevant document.

APPENDIX B SOURCE COORDINATES

The following table sets out the coordinates of the proposed wind turbine layout referenced as *NMEP_WTGLayout_V15-01* and supplied by the proponent on 4 November 2024.

Table 16: Wind turbine coordinates – GDA2020 MGA zone 54

Turbine	Easting, m	Northing, m	Terrain elevation, m
T001	747,564	6,039,129	90
T002	746,839	6,038,787	90
T003	750,749	6,038,165	90
T004	751,658	6,038,092	90
T005	752,578	6,037,996	88
T006	747,421	6,038,037	90
T007	748,295	6,037,801	90
T008	749,937	6,037,769	90
T009	747,458	6,037,139	90
T010	748,049	6,036,478	90
T011	750,019	6,036,458	90
T012	752,251	6,036,461	90
T013	748,795	6,036,017	90
T014	751,265	6,036,026	90
T015	752,597	6,035,853	89
T016	748,098	6,035,316	90
T017	749,331	6,035,323	90

The following table sets out the coordinates of the proposed transformer station supplied by the proponent on 23 September 2024.

Table 17: Transformer station coordinates – GDA2020 MGA zone 54

Item	Easting, m	Northing, m	Terrain elevation, m
HV transformer	749,010	6,042,763	80

APPENDIX C RECEIVER COORDINATES

The following table sets out the 58 assessed receivers located within 5 km of the proposed wind turbines and transformer station considered in the environmental noise assessment, their distance to the nearest wind turbine, and their land zoning. This includes 5 stakeholder receivers, as confirmed by email on 13 May 2024.

The coordinates of the receivers are based on *NMEP_Structures_Points_5kmSBBuffer_v04-05_Current*, supplied by the proponent on 18 November 2024.

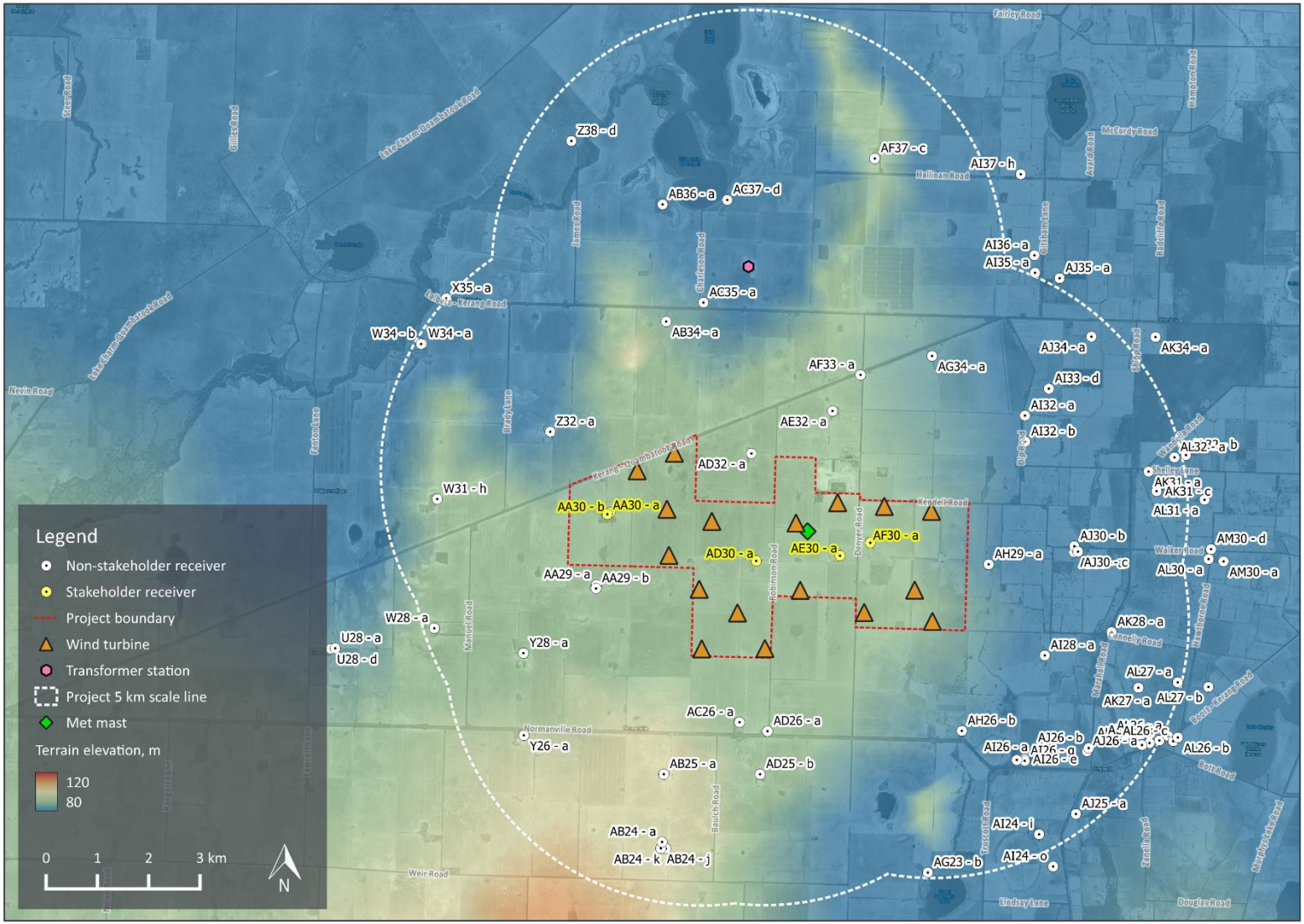
Table 18: Receivers within 5 km of the proposed wind turbines – GDA2020 MGA zone 54

Receiver	Easting, m	Northing, m	Terrain elevation, m	Distance to the nearest turbine, m	Nearest turbine	Land zoning
Non-stakeholder receivers						
AA29 - a	746,045	6,036,566	90	1,533	T009	FZ
AA29 - b	746,037	6,036,493	90	1,568	T009	FZ
AB24 - a	747,324	6,031,553	100	3,845	T016	FZ
AB24 - j	747,302	6,031,430	100	3,970	T016	FZ
AB24 - k	747,399	6,031,425	100	3,957	T016	FZ
AB25 - a	747,360	6,032,874	100	2,556	T016	FZ
AB34 - a	747,406	6,041,693	88	2,573	T001	FZ
AB36 - a	747,336	6,043,975	80	4,853	T001	FZ
AC26 - a	748,835	6,033,886	90	1,528	T017	FZ
AC35 - a	748,133	6,042,062	83	2,991	T001	FZ
AC37 - d	748,596	6,044,061	80	5,041	T001	FZ
AD25 - b	749,237	6,032,874	90	2,456	T017	FZ
AD26 - a	749,382	6,033,712	90	1,619	T017	FZ
AD32 - a	749,067	6,039,122	90	1,510	T001	FZ
AE32 - a	750,649	6,039,950	90	1,794	T003	FZ
AF33 - a	751,195	6,040,653	89	2,532	T003	FZ
AF37 - c	751,473	6,044,870	90	6,745	T003	FZ
AG23 - b	752,508	6,030,959	80	4,897	T015	FZ
AG34 - a	752,590	6,041,023	84	3,031	T005	FZ
AH26 - b	753,171	6,033,719	82	2,215	T015	FZ
AH29 - a	753,693	6,036,963	82	1,527	T005	FZ
AI24 - i	754,677	6,031,704	80	4,643	T015	FZ
AI26 - a	754,242	6,033,152	80	3,166	T015	FZ
AI26 - e	754,396	6,033,169	80	3,235	T015	FZ
AI26 - g	754,397	6,033,135	80	3,263	T015	FZ
AI28 - a	754,788	6,035,188	80	2,295	T015	FZ

Receiver	Easting, m	Northing, m	Terrain elevation, m	Distance to the nearest turbine, m	Nearest turbine	Land zoning
AI32 - a	754,401	6,039,861	80	2,613	T005	FZ
AI32 - b	754,407	6,039,354	80	2,283	T005	FZ
AI33 - d	754,867	6,040,385	80	3,313	T005	FZ
AJ25 - a	755,395	6,032,099	80	4,684	T015	FZ
AJ26 - a	755,611	6,033,320	80	3,940	T015	FZ
AJ26 - b	755,644	6,033,383	80	3,926	T015	FZ
AJ30 - a	755,359	6,037,200	80	2,897	T005	FZ
AJ30 - b	755,364	6,037,315	80	2,872	T005	FZ
AJ30 - c	755,436	6,037,210	80	2,967	T005	FZ
AJ34 - a	755,696	6,041,398	80	4,618	T005	FZ
AK26 - a	756,830	6,033,481	80	4,854	T015	FZ
AK26 - b	756,683	6,033,441	80	4,747	T015	FZ
AK27 - a	756,614	6,034,558	80	4,223	T015	FZ
AK28 - a	756,090	6,035,642	80	3,503	T015	FZ
AK31 - a	756,812	6,038,771	80	4,307	T005	FZ
AK31 - c	756,968	6,038,388	80	4,410	T005	FZ
AL26 - h	757,023	6,033,532	80	5,000	T015	FZ
AL27 - a	757,380	6,034,665	80	4,931	T015	FZ
AL32 - a	757,317	6,039,047	80	4,856	T005	FZ
W28 - a	742,884	6,035,717	90	4,793	T009	FZ
W31 - h	742,942	6,038,236	90	3,939	T002	FZ
W34 - a	742,650	6,041,260	80	4,867	T002	FZ
W34 - b	742,626	6,041,256	80	4,886	T002	FZ
Y26 - a	744,629	6,033,632	96	3,859	T016	FZ
Y28 - a	744,621	6,035,233	90	3,421	T009	FZ
Z32 - a	745,145	6,039,545	82	1,862	T002	FZ
Z38 - d	745,556	6,045,211	80	6,407	T001	FZ
Stakeholder receivers within the Project boundary						
AA30 - a	746,311	6,037,972	90	983	T002	FZ
AA30 - b	746,258	6,037,940	90	1,038	T002	FZ
AD30 - a	749,161	6,037,030	90	1,042	T011	FZ
AE30 - a	750,795	6,037,131	90	1,038	T011	FZ
AF30 - a	751,385	6,037,383	90	774	T004	FZ

APPENDIX D SITE TOPOGRAPHY

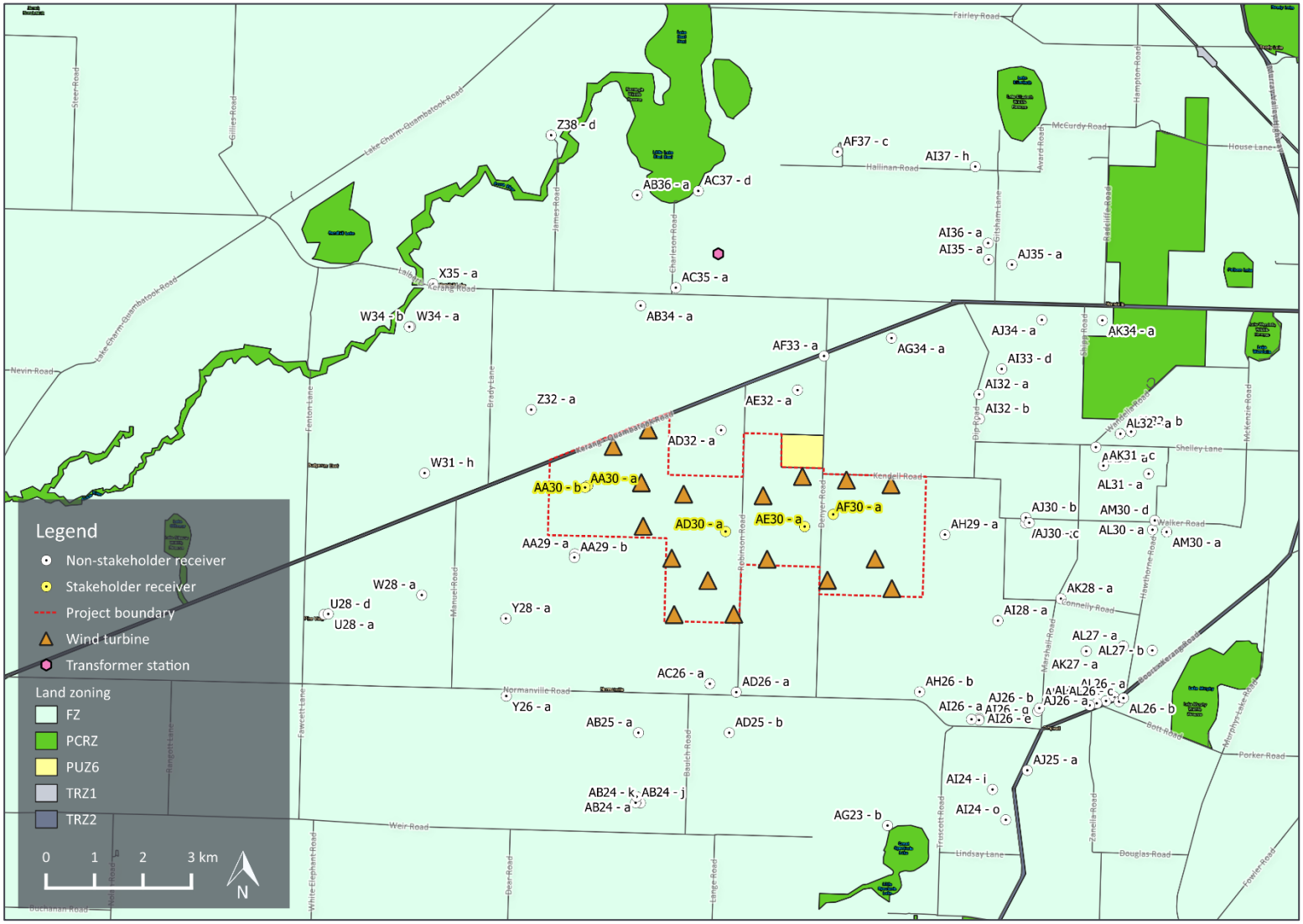
Figure 9: Terrain elevation map for the Project and surrounding area



ADVERTISED PLAN

APPENDIX E ZONING MAP

Figure 10: Zoning map for the Project and surrounding area



APPENDIX F NOISE PREDICTION MODEL

F1 Overview

In Australia, noise predictions are typically calculated using ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation* (ISO 9613-2:1996) with a set of conservative assumptions tailored to wind turbine noise assessment, as detailed in UK Institute of Acoustics publication *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* (UK Institute of Acoustics guidance).

A revised version of the standard, ISO 9613-2:2024, was published earlier in 2024 based on broadly equivalent procedures to ISO 9613-2:1996, subject to refinements, clarifications, and supplementary advice for different types of sources.[9] Notably, ISO 9613-2:2024 introduces an informative annex on wind turbine noise modelling to reflect the recommendations of the UK Institute of Acoustics guidance.

At the date of preparing this report, MDA is reviewing the implementation of ISO-9613-2:2024 in SoundPLANnoise. This is a standard quality assurance process undertaken by MDA before using any revised noise modelling standard. However, the core elements of the two versions (particularly with respect to wind farm noise modelling), are similar, and proprietary software options already implement the UK Institute of Acoustics guidance with respect to ISO 9613-2:1996.

On this basis ISO 9613-2:1996 continues to be used and referenced in Australia and has been chosen as the most appropriate method to calculate the level of broadband A-weighted wind farm noise expected to occur at surrounding receptor locations. This method is considered the most robust and widely used international method for the prediction of wind farm noise.

The use of this standard is supported by international research publications, measurement studies conducted by Marshall Day Acoustics and direct reference to the standard in NZS 6808:2010 *Acoustics – Wind farm noise* and the South Australian EPA 2009 wind farm noise guidelines.

The standard specifies an engineering method for calculating noise at a known distance from a variety of sources under meteorological conditions favourable to sound propagation. The standard defines favourable conditions as downwind propagation where the source blows from the source to the receiver within an angle of ±45 degrees from a line connecting the source to the receiver, at wind speeds between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground. Equivalently, the method accounts for average propagation under a well-developed moderate ground based thermal inversion. In this respect, it is noted that at the wind speeds relevant to noise emissions from wind turbines, atmospheric conditions do not favour the development of thermal inversions throughout the propagation path from the source to the receiver.

To calculate far-field noise levels according to ISO 9613-2, the noise emissions of each wind turbine are firstly characterised in the form of octave band frequency levels. A series of octave band attenuation factors are then calculated for a range of effects including:

- geometric divergence
- air absorption
- reflecting obstacles
- screening
- vegetation
- ground reflections.

[9] ISO 9613-2:2024 *Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors*

The octave band attenuation factors are then applied to the noise emission data to determine the corresponding octave band and total calculated noise level at receivers.

Calculating the attenuation factors for each effect requires a relevant description of the environment into which the sound propagation such as the physical dimensions of the environment, atmospheric conditions and the characteristics of the ground between the source and the receiver.

Wind farm noise propagation has been the subject of considerable research in recent years. These studies have provided support for the reliability of engineering methods such as ISO 9613-2:1996 when a certain set of input parameters are chosen in combination. Specifically, the studies to date tend to support that the assignment of a ground absorption factor of G = 0.5 for the source, middle and receiver ground regions between a wind farm and a calculation point tends to provide a reliable representation of the upper noise levels expected in practice, when modelled in combination with other key assumptions; specifically all wind turbines operating at identical wind speeds, emitting sound levels equal to the test measured levels plus a margin for uncertainty (or guaranteed values), at a temperature of 10 °C and relative humidity of 70% to 80%, with specific adjustments for screening and ground effects as a result of the ground terrain profile.

In support of the use of ISO 9613-2:1996 and the choice of G = 0.5 as an appropriate ground characterisation, the following references are noted:

- A factor of G = 0.5 is frequently applied in Australia for general environmental noise modelling purposes as a way of accounting for the potential mix of ground porosity which may occur in regions of dry/compacted soils or in regions where persistent damp conditions may be relevant
- NZS 6808 refers to ISO 9613-2:1996 as an appropriate prediction method for wind farm noise, and notes that soft ground conditions should be characterised by a ground factor of G = 0.5
- In 1998, a comprehensive study (commonly cited as the Joule Report), part funded by the European Commission found that the ISO 9613-2:1996 model provided a robust representation of upper noise levels which may occur in practice and provided a closer agreement between predicted and measured noise levels than alternative methods such as CONCAWE and ENM. Specifically, the report indicated the ISO 9613-2:1996 method generally tends to marginally over predict noise levels expected in practice

The UK Institute of Acoustics journal dated March/April 2009 published a joint agreement between practitioners in the field of wind farm noise assessment (the UK IOA 2009 joint agreement), including consultants routinely employed on behalf of both developers and community opposition groups, and indicated the ISO 9613-2:1996 method as the appropriate standard and specifically designated G = 0.5 as the appropriate ground characterisation. This agreement was subsequently reflected in the recommendations detailed in the UK Institute of Acoustics publication *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* (UK Institute of Acoustics guidance). [10]

It is noted that these publications refer to predictions made at receiver heights of 4 m. Predictions in Australia have generally been based on a lower prediction height of 1.5 m which tends to result in higher ground attenuation for a given ground factor. Conversely, predictions in Australia do not generally incorporate the -2 dB factor which is also specified in the UK Institute of Acoustics guidance to account for the difference between L_{Aeq} and L_{A90} noise levels. The result is that these differences tend to balance out to a comparable approach which supports the use of G = 0.5 in the context of Australian prediction methodologies.

A range of measurement and prediction studies for wind farms in which Marshall Day Acoustics' staff have been involved in have provided further support for the use of ISO 9613-2:1996 with G = 0.5 and modelled

[10] ETSU-R-97 *The Assessment and Rating of Noise from Wind Farms - The Working Group on Noise from Wind Turbines reference – Final Report*, dated September 1996

receiver height of 1.5 m as an appropriate representation of typical upper noise levels expected to occur in practice.[11, 12, 13]

The findings of these studies demonstrate the suitability of the ISO 9613-2:1996 method to predict the propagation of wind turbine noise for:

- the types of noise source heights associated with a modern wind farm, extending the scope of application of the method beyond the 30 m maximum source heights considered in ISO 9613-2:1996
- the types of environments in which wind farms are typically developed, and the range of atmospheric conditions and wind speeds typically observed around wind farm sites.

Importantly, this supports the extended scope of application to wind speeds in excess of 5 m/s.

More recently, the Technical Guideline released by the Victorian EPA and DTP sets out recommended default inputs for wind turbine noise modelling and refers to the use of a 4 m receiver height. The 4 m calculation from the UK Institute of Acoustics guidance is suitable for Victorian conditions when used in conjunction with the entirety of the guidance, notably including the recommendation to subtract 2 dB for the difference between equivalent (L_{Aeq}) and L_{A90} noise levels. However, NZS 6808 specifically precludes this adjustment and, despite the introduction of 4 m calculation heights in the Technical Guideline, the Technical Guideline reiterates the preclusion. As a result, the prediction method described in the Technical Guideline is significantly more conservative than the original methodology of the guidance upon which it is based.

The Technical Guideline does provide advice to indicate that other input parameters (i.e. other than the default values) may be suitable where appropriately justified. Based on the discussions detailed above, a 1.5 m calculation height remains appropriate for the Project and is justified by the evidence of operational wind farm projects throughout Australia. However, following consultations with the independent environmental auditor, the Proponent elected to present predicted noise levels based on 4 m receiver heights for the simplicity of aligning with the default modelling parameters described in the Technical Guideline. The predicted noise levels presented in this report will therefore overestimate wind farm noise levels by approximately 2 dB.

In addition to the choice of parameters referred to above, adjustments to ISO 9613-2:1996 for screening and valleys effects are applied based on recommendations of the Joule Report, UK IOA 2009 joint agreement and the UK Institute of Acoustics guidance. The following adjustments are applied to the calculations:

- screening effects as a result of terrain are limited to 2 dB
- screening effects are assessed based on each wind turbine being represented by a single noise source located at the maximum tip height of the wind turbine rotor
- an adjustment of 3 dB is added to the predicted noise contribution of a wind turbine if the terrain between the wind turbine and receiver in question is characterised by a significant valley.

  A significant valley is defined as a situation where the mean sound propagation height is at least 50 % greater than it would be otherwise over flat ground.

[11] Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions: The Risks of Conservatism*; Presented at the Second International Meeting on Wind turbine Noise in Lyon, France September 2007.

[12] Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions and Comparisons with Measurements*; Presented at the Third International Meeting on Wind turbine Noise in Aalborg, Denmark June 2009.

[13] Delaire, Griffin, & Walsh – *Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia*; Presented at the Fourth International Meeting on Wind turbine Noise in Rome, April 2011.

The adjustments detailed above are implemented in the wind turbine calculation procedure of the SoundPLANnoise v9.0 software used to conduct the noise modelling. The software uses these definitions in conjunction with the digital terrain model of the site to evaluate the path between each wind turbine and receiver pairing, and then subsequently applies the adjustments to each wind turbine's predicted noise contribution where appropriate.

F2 Uncertainty

Guidance on uncertainty in wind farm noise assessment is provided in Appendix C of NZS 6808.

The guidance in Appendix C is designated as *informative*, meaning that the content is only for information and its provisions do not form part of the mandatory requirements of the standard. Notwithstanding this, Appendix C notes that it is good practice to state the uncertainty and confidence level for all sound levels.

Uncertainty in environmental noise modelling is typically addressed in one of two ways:

1. Mean predicted noise levels: selection of mean input values and modelling parameters to calculate a mean predicted noise level. The combined uncertainty relating to the inputs and prediction method is then assessed and used to consider how noise levels in practice could differ from the predicted noise levels.
2. Upper predicted noise levels: selection of conservative input values and modelling parameters to calculate the upper predicted noise levels, inherently accounting for uncertainty in the modelling. Noise levels in practice are then expected to be lower than predicted by the modelling.

NZS 6808 Appendix C notes that uncertainty should be determined in accordance with the procedures outlined in Craven and Kerry (2001)[14]. However, the procedures referenced in Craven and Kerry are primarily applicable to measurements rather than noise modelling. The procedures are also based on the calculation of uncertainty values which are more relevant when considering mean assessment values.

The approach to uncertainty adopted for this assessment is based on calculation of upper predicted noise levels. This approach is consistent with the UK Institute of Acoustics guidance on wind turbine noise modelling which addresses uncertainty by describing procedures for the calculation of upper predicted noise levels based on conservative input selections. With this approach, it is not necessary to apply uncertainty margins to the predicted noise levels. Noise levels associated with operation of the wind farm when measured and assessed in accordance with NZS 6808 are expected to be lower than the predictions. This finding is supported by extensive post-construction noise compliance monitoring undertaken at wind farm sites across Australia. Further, Appendix C notes that when comparing a sound level with an applicable noise limit, the sound level should be deemed to comply if it is equal to or less than the noise limit and does not specify the addition or subtraction of uncertainties.

Notwithstanding the above, the elements of the modelling which may give rise to uncertainty can be considered in the context of the framework outlined in Craven and Kerry. Specifically, the procedures in Craven and Kerry suggest considering uncertainty in sections related to source, transmission and receiver. The source and transmission considerations are directly relevant to noise modelling and are discussed further below. The section related to receiver uncertainty in Craven and Kerry is solely concerned with measurement related uncertainties (e.g. instrumentation uncertainty and background noise influences) and is therefore not relevant to the noise modelling.

[14] Craven, N J, and Kerry, G. *A good practice guide on the sources and magnitude of uncertainty arising in the practical measurement of environmental noise*. University of Salford. 2001

Source uncertainties (sound power levels)

The source levels of each wind turbine are characterised in terms of the sound power levels determined in accordance with IEC 61400-11. The results of sound power testing in accordance with this standard are typically characterised by an uncertainty margin of approximately ±1 dB. To reflect this, the sound power data sourced from the manufacturer's documentation has been factored in the noise modelling as follows:

- The manufacturer data has been adjusted by the addition of +1 dB at all wind speeds
- All turbines are assumed to simultaneously emit sound power levels at the uncertainty adjusted values.

Uncertainty relating to the frequency characteristics of the wind turbine's noise emissions was also addressed by identifying the wind speed with the most unfavourable spectrum profile (i.e. the spectrum profile which would result in the highest predicted noise levels) and then applying the same profile to every wind speed.

Transmission uncertainties (prediction method)

The ISO 9613-2:1996 prediction method indicates an uncertainty margin of the order of ±3 dB in relation to calculated noise levels at distances between 100 m and 1,000 m for situations with an average propagation height between 5 m and 30 m (noting the information provided earlier in this appendix regarding the validation work undertaken to support the application of ISO 9613-2:1996 to greater propagation heights). However, the uncertainty margins are noted for a prediction in accordance with the inputs described in ISO 9613-2:1996. A strict application of ISO 9613-2:1996 would involve designating a ground factor of G = 1 (instead of the more conservative G = 0.5 ground factor used in the calculations) to represent the porous ground conditions around the site which ISO 9613-2:1996 defines as follows:

> ***Porous ground**, which includes ground covered by grass, trees or other vegetation, and all other ground surfaces suitable for the growth of vegetation, such as farming land. For porous ground G = 1.*

A prediction based on a ground factor of G = 1, instead of G = 0.5 used in the modelling, would typically result in predicted noise levels approximately 3 dB lower, thus effectively offsetting the quoted uncertainty margin. This also does not account for the other conservative aspects of the model, such as the 4 m receiver height without adjustments (as discussed above) and the assumption that each receiver is simultaneously downwind of every wind turbine at all times and consistent atmospheric conditions which result in minimal atmospheric absorption.

It is not possible to specify exact uncertainty margins for the conservative prediction approach adopted for the assessment. However, based on experience and the published studies referenced earlier in this appendix, the uncertainty in short term measured noise levels under downwind conditions is typically of the order of ±2 dB. This reduces to reduces to ±1 dB or less when comparing predictions with measured noise levels determined in accordance with NZS 6808 which are based on the analysis of aggregated data for a range of atmospheric conditions. Given the additional conservatism assumed in the noise modelling (4 m receiver height without correction for the difference between the equivalent and L_{A90} noise levels), actual noise levels in practice, for the sound power levels referenced in this study, would be lower than the predictions, even accounting for short term variations in noise levels.

APPENDIX G TABULATED PREDICTED WIND TURBINE NOISE LEVELS

Table 19: Predicted wind turbine noise levels, dB L_{A90}– V172-7.2MW

Receiver	Hub-height wind speed, m/s											
	4	5	6	7	8	9	10	11	12	13	14	≥15
Non-stakeholder receivers												
AA29 - a	24.6	25.2	28.6	32.2	35.6	36.9	36.9	36.9	36.9	36.9	36.9	36.9
AA29 - b	24.5	25.1	28.5	32.1	35.5	36.8	36.8	36.8	36.8	36.8	36.8	36.8
AB24 - a	15.6	16.2	19.6	23.2	26.6	27.9	27.9	27.9	27.9	27.9	27.9	27.9
AB24 - j	15.3	15.9	19.3	22.9	26.3	27.6	27.6	27.6	27.6	27.6	27.6	27.6
AB24 - k	15.4	16.0	19.4	23.0	26.4	27.7	27.7	27.7	27.7	27.7	27.7	27.7
AB25 - a	19.0	19.6	23.0	26.6	30.0	31.3	31.3	31.3	31.3	31.3	31.3	31.3
AB34 - a	18.8	19.4	22.8	26.4	29.8	31.1	31.1	31.1	31.1	31.1	31.1	31.1
AB36 - a	13.3	13.9	17.3	20.9	24.3	25.6	25.6	25.6	25.6	25.6	25.6	25.6
AC26 - a	24.4	25.0	28.4	32.0	35.4	36.7	36.7	36.7	36.7	36.7	36.7	36.7
AC35 - a	17.7	18.3	21.7	25.3	28.7	30.0	30.0	30.0	30.0	30.0	30.0	30.0
AD25 - b	20.1	20.7	24.1	27.7	31.1	32.4	32.4	32.4	32.4	32.4	32.4	32.4
AD26 - a	23.4	24.0	27.4	31.0	34.4	35.7	35.7	35.7	35.7	35.7	35.7	35.7
AD32 - a	26.6	27.2	30.6	34.2	37.6	38.9	38.9	38.9	38.9	38.9	38.9	38.9
AE32 - a	23.3	23.9	27.3	30.9	34.3	35.6	35.6	35.6	35.6	35.6	35.6	35.6
AF33 - a	20.5	21.1	24.5	28.1	31.5	32.8	32.8	32.8	32.8	32.8	32.8	32.8
AG23 - b	14.0	14.6	18.0	21.6	25.0	26.3	26.3	26.3	26.3	26.3	26.3	26.3
AG34 - a	18.3	18.9	22.3	25.9	29.3	30.6	30.6	30.6	30.6	30.6	30.6	30.6
AH26 - b	19.9	20.5	23.9	27.5	30.9	32.2	32.2	32.2	32.2	32.2	32.2	32.2
AH29 - a	25.1	25.7	29.1	32.7	36.1	37.4	37.4	37.4	37.4	37.4	37.4	37.4
AI24 - i	13.3	13.9	17.3	20.9	24.3	25.6	25.6	25.6	25.6	25.6	25.6	25.6
AI26 - a	16.5	17.1	20.5	24.1	27.5	28.8	28.8	28.8	28.8	28.8	28.8	28.8
AI26 - e	16.3	16.9	20.3	23.9	27.3	28.6	28.6	28.6	28.6	28.6	28.6	28.6
AI26 - g	16.2	16.8	20.2	23.8	27.2	28.5	28.5	28.5	28.5	28.5	28.5	28.5
AI28 - a	19.2	19.8	23.2	26.8	30.2	31.5	31.5	31.5	31.5	31.5	31.5	31.5
AI32 - a	18.1	18.7	22.1	25.7	29.1	30.4	30.4	30.4	30.4	30.4	30.4	30.4
AI32 - b	19.2	19.8	23.2	26.8	30.2	31.5	31.5	31.5	31.5	31.5	31.5	31.5
AI33 - d	16.1	16.7	20.1	23.7	27.1	28.4	28.4	28.4	28.4	28.4	28.4	28.4
AJ25 - a	13.0	13.6	17.0	20.6	24.0	25.3	25.3	25.3	25.3	25.3	25.3	25.3
AJ26 - a	14.4	15.0	18.4	22.0	25.4	26.7	26.7	26.7	26.7	26.7	26.7	26.7

Receiver	Hub-height wind speed, m/s											
	4	5	6	7	8	9	10	11	12	13	14	≥15
AJ26 - b	14.4	15.0	18.4	22.0	25.4	26.7	26.7	26.7	26.7	26.7	26.7	26.7
AJ30 - a	18.3	18.9	22.3	25.9	29.3	30.6	30.6	30.6	30.6	30.6	30.6	30.6
AJ30 - b	18.3	18.9	22.3	25.9	29.3	30.6	30.6	30.6	30.6	30.6	30.6	30.6
AJ30 - c	18.1	18.7	22.1	25.7	29.1	30.4	30.4	30.4	30.4	30.4	30.4	30.4
AJ34 - a	13.2	13.8	17.2	20.8	24.2	25.5	25.5	25.5	25.5	25.5	25.5	25.5
AK26 - a	12.5	13.1	16.5	20.1	23.5	24.8	24.8	24.8	24.8	24.8	24.8	24.8
AK26 - b	12.7	13.3	16.7	20.3	23.7	25.0	25.0	25.0	25.0	25.0	25.0	25.0
AK27 - a	13.9	14.5	17.9	21.5	24.9	26.2	26.2	26.2	26.2	26.2	26.2	26.2
AK28 - a	15.8	16.4	19.8	23.4	26.8	28.1	28.1	28.1	28.1	28.1	28.1	28.1
AK31 - a	13.9	14.5	17.9	21.5	24.9	26.2	26.2	26.2	26.2	26.2	26.2	26.2
AK31 - c	13.7	14.3	17.7	21.3	24.7	26.0	26.0	26.0	26.0	26.0	26.0	26.0
AL26 - h	12.3	12.9	16.3	19.9	23.3	24.6	24.6	24.6	24.6	24.6	24.6	24.6
AL27 - a	12.5	13.1	16.5	20.1	23.5	24.8	24.8	24.8	24.8	24.8	24.8	24.8
AL32 - a	12.7	13.3	16.7	20.3	23.7	25.0	25.0	25.0	25.0	25.0	25.0	25.0
W28 - a	14.5	15.1	18.5	22.1	25.5	26.8	26.8	26.8	26.8	26.8	26.8	26.8
W31 - h	15.2	15.8	19.2	22.8	26.2	27.5	27.5	27.5	27.5	27.5	27.5	27.5
W34 - a	12.6	13.2	16.6	20.2	23.6	24.9	24.9	24.9	24.9	24.9	24.9	24.9
W34 - b	12.6	13.2	16.6	20.2	23.6	24.9	24.9	24.9	24.9	24.9	24.9	24.9
Y26 - a	15.8	16.4	19.8	23.4	26.8	28.1	28.1	28.1	28.1	28.1	28.1	28.1
Y28 - a	18.0	18.6	22.0	25.6	29.0	30.3	30.3	30.3	30.3	30.3	30.3	30.3
Z32 - a	21.2	21.8	25.2	28.8	32.2	33.5	33.5	33.5	33.5	33.5	33.5	33.5
Stakeholder receivers within the Project boundary												
AA30 - a	28.4	29.0	32.4	36.0	39.4	40.7	40.7	40.7	40.7	40.7	40.7	40.7
AA30 - b	28.0	28.6	32.0	35.6	39.0	40.3	40.3	40.3	40.3	40.3	40.3	40.3
AD30 - a	30.9	31.5	34.9	38.5	41.9	43.2	43.2	43.2	43.2	43.2	43.2	43.2
AE30 - a	30.6	31.2	34.6	38.2	41.6	42.9	42.9	42.9	42.9	42.9	42.9	42.9
AF30 - a	31.0	31.6	35.0	38.6	42.0	43.3	43.3	43.3	43.3	43.3	43.3	43.3

Table 20: Predicted wind turbine noise levels, dB L_{A90} – V162-6.8MW

Receiver	Hub-height wind speed, m/s											
	4	5	6	7	8	9	10	11	12	13	14	≥15
Non-stakeholder receivers												
AA29 - a	23.9	23.9	24.9	28.2	31.4	33.2	33.2	33.3	33.7	34.0	34.2	34.4
AA29 - b	23.7	23.7	24.7	28.0	31.2	33.0	33.0	33.1	33.5	33.8	34.0	34.2
AB24 - a	14.7	14.7	15.7	19.0	22.2	24.0	24.0	24.1	24.5	24.8	25.0	25.2
AB24 - j	14.4	14.4	15.4	18.7	21.9	23.7	23.7	23.8	24.2	24.5	24.7	24.9
AB24 - k	14.5	14.5	15.5	18.8	22.0	23.8	23.8	23.9	24.3	24.6	24.8	25.0
AB25 - a	18.2	18.2	19.2	22.5	25.7	27.5	27.5	27.6	28.0	28.3	28.5	28.7
AB34 - a	18.0	18.0	19.0	22.3	25.5	27.3	27.3	27.4	27.8	28.1	28.3	28.5
AB36 - a	12.3	12.3	13.3	16.6	19.8	21.6	21.6	21.7	22.1	22.4	22.6	22.8
AC26 - a	23.7	23.7	24.7	28.0	31.2	33.0	33.0	33.1	33.5	33.8	34.0	34.2
AC35 - a	16.9	16.9	17.9	21.2	24.4	26.2	26.2	26.3	26.7	27.0	27.2	27.4
AD25 - b	19.3	19.3	20.3	23.6	26.8	28.6	28.6	28.7	29.1	29.4	29.6	29.8
AD26 - a	22.7	22.7	23.7	27.0	30.2	32.0	32.0	32.1	32.5	32.8	33.0	33.2
AD32 - a	25.9	25.9	26.9	30.2	33.4	35.2	35.2	35.3	35.7	36.0	36.2	36.4
AE32 - a	22.5	22.5	23.5	26.8	30.0	31.8	31.8	31.9	32.3	32.6	32.8	33.0
AF33 - a	19.7	19.7	20.7	24.0	27.2	29.0	29.0	29.1	29.5	29.8	30.0	30.2
AG23 - b	13.1	13.1	14.1	17.4	20.6	22.4	22.4	22.5	22.9	23.2	23.4	23.6
AG34 - a	17.5	17.5	18.5	21.8	25.0	26.8	26.8	26.9	27.3	27.6	27.8	28.0
AH26 - b	19.1	19.1	20.1	23.4	26.6	28.4	28.4	28.5	28.9	29.2	29.4	29.6
AH29 - a	24.4	24.4	25.4	28.7	31.9	33.7	33.7	33.8	34.2	34.5	34.7	34.9
AI24 - i	12.4	12.4	13.4	16.7	19.9	21.7	21.7	21.8	22.2	22.5	22.7	22.9
AI26 - a	15.7	15.7	16.7	20.0	23.2	25.0	25.0	25.1	25.5	25.8	26.0	26.2
AI26 - e	15.4	15.4	16.4	19.7	22.9	24.7	24.7	24.8	25.2	25.5	25.7	25.9
AI26 - g	15.4	15.4	16.4	19.7	22.9	24.7	24.7	24.8	25.2	25.5	25.7	25.9
AI28 - a	18.4	18.4	19.4	22.7	25.9	27.7	27.7	27.8	28.2	28.5	28.7	28.9
AI32 - a	17.3	17.3	18.3	21.6	24.8	26.6	26.6	26.7	27.1	27.4	27.6	27.8
AI32 - b	18.4	18.4	19.4	22.7	25.9	27.7	27.7	27.8	28.2	28.5	28.7	28.9
AI33 - d	15.2	15.2	16.2	19.5	22.7	24.5	24.5	24.6	25.0	25.3	25.5	25.7
AJ25 - a	12.1	12.1	13.1	16.4	19.6	21.4	21.4	21.5	21.9	22.2	22.4	22.6
AJ26 - a	13.5	13.5	14.5	17.8	21.0	22.8	22.8	22.9	23.3	23.6	23.8	24.0
AJ26 - b	13.5	13.5	14.5	17.8	21.0	22.8	22.8	22.9	23.3	23.6	23.8	24.0

Receiver	Hub-height wind speed, m/s											
	4	5	6	7	8	9	10	11	12	13	14	≥15
AJ30 - a	17.5	17.5	18.5	21.8	25.0	26.8	26.8	26.9	27.3	27.6	27.8	28.0
AJ30 - b	17.4	17.4	18.4	21.7	24.9	26.7	26.7	26.8	27.2	27.5	27.7	27.9
AJ30 - c	17.2	17.2	18.2	21.5	24.7	26.5	26.5	26.6	27.0	27.3	27.5	27.7
AJ34 - a	12.3	12.3	13.3	16.6	19.8	21.6	21.6	21.7	22.1	22.4	22.6	22.8
AK26 - a	11.6	11.6	12.6	15.9	19.1	20.9	20.9	21.0	21.4	21.7	21.9	22.1
AK26 - b	11.8	11.8	12.8	16.1	19.3	21.1	21.1	21.2	21.6	21.9	22.1	22.3
AK27 - a	13.0	13.0	14.0	17.3	20.5	22.3	22.3	22.4	22.8	23.1	23.3	23.5
AK28 - a	15.0	15.0	16.0	19.3	22.5	24.3	24.3	24.4	24.8	25.1	25.3	25.5
AK31 - a	13.0	13.0	14.0	17.3	20.5	22.3	22.3	22.4	22.8	23.1	23.3	23.5
AK31 - c	12.8	12.8	13.8	17.1	20.3	22.1	22.1	22.2	22.6	22.9	23.1	23.3
AL26 - h	11.3	11.3	12.3	15.6	18.8	20.6	20.6	20.7	21.1	21.4	21.6	21.8
AL27 - a	11.6	11.6	12.6	15.9	19.1	20.9	20.9	21.0	21.4	21.7	21.9	22.1
AL32 - a	11.8	11.8	12.8	16.1	19.3	21.1	21.1	21.2	21.6	21.9	22.1	22.3
W28 - a	13.6	13.6	14.6	17.9	21.1	22.9	22.9	23.0	23.4	23.7	23.9	24.1
W31 - h	14.3	14.3	15.3	18.6	21.8	23.6	23.6	23.7	24.1	24.4	24.6	24.8
W34 - a	11.7	11.7	12.7	16.0	19.2	21.0	21.0	21.1	21.5	21.8	22.0	22.2
W34 - b	11.7	11.7	12.7	16.0	19.2	21.0	21.0	21.1	21.5	21.8	22.0	22.2
Y26 - a	15.0	15.0	16.0	19.3	22.5	24.3	24.3	24.4	24.8	25.1	25.3	25.5
Y28 - a	17.1	17.1	18.1	21.4	24.6	26.4	26.4	26.5	26.9	27.2	27.4	27.6
Z32 - a	20.4	20.4	21.4	24.7	27.9	29.7	29.7	29.8	30.2	30.5	30.7	30.9
Stakeholder receivers within the Project boundary												
AA30 - a	27.7	27.7	28.7	32.0	35.2	37.0	37.0	37.1	37.5	37.8	38.0	38.2
AA30 - b	27.3	27.3	28.3	31.6	34.8	36.6	36.6	36.7	37.1	37.4	37.6	37.8
AD30 - a	30.2	30.2	31.2	34.5	37.7	39.5	39.5	39.6	40.0	40.3	40.5	40.7
AE30 - a	29.9	29.9	30.9	34.2	37.4	39.2	39.2	39.3	39.7	40.0	40.2	40.4
AF30 - a	30.3	30.3	31.3	34.6	37.8	39.6	39.6	39.7	40.1	40.4	40.6	40.8

Table 21: Predicted wind turbine noise levels, dB L_{A90} – GE 6.0-164

Receiver	Hub-height wind speed, m/s											
	4	5	6	7	8	9	10	11	12	13	14	≥15
Non-stakeholder receivers												
AA29 - a	22.1	24.0	27.5	30.8	33.0	35.0	35.3	35.3	35.3	35.3	35.3	35.3
AA29 - b	21.9	23.8	27.3	30.6	32.8	34.8	35.1	35.1	35.1	35.1	35.1	35.1
AB24 - a	12.0	13.9	17.4	20.7	22.9	24.9	25.2	25.2	25.2	25.2	25.2	25.2
AB24 - j	11.7	13.6	17.1	20.4	22.6	24.6	24.9	24.9	24.9	24.9	24.9	24.9
AB24 - k	11.8	13.7	17.2	20.5	22.7	24.7	25.0	25.0	25.0	25.0	25.0	25.0
AB25 - a	15.9	17.8	21.3	24.6	26.8	28.8	29.1	29.1	29.1	29.1	29.1	29.1
AB34 - a	15.6	17.5	21.0	24.3	26.5	28.5	28.8	28.8	28.8	28.8	28.8	28.8
AB36 - a	9.5	11.4	14.9	18.2	20.4	22.4	22.7	22.7	22.7	22.7	22.7	22.7
AC26 - a	21.9	23.8	27.3	30.6	32.8	34.8	35.1	35.1	35.1	35.1	35.1	35.1
AC35 - a	14.4	16.3	19.8	23.1	25.3	27.3	27.6	27.6	27.6	27.6	27.6	27.6
AD25 - b	17.0	18.9	22.4	25.7	27.9	29.9	30.2	30.2	30.2	30.2	30.2	30.2
AD26 - a	20.7	22.6	26.1	29.4	31.6	33.6	33.9	33.9	33.9	33.9	33.9	33.9
AD32 - a	24.2	26.1	29.6	32.9	35.1	37.1	37.4	37.4	37.4	37.4	37.4	37.4
AE32 - a	20.5	22.4	25.9	29.2	31.4	33.4	33.7	33.7	33.7	33.7	33.7	33.7
AF33 - a	17.5	19.4	22.9	26.2	28.4	30.4	30.7	30.7	30.7	30.7	30.7	30.7
AG23 - b	10.2	12.1	15.6	18.9	21.1	23.1	23.4	23.4	23.4	23.4	23.4	23.4
AG34 - a	15.0	16.9	20.4	23.7	25.9	27.9	28.2	28.2	28.2	28.2	28.2	28.2
AH26 - b	16.8	18.7	22.2	25.5	27.7	29.7	30.0	30.0	30.0	30.0	30.0	30.0
AH29 - a	22.7	24.6	28.1	31.4	33.6	35.6	35.9	35.9	35.9	35.9	35.9	35.9
AI24 - i	9.6	11.5	15.0	18.3	20.5	22.5	22.8	22.8	22.8	22.8	22.8	22.8
AI26 - a	13.1	15.0	18.5	21.8	24.0	26.0	26.3	26.3	26.3	26.3	26.3	26.3
AI26 - e	12.9	14.8	18.3	21.6	23.8	25.8	26.1	26.1	26.1	26.1	26.1	26.1
AI26 - g	12.8	14.7	18.2	21.5	23.7	25.7	26.0	26.0	26.0	26.0	26.0	26.0
AI28 - a	16.2	18.1	21.6	24.9	27.1	29.1	29.4	29.4	29.4	29.4	29.4	29.4
AI32 - a	14.9	16.8	20.3	23.6	25.8	27.8	28.1	28.1	28.1	28.1	28.1	28.1
AI32 - b	16.1	18.0	21.5	24.8	27.0	29.0	29.3	29.3	29.3	29.3	29.3	29.3
AI33 - d	12.6	14.5	18.0	21.3	23.5	25.5	25.8	25.8	25.8	25.8	25.8	25.8
AJ25 - a	9.3	11.2	14.7	18.0	20.2	22.2	22.5	22.5	22.5	22.5	22.5	22.5
AJ26 - a	10.8	12.7	16.2	19.5	21.7	23.7	24.0	24.0	24.0	24.0	24.0	24.0
AJ26 - b	10.8	12.7	16.2	19.5	21.7	23.7	24.0	24.0	24.0	24.0	24.0	24.0

Receiver	Hub-height wind speed, m/s											
	4	5	6	7	8	9	10	11	12	13	14	≥15
AJ30 - a	15.1	17.0	20.5	23.8	26.0	28.0	28.3	28.3	28.3	28.3	28.3	28.3
AJ30 - b	15.0	16.9	20.4	23.7	25.9	27.9	28.2	28.2	28.2	28.2	28.2	28.2
AJ30 - c	14.8	16.7	20.2	23.5	25.7	27.7	28.0	28.0	28.0	28.0	28.0	28.0
AJ34 - a	9.5	11.4	14.9	18.2	20.4	22.4	22.7	22.7	22.7	22.7	22.7	22.7
AK26 - a	8.8	10.7	14.2	17.5	19.7	21.7	22.0	22.0	22.0	22.0	22.0	22.0
AK26 - b	9.0	10.9	14.4	17.7	19.9	21.9	22.2	22.2	22.2	22.2	22.2	22.2
AK27 - a	10.2	12.1	15.6	18.9	21.1	23.1	23.4	23.4	23.4	23.4	23.4	23.4
AK28 - a	12.4	14.3	17.8	21.1	23.3	25.3	25.6	25.6	25.6	25.6	25.6	25.6
AK31 - a	10.2	12.1	15.6	18.9	21.1	23.1	23.4	23.4	23.4	23.4	23.4	23.4
AK31 - c	10.1	12.0	15.5	18.8	21.0	23.0	23.3	23.3	23.3	23.3	23.3	23.3
AL26 - h	8.5	10.4	13.9	17.2	19.4	21.4	21.7	21.7	21.7	21.7	21.7	21.7
AL27 - a	8.8	10.7	14.2	17.5	19.7	21.7	22.0	22.0	22.0	22.0	22.0	22.0
AL32 - a	9.0	10.9	14.4	17.7	19.9	21.9	22.2	22.2	22.2	22.2	22.2	22.2
W28 - a	10.8	12.7	16.2	19.5	21.7	23.7	24.0	24.0	24.0	24.0	24.0	24.0
W31 - h	11.7	13.6	17.1	20.4	22.6	24.6	24.9	24.9	24.9	24.9	24.9	24.9
W34 - a	8.9	10.8	14.3	17.6	19.8	21.8	22.1	22.1	22.1	22.1	22.1	22.1
W34 - b	8.8	10.7	14.2	17.5	19.7	21.7	22.0	22.0	22.0	22.0	22.0	22.0
Y26 - a	12.3	14.2	17.7	21.0	23.2	25.2	25.5	25.5	25.5	25.5	25.5	25.5
Y28 - a	14.6	16.5	20.0	23.3	25.5	27.5	27.8	27.8	27.8	27.8	27.8	27.8
Z32 - a	18.4	20.3	23.8	27.1	29.3	31.3	31.6	31.6	31.6	31.6	31.6	31.6
Stakeholder receivers within the Project boundary												
AA30 - a	26.3	28.2	31.7	35.0	37.2	39.2	39.5	39.5	39.5	39.5	39.5	39.5
AA30 - b	25.9	27.8	31.3	34.6	36.8	38.8	39.1	39.1	39.1	39.1	39.1	39.1
AD30 - a	28.8	30.7	34.2	37.5	39.7	41.7	42.0	42.0	42.0	42.0	42.0	42.0
AE30 - a	28.5	30.4	33.9	37.2	39.4	41.4	41.7	41.7	41.7	41.7	41.7	41.7
AF30 - a	29.0	30.9	34.4	37.7	39.9	41.9	42.2	42.2	42.2	42.2	42.2	42.2

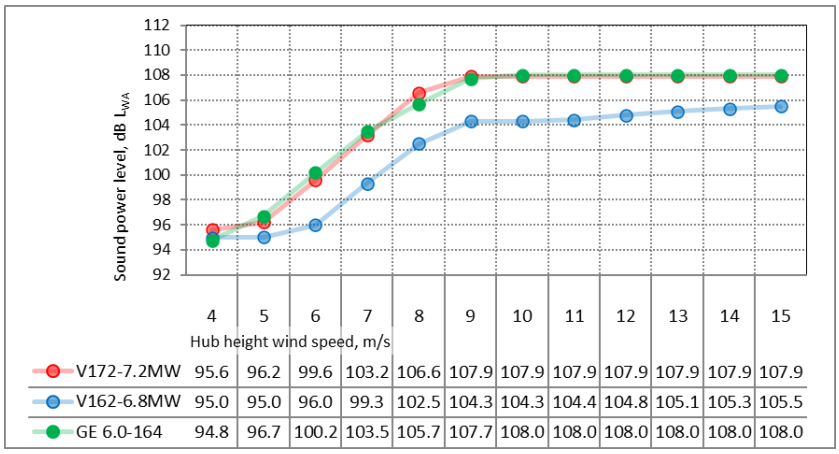
APPENDIX H NZS 6808 DOCUMENTATION

(a) Map of the site showing topography, wind turbines and residential properties: See Appendix D

(b) Noise sensitive locations: See Section 2.0 and Appendix C

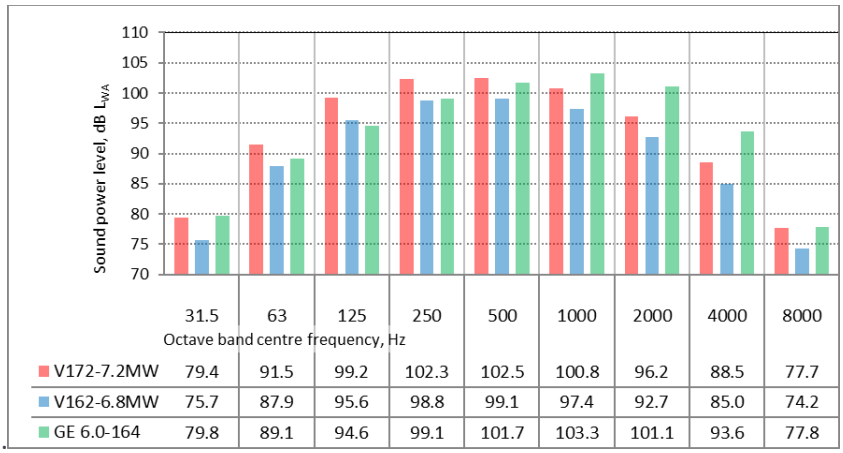
(c) Wind turbine sound power levels, L_{WA} dB (refer to Section 6.3.1)

Sound power levels (manufacturer specification +1 dB margin for uncertainty), dB L_{WA}



	4	5	6	7	8	9	10	11	12	13	14	15
V172-7.2MW	95.6	96.2	99.6	103.2	106.6	107.9	107.9	107.9	107.9	107.9	107.9	107.9
V162-6.8MW	95.0	95.0	96.0	99.3	102.5	104.3	104.3	104.4	104.8	105.1	105.3	105.5
GE 6.0-164	94.8	96.7	100.2	103.5	105.7	107.7	108.0	108.0	108.0	108.0	108.0	108.0

Reference octave band spectra adjusted to the highest sound power level detailed above dB L_{WA}



	31.5	63	125	250	500	1000	2000	4000	8000
V172-7.2MW	79.4	91.5	99.2	102.3	102.5	100.8	96.2	88.5	77.7
V162-6.8MW	75.7	87.9	95.6	98.8	99.1	97.4	92.7	85.0	74.2
GE 6.0-164	79.8	89.1	94.6	99.1	101.7	103.3	101.1	93.6	77.8

(d) Wind turbine model: See Table 8 of Section 6.2

(e) Wind turbine hub height: See Table 8 of Section 6.2

(f) Distance of noise sensitive locations from the wind turbines: See Appendix C

(g) Calculation procedure used: ISO 9613-2 prediction algorithm as implemented in SoundPLANnoise v9.0 (See Section 4.3 and Appendix F)

(h) Meteorological conditions assumed: See Table 4 of Section 4.3

(i) Air absorption parameters:

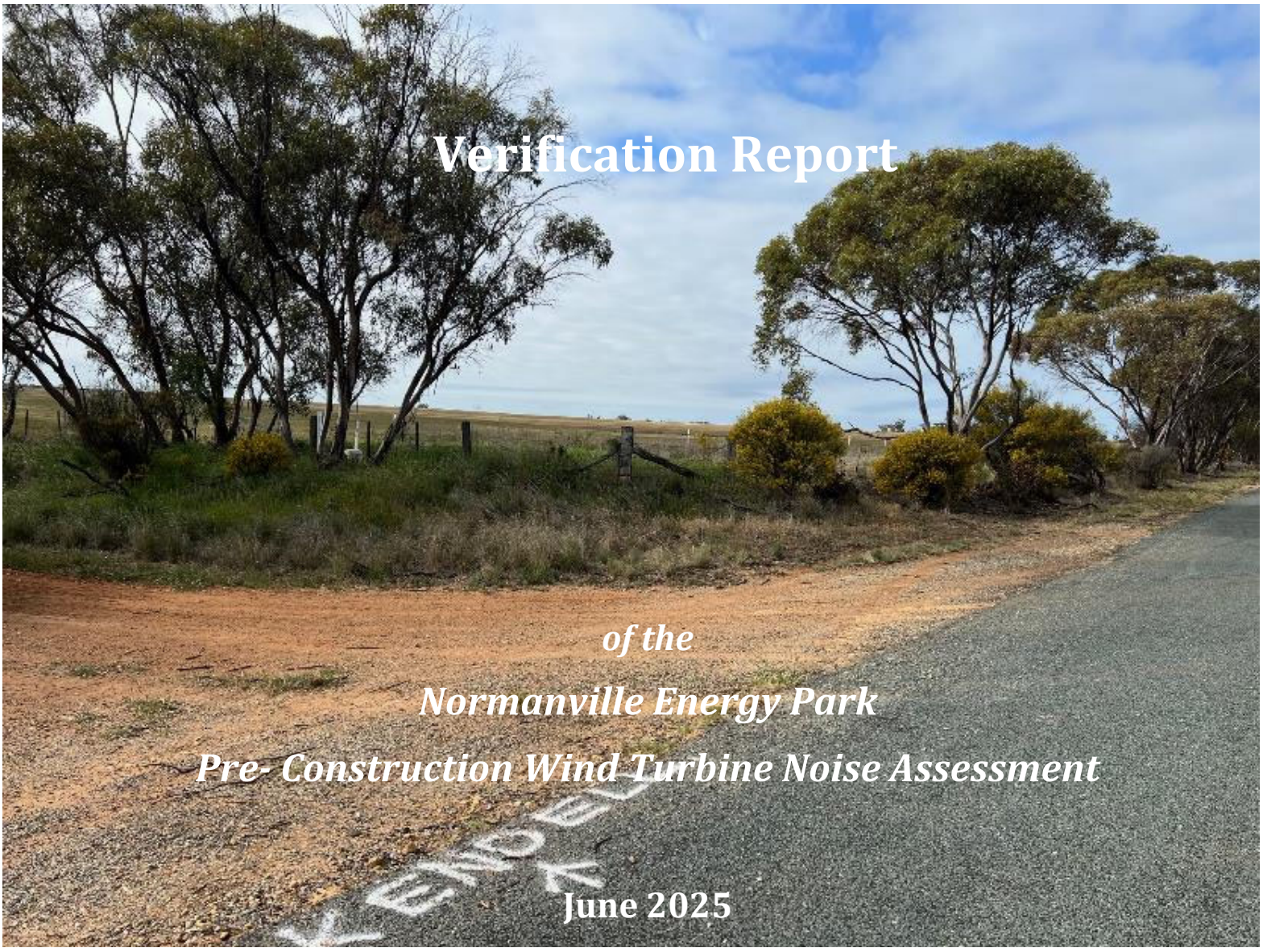
	Octave band mid frequency, Hz							
Description	**63**	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**	**8,000**
Atmospheric attenuation, dB/km	0.12	0.41	1.04	1.93	3.66	9.66	32.8	116.9

(j) Topography/screening: 10 m resolution elevation contours – See Appendix D

(k) Predicted far-field wind farm sound levels: See Section 6.4 and Appendix G

EnviroRisk

APPROVALS - SUSTAINABILITY - COMPLIANCE



Verification Report

of the

Normanville Energy Park

Pre- Construction Wind Turbine Noise Assessment

June 2025

for

Normanville Energy Park Pty Ltd

GENERAL INFORMATION

Report Descriptor:	Descriptor: r_Normanville_PreConstruction_Verify_250606_R0.docx
Title:	Verification Report of the Normanville Energy Park Pre-construction Wind Turbine Noise Assessment, 12 May 2025
Completed By:	
Name:	Stephen Jenkins BAppSci GradDipMgt. CEnvP, MAAS, FEIANZ
Company Details:	EnviroRisk Management Pty Ltd ABN 24 069 947 904 www.envirorisk.com.au
Appointments:	Environmental auditor appointed pursuant to the Environment Protection Act 2017
Report(s) Verified	
Pre-construction Noise Assessment	Normanville Energy Park Environmental Noise Assessment Rp 001 R03 20221016 dated 12 May 2025
Report Distribution:	
Stephen Jenkins	EnviroRisk Management Pty Ltd (Master Copy)
Lachlan Smith	Project Developer, West Wind Energy

Revision	Summary of Amendments	Reviewed by	Issued by	Issue Date
0		S Carter	S Jenkins	10 June 25

VERIFICATION APPROACH AND COVERAGE

This verification report is based on a systematic examination of a pre-construction predictive noise assessment report. It specifically relates to wind turbine generator (WTG) noise and does not assess site construction noise, nor noise attributed to separate facilities such as electrical sub-stations.

The verification coverage is strictly against the Victorian planning provisions to '*verify if the acoustic assessment undertaken for the purpose of the pre- construction (predictive) noise assessment report has been conducted in accordance with the Standard.* The Standard being NZ Standard 6808:2010: Acoustics - Wind farm noise. Additional noise requirements contained within the Environment Protection Act 2017, the Environment Protection Regulations 2021 (as amended) and EPA published environmental guidelines are not covered by this verification [e.g. consideration of the General Environmental Duty (GED), applicability of the Environment Reference Standard (ERS) as relevant under the EP Act 2017, and dwellings considered located 'on the wind farm' site' as these aspects are not catered for in the Standard.

Noise monitoring has not been undertaken by the verifier, nor has any raw data analysis or predictive noise modelling been repeated. There was, however, interrogation of the technical content within the subject report, enquiries relating to modelling input and quality assurance processes, interrogation of background monitoring data, a site inspection conducted and communications with the proponent and specialist personnel who prepared the acoustic reports to verify against specifications within the Standard.

Enquiries support no conflict of interest exists in order to make a verification.

Information presented within this report relies on:

- the completeness and accuracy of technical details, plans and data contained within the pre-construction noise report, or made available to support verification enquiries; and
- the accuracy and completeness of subsequent information provided during communications with the proponent's representative and the subject report's authors.

The report should only be reproduced and distributed in full.

Table of Contents

ABBREVIATIONS

ABBREVIATION	WORD/PHRASE
AS/NZS	Australian and New Zealand Standard
dB_{LA90}	Decibels, A-weighted, exceeded for 90% of the time over a period of 10 min
EPA	Environment Protection Authority
EP Act	Environment Protection Act 2017
DTP	Department of Transport and Planning, Victoria
m/sec	meters per second
NMP	Noise Management Plan
NSL	Noise Sensitive Locations
NZS	New Zealand Standard
SAC	Special Audible Characteristics
SPL	Sound Power Level
WEF	Wind Energy Facility
WTG	Wind Turbine Generator

DEFINITIONS

Standard:

New Zealand Standard NZS 6808:2010 Acoustics – Wind farm noise

Noise Sensitive Location (source NZS 6808:2010):

The location of a noise sensitive activity, associated with a habitable space or education space in a building not on the wind farm site. Noise sensitive locations include:

(a) Any part of land zoned predominantly for residential use in a district plan;
(b) Any point within the notional boundary of buildings containing spaces defined in (c) to (f)
(c) Any habitable space in a residential building including rest homes or groups of buildings for the elderly or people with disabilities, papakainga and marae, excluding habitable spaces in buildings where the predominant activity is commercial or industrial. (Residential buildings designed for permanent habitation on land zoned for predominantly rural or rural-residential use are not classified as commercial or industrial for the purposes of this Standard);
(d) Teaching areas and sleeping rooms in educational institutions, including public and private primary, intermediate, and secondary schools, universities, polytechnics, and other tertiary institutions;
(e) Teaching areas and sleeping rooms in buildings used for licensed kindergartens, childcare, and day-care centres; and
(f) Temporary accommodation including in hotels, motels, hostels, halls of residence, boarding houses, and guest houses.

Stakeholder dwelling – a dwelling on the wind energy facility (wind farm) site, or one that has a written agreement to exceed the noise limit as specified under the Standard.

Micro-siting:

- within 100m in any direction from the centre of the turbine at ground level as shown on the development plans.

EXECUTIVE SUMMARY

Table E1: Summary of Information and Outcome

Name of proposed WEF	*Normanville Energy Park*
Predictive WTG Noise Report	*Normanville Energy Park Environmental Noise Assessment Marshall Day Acoustics Rp 001 R03 20221016 dated 12 May 2025*
Applicable Standard	*Verified in accordance with NZS 6808:2010*
Verifier	*Stephen Jenkins*
Credentials	*Environmental Auditor (appointed pursuant to the EP Act 2017)*
Outcome	*It is verified the acoustic assessment undertaken for the purpose of the preconstruction (predictive) noise assessment report[1] has been conducted in accordance with the Standard.*

I have assessed the pre-construction (predictive) noise compliance assessment report[1] titled Normanville Energy Park Environmental Noise Assessment against the specification contained within NZS 6808:2010 Acoustics - Wind farm noise (the Standard). The noise assessment report has made predictions against a base standard noise amenity limit of 40 dB L_{A90} given the noise sensitive locations within the predicted 35 dB L_{A90} contour fall within a Farming Zone, as defined within the local planning scheme. This compliance limit is appropriate considering available guidelines and written advice from the Department of Transport and Planning, Victoria (DTP) that supports a Farming Zone does not attract a high noise amenity noise limit.

Background sound has been measured surrounding the WTG and, for locations within the predicted 35 dB L_{A90} contour, found to be low (e.g. 15 - 25 dB L_{A90}) during winds speeds up to 12 m/sec. Such wind speeds mean the wind turbine generators (WTG) are operating at their maximum sound power level (SPL). Background sound results therefore do not alter the base noise limit specified under the Standard for hub height wind speeds up to at least 12 m/sec (i.e. 40 dB L_{A90}).

This verification report has assessed noise predictions from three (3) candidate wind turbine generators (WTGs) namely: GE 6.0-164, Vestas V162-6.8 MW and Vestas V172-7.2 MW. The pre-construction acoustic report has focussed on the V172-7.2 MW WTGs as this option reviews a higher sound power level amongst the candidate turbines. Predicted compliance for the V172-7.2 MW WTG therefore extrapolates to predicted compliance for the other nominated models should they be constructed. It is noted the GE and Vestas V172 candidates have a similar maximum SPL. However, the Vestas V172 model exhibits higher comparative lower frequency noise, which attenuates less over distance and represents the higher noise risk option.

I confirm I have reviewed the manufacturer's technical reports on noise from the candidate turbines, reviewed compliance limits specified in the noise assessment report, interrogated the rigor of the modelling selected parameters and processes, assessed considerations on uncertainties, sought clarifications on report content within the subject report, noted background sound monitoring outcomes, sought clarification on mapped noise sensitive locations (NSLs), and obtained an appreciation of the locality based on a site inspection, topography maps and aerial imagery.

[1] The Environmental Noise Assessment Report contains information, comment and assessment on noise and regulations that are not applicable to the Standard e.g. non- wind turbine generator noise. These sections are outside the scope of verification against the Standard and are not subject to this verification. The verification does not extend to cumulative noise as no detail on other WEFs are available to enable such a verification.

Cumulative noise from other planned WEFs in the vicinity of the Normanville WEF is discussed in the noise assessment report. Verification against the Standard cannot reasonably be undertaken at this point due to insufficient detail being available on the Meering West WEF reported to be located south of the Normanville project.

With consideration to cumulative noise being excluded, I verify the noise assessment report has been prepared in accordance with the Standard and that compliance is predicted against the base noise limit of 40 dB L_{A90} at noise sensitive locations in the Farming Zone.

It is emphasised that wind turbine noise approaching the 40 dB L_{A90} noise limit at a NSL, as is specified as the base compliance limit in the Standard, means the noise will at times be readily audible, particularly during moderate hub height wind speeds that align with the low background sound conditions during the night-time period across the Normanville area.

1.0 Introduction

This verification report describes the outcome of a review of the pre-construction noise compliance assessment report prepared by Marshall Day Acoustics (i.e. the subject noise assessment report) for the proposed Normanville wind energy facility (WEF), located approximately 10km south-west of Kerang, Victoria.

The verification was commissioned by Normanville Energy Park Pty Ltd (the proponent), to fulfil obligations under Clause 52.32-4 of the Victorian Planning Provisions (Amendment Feb 2022) 'Mandatory noise assessment' i.e.

52.32-4
03/02/2022
VC199

Application requirements

An application must be accompanied by the following information as appropriate:…

Mandatory noise assessment

A pre-construction (predictive) noise assessment report demonstrating that the proposal can comply with the New Zealand Standard NZS6808:2010, Acoustics – Wind Farm Noise, including an assessment of whether a high amenity noise limit is applicable under Section 5.3 of the Standard.

An environmental auditor appointed under Part 8.3 of the *Environment Protection Act 2017* must prepare a report that verifies if the acoustic assessment undertaken for the purpose of the preconstruction (predictive) noise assessment report has been conducted in accordance with the Standard.

This requirement does not apply to an application to amend a permit under section 72 or 97I of the *Planning and Environment Act 1987*, if the amendment to the permit sought by the application will not alter the noise assessment of the wind energy facility.

The specific item being verified is the noise assessment report prepared to demonstrate that the proposed WEF can comply with the noise limits specified in the New Zealand Standard NZS6808:2010, Acoustics - Wind farm noise (the Standard), including an assessment of whether a high amenity noise limit is applicable under Section 5.3 of the Standard.

The WEF is reported to comprise up to seventeen (17) wind turbine generators (WTG) and has adopted as the pre-construction candidate turbines:

- Vestas V172-7.2 MW model PO7200 (hub height of 150m, and blade diameter of 172m),
- Vestas V162-6.8 MW model PO6800 (hub height of 150m, and blade diameter of 162m), or
- GE 6.0 – 164 6.0 MW (hub height of 150m, and blade diameter of 164m).

2.0 Verification Review Components

2.1 Objectives

The objectives of the review are to assess the noise assessment report and verify the assessment has been conducted in accordance with the Standard.

The Standard specifies noise limits for noise sensitive locations (NSLs). NSLs are defined as '*the location of a noise sensitive activity, associated with a habitable space or education space in a building not on a wind farm site'*.

NSLs include residential use dwellings, child-care and educational facilities that are not located on the wind farm site.

For the purposes of this verification review, a stakeholder dwelling (e.g. landowner or host property, or a neighbouring property owner that holds a noise agreement with the WEF) is located on the wind farm site and is therefore outside the scope of the verification.

2.2 Scope

The scope is to verify whether the predicted compliance determination provided within the noise assessment report titled *Normanville Energy Park Environmental Noise Assessment Rp 001 02 20221016 / 12 May 2025,* has been conducted in accordance with the Standard.

2.2.1 Activity

The activity is the noise from wind turbine generators, as defined within the Standard, including any cumulative noise from adjacent wind energy facilities, either operating or under planning approval to develop.

2.2.2 Segment & Boundary

The segment being assessed specifically relates to the noise being generated by the WTGs with the potential to impact NSLs.

The boundaries of the review are the noise sensitive locations as identified in the subject noise assessment report within, and in reasonable proximity to, the 35 dB L_{A90} prediction contour.

Locations beyond this contour need not be considered under the Standard unless they are located within a high noise amenity area, upon which these NSL's will be assessed if in reasonable proximity to the 30 dB L_{A90} prediction contour.

Under best practice turbine design, operation and maintenance, and with consideration of the number and layout of the turbines, the boundaries under review generally lie within a 2km radius of the nearest wind turbine's centroid point to a noise sensitive location.

2.2.3 Element & Environmental Values

The element of the environment under consideration is the protection of human health and well-being as a result of noise annoyance and amenity loss.

The environmental values being protected are the normal domestic and recreational activities within a habitable space including sleep, or an education or child-care space in a building not on the WEF site.

2.2.4 Verification Period

The review was conducted over the period: 12 September 2024 to 6 June 2025.

2.2.5 Criteria

The criteria used for the verification review are specified in the New Zealand Standard 6808:2010 Acoustics – Wind farm noise (NZS 6808:2010), which forms the noise standard.

Noise limits are defined in Table 2 of the Standard as:

Background sound level	Noise limit ($L_{A90(10\ min)}$)	High amenity noise limit ($L_{A90(10\ min)}$)
> 35 dB	background + 5 dB	background + 5 dB
30 – 35 dB	40 dB	
< 30 dB		35 dB

Notes:

Where a high amenity noise limit is shown to be justified in accordance with 5.3.1 (of the Standard), under wind conditions determined in accordance with 5.3.2, wind farm sound levels ($L_{A90(10\ min)}$) during evening and night-time should not exceed the background sound level by more than 5 dB or a level of 35 dB $L_{A90(10min)}$, whichever is the greater. During daytime the noise limit in (section) 5.2 should always apply.

The Standard recommends that the wind farm noise limits should not be set lower than 35 dB $L_{A90(10min)}$ at any time.

Under section 5.3.2. 'A high amenity noise limit should only be applied, and can only be maintained, under wind conditions when low background sound levels are common at a noise sensitive location, while the wind farm is operating. Therefore, even when a high amenity noise limit is justified in accordance with 5.3.1 it is appropriate to restrict application of that limit by conditions of consent to wind conditions when the wind farm wind speed falls below a fixed threshold. It is recommended that the high amenity noise limit should apply when the wind farm wind speed is 6 m/s and lower. An alternative wind farm wind speed threshold may be applied where justified on meteorological, topographical, and acoustical grounds.

The Standard specifies 40 dB $_{LA90}$ being the 'limit' to protect from noise in the absence of background influence. Background sound has potential to increase the noise limit.

Additional standards and guidance referenced during the verification included:

- ISO 1996-1:2016 Preview. Acoustics– Description, measurement and assessment of environmental noise. Part 1: Basic quantities and assessment procedures
- AS 1055:2018 Acoustics– Description and measurement of environmental noise.
- United Kingdom Institute of Acoustics. A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise, 2013.
- A Good Practice Guide on the Sources and Magnitude of Uncertainty Arising in the Practical Measurement of Environmental Noise. N J Craven, G Kerry, School of Computing, Science & Engineering, The University of Salford, May 2007.
- ISO 9613-2:2024 Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors.

- DTP/EPA Victoria State Government. Environmental Auditor Guidelines. Verification and Review for Wind Energy Facilities, Publication 1692.1. December 2024.
- DTP/EPA Victoria State Government. Wind Energy Facility Turbine Noise, Technical Guideline. Publication 3011. December 2024.
- EPA Victoria. Environmental auditor guidelines for appointment and conduct Publication 865.
- DTP Victoria State Government. Planning Guidelines for Development of Wind Energy Facilities, September 2023.

2.2.6 Exclusions

The verification only includes proposed operational wind turbine generator noise assessed specifically against the requirements of NZS 6808:2010 Acoustics – Wind farm noise. As such, it does not include other noise sources such as off-turbine substations, transformers, construction and maintenance activities that are not integral with the wind turbine operation. These are better assessed against different standards and criteria (e.g. EPA Publication 1834, *Civil construction, building and demolition guide*, Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, and the Environment Reference Standard).

The Standard does not address noise at a dwelling on the wind farm site. Therefore, reported stakeholder (host) that may including neighbouring dwellings holding a noise agreement have been excluded from the verification (refer Appendix 2).

The verification is specific to the detail contained in the noise assessment report and the subsidiary reports that are referenced. It relates to the number and configuration of WTGs, the turbine candidate variant modelled and their configuration, the sound power ratings at respective octave band frequency specifications and hub height wind speeds as detailed within the reports reviewed.

The verification has, as far as is reasonably practicable, interrogated the process to identify relevant non-stakeholder noise sensitive locations (NSL) to ensure they are appropriately represented within the noise assessment reports; including reviewing the figures and tables that illustrate noise modelling compliance predictions, sampling the GPS locations of a selection of NSL and conducting a site tour such that all NSLs are represented.

Broader consideration beyond the Standard, including the General Environmental Duty under the EP Act 2017, are excluded from the scope of the verification. The Environment Reference Standard, as proclaimed under the EP Act 2017, is also excluded from the scope of this verification. This includes ambient sound objectives for a Farming Zone over the night period (i.e. Category IV,

- Outdoor $L_{Aeq,8h}$ from 10pm to 6am = 35 dB(A)

2.3 Methodology

The following method was adopted for the review:

1. Communications with the client as to the verification process.
2. Obtaining a complete copy of the noise assessment report subject to verification (the subject report).
3. Aerial photography check of potential receptors using NearMap™ and Google Earth.
4. Conducting a site inspection of the proposed WEF area.
5. Detailed review of the noise assessment report's modelling methodology, source data, uncertainty considerations, predictions and methods adopted against the Standard.
6. Review of planning schemes in relation to potential high amenity noise areas.
7. Communications with the Department of Transport and Planning and the EPA to provide clarity as to whether the Environment Reference Standard (ERS) may be considered a 'plan' under the Standard that may trigger a high amenity noise limit.
8. Communications with the proponent as to the identification and mapping of all relevant noise sensitive locations.
9. Data interrogation and review of the locality of noise sensitive locations in reasonable proximity to the predicted 40 dB L_{A90} contour in the Farming Zone.
10. Review of the candidate turbine manufacturers sound power technical information.
11. Interviews with the proponent and communications with their acoustic consultant to clarify noise assessment report content with respect to quality assurance steps in the modelling, blade tip height influence and topography aspects.
12. Completion of the verification protocol, issue of a draft version, a final version and then an updated version of the verification report to capture potential cumulative WEF noise and EPA/DTP technical guideline requirements for modelling.

2.4 Process

The verification was conducted in general accordance with auditing techniques specified within AS/NZS ISO19011:2019 *Guidelines for auditing management systems*.

The process included a review of the subject noise assessment report, an evaluation of available material to assist with a determination as to whether a high amenity noise area is justified (e.g. guidelines, evaluation of previously written advice received from the EPA, planning decisions including the Cherry Tree Wind Farm decision, communications from the DTP on whether the ERS represent 'a plan' under the Standard), and assessment of the veracity of the modelling process and predicted noise levels. The process aimed to establish whether the noise assessment report provides sufficient detail to support a verification that compliance predictions within the report were made in accordance with the Standard.

The protocol used to assess conformance against the Standard is provided in Appendix 1 of this report. The appended spreadsheet lists the criteria as taken directly from the Standard and the auditor's findings and make comments to substantiate (as needed) determinations of compliance or non-compliance against each criterion.

The protocol content should be read with reference to the relevant sections of the Standard (i.e. NZS 6808:2010).

Compliance with the condition or requirement is rated Yes, No or other: whereby 'other' can include an item being 'Not Applicable (NA)' as it is not within the scope, 'Not Determined (ND)' based on information made available in the report and ambiguities between the Standards, guidelines and information within noise reports, or 'Part Compliant (PC)' where the requirement has inherently several parts to it.

Where a qualification on a determination is required, it has been captured in the comments section of the protocol. Where an issue has been identified with respect to content within the subject noise assessment report, a recommendation has been provided. Sections that are not in the scope of this pre-construction compliance verification are identified as such. The rationale for exclusion from the scope is provided in the comments column where required, or in Section 2.2.6 above.

The verification process has included communications with the proponent's representative, and the acoustic consultants who prepared the predictive noise modelling report.

3.0 Noise Limits

The noise assessment report has adopted a 40 dB $L_{A90\ (10min)}$ base noise limit for non-stakeholder NSLs in a Farming Zone.

Background monitoring data is referenced in the subject report that may result in an increase in the compliance limits at certain NSL (i.e. background + 5 dB $L_{A90\ (10min)}$). However, the predictive modelling has assessed only against the base noise limit. This is considered a representative approach for the Vestas V172-7.2MW – PO 7200, and GE 6.0-164 candidate WTG models as the maximum sound power (i.e. 106.9 dB L_{WA} & 107 dB L_{WA} as specified in manufacturers data) is reached at a hub height wind speed of 9 m/sec, which has been confirmed to coincide with low background sound[2].

The noise assessment has reported maximum noise predictions at all NSL's are predicted to be below the base noise limit of 40 dB L_{A90}.

3.1 Consideration of a High Amenity Noise Limit

It is noted that the Normanville area has been shown to exhibit low background sounds during the night period. This is likely to reflect the cropping use of the land and sparse vegetation at a low height which is not susceptible to wind generation noise even during moderate wind speeds at hub height.

Wind speeds of up to 12 m/sec have been measured via background monitoring (MDA, 2024b) to align with night-time (i.e. 10pm – 7am) background sounds that are >8dB below

[2] Normanville Energy Park Background Noise Monitoring, Marshall Day Acoustics, Rp 002 01Draft 20221016 12 Sept 2024.

the base noise limit of 40 dB LA90, and at locations (e.g. AA29-a proxy) being more than 20 dB_{LA90} lower than this criterion during the night period.

Such low night-time (period) background conditions will mean noise from the WEF may be clearly audible and dominant during conditions up to maximum WTG sound power speeds. These conditions necessitated a detailed evaluation of whether a high amenity noise limit may be applicable.

A determination as to whether a high amenity area noise limit was applicable is made within the subject report (i.e. Section 6.1.1 High amenity) which states:

> *"Based on the predicted noise level contours presented in Section 6.4, and the zoning map for the area presented in Appendix E, receivers within the predicted 35 dB LA90 contour are located within the Farming Zone (FZ).*
>
> *Following guidance from the VCAT determination for the Cherry Tree Wind Farm, as required by the Victorian Wind Energy Guidelines, the areas within the Farming Zone do not warrant consideration of the high amenity noise limit. Similar guidance concerning the Farming Zone is provided in EPA Publication 2061 Wind Energy Facility Turbine Noise Regulation Guidelines which indicates that the high amenity noise limit should not apply to the Farming Zone.*
>
> *Based on the above, the high amenity noise limit is not justified for the proposed wind farm."*

In assessing whether this is a reasonable conclusion, the auditor has referred to relevant guidelines, advisory notes and sought regulator interpretation on the applicability of a high amenity noise limit.

EPA guideline (former Pub. 1692, 2018) states:

'The audit should include review of the assessment as it relates to:
- whether a high amenity noise limit is applicable, as assessed under Section 5.3 of the Standard following procedures outlined in clause C5.3.1 of the Standard. Where the Standard refers to a District Plan (or Plan) this shall be taken to mean a Scheme as defined within the VPPs."

Section 5.3 of the Standard is applied to determine whether a '*high amenity noise limit of 35 decibels may be justified in special circumstances*'. This section further states '*All wind energy facility applications must be assessed using Section 5.3 of the Standard to determine whether a high amenity noise limit is justified for special locations, following procedures outlined in 5.3.1 of the Standard*'.

The terms 'special circumstances' and 'special locations' are not defined either within the planning guidelines (DTP, 2023), nor the Standard (NZS 6808:2010).

Furthermore, these guidelines reference a tribunal report in that '*Guidance can be found on this issue in the VCAT determination for the Cherry Tree Wind Farm*'.

Taking wording directly from this report:

"The Mitchell Planning Scheme does not anywhere expressly or by implication "promote a higher degree of protection of amenity related to the sound environment of a particular area". Approaching the matter by a process of elimination it can be seen with certainty that the controls contained within the Farming zone, which includes most of the locality, do not answer

this description. The purpose of the Farming zone is to encourage agricultural use, which is not an inherently quiet land use. In fact reference to the zone purposes confirm that agricultural use is to be preferred to residential use if there is potential conflict between the two.

Accordingly, the Tribunal concludes that the subject land and its locality is not capable of designation as a high amenity area because it does not possess the necessary characteristics of such an area as specified in the NZ standard.[3]"

Under this outcome, land within a Farming Zone would appear to not fall within a 'high amenity area'.

An opinion as to the relevance of a high amenity area is provided against each relevant element of the Standard below (*Note*: clauses taken directly from Section 5.3 of the Standard: High Amenity Areas):

> *"5.3.1*
>
> *The wind farm noise limit of 40 dB LA90(10 min) in 5.2 is appropriate for protection of sleep, health, and amenity of residents at most noise sensitive locations. In special circumstances at some noise sensitive locations a more stringent noise limit may be justified to afford a greater degree of protection of amenity during evening and night- time.'*
>
> High amenity protection is therefore only relevant in 'special circumstances' during the evening and night period.
>
> *"A high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area, for example where evening and night-time noise limits in the plan for general sound sources are more stringent than 40 dB LAeq(15 min) or 40 dBA L10."*

The plan being referenced refers to the New Zealand planning schemes under the NZ Resource Management Act (as the Standard is taken from New Zealand).

The relevant zone for all noise sensitive locations within the predicted 35 dB L_{A90} in this case is a Farming Zone, which is not 'predominantly used for residential purposes.' As such, noise sensitive locations within the Farming Zone are not specifically within a high amenity area and therefore no high amenity noise limit warrants consideration unless it is specifically included under the planning scheme.

Interrogation of the relevant Planning Scheme (refer to Figure 1 zoning map) did not identify any overlay nor reference to a high noise amenity area in the Farming Zone.

It is noted that both NZS 6808:2010 and the guidelines state that the high amenity limit would only be justified in 'special circumstances'. Considering large areas surrounding the proposed WEF, and across Victoria more generally, are Farming Zones, application of the high amenity limit to a Farming Zone would appear to contradict the requirement that it only apply in special circumstances.

[3] Cherry Tree Wind Farm Pty Ltd v Mitchell SC & Ors (Includes Summary) (Red Dot) [2013] VCAT 521. [108 - 109].

EPA website (webpage dated 2 May 2025) interprets the Standard and states:

'In Victoria the HAA limit is only intended to apply in the following circumstances.

An HAA limit:

- *should apply to a dwelling located in the following zones predominantly intended for residential development: Low Density Residential Zone (LDRZ), Township Zone (TZ), Rural Living Zone (RLZ), Green Wedge A Zone (GWAZ) and Rural Conservation Zone (RCZ)*
- *should not apply to the Farming Zone (FZ)*
- *should not be applied in any location where background sound levels are already affected by other specific sources such as road traffic noise*
- *only applies for WEF wind speeds up to and including 6 m/s*
- *is applicable only when there is no agreement made in accordance with regulation 131A.*

Consistent with section 5.3 of the 2010 Standard, where an HAA noise limit applies, the base wind turbine noise limit should be 35 dB(A) for wind speeds ≤ 6 m/s at hub height. Above 6 m/s the base wind turbine noise limit should be 40 dB(A) (i.e. the standard acceptable noise limit).

On this basis, with particular consideration of the VCAT determination for the Cherry Tree Wind Farm proposal, it is apparent that the Planning Scheme does not envisage a higher level of amenity for the subject site and surrounding land containing the nearest noise-sensitive locations. Therefore, the high amenity limit has not been applied to noise sensitive land uses in the Farming Zone in the past.

Given the low background sound that has been identified at this site, and considering the Environment Reference Standard (ERS) was released after the Cherry Tree VCAT determination, confirmation was sought from the Department of Transport and Planning (DTP) as to whether the ERS represented 'a plan' [Reference 8].

In reference to the relevance of the ERS as 'a plan':

> *Question: "Can you please confirm that the ERS is not considered 'a plan' promoting a higher degree of protection warranting consideration under the NZS 6808:2010?"*
>
> DTP Response: "No it is not considered to be a plan promoting a higher degree of protection for the purpose of NZS 6808:2010."

In reference to EPA guideline publication 2061*, i.e.* In Victoria the HAA limit:
- should not apply to the Farming Zone (FZ).'

> *Question:*
> *Does the term 'should not apply' mean 'does not ever apply'.*
>
> DTP Response*: "*HAA does not apply in farming zone."

A '*high amenity area noise limit',* as specified under the Standard, has been considered for the proposed Normanville NSLs within an area surrounding the WEF where it could potentially be relevant (refer Figures 1 and 2). All NSLs within the predicted 30 dB L_{A90} contour fall within a Farming Zone. Interrogation of guidance, coupled with enquiries and advice from Regulators support a conclusion that a high amenity area noise limit is not applicable within the Farming Zone.

I therefore concur with the determination within the noise assessment report that a standard noise limit of 40 dB L_{A90} would apply under existing guidance for noise sensitive locations within the Farming Zone.

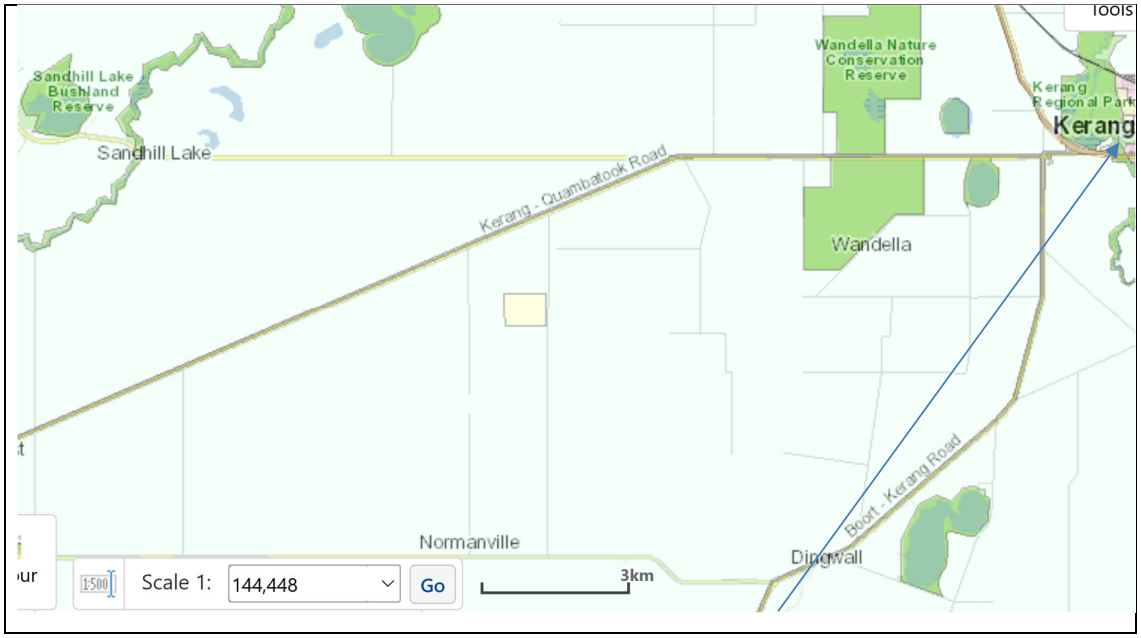


Figure 1: Planning Scheme (nearest high noise amenity zoned areas to the nearest WTG >5km)

4.0 Evidence

The evidence used to form conclusions is summarised within the completed compliance protocol that is provided in Appendix 1.

Specific comments are discussed below.

4.1 Determinations

4.1.1 Familiarisation with the WEF development proposal and planned operation

Details of the development proposal were specified within the subject report including sound power data provided by the manufacturer, details of test reports for a range of audible octave band Sound Power Levels (SPLs) and the reported specification of an absence of any tonal noise or a special audible characteristic (SAC) associated with the turbines.

To confirm the reported SPLs used in the modelling reflected manufacturers' data, copies of the manufacturers third octave SPL test reports on the WTG were reviewed. It was confirmed the data specified in the subject report reflected manufacturers information with a 1 dB(A) addition to modelling input data to account for some test uncertainties.

A map of the proposed turbine locations with predicted noise contours for the Vestas candidate turbine, has been taken from the subject report and reproduced in Figure 2.

- Vestas V172-7.2 MW model PO7200 (hub height of 150m).

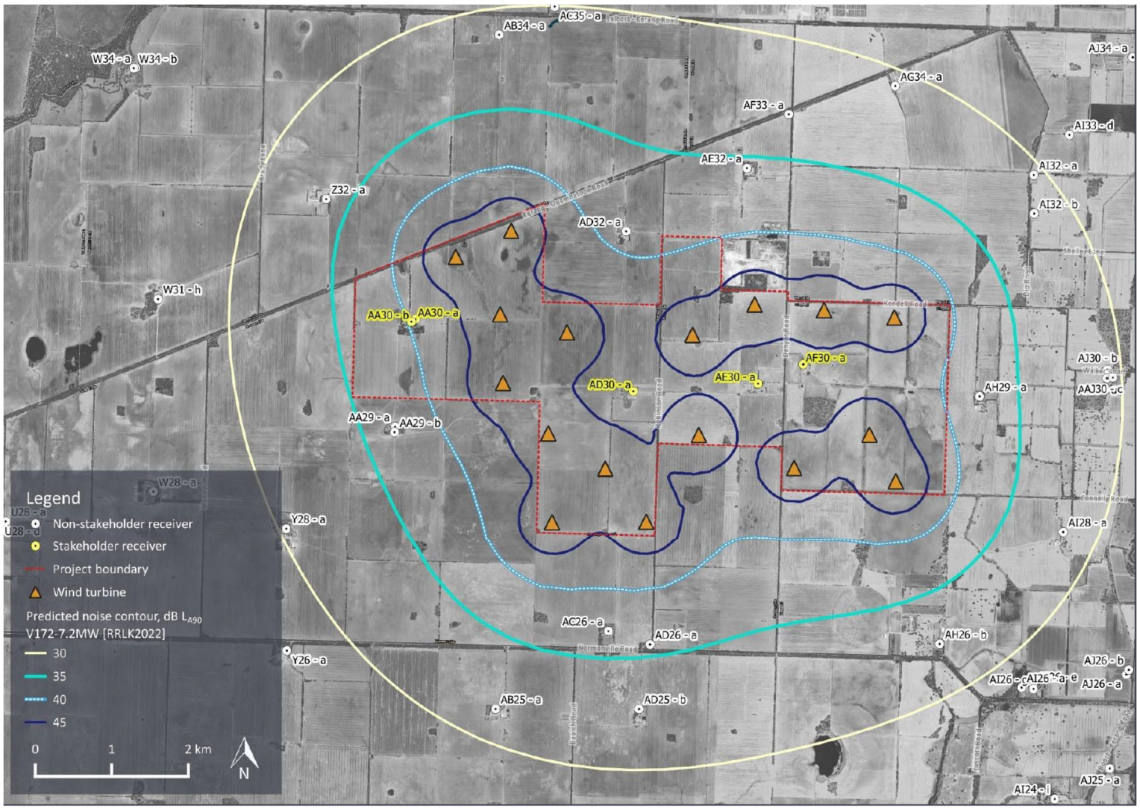


Figure 2: Predicted noise contours (from Figure 2 MDA, 2025)

4.1.2 Inspection of the WEF project site and the surrounding environment

A review of the proposed development locality was made using ground surveillance, Google Earth and Google Maps, NearMap imaging and communications with the proponent's personnel.

A detailed site inspection was undertaken to appreciate the project site and surrounds during September 2024. NSL were observed as best as reasonably practicable within 2km of a proposed WTG. Site tours were made along several accessible public roads around the proposed WEF and its surrounds.

4.1.3 Assessment of the rigour of the process used to identify noise sensitive locations

The WEF covers a relatively small area with less than ten (10) dwellings (including stakeholders) falling within the predicted 35 dB L_{A90} to 40 dB L_{A90} noise contours (refer Figure 2). The nearest turbine to a non-stakeholder NSL is assessed to be over 1.0 km.

Interviews were held with the proponent to establish the process used to identify non-stakeholder properties. Confirmation was sought and obtained from the proponent that all applicable non-stakeholder NSLs were nominated and mapped within the noise assessment report (refer Appendix 2).

I am therefore satisfied that the process followed to identify non-stakeholder properties and NSLs for the purpose of noise assessment has been rigorous and is likely to be complete.

4.1.4 Review of the pre-construction noise assessment considering the WEF development proposal and operations

The following items have been considered during the review:

- turbine technical specifications and power ratings;
- tower locations;
- topography;
- transformer stations[4];
- any other relevant factors.

The noise assessment report identifies that the WEF's candidate turbine with the highest noise potential over distance comprises the Vestas 172-7.2MW (PO7200).

The candidate turbine has been modelling with serrated tail edge (STE) blades. Noise emission data indicates the adoption of a STE reduces noise against non-STE blades by several decibels and would arguably represent best practice on blade noise control.

A terrain elevation heat map was provided in the subject report. The locality is generally relatively flat to undulating.

Assumptions, such as ground attenuation and the absence of tonality, appear reasonable based on the Standard's guidance and based on experience held with operational wind energy facilities.

Communications were held to clarify some aspects of the modelling process including adopted SPLs for the model selected, turbine hub height variances, topographical detail, tonal considerations within manufacturers' testing reports and mapping of NSLs. It was noted the Vestas technical manual data was obtained from a similar WTG and extrapolated to the candidate model. Previous advice from the acoustic consultant confirmed they were confident it is relatable. This approach, with the addition of a 1 dB margin allocated during modelling to account for some uncertainty, is arguably in accordance with the Standard should the actual WTG data not be available. Communications were held relating to quality checks of modelling outcomes and background report relevance against compliance levels.

The source information was reportedly fed into the SoundPLANnoise version 9.0 software model, adopting the ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors*[5] inputs to predict noise levels surrounding the wind farm. The input parameters were specified for the model.

The Standard references the ISO 9613-2 as '*an example that has been shown to correlate well with measured data from wind farms*'.

[4] Discussions with the proponent reveals that transformers may be integrated within the turbine structure and therefore form part of the noise curves and test data provided as source information for noise modelling. External to turbine sub-station transformers have not been included in noise predictions.

[5] Noting the ISO 9613-2:2024 standard refinements have not yet been integrated into modelling software programs due to its recent release.

Details of my review against the modelling process are provided within the verification protocol in Appendix 1.

4.1.5 Review of background sound

Background noise measurements have been completed at representative locations that surrounding the proposed WEF and are documented in report titled *Normanville Energy Park Background Noise Monitoring, Draft, MDA 2024*.

Results confirm a low background sound environment during the night period for wind speeds up to 12 m/sec (e.g. at location AA29-a proxy, background sounds are shown to be approximately 20 dB L_{A90} below the base noise limit).

As low background sound levels could conceivably coincide with the rated maximum SPL from the WTGs, a detailed evaluation of whether a high amenity noise limit may be relevant during the night period was progressed. This detail is discussed in Section 3.1 above.

4.1.6 Technical verification of the predictive noise assessment

The following items were evaluated:

- methodology applied to conduct the assessment,
- base technical reports where input data was sourced,
- sound modelling programs employed, and
- verification that the assessment was conducted in line with the Standard.

A line- item review of technical considerations against items specified within the Standard is provided within the verification protocol (refer to Appendix 1).

4.1.6.1 Cumulative Impact Considerations

Cumulative noise impact has been discussed within the predictive noise assessment report.

Communications between the WEF developer and the DTP reveal that two nearby WEF are in the initial planning phase namely the Cannie Wind Farm to the west and north-west and, to the south the Meering West Wind Farm. Accordingly DTP requested a review of potential cumulative impact within the predictive noise assessment report.

At this stage of planning only site boundaries have been made available. Given there is no detail on the precise locations of the WTGs, nor the turbine model proposed, a definitive calculation of cumulative noise impact cannot reasonably be undertaken. Instead the predictive noise assessment report has, as best reasonably practicable, assessed the likely contribution of noise from nearby WEFs based on distance and likely WTG sound power levels that would enable compliance against the Standard noise limit at a nearest NSL. The outcome suggests there would be a minimal cumulative noise contribution against predicted noise levels for the Cannie WEF given its separation distance (i.e. more than 10 dBA lower than the predicted noise

levels at each NSL). Such a contribution does not compromise noise compliance predictions at any NSL.

The Meering West WEF boundary is adjacent the Normanville projects south and south-east boundary as depicted in Figure 6 of the MDA environmental assessment noise report. As such, there is potentially a cumulative noise impact contribution to NSLs to the south and east of the Normanville project boundary (i.e. NSL receivers AC26-a, AD26-a and AH29-a in particular but also NSL receivers including but not restricted to AB25-a, AD25-b, AH26-b). Noise modelling predicts two NSL to the south and one NSL to the east of the Normanville project to be within the 35 dB_{LA90} contour. These would be at the highest risk of non-compliance with the Standard base limit should the Meering West WEF not carefully consider noise compliance in a future development. Therefore, care will need to be asserted over future WTGs, including turbine type and separation distances from NSL, to ensure cumulative noise does not exceed the Standards base noise limit.

In so far as meeting the Standard's requirements, as noise information associated with the Meering West WEF proposal is not available, the compliance determinations and commentary contained within the predictive pre-construction noise assessment report represent what is reasonably practicable at this point in time.

Noise will need to be managed along the Meering West northern and north- eastern boundaries to ensure cumulative noise compliance. This will need to strategically consider the model and locations of WTGs in conjunction with the Normanville proposal. However, without additional details being provided on the Meering West WEF turbine types and locations, it is not possible to verify conformance with Section 5.6.1 of the Standard for a number of NSLs (as identified above). It is reasonable to deduce that a future Meering West WEF is capable of achieving compliance with the Standard's cumulative noise limit subject to WTG's being strategically located and operated with a similar or lower sound power level to candidate WTGs proposed for the Normanville WEF.

4.1.6.2 Topographical Influences

Topographical influences were reported to be integrated into the model based on the topographical information within the subject report.

The topographic map reveals a relatively flat terrain with no significant valleys nor concave environs over the areas in proximity to the WEF which may result in significant uncertainties associated with the modelling.

4.1.6.3 Noise Spectrum for Candidate Turbines

Confidential manufacturers' test data reports were provided and reviewed.

The raw technical data on the turbines was confirmed to reflect data that was adopted into the modelling up to a hub height wind speed of 12 m/sec which captures the maximum SPL for the candidate WTG.

It is stated the selected turbine will have serrated tail edges to minimise noise. This is considered to represent standard industry practice to implement and has been adopted within the modelling.

Third-octave band charts were provided. The height of the WTG was not provided in the Vestas technical manual and it has been taken the SPLs are representative.

Noise predictive modelling has been conducted in the absence of any Special Audible Characteristics (SACs). Best practice wind turbines can operate without SACs where sufficient distance is available between the turbine and an NSL.

According to the provided technical manual, the candidate turbines appear to have the option of operating in a noise reduction mode if required.

4.1.6.4 Effect of Turbine Changes Should Micro-Siting Occur

It is noted that micro-siting is typically permitted under planning approval. Given that this can result in turbines being repositioned closer to an NSL, micro-siting may present additional risk. A re-evaluation of compliance would become necessary if one or more turbines, in reasonable proximity to an NSL that could impact noise levels, are relocated closer as a result of micro-siting.

4.1.6.5 Uncertainties and Error Considerations

Uncertainties in the candidate turbine manufacturers data and the associated modelling process become important where marginal compliance is predicted.

Within the manufacturers data no specific discussion of uncertainty is provided for the Vestas candidate turbine.

Product and testing reproducibility uncertainties were not discussed in detail in the subject report. MDA has made an allowance of 1 dBA to the SPL provided by the manufacturers to account for uncertainties in the data and modelling.

MDA has provided detail as to uncertainty considerations, including referencing *Craven and Kerry (2001)*[6] procedures and its limitations, as is required under the Standard.

The Vestas supplied third octave technical data for the 7.2 MW WTG [EnVentus 2022], as was reported to be used in the modelling, was reviewed. This technical document stated that third octave SPLs were obtained from a similar but smaller

[6] *"It is good practice to state the uncertainty and confidence level for all sound levels determined in accordance with this Standard. Uncertainty should be determined in accordance with the procedures in Craven and Kerry (2001)* (Note: The 2001 edition was re-issued in 2007 as version 1a. It is this publication that has been referenced during this verification review as it was relevant at the time of the Standard issue i.e. 2010*).*

capacity V136 WTG and not the actual V172 candidate WTG. The use of data extrapolated from a different WTG presented an undisclosed degree of uncertainty. However, an updated technical report detailing third octave SPLs prepared by EnVentus was obtained in November 2024 [EnVentus, 2024]. The 2024 data was derived from the Vestas PO7200 WTG and would therefore reduce uncertainties.

The EnVentus 2024 report revealed a marginally higher overall SPL (i.e. 107.8 c.f 106.9 dB(A)). However, an examination of the frequency spectrum revealed that third octave bands below 1000 Hz had an overall lower SPL (i.e. 92.9 c.f. 93.7 dB(A)). This meant the modelling results predicting compliance, as based on the EnVentus 2022 technical report, remain reliable for distances beyond 1.2km (i.e. at all NSLs), as sound frequencies above 1000 Hz are subjected to greater atmospheric attenuation. When the candidate model is confirmed, re-modelling of noise levels and contours should be undertaken to provide predictions based on latest data available.

It is noted that modelling has predicted a compliance margin of over 1.0 dB L_{A90} for the highest noise emitting candidate turbine at the nearest NSL to the north i.e. AD32-a.

This provides a level of confidence that compliance is achievable after accounting for uncertainties. The Standard specifies uncertainties should be considered but is vague on their application. It specifies modelling is to assess against the compliance limit of 40 dB L_{A90}, which has occurred in the noise assessment report. Arguably it is deemed to have achieve the Standard. Ultimately, compliance will need to be demonstrated by actual monitoring should approval be granted.

5.0 Risk Assessment

Guidelines specify consideration must be given to the risk of non-compliance associated with the proposed WEF. However, it is noted the planning requirement is for the verification to be made against the Standard, which does not include a risk assessment. For completeness a qualitative opinion on risk is presented. Given this is a pre-construction assessment of noise compliance, three prominent reasonably foreseeable risk of harm noise scenarios are summarised below, with a qualitative statement on risk provident based on expert opinion.

i. Risk Scenario 1: The noise predictions are ultimately found to be inaccurate during the post commissioning monitoring program.

If unexpectedly, inaccuracies are subsequently present in the reported WTG technical SPLs, or within modelling vagrancies and uncertainty allowances, and the noise was found to marginally exceed compliance limits by a few decibels. The response would be to curtail the nearest turbines to an impacted NSL or enact further noise optimisation management to address a non-compliant situation.

The risk of a non-compliant situation extending for a significant period of time is rated as low.

ii. Risk Scenario 2: The constructed WTG have faults and require maintenance to reduce noise.

This occurrence would reasonably be expected to be identified during the commissioning phase and rectified prior to full operation. A robust noise management plan (NMP) will include on-going maintenance to mitigate noise. It is reasonable to expect a future NMP will address this risk.

The risk of a WTG fault resulting in unacceptable noise following the commissioning phase is rated as low.

iii. Risk Scenario 3: A higher noise candidate WTG is selected for construction, as opposed to selecting a WTG candidate with lower noise that has been demonstrated to more readily comply with noise limits e.g. the Vestas V162 c.f. V172 model; where noise is predicted below 35 dB L_{A90} at all bar one of the surrounding NSLs for the V162 candidate. Noting, both candidates predict compliance with the Standard.

What may be considered reasonably practicable to prevent harm from WTG noise during the design phase of a WEF requires consideration of many aspects. A lower noise candidate WTG, however, would reasonably represent a lower risk of harm from noise to nearby NSLs.

Whilst all candidate turbines have been assessed to represent a low risk of non-compliance against the Standard, the selection of a WTG candidate option with an overall lower SPL would arguably represent an even lower risk, particularly given the demonstrably low background noise identified in the Normanville Energy Park area during the night period.

6.0 Results & Conclusions

The following conclusions are drawn based on the noise assessment report:

- I have found the process employed by the proponent designed to identify the relevant noise sensitive locations (NSLs) (i.e. non-stakeholder dwellings) with the potential to be impacted by wind turbine noise to have been rigorous.

- The predictive noise assessment report adopts processes that are based on sound methodology. The modelling undertaken and the report prepared have been undertaken by personnel with appropriate qualifications and experience.

- I have found the pre-construction noise report predicted maximum noise levels at NSLs from the wind energy facility's candidate turbines to have followed the Standard, which predicts compliance against the base noise limit of 40 dB L_{A90}.

  The noise limit is considered relevant for all time periods at NSLs within the Farming Zone that surrounds the WEF. This determination is relevant for the candidate turbine type, the siting plan used in the predictive modelling and the absence of special audible characteristics (SACs), including tones. It is important for compliance predictions that SACs are not present when assessed under the Standard, and the proponent should seek guarantees from the wind turbine supplier as to the same.

  The noise assessment report has also considered the influence of cumulative WEF noise, as reasonably practicable, noting no specific noise details are available at this point of time relating to other planned WEFs. However, considering no detail is available for the Meering West WEF, cumulative noise compliance cannot reasonably be verified at this point. Noise will need to be managed along the Meering West northern and north-eastern boundaries to ensure cumulative noise compliance. This will need to strategically consider the model and locations of WTGs in conjunction with the Normanville proposal.

Given the low background sound levels during the night period at rated operational wind speeds that generated maximum SPLs, confirmation was received from the DTP that a Farming Zone does not attract a high amenity noise limit; particularly whether the Environment Reference Standard may represent a Plan. It was confirmed it is not considered a Plan under the Standard being verified against.

I can verify that the noise assessment report has been conducted in accordance with the Standard with respect to wind turbine noise predictions. This conclusion suggests the proposed WEF can comply with noise limits specified under the Standard[7].

It needs to be emphasised that the 40 dB L_{A90} noise limit specified in the Standard (and adopted under DTP/EPA guidelines) means that WTG noise may, at times, be readily audible and identifiable, particularly when moderate hub height wind speeds (e.g. 6 – 12 m/sec) align with low background noise conditions.

[7] It is noted Section 2.6.1 of the DTP/EPA Guidelines Publication 1692.1 states the auditor's report is to verify the '*proposed WEF will comply with noise limit for the facility under the Regulations 2021'*. This report verification is made on the basis that the WEF can comply based on a predictive assessment against the Standard's specifications.

Future operational compliance is ultimately up to the WEF operator and cannot be verified by an auditor at the pre-construction stage. This appears to be accepted in Section 3 of the Guidelines, which states: '*The pre-construction (predictive) noise assessment report must demonstrate that the proposal can comply with'* the Standard.

7.0 References

1. New Zealand Standard NZS 6808:2010 *'Acoustics – Wind Farm Noise'.*
2. Department of Transport and Planning (DoT). Planning Guidelines for the Development of Wind Energy Facilities, September 2023.
3. AS/NZS ISO19011:2019 *Guidelines for auditing management systems.*
4. ISO 1996-2:2017 *Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures.*
5. NZS 6801:2008 Acoustics- Measurements of environmental sound.
6. Cherry Tree Wind Farm Pty Ltd v Mitchell SC & Ors (Red Dot) [2013] VCAT 521.
7. EnVentus, 2022. Third octave noise emission EnVentus Vestas V172-7.2MW 50/60 Hz Document No. 0128-4336_00 2022-06-30 (*Confidential Issue*)
8. EnVentus, 2024. Sound Performance Specification EnVentus V172, Document No. 0180-4980 V01 2024-11-02 (*Confidential Issue*)
9. *Normanville Energy Park Environmental Noise Assessment report versions Rp 001 02 20221016 / 12 September 2024, 20 November and 19 December 2024.*
10. Normanville Energy Park Background Noise Monitoring, Draft report Rp002 01Draft 20221016, MDA 12 September 2024
11. Email communication M. Juttner, Department of Transport and Planning, 23 October 2024.
12. DTP/EPA Victoria, 2024a. Environmental Auditor Guidelines. Verification and review for wind energy facilities, Publication 1692.1. December 2024. Department of Transport and Planning, Environment Protection Authority, Victoria State Government.
13. DTP/EPA Victoria, 2024b. Wind Energy Facility Turbine Noise, Technical Guideline Publication 3011. December 2024. Department of Transport and Planning, Environment Protection Authority, Victoria State Government.
14. EPA Victoria Publication 1856, September 2020. Reasonably practicable
15. EPA Victoria Publication 1695.1, August 2018. Assessing and controlling risk: A guide for business

APPENDICES

APPENDIX 1:
VERIFICATION PROTOCOL/ CHECKLIST

WIND ENERGY FACILITY WIND TURBINE NOISE ASSESSMENT VERIFICATION PROTOCOL

Facility Proposed Normanville Energy Park, south-west of Kerang, Victoria
Standard NZS6808:2010 Acoustics - Wind farm noise
Evidence
Normanville Energy Park Environmental Noise Assessment
Rp 001 R03 20221016 dated 12 May 2025, Marshall Day Acoustics
(i.e. 'the noise assessment report')

Standard specifications:

Section	Requirement	Achieves criteria	Observations/ Comments
Definitions	Measurement time: 10min accuracy 1% i.e. 6 secs		
	Noise Limit: not to be exceeded		
	Notional Boundary: A line 20m from any side of a noise sensitive location		
	Post-installation sound level: A weighted L90 centile level		
	Cut in speed typical: 4 m per sec. Shut down 25 m per sec		Cut in speed reported in manufacturers information range from 3 m/sec, cut-out is not specified but maximum sound power generation is reached by 9 m/sec. SPLs are provided from 4 m/sec up to 15 m/sec (hub height). Modelling has been performed at the maximum SPL and this is attained by 9m/sec for Vestas V172 - 7.2 MW candidate, 10 m/sec for the GE 6.0 - 164 (6MW) candidate and 11 m/sec for the Vestas V162-6.8 MW model. The absence of 3 m/sec in the noise report has no bearing on the predictive modelling against compliance outcomes.
3.1	Metric for wind farm sound: A weighted L90 centile level i.e. dB L90(10min)	Yes	This metric has been used within the noise assessment report.
3.2	Process: Figure 1		
	Determine location of 35 dB Contour	Yes	Modelling was reportedly undertaken using ISO 9613-2 propagation parameters within the SoundPLAN software (version 9). Predicted noise levels were derived by the model. Predicted maximum noise levels were derived and tabulated for each NSL within at least a 3km distance from the nearest turbine and a noise contour map was plotted atop of aerial imagery. Predicted noise level contours of 30, 35, 40 and 45 dB LA90 have been illustrated in reference to NSL (and also stakeholder receivers that are on the wind farm site). The Standard references ISO 9613-2:1996 which has been used in the modelling software. This Standard has been cancelled and updated with ISO 9613-2:2024. This is acknowledged in the report and commentary is made on the appropriateness in using the current ISO 9613-2:1996 edition procedures. Considering the Standard being verified, and this specifically references ISO 9613-2:1996 edition, this is considered reasonable and acceptable. Predictive noise results are reported as dB LA90 (recognising they are LAeq and the Standard specifies the LA90 is to be taken as LAeq for predictive modelling purposes i.e. S 6.2.1). The 35 dB contour is included in the subject report revealing candidate turbine prediction maps modelled under the maximum SPL for each WTG. The modelling has also considered the EPA/DTP Publication 3011 WEF Turbine Noise Technical Guideline which adopts a conservative approach with receivers at 4m and Leq outcomes considered to represent L90 noise levels.
	Determine wind farm noise limits	Yes	The report has adopted a base 40 dB LA90 limit for the NSL in a Farming Zone. Background noise measurements have been completed and confirm a low background sound environment, up to 12 m/sec (at 102m height and extrapolated to 150m) which encapsulates wind conditions up to and above the rated maximum SPL wind speeds. The pre-construction noise assessment report does not discuss whether such low background sound conditions may justify 'acoustic grounds' for a high amenity area noise limit, or otherwise. The base noise limit has therefore been used for predictive compliance assessment purposes. The Standard provides advice as to when a high amenity limit is applicable i.e. 'a high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area. NSLs within 3km of a WTG are located in a Farming Zone. EPA and Department of Transport and Planning communications support there are no special circumstances nor special locations that would suggest a noise amenity other than standard within a Farming Zone i.e. the zoning would not support a high noise amenity. This also follows the outcome of the Cherry Tree Wind Farm decision, which is referenced in the planning guidelines (Victorian Wind Energy Planning Guidelines, Sept 2023). A high amenity noise limit is stated in the noise assessment report as not being relevant and provides justification for same. The noise assessment report adoption of a base standard for predictive modelling against NSL in the Farming Zone is therefore appropriate. The DTP has provided written response that the Environment Reference Standard (ERS) does not represent a plan as specified in the Standard. All information supports that a high amenity area noise limit is not applicable.
	Refine predictions at each noise sensitive location	Yes	NSLs are included in the noise assessment report along with GPS locations for each NSL. A sample confirmed these as likely to be accurate. A ground truthing exercise involving aerial photos and car surveillance was conducted. Further confirmation was sought and received from the proponent that supports all relevant NSLs have been considered and are included in the noise assessment reports. Stakeholder receivers (host) dwellings are included within the noise assessment and are deemed to be located 'on the wind farm site'. According to the Standard, these are not NSLs and are therefore excluded from verification (as they are not captured by the Standard). This verification does not capture guidelines or legislation outside that specifically contained in NZS 6808:2010 (the Standard).

	Report	Yes	The subject noise assessment report was issued by MDA. The noise assessment report details the SPL per octave frequency band for the Vestas (x2) and GE candidate models at wind speeds where they generate maximum SPLs, the NSLs and the blade tip height used in modelling. The noise assessment report contains predictions of noise. It also included discussion on the Environment Reference Standard and General Environmental Duty. These requirements are outside the requirements of the Standard and are therefore outside the scope of this verification.
	Post installation sound level measurements	NA	
4.1.1	Audibility is not an appropriate basis for setting noise limits. Limits based on Section 5.	NA	see below.
4.2	Reverse Sensitivity		
	Nomination of a 40dB wind farm sound level contour and the 35dB contour.	Yes	Predicted contour maps have been prepared and are included in the noise assessment report.
5	**NOISE LIMITS** - designed to protect sleep disturbance whilst inside house		
5.1.2	Upper limit at residential location of 40 dB L90	Yes	This limit has been confirmed as being used for compliance predictions against the maximum sound power rating level provided from the manufacturers noise test data.
	(assumes 15 dB reduction indoors to <30 dB Leq)	NA	for information only
	Sleep protection also protects health and amenity.	NA	for information only
	C5.1.4. *The use of a background +5dB limit means that the wind farm sound may be the dominant sound heard at a noise sensitive location for a significant proportion of the time when the wind farm is operating* .	NA	for information only
5.2	Noise limit		*Note: the Standard acknowledges and states that 'the wind farm may be the dominant sound heard at a noise-sensitive location for a significant proportion of the time the wind farm is operating'.* *The background sound monitoring confirms low background sound. This statement holds true and noise from this proposed WEF and noise will, at times, be clearly audible at levels below 40 dB LA90.*
	Wind farm sounds (as L90 10 min) should not exceed background by more than 5 dB or a level of 40 dB LA90 10min, whichever is the greater at the notional boundary of any noise-sensitive location	Yes	40dB LA90 10 min has been used as the compliance limit in all instances for predictions made within the noise assessment report. Available background noise data for all time periods was made available and confirms the base noise limit is applicable for wind speeds up to at least 12 m/sec (at 102m extrapolated to 150m hub heights). Night period background sound was reported between 17.4 - 23.8 dB LA90. This confirms a low background noise area. A higher noise amenity would arguably be applicable should a 'plan' dictate.
5.3	Secondary noise limit: only considered…		
	Background noise levels are commonly less than 30dB (when predicted to exceed by 10dB or more).	NA	40dB LA90 10 min has been used as the compliance limit for predictions within a Farming Zone.
5.3.1	The wind farm noise limit of 40 dB LA90(10 min) in 5.2 is appropriate for protection of sleep, health, and amenity of residents at most noise sensitive locations.	Yes	All dwellings within the predicted 35 dB LA90 contour are located within a Farming Zone. There is no specific planning requirement that could be identified that directly specifies a high amenity area in a Farming Zone within the relevant Planning Scheme (i.e. a 'plan promoting a higher degree of protection'). A high amenity noise limit is discussed in the noise assessment report and is not considered applicable in the Farming Zone. According to the Cherry Tree VCAT decision and other EPA web site commentary, a Farming Zone is not considered a High Amenity Area unless the schemes, planning or otherwise, specified otherwise e.g. provided as an overlay. Accordingly, a standard noise amenity appears appropriate for noise-sensitive locations within a Farming Zone, and a higher degree of amenity protection does not appear to be required under available interpretations of the Standard, as there is no apparent planning trigger. As there is interpretation of the Standard required, advice was sought from the DTP. The DTP advised that the ERS is not considered a plan as specified in the Standard. There are other planning zones, including a Public Conservation & Recreation Zone and a Public Use Zone, located outside the 35 dB LA90 contour. The Public Use Zone exists adjacent to the WEF boundary; this being a quarry and not a NSL. No detailed discussion is considered necessary around compliance within these zones given they fall outside the predicted 35 dB LA90 contour (the PCRZ falls outside the predicted 30 dB LA90 contour and contains no NSLs).
	In special circumstances at some noise sensitive locations a more stringent noise limit may be justified to afford a greater degree of protection of amenity during evening and nighttime. A high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area, for example where evening and night-time noise limits in the plan for general sound sources are more stringent than 40 dB LAeq(15 min) or 40 dBA L10.	Yes	No definitive planning scheme overlays were identified that would necessitate high amenity noise protection. Advice from EPA and the DTP was sought as to the relevance of the Environmental Reference Standard (ERS) in relation to whether it represents 'a plan' according to the Standard. It is noted the ERS was promulgated after the Cherry Tree Wind Farm VCAT decision. The advice received (23 Oct 2024, M Juttner, Manager, Development Approvals and Design, Renewables, State Planning Facilitation, DTP) was that it is not a plan and high amenity noise limits do not apply in a Farming Zone.
	Only applies to locations within 35dB contour	Yes	NSLs fall within a Farming Zone within the 35 dB LA90 contour under maximum sound power level predictive modelling and therefore would be applicable.
	Arithmetically average difference for all 10-minute intervals. If less than 8 dB secondary not justified.	Yes	It would be justified at most locations (if high amenity applies) as the difference is > 8dB.

5.3.2	Lowest stated level is 35dB or 5db above background if above 35db L90 10 min.	Yes	The noise assessment report specifies noise is predicted to be below the base noise limit of 40 dB LA90 at all NSLs. It states a high amenity noise limit is not applicable. It therefore has not assessed predicted compliance against a high amenity noise limit of 35 dB LA90. In accordance with the available court and regulator guideline interpretations of the Standard's specifications, dwellings within the Farming Zone land are unlikely to be afforded high amenity noise protection unless specified in a plan (e.g. planning scheme) as being of high noise amenity. No specification was identified in the planning scheme. The Cherry Tree Wind Farm planning decision and EPA commentary on their website supports high amenity is not likely to be relevant in a Farming Zone. A background sound monitoring report was made available (MDA, 2024b) and reveals NSLs with low to very low background sound during the night period i.e. often below 20 dB LA90. Background monitoring data is not required if high amenity does not apply, and base noise limits are selected for the predictive noise assessment. However, background monitoring has been undertaken and further informs the pre-construction ambient sound levels. Low background sound occurs up to at least 12 m/ sec (102m height extrapolated to 150m hub height within the background sound assessment report) meaning that the WTG will be operating at their maximum SPL. Under what could be termed typical night time conditions, the WEF noise will be clearly audible and, it is reasonable to deduce, the dominant sound at a number of the NSLs. Given that interpretation of the Standard was required, and considering the Bald Hills Wind Farm judgement (i.e. Uren v Bald Hills Wind Farm Pty Ltd, 2022. Para 175. 'Ultimately, the proper interpretation of the NZ Standard is for a court or tribunal adjudicating a question of permit compliance; it is not a matter for acoustic experts'), coupled with the background sound levels being sufficiently low during the night period to prompt an argument for a greater degree of noise protection to mitigate potential for noise nuisance, advice was received from the regulator to definitively confirm whether high amenity could be triggered in a Farming Zone. The response was that it could not.
	Generally only applies when wind speed at hub height is less than 6m per sec	Yes	See comments above that it does not apply in a Farming Zone. It is noted the use of the word 'generally' as used in the Standard is ambiguous and warrants legal interpretation. EPA guidelines (NMP accessed 1 December 2024) state any high amenity limit 'should apply' to 6m/sec hub height wind speeds or lower. The Standard also recommends this but also provides qualifications where this may be altered i.e. 'An alternative wind farm wind speed threshold may be applied where justified on meteorological, topographical, and acoustical grounds' Note. The Standard states the following for the basis of the 6 m/sec wind speed: *Section C5.3.2_Wind farm wind speeds of 6 m/s and lower would generally coincide with the periods of the lowest background sound levels at the noise sensitive locations.* At Normanville this is not the case as much higher wind speeds still represent low background conditions. An example being location AS29-a where the regression curve remains below 17 dB LA90 at wind speeds <12 m/ sec. This supports Normanville as a very quiet area during the night time. However, the wind speed issue is mute, as there is no Plan promoting a high amenity area noise limit.
	An alternative wind speed threshold may be applicable. The Standard states - S.5.3.2 A high amenity noise limit should only be applied, and can only be maintained, under wind conditions when low background sound levels are common at a noise sensitive location, while the wind farm is operating. Therefore, even when a high amenity noise limit is justified in accordance with 5.3.1 it is appropriate to restrict application of that limit by conditions of consent to wind conditions when the wind farm wind speed falls below a fixed threshold. It is recommended that the high amenity noise limit should apply when the wind farm wind speed is 6 m/s and lower. <u>An alternative wind farm wind speed threshold may be applied where justified on meteorological, topographical, and acoustical grounds.</u> (*my underline*)	Yes	Wind speeds of up to 12 m/sec have been found via background monitoring (MDA, 2024b) to align with low background conditions during the night period (i.e. >8dB below the base noise limit of 40 dB LA90, and at locations (e.g. AA29-a proxy) more than 20 dB LA90 below). The Standard does not elaborate on what it means by 'meteorological, topographical and acoustic grounds' as justification for an alternative wind speed threshold that would trigger a high amenity noise limit. Noting that, according to the Standard, this is only to apply if 'a plan promotes' a higher noise amenity (i.e. Section 5.3.1: '*A high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area*') which has been confirmed by DTP as not the case in a Farming Zone, including consideration of the Environment Reference Standard (ERS) night period objectives. i.e. the ERS ambient sound environment specified in a Category IV land use category (applicable to a Farming Zone) state a noise objective of 35 dB(measured as LAeq 8h) during the period 10pm - 6am i.e. most of the night period, which is below the standard base noise limit of 40 dB LA90 .
		NA	The noise assessment report identifies proposed 'stakeholder receivers'. These are considered located within the wind farm boundaries. Dwellings on the wind farm site are not included in the Standard and are therefore outside the scope of verification.
5.4	**SPECIAL AUDIBLE CHARACTERISTICS**		

5.4.1	Considerations to be given to special audible characteristics of the wind farm sound when comparing levels against noise limits.	Yes	Experience with other operational WTG support an absence of any tonal characteristics when well maintained. Third-octave data has been reviewed and indicates no distinctive tonality below 4,000 Hz. Based on experience with other candidate turbines there is potential for a tone to be present above this frequency. However, high-frequency noise will be attenuated within the atmosphere to non-audible levels within a few hundred meters from the turbine, and therefore not audible at the nearest NSL. The auditor has previously had access to a test report on a lower power output Vestas turbine that supports no tones present. A specification of no tonal audible characteristics needs to be confirmed and is suggested to be warranted with the manufacturer, with the final selected turbine.
5.4.2	Tonal, impulsiveness, amplitude modulation shall be adjusted by arithmetically adding up to +6dB to the measured level,	Yes	No special audible characteristics are considered applicable. This should be warranted in the turbine supplier agreement.
	If there is doubt about the presence of tonality, the following two methods provide an objective measure for tonality. The simplified test method may be carried out using one-third octave-band measurement equipment. The reference test method requires the use of narrow-band analysis. If the simplified method does not indicate tonality, it may still be necessary to use the reference method to confirm the presence or absence of tonality. In addition, the reference method can properly assess modulated tones where the tone is varying or where there are complex tones with many closely-spaced tone components. *However, the method does not address wind farm amplitude modulation.*	NA	
	No appropriate objective test for amplitude modulation has been standardised. If a local authority enforcement officer or an acoustics advisor to a local authority considers that a wind farm creates sound with clearly audible amplitude modulation at a noise-sensitive location, an adjustment of +5 dB shall be applied to the wind farm sound level at that location for the wind conditions under which the modulation	NA	
	In making an assessment under B3.1, modulation special audible characteristics are deemed to exist if the measured A-weighted peak to trough levels exceed 5 dB on a regularly varying basis, or if the measured third-octave band peak to trough levels exceed 6 dB on a regular basis in respect of the blade pass frequency.	NA	
	Where special audible characteristics are confirmed, the value of the adjustment (k2) shall be 5 dB for that sample, provided that where the reference test method for tonality is used, the value of the adjustment (k2) shall be between 1 and 6 dB where justified. The adjustment (k2) shall only be applied to samples in which special audible characteristics are present. Only one adjustment value (k2) shall be applied to each measurement, even if more than one type of special audible characteristic is present.	NA	
5.4.3	Conducted in accordance with Appendix B of the NZS.	NA	
	Cumulative adjustments shall not be made. Max adjustment is 6 dB.	NA	
5.5	**Other Factors**	NA	
5.5.1&.2	Ultrasound and infrasound frequencies considered to be outside normal range of human hearing. Paucity of evidence to set a limit more stringent that recommended in Sect. 5.2.	NA	Commentary only.
5.6	**Cumulative Effects**		
5.6.1	Limits apply to cumulative levels of all wind farms.	ND	There is limited detail currently available for the reportedly planned Cannie and Meering West proposed WEFs. The DTP has advised these are possible. The proposed site area for the Cannie WEF is considered sufficiently distanced from a Normanville WTG that their contribution is not expected to influence the predicted compliance against the Standard outcome. The Meering West WEF however abuts the proposed Normanville project site. Dwellings located to the south through to the east of the proposed Normanville project site may be subjected to cumulative noise effects that have potential to influence noise compliance outcomes, particularly locations labelled AC26-a, AD26-a and AH29-a. The predicted noise from the proposed Normanville WEF potentially has sufficient noise compliance margins (i.e. dwelling AC26-a & AD26-a are predicted with a compliance margin of >3 dB_{LA90} and AH29-a is predicted to have a margin of 2.6 dB_{LA90}) to reasonably accommodate best practice noise controlled WTGs on the Meering West WEF subject to the WTG being strategically positioned away from the site boundaries closest to NSLs. A complete cumulative noise assessment can only proceed and be verified when the Meering West WTGs model and location details become available. This cumulative noise assessment is therefore recommended to progress by future WEFs and is expected to inform WTG locations so that compliance is assured.
5.6.2	Staging of a wind farm is not to affect pre-wind farm background readings.	NA	
5.6.3	Where a new wind farm will impact on the same noise sensitive locations as an existing wind farm, the assessment of background sound should exclude wind farm sound generated by all existing wind farms.	NA	Background noise monitoring has been conducted with no other WEF present.
5.6.4	If predicted wind farm sound levels for a new wind farm are at least 10dB below an existing wind farm, then the cumulative effect shall not be taken into account.	NA	
5.7	**Uncertainty** (refer Appendix C below)	Yes	Refer to discussion below.
6	**Predictions**		
6.1	**Methods.** Predictions to identify levels greater than 35dB LA90(10min) at 95% rated power. In octave bands from at least 63Hz-4KHz, and against wind speed (hub speed) and 35 and 40 predicted contours are shown.	Yes	A review of the subject report coupled with communications with the acoustic consultant supports the reasonable worst-case noise spectra were selected for modelling. Predictions have been made for turbines at wind speeds that correlate with maximum sound power output. The highest noise equated to the PO7200 specifications for the Vestas candidate WTGs. A copy of the manufacturer's report was requested and reviewed (and referenced). The frequency band spectra and a noise test report have been confirmed as that specified by the manufacturer with an additional 1 dB added to each octave band centre frequency SPL as reflected in the subject report. An additional Vestas (EnVentus) report was identified during the course of the verification process. This was obtained and reviewed. It had a similar low frequency SPL to the initial document used in the modelling. The lower frequency third octave SPLs (i.e. below 1000 Hz) had an overall lower SPL in the updated V172 document.

6.2	**Sound Power Levels.** Obtain from manufacturer obtained in accord with IEC 61400-11	Yes	Manufacturer sound power levels were reported. The test reports provided specified results were derived in accord with the IEC 61400-11 and -22 standards. Also noted is the data was taken from a 'like' WTG being V136 turbines as test results were reported in the technical document as not being available. The turbines were noted to be as close as possible in size.
	Requires SPL to be measured against a wind speed of 10m AGL converted to Hub Height	PC	It is not clear how the conversion progressed, and it is not specified in the noise assessment report. However, modelling has assumed SPL at turbine hub height (150m) wind speeds. The report acknowledges that Manufacturers' manuals specify SPL are valid at hub height. Vestas does not specify the height in their technical documents. The GE candidate model technical data however does and
7	**MEASUREMENTS**		
7.1	**Locations**		
7.1.2	(a) Has the operator chosen to adopt a noise limit of 40 dB for all wind speeds?	Yes	See comments in Sect 3.2 above
	(b) Has the operator agreed to conduct on/off testing if required.	NA	
7.1.3	Have noise sensitive locations been clearly identified	Yes	A site tour was undertaken as part of the verification process and included sighting NSLs within the 35dB contour. This was aided by an aerial imagery search using NearMap and Google Earth. This check did not identify additional habitable dwellings outside those marked. Due to the difficulties in ground truthing all NSLs the auditor has sought confirmation that the report mapping is complete, and this was confirmed in writing by the proponent. The NSL identification process reportedly undertaken by the proponent involved what is considered to be a rigorous program to identify nearby NSLs.
	b. Does the appointed auditor consider all noise sensitive locations are appropriately captured	Yes	As best reasonably within or near the predicted 35dB contour. Advice received from the proponent supports the NSLs as illustrated in the noise assessment report are complete.
7.1.4	Have background sound level measurements been appropriately established and representative of the group: proximity and character	Yes	Background noise monitoring was recently conducted. Predictions were made using base criteria as this was confirmed as being the compliance limit up to at least 12 m/sec wind speeds (at 102m extrapolated to 150m nominal hub heights). Given that predictive noise modelling has been undertaken against the base noise limit, a review of background monitoring is typically not required for compliance predictions within a Farming Zone. However, low to very low background sound has been established particularly during the night time (period). This raises questions on high noise amenity that have been discussed above.
	When and where were they taken.	Yes	Appear to be around the proposed WEF at or near NSLs.
	Were predictions at 95% rated power made in deriving 35 dB LA90 (10 min.) contour background locations	Yes	Properties selected for background assessment in proximity to the 35dB contour.
	If there are no noise sensitive locations within the 35dB LA90(10min) predicted wind farm sound level contour, then background sound level measurements are not required.	NA	There are NSL within proximity of the 35 dB LA90 predicted contour. Background noise levels were triggered, and monitoring has been undertaken. The base limit of 40 dB LA90 was used for the pre-construction compliance assessment.
7.1.5	If there are a group of noise-sensitive locations… locations selected are representative of the group in terms of proximity and character	NA	Individual NSL's have been identified and mapped.
7.1.6	Selected on wind farm side of buildings. >3.5m from significant reflecting surfaces. Not near streams nor watercourses where possible (or substantiated if not)	NA	
7.2	**SOUND DATA**		
7.2.1	Made during a representative range of wind speeds and durations from cut-in to rated power.	Yes	Predictions included from 3 - 15m/s. Maximum SPL experienced by 9 m/s for the Vestas and 10 m/sec for the GE WTGs. Rated electrical power is not specified but likely to be within 9 - 15 m/s (hub height) where maximum SPL has been reached.
	For dual speed turbines, include cut-in wind speed for the higher generating capacity.	NA	
	The number of measurements made are to be sufficient to obtain dependable correlations between sound levels and wind speeds	Yes	In terms of background sound monitoring.
C7.2.1	Minimum of 10 days continuous monitoring >1440 data points plotted against wind data.	NA	
	Further measurements if: data points is not uniform between min. and max. for each 1m/s interval; a lack of sparseness exists for one or more wind conditions; seasonal variations.	NA	
7.2.2	Sound measured in accordance with NZS6801	NA	
	Section 7.1.5 of NZS 6801 states 'the provisions of this section do not apply for the purposes of NZS 6808'.	NA	
	Instrument used shall meet requirements of Section 5 of NZS6801.	NA	
	Measurements time intervals of 10 minutes to be used.	NA	
7.2.3	Microphone protected from extraneous wind sound by wind shield in accord with NZS 6801.	NA	
	Cables etc. secured to avoid extraneous wind noise.	NA	
	Class 1 meter may be necessary so that sound levels at low wind speeds can be accurately measured.	NA	
7.2.4	Extraneous sounds caused by events, including precipitation, insects, fauna and so on, should, as far as is practical for an unattended monitoring exercise, be identified and removed from the data set.	NA	
	Streams and tree induced background sound may be considered part of the overall background at the locations. Traffic lulls need to be included.	NA	
	Octave band spectrum analysis and resident logs may be used.	NA	
7.3	**WIND DATA**	NA	Relevant for post construction noise reporting, and not required for predictive noise modelling when assessing compliance against a base limit of 40 dBA.

7.3.1	Concurrent measurements of wind speed and direction taken from a known height preferably the wind turbine hub.		
	Monitored over 10 minute intervals synchronised with SLM time intervals and average values found for every interval		
	Concurrent measurements of wind speed and direction taken from a known height preferably the wind turbine hub.		Wind measurements were taken during background testing at a height less than hub height. Correlation however, is not required for compliance predictions as the background data confirms a base noise limit for the night period up to and beyond rated maximum SPL hub height speeds (i.e. at least 12 m/sec).
7.3.2	If wind speeds are not taken from hub height… predictions may be used from wind shear relationships: at least two heights		
	Wind flow modelling may be required since wind measurements are not representative.		
7.3.3	Same location and height used for before and after installation where not impacted by turbines.		
	If a high amenity noise limit is applied the wind farm wind speed threshold should be determined at this same wind speed measurement position.	NA	
7.4	**BACKGROUND MEASUREMENTS**		
7.4.1	Background SLM to be plotted against the hub-height wind speeds to obtain a scatter plot	Yes	Background monitoring regression curves are provided against wind speed. The wind speed was based on 102m (and not the then proposed hub height of 150m). This is discussed in the report which states the 102m wind measurements are appropriate for a 150m hub height - which is the proposed height of the candidate WTG as of November 2024. Discussion is made in the background noise report that the results will be comparable.
	Plot to be examined to establish whether a singular regression relationship is evident.	Yes	
	If there are markedly different groups, separate scatter plots may be required for different conditions, including wind directions and times of day.	Yes	During night time, the scatter plots differ from all time results.
7.4.2	Find the regression curve that gives the best correlation coefficient between the sound level and wind speed for each scatter plot and use it to describe the average background sound level at different wind speeds.	Yes	Undertaken for each background monitoring point.
	Sparseness of data or obvious outliers should not be allowed to unreasonably influence the regression curve.	Yes	
	Removal of outliers may be required.	Yes	
	Has a bin analysis procedure IEC 61400-11 been used? If so, is it reasonable and appropriate.	Yes	Stated to be conducted in accordance with the Standard and UK Institute of Acoustics publication 'A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise, dated May 2013'. Analysis details are provided in Section 2.3. Although not specific on the bin analysis procedure, the information provided, charts and regression curves suggest it may be relied upon.
7.4.3	If there is a poor correlation between wind speed and sound level, further investigation of wind conditions should be undertaken e.g. wind flow modelling, local knowledge, site observations or local wind monitoring	Yes	Unusual data has reportedly been removed and extraneous noises e.g. condenser, water pumps.
7.4.4	Where multiple regressions are indicated and several regression curves obtained, noise limits should be set on the basis of each regression curve derived. Where not practical, use the most stringent regression curve with lowest SL.	NA	
	Where the lowest BG is when wind is blowing from the noise sensitive location to the wind farm, it is reasonable to consider additional attenuation that may occur.	NA	
7.5	**POST INSTALLATION MEASUREMENTS**	NA	N/A - considered relevant for post construction
7.5.1	Measure where practical at the same locations where background SL were determined.		
7.5.2	Scatter curves shall be drawn of SL against wind speed and regression curved obtained (as per 7.4)		
7.5.3	Capture both the wind farm sound and the background sound.		
	The contribution of the background sound shall be removed from the regression curve drawn in S. 7.5.3 at each integer wind speed.		
7.5.4	An assessment for any special audible characteristics shall be undertaken (S. 5.4) covering the range of operational wind speeds.		
7.6	**COMPLIANCE ASSESSMENT**	NA	Relevant for post construction noise assessment
7.6.1	The 35dB wind farm SL contour shall be predicted and measurements made within this contour.		The 35dB sound level contour has been predicted and included within the subject reports.
7.6.2	Compare the best-fit regression lines of the background SLs and the regression curves of the wind farm sound levels adjusted for any special audible characteristics at each noise-sensitive location.		
	Adjustments apply to wind farm speeds at which it is assessed and applied before comparison with the noise limit.		
7.6.3	If background SLs were not measured prior to installation, it may be necessary to obtain SLM for limited periods at critical wind speeds. These may be for a limited range of end speeds and directions while the wind turbines are not operating, i.e. on/off testing to get a representative number of measurements		
	Turbines 10dB lower that the higher contribution need not be turned off for testing.		
7.6.4	Compliance at one period does not negate the need for further testing.		
	Note: Section 7.1.2 of NZ6801-2008 states: *'To demonstrate compliance, measurements should be appropriately adjusted to slightly positive propagation conditions which are the upper limits of the meteorological window '.* However, section 7.1.5 states '*the provisions of this section do not apply for the purposes of NZS 6808'.*		
7.7	**ON/OFF TESTING**	NA	
	Often an appropriate method for measuring small wind turbine sound levels.		

8	**DOCUMENTATION**		
8.1	**Predictions**		
	Any report of wind farm sound level predictions in accordance with this Standard shall refer to this Standard and provide the following: (a) A map showing the topography (contour lines) in the vicinity of the wind farm, the position of the wind turbines, and noise-sensitive locations;	Yes	The topography is illustrated by a heat map (not contours but heat map). The terrain is relatively flat with only a marginal rise between NSLs.
	(b) Noise sensitive locations for which wind farm sound levels are calculated;	Yes	Both stakeholder dwellings and non-stakeholder noise sensitive locations are included on the map and are marked differently for ease of identification. Received height is stated to be at 4m (noting an argument is made that this is conservative and 1.5m may be more appropriate for modelling). The 4m height is as per the Technical Guidelines (i.e.EPA/DTP Publication 3011). It is noted location AC26-A is not labelled on the aerial images in the report. This location is mapped within the draft Background Noise Monitoring report. During the initial review it was relayed it would be beneficial to label all NSLs, yet this was not updated in the final release. The location is included in Table 12 and under the V172 candidate WTGs falls within the predicted 35 dBA contour.
	(c) Wind turbine sound power levels;	Yes	Included for the candidate turbines selected as representative of the WTGs likely to be installed.
	(d) The make and model of the wind turbines;	Yes	Candidate turbines are nominated with make and model - noting these are candidates for assessment and not the final turbine selected. It has been taken that the model PO7200 is the candidate with serrated edges which is the limiting candidate WTG as the 35 dB LA90 noise contour extends further out than the GE model in the predictions.
	(e) The hub-height of the wind turbines;	Yes	Specified at 150m; Data from manufacturers testing is not stated. Interviews with the SQEA indicate it is considered representative.
	(f) Distance of noise sensitive locations from the wind turbines;	Yes	Illustrated on a scaled map with North direction marked i.e. Figure 1. A table is also provided with the distance to the nearest WTG from a NSL (Appendix C).
	(g) Calculation procedure used;	Yes	Attenuation of noise is reported to follow ISO 9613-2 Acoustics- Attenuation of sound during propagation outdoors. This is referenced in NZS 6808:2010 as an appropriate prediction method (Appendix F). It is noted this has been superseded in 2024, and this is discussed in the Appendix of the report.
	(h) Meteorological conditions assumed;	Yes	10 degrees C and 70 percent humidity used which is reasonably representative of low atmospheric attenuation conditions.
	(i) Air absorption parameters used;	Yes	Attenuated by frequency octave band nominated to be applied as per Appendix H of subject report. Octave band attenuation factors include 0.12 dB/km for 63 Hz, 3.66 dB/km for 1 kHz and >9.66 dB/km for frequencies above 2,000 Hz.
	(j) Ground attenuation parameters used;	Yes	G=0.5 with rationale described in Appendix F and specified in NZS 6808:2010 as a default. The term acoustically soft ground is used in the acoustic report. The area under drought conditions may not reflect this. However, for modelling purposes the use of G=0.5 is considered appropriate. The margin available to account for uncertainties against a base 40 dB LA90 noise limit (e.g. where a high amenity noise limit is not applicable), supports the predictive compliance is made in accordance with the Standard.
	(k) Topography/screening assumed	Yes	As per topographical terrain heat map. Limited near field adjustment within the 30 dB LA90 contour.
	(l) Predicted far-field wind farm sound levels.	Yes	Predictions occur to 30dB(A) within the report and absolute predicted noise levels within Appendix G.
			The model assumes downwind +/-45 degrees. Inversions are not considered due to wind turbines likely to be not operating or at a low power output speed during inversion conditions.
	Detail (note: not specified in standard but applicable for modelling):		
	Turbine Sound Power Levels	Yes	SPL provided for 3x candidate turbines; Vestas V172-7.2MW, Vestas 162-6.8MW & GE 6.0-164. Manufacturing information on noise from the Vestas V172 and GE 6.0 was reviewed, The Vestas V172 was considered the limiting WTG being slightly higher in SPL at lower frequencies. However, all turbine noise predictions were included in the noise assessment report. The final turbine type is yet to be confirmed.
	Micro Siting Allowance (noting 'model planning permit conditions allow up to 100m change if nominated).	N/A	Likely to be 100m.
	Identification of relevant noise sensitive locations - process and outcomes	Yes	The process for identification was not detailed yet written advice from the proponent supports all NSL within 5km are identified within the noise assessment report (e.g. Figure 1). This is considered appropriate considering there are not too many NSL within 5km of a WTG.
	SACs- Tonality allowance at various wind speeds	Yes	Candidate turbine under best practice design should not have any special tonal characteristics and this is specified in the subject report.
	Noise level (SPL) with respect to varying wind speed	Yes	Provided SPL for each candidate turbine including octave band SPL.
	Best practice blade design	Yes	Modelling assumes the turbine blade will have a serrated tail edge. If blade changes are made on the turbines (or an alternative turbine to that modelled is selected), a revised noise assessment should be conducted and a discussion on best practice low noise blade design incorporated into the noise assessment report.
	Cumulative influences	ND	The cumulative impact is considered in the subject report . The site tour supports there are no other WEFs currently operating. Wind masts were noted to the east and south of Normanville yet no planning approval was identified for other nearby WEFs. The DTP advices there are 2x other proposed WEFs although there are in the preliminary planning stage i.e. Cannie and Meering West. The noise assessment report identifies the proposed site boundaries, yet provides no detail on WTG location or type. It is therefore not possible to verify a cumulative compliance outcome.
	Ground absorption ratio 'G'	Yes	G ratio =0.5 reasonable approach given the terrain; and the example provided in the Standard deems this specification as acceptable.
	Predictive model used	Yes	SoundPLAN (version 9); an acceptable and internationally used model.

	Results discussion - non stakeholder sensitive locations	Yes	Compliance was evaluated via the 40dB L90 contour only as the noise assessment report deemed the high amenity area noise limit was not applicable due to planning grounds.
	Results discussion - Stakeholder Properties	Yes	Included in subject report, yet outside scope of the Standard.
8.2	Any report of background sound level measurements and assessment in accordance with this Standard shall refer to this Standard and provide the following:	Yes	Noting the verification is not made against the background sound monitoring report. It is used for reference only.
	(a) Description of the sound monitoring equipment including ancillary equipment;	Yes	
	(b) The location of sound monitoring positions;	Yes	
	(c) Description of the anemometry equipment including the height AGL of the anemometer	Yes	
	(d) Position of wind speed measurements;	Yes	
	(e) Time and duration of the monitoring period;	Yes	
	(f) Averaging period for both sound and wind speed measurements;	Yes	
	(g) Atmospheric conditions: the wind speed and direction at the wind farm position & rainfall shall be recorded.	Yes	Rainfall was discussed and reportedly recorded yet actual data was not provided. The relevance of this however is marginal as the base noise limit applies up to at least 12 m/sec hub height wind speeds during the night period, capturing reasonable worst case conditions prior to wind generated noises masking WTG noise
	(h) Number of data pairs measured (wind speed in m/s, background sound in L90);	Yes	
	(i) Description of the regression analysis; and	Yes	
	(j) Graphical plots showing the data scatter and the regression curves	Yes	
8.3	**COMPLIANCE ASSESSMENT**	NA	Relevant to a Post Construction Noise Assessment
	Any report of wind farm post-installation sound level measurements and compliance assessment, other than on/off tests, made in accordance with this Standard shall refer to this Standard and provide the following:		
	(a) Description of the sound monitoring equipment including any ancillary equipment		
	(b) A statement confirming the use of A-frequency-weighting;		
	(c) The location of sound monitoring positions;		
	(d) Description of the anemometry equipment including the height AGL of the anemometer		
	(e) Position of wind speed measurements;		
	(f) Make and model of the wind turbines;		
	(g) Number of operational wind turbines;		
	(h) Time and duration of monitoring period;		
	(i) Averaging period for both sound and wind speed measurements		
	(j) Atmospheric conditions: the wind speed and direction at the wind farm position & rainfall		
	(k) Number of data pairs measured (wind speed in m/s, sound in L90);		
	(l) Description of the regression analysis;		
	(m) Graphical plots showing the data scatter and the regression lines;		
	(n) Graphical plots showing the data scatter and the regression lines for both the background and the wind farm in operation.		
	(o) Assessment of special audible characteristics; and		
	(p) A statement that the wind farm complies with relevant limits – or not – as determined from the results of the measurements		
Other	No noise complaints have been recorded	NA	Proposed facility
	Previous Assessments	NA	The noise assessment report is an update of Sept 2024 report. This is the latest version.
Appendix C	**Uncertainty**		

	It is good practice to state the uncertainty and confidence level for all sound levels determined in accordance with this Standard. Uncertainty should be determined in accordance with the procedures in Craven and Kerry (2001). These procedures involve determining the standard uncertainty for every source of uncertainty in the measurement/assessment process and summing these standard uncertainties in quadrature (root sum of squares) to obtain the combined uncertainty. If a source of uncertainty is assumed to have a normal distribution, standard uncertainty is related to standard deviation, but this is not always the case and rectangular distributions are also common. When comparing a sound level with an applicable noise limit, the sound level should be deemed to comply if the sound level is equal to or less than the noise limit. It should be deemed not to comply if the sound level is greater than the noise limit, regardless of the uncertainty. Where compliance or non-compliance is marginal and contested, steps should be taken to reduce the uncertainty, where practical.	PC	Appendix F of the subject report discusses aspects associated with the model. It also makes mention of uncertainty margins, although no specific discussion of uncertainties in the manufacturers supplied information as used in source data is made. Included in the subject report is a 1 dB addition made to the SPL provided by the manufacturers on the candidate turbines as a measure of conservatism. The allowance is considered reasonable. The provisions arguably meet the Standards wording, noting Appendix C largely relates to post construction uncertainties. A discussion is made on ground factor being 0.5 with an argument that it should be G= 1.0 to reflect ISO 9613-2 farmland specifications. This is not supported in all seasons as it does not consider dry summer Australian crop land agricultural conditions, where there is sparse vegetation and hard baked soil. The example provided in the Standard to adopt G=0.5 should be used, and has been used, in modelling. It is not supported that it may be used to support an argument to bridge uncertainty considerations. Against this is the predicted maximum noise level under reasonably conservative assumptions (e.g. NSL downwind from all WTG) is over 1 dBA below the compliance limit using the highest SPL candidate turbine and the highest predicted result at a NSL. Other NSL are predicted to be >2.5 dBA below the compliance limit. The noise assessment report contains a section on the relevance of the approach specified in Craven and Kerry, and an argument presented that uncertainties have been appropriately factored into the modelling outcomes. The uncertainty budget presented in Craven and Kerry is not specifically followed as the noise report quirries its relevance for modelling. Additionally, the report relies on imperfect data given the turbine type has yet to be selected. A recalculation should follow the selection of a final turbine not within the candidate list or should the blades not have serrated edges. Furthermore, the assessment should be recalculated should the location of any turbine vary with micro-siting allowances towards an NSL which potentially will raise noise levels by >0.5dB. Overall, a typical sigma (total) uncertainty allowance of +/-3 dB is considered a reasonably conservative approach against standard compliance modelling prediction results. Given that the noise assessment report has included a 1 dB uncertainty allowance against the nominated SPL, has adopted a 4m receiver height and has assumed L90 outcomes equate to Leq modelling results, it is considered that adequate conservativism is present within the model to account for these uncertainties. A compliance margin at the three nearest NSL is predicted over 1 dB LA90 (AD32-a) and >2.5 dBA (for AH29-a and AA29-a). The outcome predicts compliance with a 40 dB LA90 noise limit at all locations, as is required by the Standard's wording. It is therefore considered the noise assessment report has therefore been prepared in accordance with the Standard.
	Definitions (from NZS6808:2010)		
	Noise Sensitive Location: The location of a noise-sensitive activity, associated with a habitable space or education space in a building, not on the wind farm site. Noise-sensitive locations include: (a) Any part of land zoned predominantly for residential use in a district plan; (b) Any point within the notional boundary of buildings containing spaces defined in (c) to (f) (c) Any habitable space in a residential building including rest homes or groups of buildings for the elderly or people with disabilities, papakainga and marae, excluding habitable spaces in buildings where the predominant activity is commercial or industrial. (Residential buildings designed for permanent habitation on land zoned for predominantly rural or rural-residential use are not classified as commercial or industrial for the purposes of this Standard); (d) Teaching areas and sleeping rooms in educational institutions, including public and private primary, intermediate, and secondary schools, universities, polytechnics, and other tertiary institutions; (e) Teaching areas and sleeping rooms in buildings used for licensed kindergartens, childcare, and day-care centres; and (f) Temporary accommodation including in hotels, motels, hostels, halls of residence, boarding houses, and guest houses. **In some instances, holiday cabins and camping grounds might be considered noise-sensitive locations. Matters to be considered include whether it is an established activity with existing rights**.	NA	NSL are included in the subject noise report and confined to dwellings within a Farming zone within the 35 dBA (and 30 dBA predicted contours).
	Commentary of note in NZS: *Wind farm sound may be audible at times at noise-sensitive locations, and this Standard does not set limits that provide absolute protection for residents from audible wind farm sound. Guidance is provided on noise limits that are considered reasonable for protecting sleep and amenity from wind farm sound received at noise-sensitive locations.*	*NA*	*This will be the case at this wind farm during the night period with moderate wind speeds due to the low background sound that exists.*
	Other commentary of note: *Background noise is a combination of sounds including tree leaf and grass rustle, crickets, insects, frogs, birds, dogs, cattle, sheep, distance traffic (car and air) and even wave motion. When a source, such as turbine noise, is introduced the background noise level may increase.* *The addition of a new source with a noise level 10dB below the background would increase the noise to a new background 0.4dB higher.* *If the two sources have the same noise level then an increase of 3.0dB results. Therefore if the background is 35dB and the turbine is also 35dB, the resultant noise is 38dB.* *To increase the L90 by 5dB, the new turbine-based source would need to be 3.3dB above the previously confirmed background.*		

LEGEND

Yes; No; Not Determined (ND); Not Applicable (NA); Part Compliant (PC)

APPENDIX 2:

Proponents letter supporting NSLs have all been identified and included in the pre-construction noise assessment and noise agreements are in place for all involved receivers

Normanville Energy Park Pty Ltd
ACN 669 902 792
As trustee for the Normanville Energy Park Unit Trust (ABN 93 100 163 730)
PO Box 433
Gisborne VIC 3437
Telephone: 03 5421 9999
E -Mail: info@normanvilleenergypark.com.au

7 January 2025

Stephen Jenkins
EnviroRisk Management Pty Ltd
ABN 24 069 947 904
PO Box 183
LARA VIC 3212

Dear Stephen,

RE: Noise verification assessment

As part of the 'pre- construction' wind energy noise verification assessment as required under Clause 52.32-4 of the Victorian Planning Provisions (latest Amendment) 'Mandatory noise assessment', the following noise sensitive locations have been identified and assessed as part of the Normanville Energy Park Project's Noise Assessment as shown in ***'Rp 001 R01 20221016 - Normanville Energy Park - Environmental noise assessment'***:

- AF30 – a (associated receiver)
- AA30 – a (associated receiver)
- AE30 – a (associated receiver)
- AD30 – a (associated receiver)
- AD30 – a (associated receiver)
- AA30 – b (associated receiver)
- AD32 – a
- AH29 – a
- AC26 -a
- AA29 – a
- AA29 -b
- AD26 a
- AE32 a
- Z32 – a
- AH26 – b
- AI32 -b
- AI28 – a
- AD25 – b
- AF33 – a
- AB25 – a
- AB34 -a
- AI32 – a
- AJ30 – b
- AJ30 -a
- AJ30 – c
- AC35 - a

The noise pre-construction assessment report has accurately identified and positioned all NSL located within 3km of a proposed WTG. All associated receiver properties, hold a noise agreement and that the 45 dB LA90 limit is applicable.

Please contact Sebastian Madden, Project Developer on 0419 887 779 or sebastianm@w-wind.com.au if you have any questions.

Yours sincerely,

Marla Brauer

Marla Brauer
Chief Development Officer

MARSHALL DAY Acoustics

NORMANVILLE ENERGY PARK
BACKGROUND NOISE MONITORING

Rp 002 20221016 | 20 November 2024

Marshall Day Acoustics Pty Ltd
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Project: **Normanville Energy Park**

Prepared for: **WestWind Energy Development Pty Ltd**
Office 4, Nexus Centre
17 Goode Street
Gisborne VIC 3437

Attention: **Sebastian Madden**

Report No.: **Rp 002 20221016**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Complete	-	-	20 Nov 2024	O. Wesley-Smith P. Frampton	C. Delaire

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the background noise monitoring assessment and results for the Normanville Energy Park (the wind farm), which is proposed to be developed by WestWind Energy Development Pty Ltd (WestWind). The assessment is based on the proposed wind farm layout comprising 17 multi-megawatt wind turbines.

The background noise monitoring was commissioned by WestWind as part of the preliminary noise studies associated with the wind farm's planning application, to obtain a representation of typical baseline conditions at receivers in the vicinity of the wind farm.

This report documents the survey method and the results of the background noise monitoring which would be used to derive noise limits to assess the wind farm's operational compliance.

Acoustic terminology used throughout this report is presented Appendix A.

The coordinates of the wind turbines associated with the wind farm are detailed in Appendix B.

Throughout this report, the term receiver is used to identify any dwelling existing on land in the vicinity of the wind farm.

2.0 BACKGROUND NOISE SURVEY & ANALYSIS METHOD

The background noise survey and analysis has been conducted in accordance with the following:

- New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808), as required by Victorian Government's *Planning Guidelines for Development of Wind Energy Facilities* dated September 2023 (Victorian Guidelines).
- supplementary guidance contained in UK Institute of Acoustics publication *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* dated May 2013 (UK Institute of Acoustics guidance).

This section of the report presents:

- an overview of the survey method
- details of the selected noise monitoring locations
- a summary of the data analysis procedures.

2.1 Monitoring locations

The noise modelling results presented in the Noise Assessment Report demonstrate that predicted noise levels are greater than 35 dB L_{A90} at 5 non-stakeholder receivers.[1] As such, in accordance with NZS 6808, and based on the wind turbine layout detailed in Appendix B and the selected candidate wind turbine model, background noise monitoring is required to be undertaken at these 2 locations.

It is noted that consent to undertake background noise monitoring was not granted at 3 of the 5 non-stakeholder receivers where wind turbine noise levels where predicted higher than 35 dB L_{A90}. As such, 2 alternative monitoring locations were selected:

- proxy location representative of AA29 – a and AA29 – b, to the east of the wind farm. This location is referenced as *AA29 – a (proxy)*.
- receiver AD26 – a, approximately 575 m to the west southwest of AC26 – a

For community engagement purposes, WestWind has also requested that additional, voluntary, noise monitoring be undertaken at 2 other non-stakeholder receivers at which predicted noise levels are below 35 dB L_{A90}.

Based on the above, 6 background monitoring locations have been selected and measurements undertaken in accordance with NZS 6808. These locations were selected on the basis of:

- the predicted operational wind turbine noise levels, as presented in the Noise Assessment Report
- the locations of the 17 wind turbines positioned at the coordinates detailed in Appendix B
- the noise monitoring procedures outlined in NZS 6808.

These locations are listed in Table 1 and illustrated in Figure 1.

[1] MDA report Rp 001 20221016 *Normanville Wind Farm – Environmental noise assessment*, dated 20 November 2024

Table 1: Background noise monitoring locations

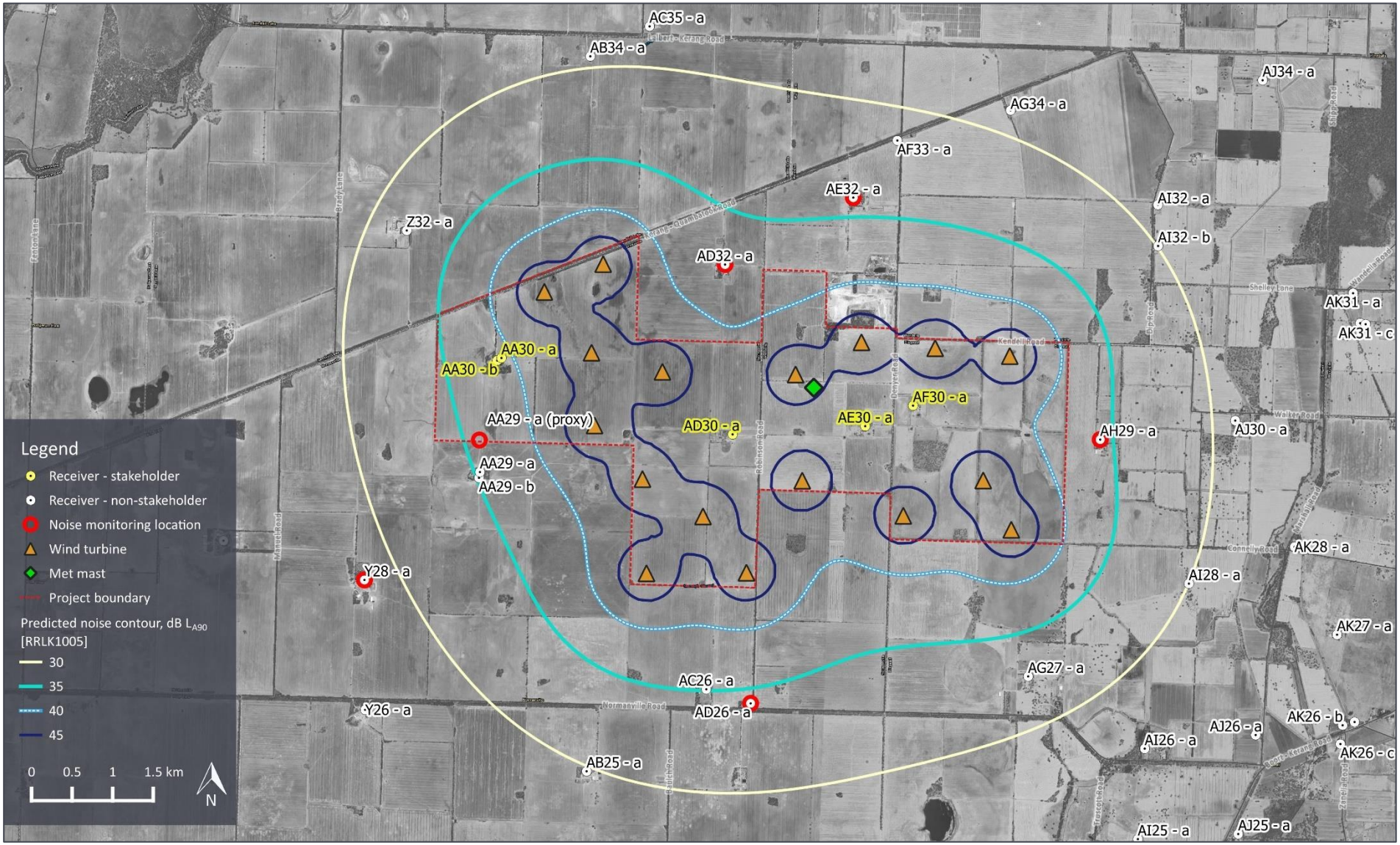
Receiver	Nearest wind turbine	Approximate distance from nearest wind turbine, m	Direction to nearest wind turbine
AA29 - a (proxy)	T009	1,430	East
AD26 - a	T017	1,595	North
AD32 - a	T001	1,485	West
AE32 - a	T003	1,760	South
AH29 - a	T005	1,500	Northwest
Y28 - a	T009	3,390	Northeast

At each of the receivers where noise monitoring was undertaken, the choice of location relative to the dwelling was made on account of the range of considerations specified in NZS 6808. The following specific considerations were factored:

- The noise monitor is located on the proposed wind farm side of the dwelling, where applicable.
- The noise monitor is located at least 3.5 m away from the dwelling and any significant vertical reflecting structures.
- The noise monitor is located as far as practical from taller vegetation at each dwelling and any obvious sources of extraneous noise.

Coordinates and photographs for the noise monitoring locations are provided from Appendix F to Appendix K..

Figure 1: Monitoring locations relative to the proposed Normanville Energy Park



2.2 Survey description

The background noise survey comprised unattended monitoring over a number of weeks to measure sound levels for a range of environmental conditions. Site wind speeds and local weather conditions were simultaneously recorded throughout the survey, along with periodic audio samples, to enable the relationship between background noise levels and site wind speeds to be assessed.

The key elements of the background noise survey are summarised in Table 2 below.

Table 2: Summary of key elements of background noise survey

Item	Description
Monitoring locations	Six locations as described in Section 2.1.
Monitoring period	4 June to 19 July 2024 equating to approximately 6 weeks at each location. The duration was chosen to satisfy the guidance of NZS 6808 which indicates the measurements should be made for a representative range of wind speeds and directions for the site, and that a minimum of 1,440 individual 10-minute measurements, equivalent to 10 days of monitoring is normally required to obtain a satisfactory range.
Sound level meters	Class 1 automated sound loggers (most accurate class rating for field usage). Microphones mounted at approximately 1.5 m above ground level and fitted with enhanced wind shielding systems based on the design recommendations detailed in the UK Institute of Acoustics guidance. See equipment specifications and calibration records in Appendix C.
Noise measurement data	A-weighted average and statistical sound pressure levels. One-third octave band frequency noise levels and a brief audio sample every 10 minutes to aid the identification of extraneous noise influences.
Local wind speed and rainfall data	A weather station was installed beside one of the noise monitoring locations to concurrently record rainfall and wind speeds at microphone height. This data was recorded to identify periods when local weather conditions may have resulted in excessive extraneous noise at the microphone (i.e. rainfall).
Site wind speed data	Hub height wind speeds for correlating background noise levels with site wind speeds. Site wind speed data was sourced from the site met mast, which extends to a height of 102 m and is located at 750,161 E & 6,037,605 N (MGA 2020 zone 54). Hub height wind speed data (150 m above ground level) was provided by the WestWind, based on analysis using site-specific wind shear calculations, as documented in Appendix D.

2.3 Data analysis

The analysis of the survey data has been conducted in accordance with the NZS 6808. This analysis broadly involves:

- collating the measured noise levels, site wind speeds and local weather data into a single dataset
- filtering the data set to remove measurement results affected by extraneous or atypical noise
- filtering the data for the range of site wind speeds in which the turbines are expected to operate
- filtering the data where necessary to account for site wind directions
- plotting a chart of noise levels versus wind speeds and determining the line of best fit to the data.

A summary of the key steps in the analysis of the data is presented in Table 3.

Table 3: Background noise data analysis

Process	Description
Data collation	Time stamps for each source of measurement data are reviewed to clarify start or end times and measurement time zone. Measured noise levels, site wind speeds and local weather conditions are then collated for each 10-minute measurement interval.
Local weather data filtering	10-minute intervals are identified and filtered from the analysis if rainfall was identified for any ten-minute measurement interval
Extraneous noise filtering	The measured sound frequencies (one-third octave bands) in each 10-minute interval are used to identify periods that are significantly affected by bird or insect sounds. 10-minute intervals have been identified, and filtered from the analysis, when the following conditions[2] are satisfied: • the highest A-weighted one-third octave band noise level is within 5 dB of the broadband A-weighted background noise level for that interval; and • the identified one-third octave band A-weighted noise level is greater than a level of 20 dB L_{A90}.
Time periods	In accordance with Section 7.4.1 of NZS 6808, as separate trends were identified in the scatter plots, the data sets are considered for the following separate periods: • All periods: no restriction on hours (i.e. data during day and night hours included) • Night period: 2200 to 0700 hours

[2] Griffin, D., Delaire, C., & Pischedda, P. (2013). Methods of identifying extraneous noise during unattended noise measurements. *20th International Congress of Sound & Vibration*.

Process	Description
Regression analysis	Two datasets are plotted on a chart of noise levels versus wind speeds: • All data points that have been removed from the analysis using the above processes • The filtered dataset comprising all retained measurement data The chart of filtered noise levels versus wind speed is reviewed to determine if there are any distinctive trends or gaps in the data which could warrant separation of the measurement results into subgroups (e.g. subgroups for time of day or wind direction). A line of best fit is determined for the filtered data and, where applicable, any subgroups of the filtered data. The line of best fit is determined using a regression analysis of the range of noise levels and wind speeds or, where necessary, analysis of noise levels at individual wind speeds.

3.0 SURVEY & ANALYSIS RESULTS

This section presents a summary of the background noise measurement results, analysed in accordance with the method described in Section 2.2.

The tabulated data presented in Table 4 and Table 5 summarises the derived background noise levels for the all-time and night-time periods respectively.

The measured background noise levels exhibit variations which are consistent with rural areas and are characterised by lower background noise levels during the night period. This is particularly evident during periods of lower wind speeds near ground level, and consequently lower background noise levels from wind disturbance or vegetation.

The data in these tables is provided for the key wind speeds relevant to the assessment of wind farm noise. The results for all surveyed wind speeds are illustrated in the graphical data provided for each receiver in Appendix F to Appendix K.

Table 4: All-time period – background noise levels, dB LA90

Location	Hub height wind speed, m/s [1]									
	3	4	5	6	7	8	9	10	11	12
AA29 - a (proxy)	17.9	19.8	21	21.7	21.9	21.8	21.5	21.1	20.9	20.8
AD26 - a	20.7	23.4	25.2	26.2	26.7	26.7	26.5	26.2	26.1	26.2
AD32 - a	20.7	22.9	24.4	25.2	25.5	25.5	25.4	25.2	25.1	25.4
AE32 - a	21.5	23	23.9	24.3	24.4	24.3	24.2	24.1	24.2	24.7
AH29 - a	20.8	23.5	25.2	26.1	26.4	26.3	25.9	25.5	25.3	25.3
Y28 - a	22.6	25.1	26.7	27.7	28.2	28.3	28.2	28	27.9	27.9

1 150 m above ground level at 750,161 E & 6,037,605 N (MGA 2020 zone 54)

Table 5: Night-time period – background noise levels, dB L_{A90}

Location	Hub height wind speed, m/s [1]									
	3	4	5	6	7	8	9	10	11	12
AA29 - a (proxy)	- [2]	- [2]	- [2]	- [2]	- [2]	- [2]	- [2]	16.8	16.9	17.4
AD26 - a	- [2]	- [2]	- [2]	- [2]	- [2]	19.4	19.5	19.8	20.4	21.4
AD32 - a	- [2]	- [2]	- [2]	- [2]	- [2]	18.6	18.6	18.8	19.3	20.3
AE32 - a	- [2]	- [2]	- [2]	- [2]	- [2]	- [2]	21.5	21.4	21.6	22.3
AH29 - a	- [2]	- [2]	- [2]	- [2]	- [2]	- [2]	19.6	19.5	19.8	20.6
Y28 - a	- [2]	- [2]	- [2]	- [2]	- [2]	20.6	21.1	21.8	22.7	23.8

1 150 m above ground level at 750,161 E, 6,037,605 N (MGA 2020 zone 54)

2 Regression lines indicate an increase of background noise levels as hub height wind speed decreases. As this feature is deemed to be an artifact of the regression analysis process due to the large scatter of points at low hub height wind speeds, the regression lines have been truncated at their lowest values.

4.0 SUMMARY

During the 6-week survey, noise and atmospheric conditions were measured at 6 locations and 1 meteorological mast in the vicinity of the proposed Normanville Energy Park.

The survey and analysis have been carried out on the basis of:

- New Zealand Standard 6808:2010 *Acoustics – The assessment and measurement of sound from wind turbine generators* (NZS 6808), as required by Victorian Government's *Planning Guidelines for Development of Wind Energy Facilities* dated September 2023
- supplementary guidance contained in UK Institute of Acoustics publication *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* dated May 2013.

The results of the background survey provide a representation of the typical noise levels in the vicinity of the wind farm. Accordingly, for all receivers:

- The background noise levels have been analysed in accordance with NZS 6806 to derive background noise levels.
- The results can be used to derive noise limits.
- The results of the measurements are to be referenced during the compliance monitoring phase of the project as an indication of potential background noise levels contributing to the compliance measurements.

APPENDIX A GLOSSARY OF TERMINOLOGY

The basic quantities used within this document to describe noise adopt the conventions outlined in ISO 1996-1:2016 *Acoustics - Description measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures*. Accordingly, all frequency weighted sound pressure levels are expressed as decibels (dB) in this report. For example, sound pressure levels measured using an "A" frequency weighting are expressed as dB L_A. Alternative ways of expressing A-weighted decibels such as dBA or dB(A) are therefore not used within this report.

Term	Definition	Abbreviation
A-weighting	A set of frequency-dependent sound level adjustments that are used to better represent how humans hear sounds. Humans are less sensitive to low and very high frequency sounds. Sound levels using an "A" frequency weighting are expressed as dB L_A. Alternative ways of expressing A-weighted decibels are dBA or dB(A).	See discussion above this table.
A-weighted 90th centile	The A-weighted pressure level that is exceeded for 90 % of a defined measurement period. It is used to describe the underlying background sound level in the absence of a source of sound that is being investigated, as well as the sound level of steady, or semi steady, sound sources.	L_{A90}
Decibel	The unit of sound level.	dB
Hertz	The unit for describing the frequency of a sound in terms of the number of cycles per second.	Hz
Octave band	The interval between one frequency and its double. Sound is divided into octave bands for analysis. The typical octave band centre frequencies are 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz and 4 kHz.	-
Sound pressure level	A measure of the level of sound expressed in decibels.	L_p

APPENDIX B WIND TURBINE COORDINATES

The following table sets out the coordinates of the 17 wind turbine layout of the Normanville Energy Park as supplied by WestWind on 4 November 2024.

Table 6: Turbine coordinates – MGA 2020 zone 54

Turbine	Easting, m	Northing, m	Terrain elevation, m
T001	747,564	6,039,129	90
T002	746,839	6,038,787	90
T003	750,749	6,038,165	90
T004	751,658	6,038,092	90
T005	752,578	6,037,996	88
T006	747,421	6,038,037	90
T007	748,295	6,037,801	90
T008	749,937	6,037,769	90
T009	747,458	6,037,139	90
T010	748,049	6,036,478	90
T011	750,019	6,036,458	90
T012	752,251	6,036,461	90
T013	748,795	6,036,017	90
T014	751,265	6,036,026	90
T015	752,597	6,035,853	89
T016	748,098	6,035,316	90
T017	749,331	6,035,323	90

APPENDIX C SURVEY INSTRUMENTATION

Table 7: Sound level measurement instrumentation summary

Item	Description
Equipment type	Automated/unattended integrating sound levels
Make & model	01dB CUBE & FUSION
Instrumentation class	Certified to Class 1 (precision grade) standards in accordance with IEC 61672.1-2019[3]
Instrumentation noise floor	Less than 20 dB
Time synchronisation	Internal GPS clocks
Wind shielding	Enhanced wind shielding system based on the design recommendations detailed in the UK Institute of Acoustics guidance. The system comprises an inner solid primary wind shield and an outer secondary large diameter hollow wind shield

[3] IEC 61672.1-2019 E*lectroacoustics - Sound level meters, Part 1: Specifications*

Table 8: Sound level meter installation records

Noise monitoring location	System	Unit serial number	Microphone serial number	Independent calibration date [1]	Calibration drift [2,3]	Measurement start date	Measurement end date
AA29 - a (proxy)	01dB CUBE	14398	562243	1/09/2023	-0.40	5/06/2024	17/07/2024
AD26 - a	01dB FUSION	15357	13682	28/11/2023	-0.07	5/06/2024	23/07/2024
AD32 - a	01dB FUSION	15430	141118	23/01/2024	-0.36	4/06/2024	18/07/2024
AE32 - a	01dB FUSION	15431	144928	24/01/2024	-0.79	4/06/2024	19/07/2024
AH29 - a	01dB FUSION	15358	162058	28/11/2023	-0.23	4/06/2024	17/07/2024
Y28 - a	01dB FUSION	15354	144885	23/11/2023	-0.14	4/06/2024	18/07/2024

1 Independent (laboratory) calibration date to be within 2 years of measurement period as per AS 1055:2018[4]

2 Difference between reference level checks during deployment and collection of instruments

3 Calibration drift should not be greater than 1 dB as specified in AS 1055:2018

[4] AS 1055-1:2018 *Acoustics - Description and measurement of environmental noise*

Table 9: Wind speed measurement instrumentation

Wind speeds	Description
Local wind speeds	Vaisala WTX 520 weather station (serial number K1850003) positioned at Receiver AH29 - a
Site wind speeds	Third party owned and operated system comprising one (1) meteorological mast with anemometry at multiple heights up to 150 m Coordinates: 750,161 E & 6,037,605 N (MGA 2020 zone 54) Further information provided in Appendix D

APPENDIX D SITE WIND SPEED DATA DERIVATION

This appendix reproduces correspondence provided by WestWind on 2 September 2024 documenting the process used to derive the 150 m AGL wind speeds required to analyse the measured background noise data.

> *The meteorological mast situated at the Normanville Energy Park has cup anemometers mounted at 60m, 80m, 98m and 102m. Data is averaged over a 10-minute period and recorded. For each time stamp an exponential curve is fitted to the wind speed data and each height. Using the exponential curve, the wind speed can be extrapolated to the desired height of 150m. This process is done using the industry standard software Wind Pro.*

APPENDIX E SUMMARY OF BACKGROUND NOISE LEVEL DERIVATION

Table 10: Regression equation coefficients – All-time period

	Regression equation coefficients for background noise equation of best fit $L_{A90} = ax^3+bx^2+cx+d$, where x = windspeed in m/s					
Location	**a**	**b**	**c**	**d**	**R^2**	**Valid wind speed range, m/s**
AA29 - a (proxy)	0.02116	-0.5364	4.187	11.48	0.072	3-12
AD26 - a	0.02808	-0.7084	5.684	11.99	0.0768	3-12
AD32 - a	0.02559	-0.6238	4.865	13.26	0.0858	3-12
AE32 - a	0.02146	-0.483	3.474	16.34	0.1725	3-12
AH29 - a	0.03081	-0.7662	5.937	11.71	0.1027	3-12
Y28 - a	0.02305	-0.6003	5	14.85	0.0703	3-12

Table 11: Regression equation coefficients – Night period

	Regression equation coefficients for background noise equation of best fit $L_{A90} = ax^3+bx^2+cx+d$, where x = windspeed in m/s					
Location	**a**	**b**	**c**	**d**	**R^2**	**Valid wind speed range, m/s**
AA29 - a (proxy)	0.01927	-0.4067	2.613	12.21	0.4804	3-12
AD26 - a	0.01984	-0.3887	2.593	13.52	0.4226	3-12
AD32 - a	0.02396	-0.4799	3.152	11.83	0.4661	3-12
AE32 - a	0.0249	-0.5297	3.543	14.27	0.426	3-12
AH29 - a	0.02851	-0.6123	4.192	10.6	0.4499	3-12
Y28 - a	0.01265	-0.2276	1.771	15.06	0.4147	3-12

APPENDIX F RECEIVER AA29 - a (proxy) DATA

F1 Receiver AA29 - a (proxy) data

Table 12:Receiver AA29 - a (proxy) noise monitor coordinates - MGA 2020 zone 54

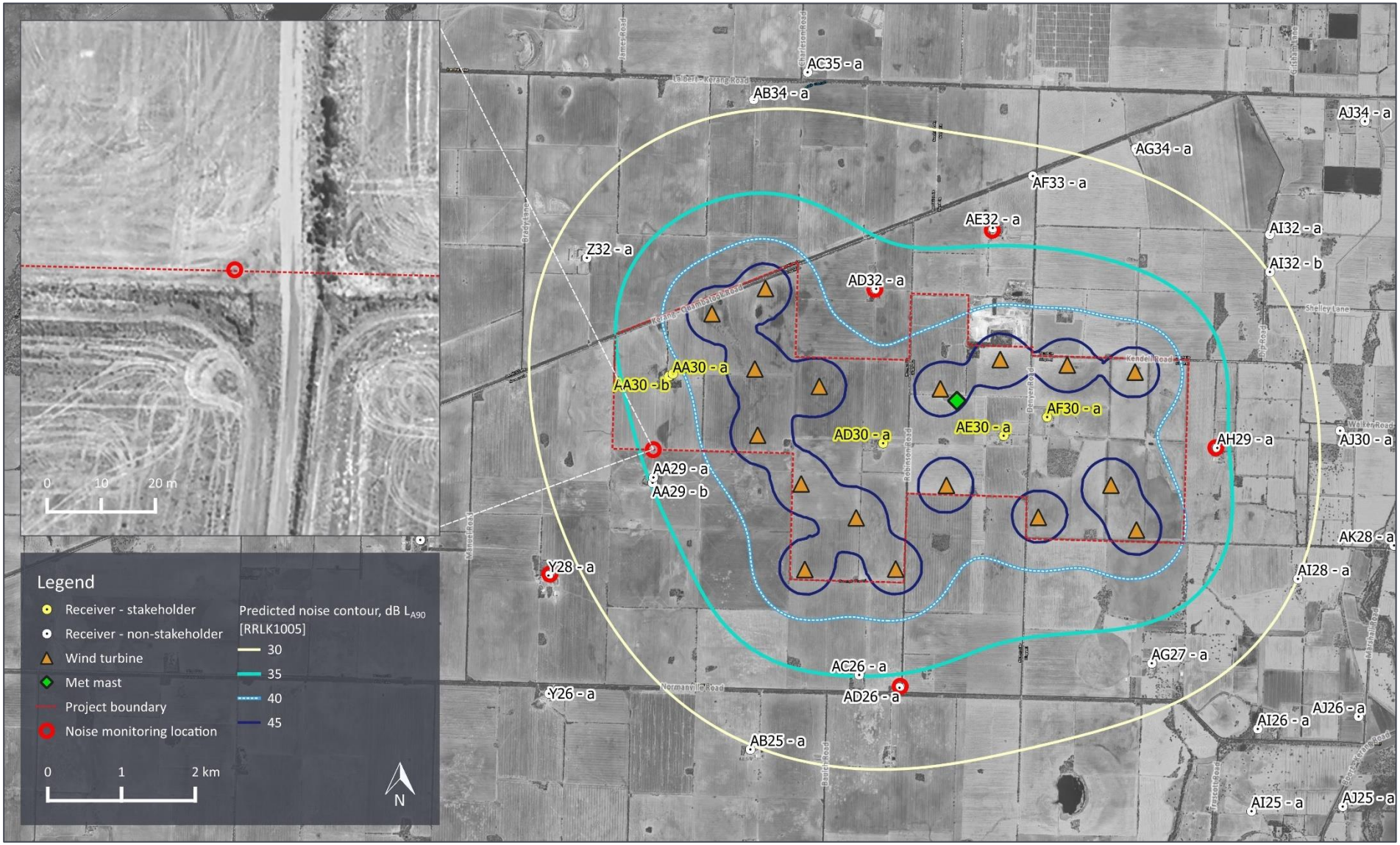
Location	Easting	Northing
Background noise monitoring location	746,043	6,036,942

Table 13: Receiver AA29 - a (proxy) monitor installation photos

Looking North[5]	Looking East
	
Looking South	**Looking West**
	

[5] Limited view due to property boundary restrictions

Figure 2: Receiver AA29 - a (proxy) - dwelling and noise monitor locations

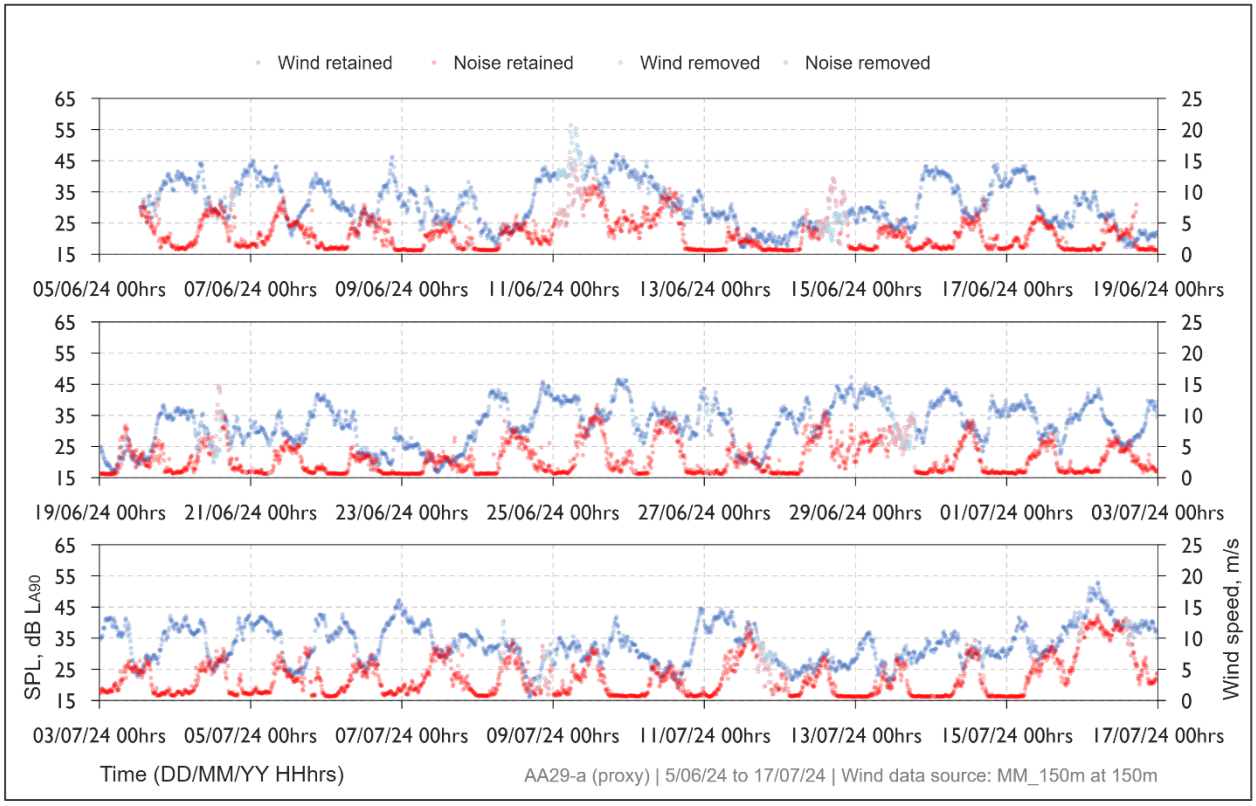


F2 Receiver AA29 - a (proxy) measurement data summary

Table 14: Receiver AA29 - a (proxy) background noise level analysis summary

Item	All-time period	Night period
Number of data points collected	5,983	2,213
Number of data points removed	270	69
Number of data points for analysis	5,713	2,144

Figure 3: Receiver AA29 - a (proxy) noise level and wind speed time history



In addition to the filtering detailed in Section 2.3, the data was filtered to exclude a period of uncharacteristically high wind speeds and high noise levels on the morning of 11 June 2024. This approach is considered conservative.

Figure 4: Receiver AA29 - a (proxy) background noise levels - All-time period

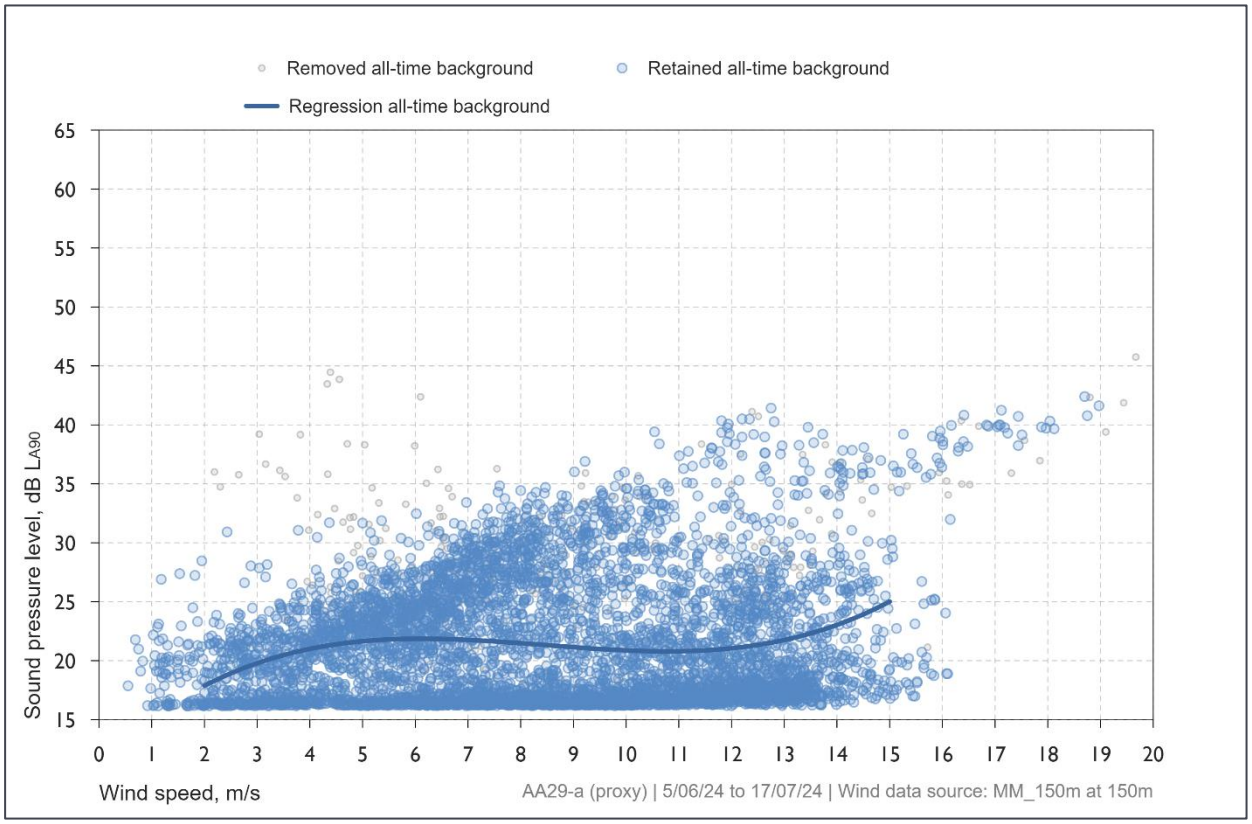
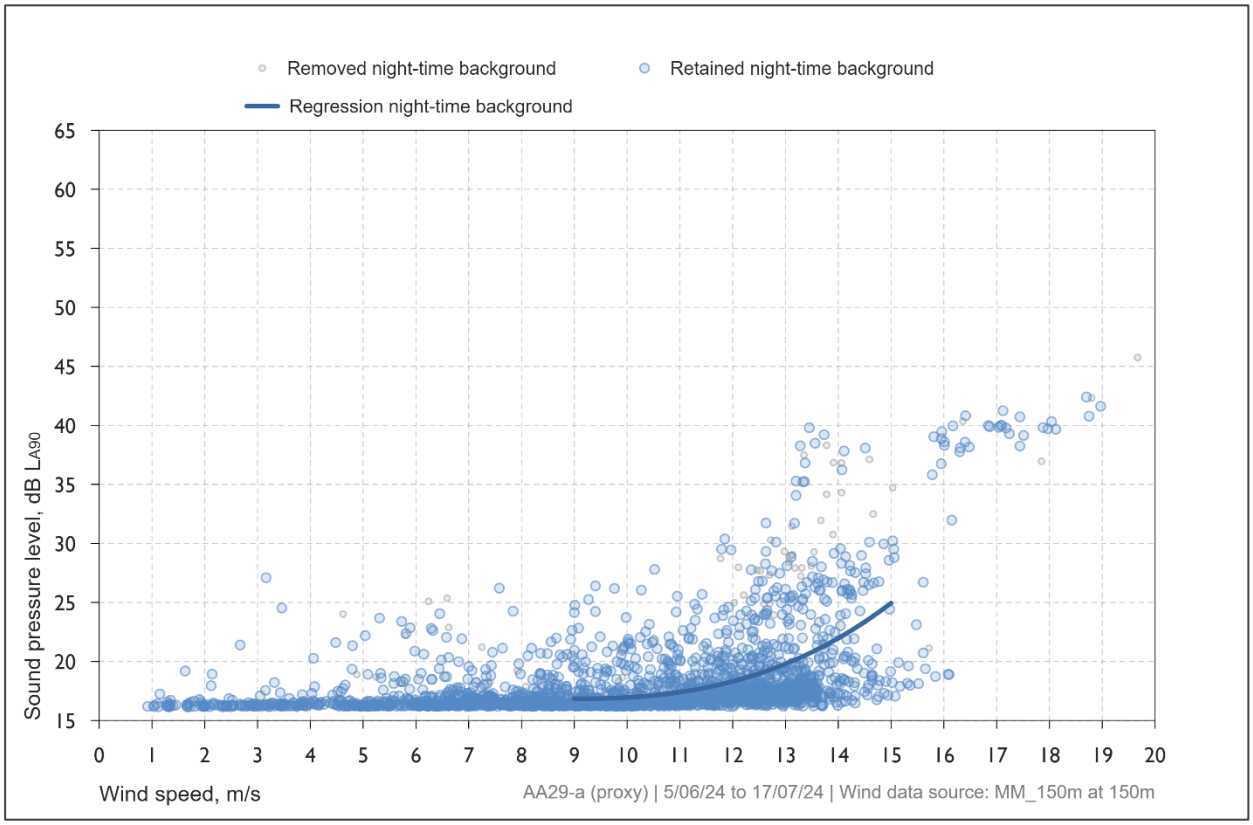


Figure 5: Receiver AA29 - a (proxy) background noise levels - Night period



APPENDIX G RECEIVER AD26 - a DATA

G1 Receiver AD26 - a location data

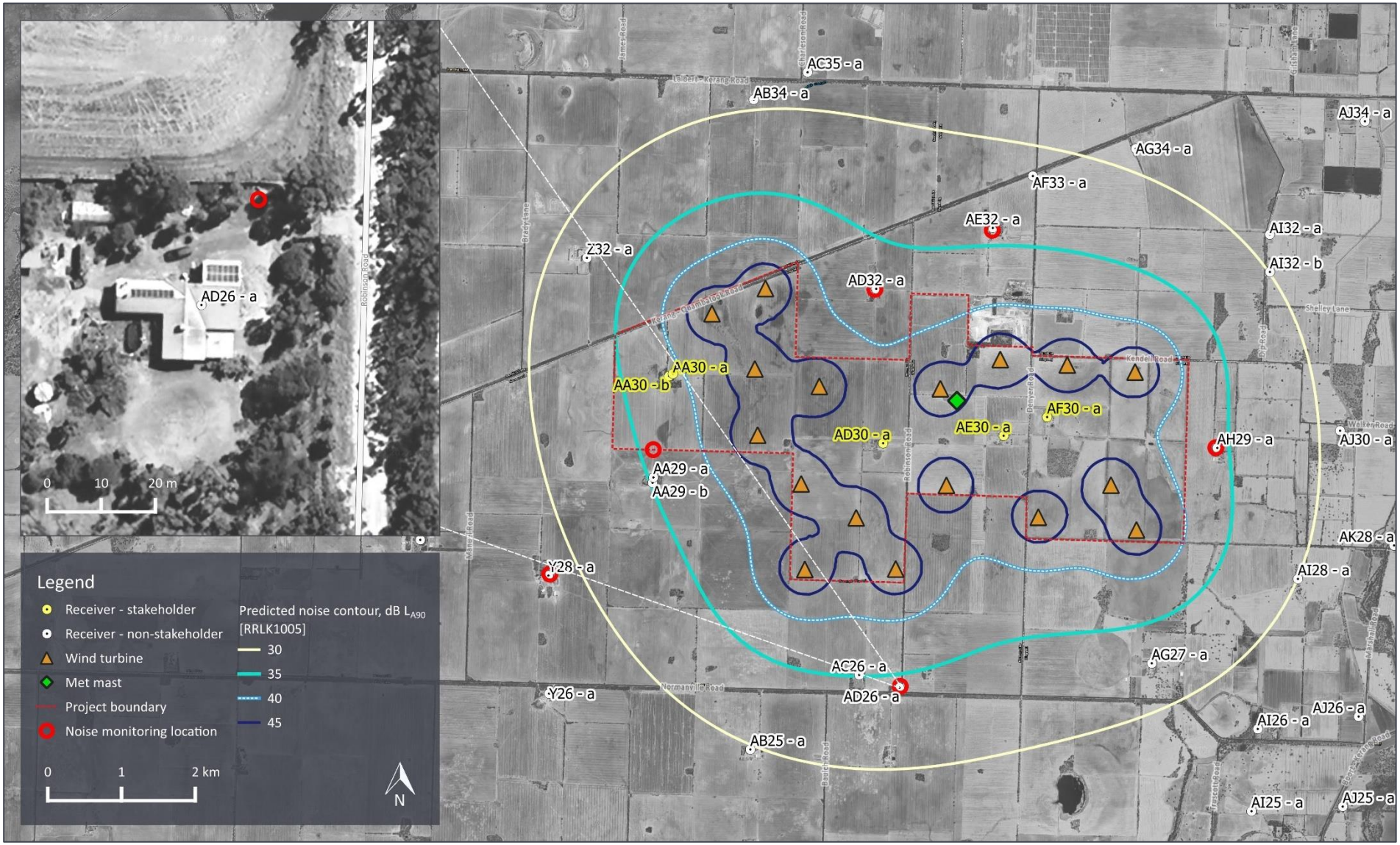
Table 15: Receiver AD26 - a noise monitor coordinates - MGA 2020 zone 54

Location	Easting	Northing
Dwelling location	749,382	6,033,711
Background noise monitoring location	749,393	6,033,731

Table 16: Receiver AD26 - a monitor installation photos

Looking North	Looking North-East
	
Looking South	**Looking South-West**
	

Figure 6: Receiver AD26 - a - dwelling and noise monitor locations

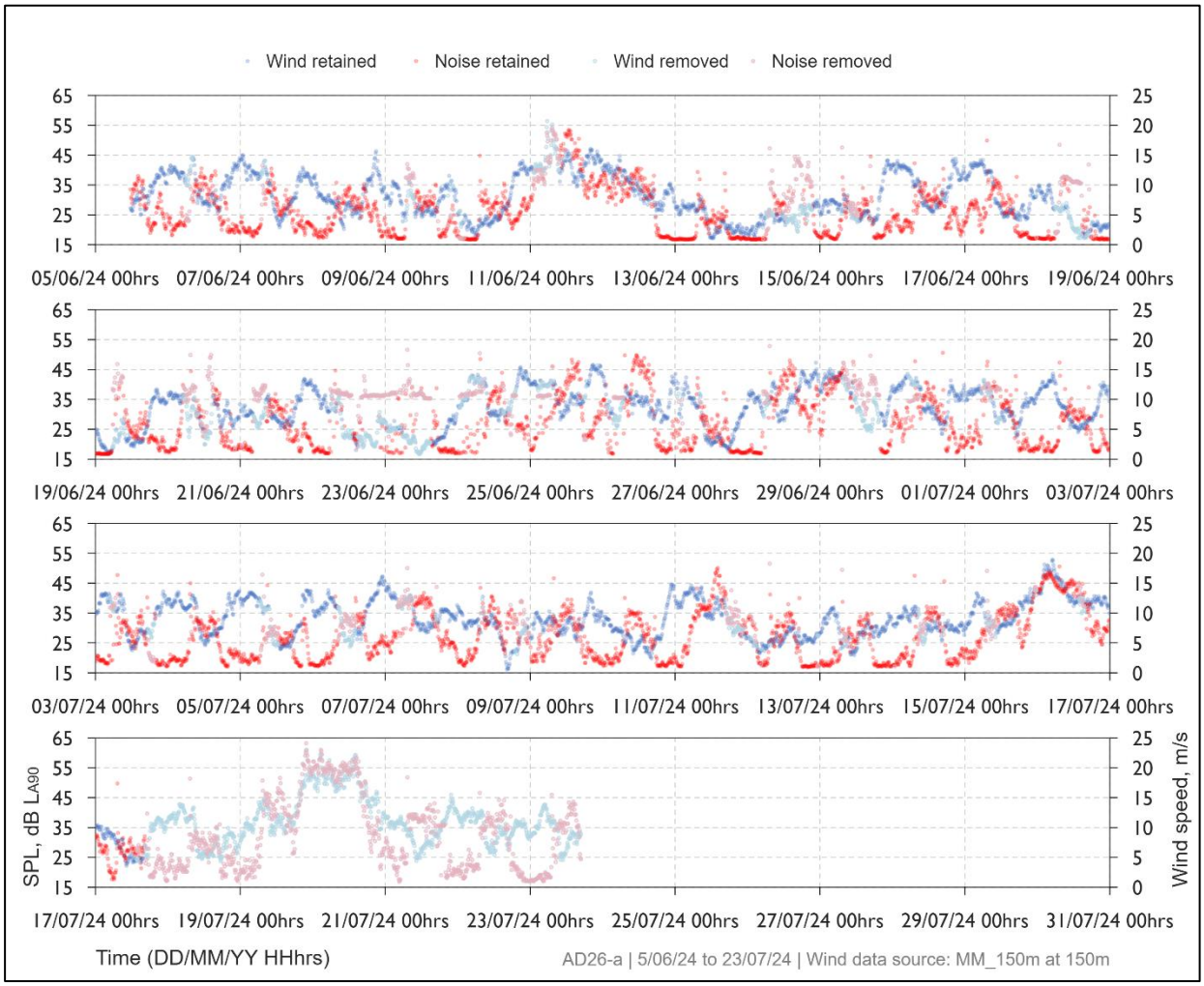


G2 RECEIVER AD26 - a measurement data summary

Table 17: Receiver AD26 - a background noise level analysis summary

Item	All-time period	Night period
Number of data points collected	6,839	2,517
Number of data points removed	1,728	569
Number of data points for analysis	5,111	1,948

Figure 7: Receiver AD26 - a noise level and wind speed time history



During the equipment deployment, condenser units were identified in the vicinity of the noise monitor. The analysis indicated the presence of extraneous noise associated with the condenser units, based on review of selected audio samples. Data points affected by this extraneous noise were filtered out of the analysis based on prominent levels identified at 20 Hz, 40 Hz and 80 Hz.

In addition to the filtering detailed above and in Section 2.3, the data was filtered to exclude a period of uncharacteristically high wind speeds and high noise levels on the morning of 11 June 2024. This approach is considered conservative.

Figure 8: Receiver AD26 - a background noise levels - All-time period

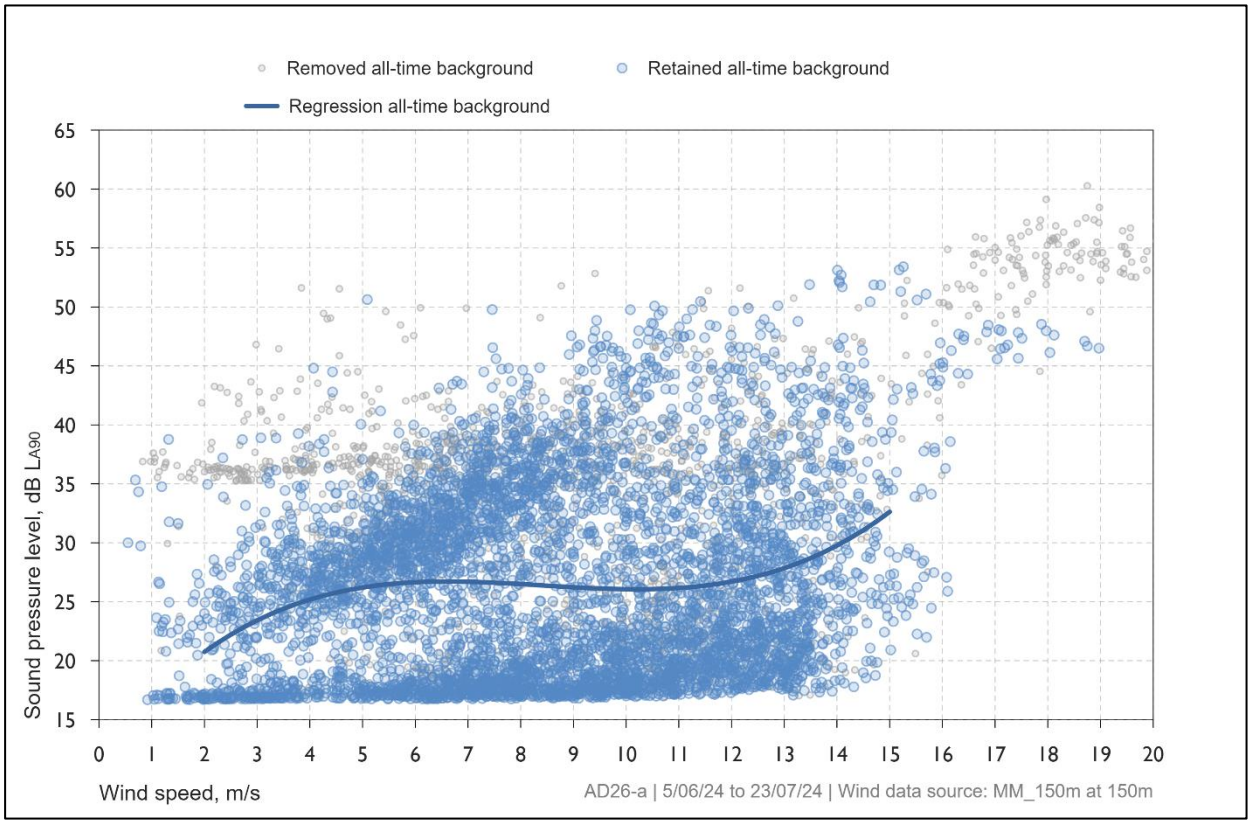
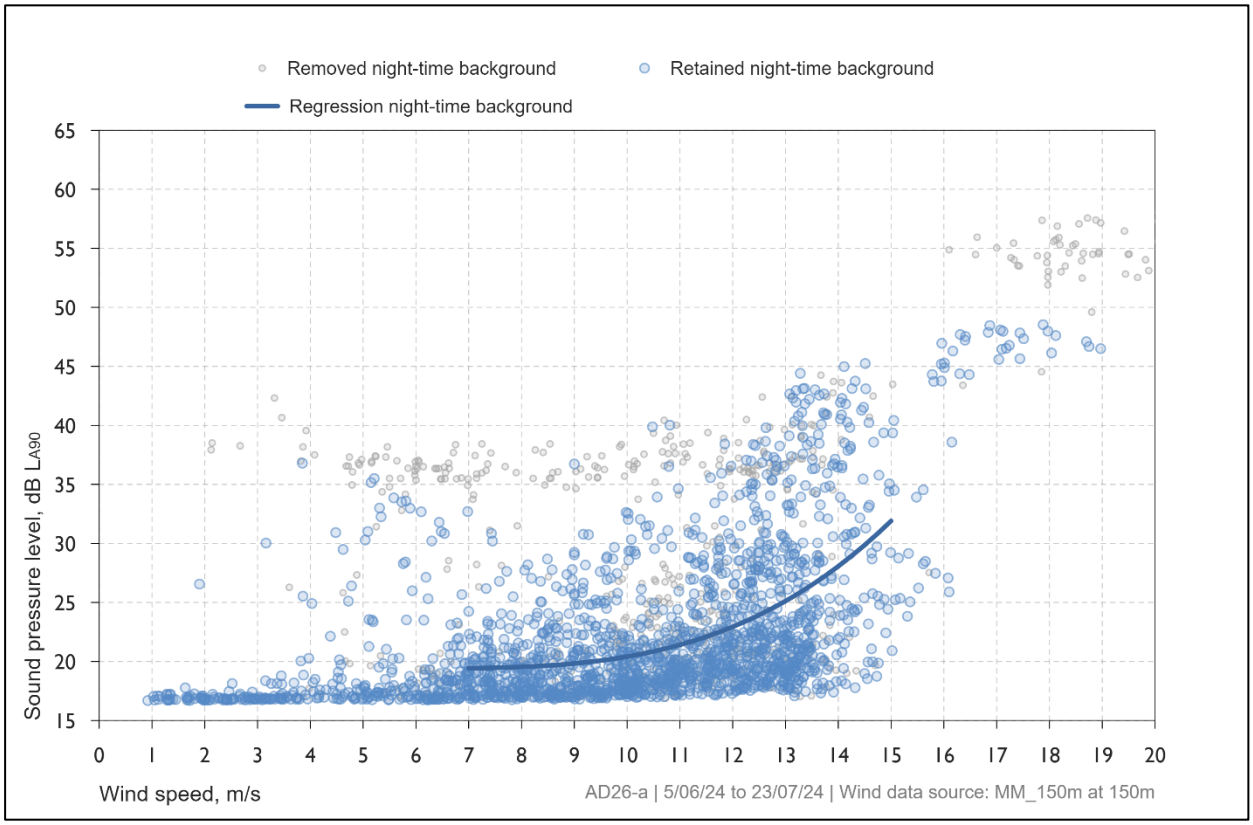


Figure 9: Receiver AD26 - a background noise levels - Night period



APPENDIX H RECEIVER AD32 - a DATA

H1 Receiver AD32 - a location data

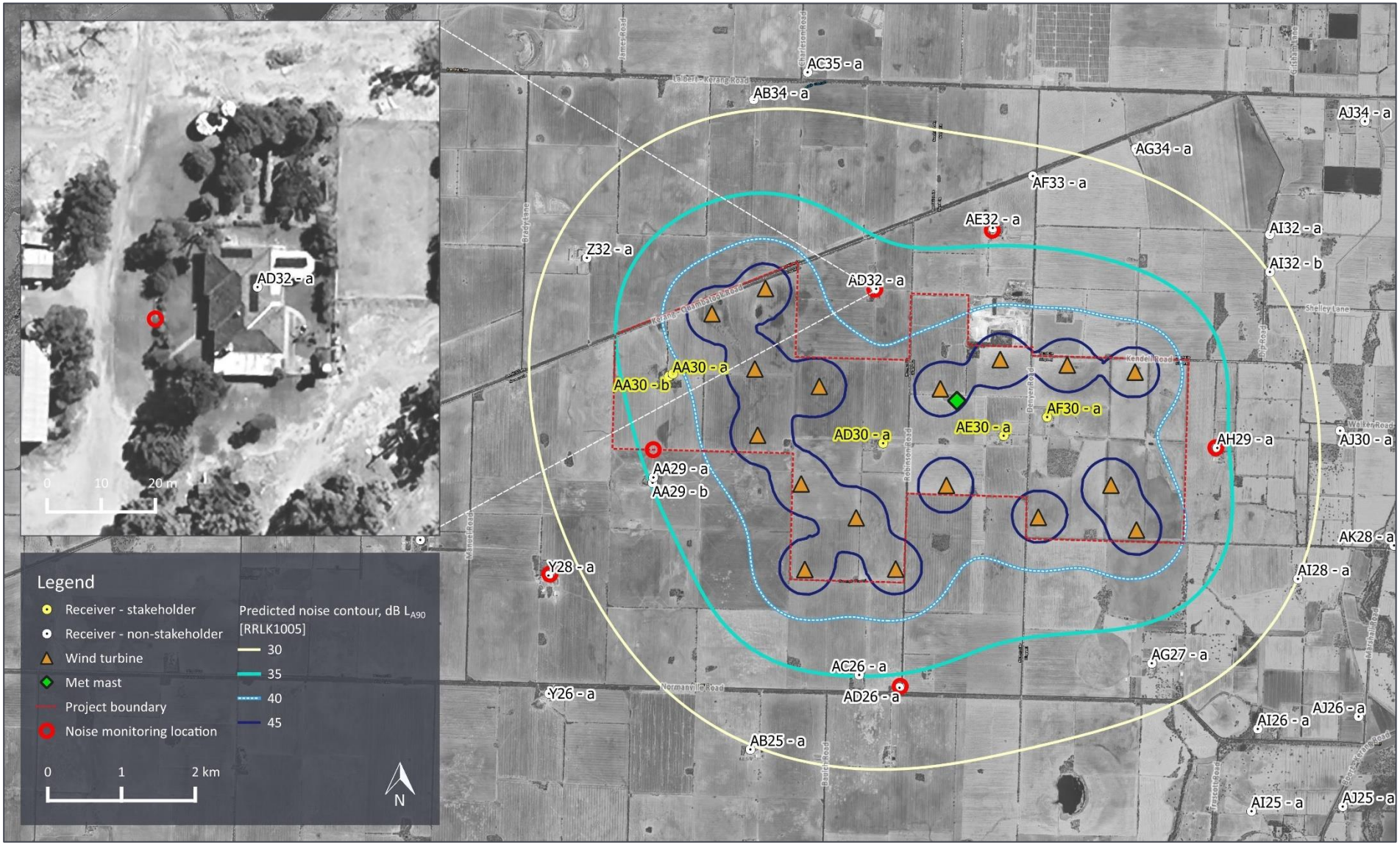
Table 18: Receiver AD32 - a noise monitor coordinates - MGA 2020 zone 54

Location	Easting	Northing
Dwelling location	749,068	6,039,124
Background noise monitoring location	749,049	6,039,118

Table 19: Receiver AD32 - a monitor installation photos

Looking North	Looking East
	
Looking South	**Looking West**
	

Figure 10: Receiver AD32 - a - dwelling and noise monitor locations



H2 Receiver AD32 - a measurement data summary

Table 20: Receiver AD32 - a background noise level analysis summary

Item	All-time period	Night period
Number of data points collected	6,248	2,315
Number of data points removed	411	121
Number of data points for analysis	5,837	2,194

Figure 11: Receiver AD32 - a noise level and wind speed time history

In addition to the filtering detailed in Section 2.3, the data was filtered to exclude a period of uncharacteristically high wind speeds and high noise levels on the morning of 11 June 2024. This approach is considered conservative.

Figure 12: Receiver AD32 - a background noise levels - All-time period

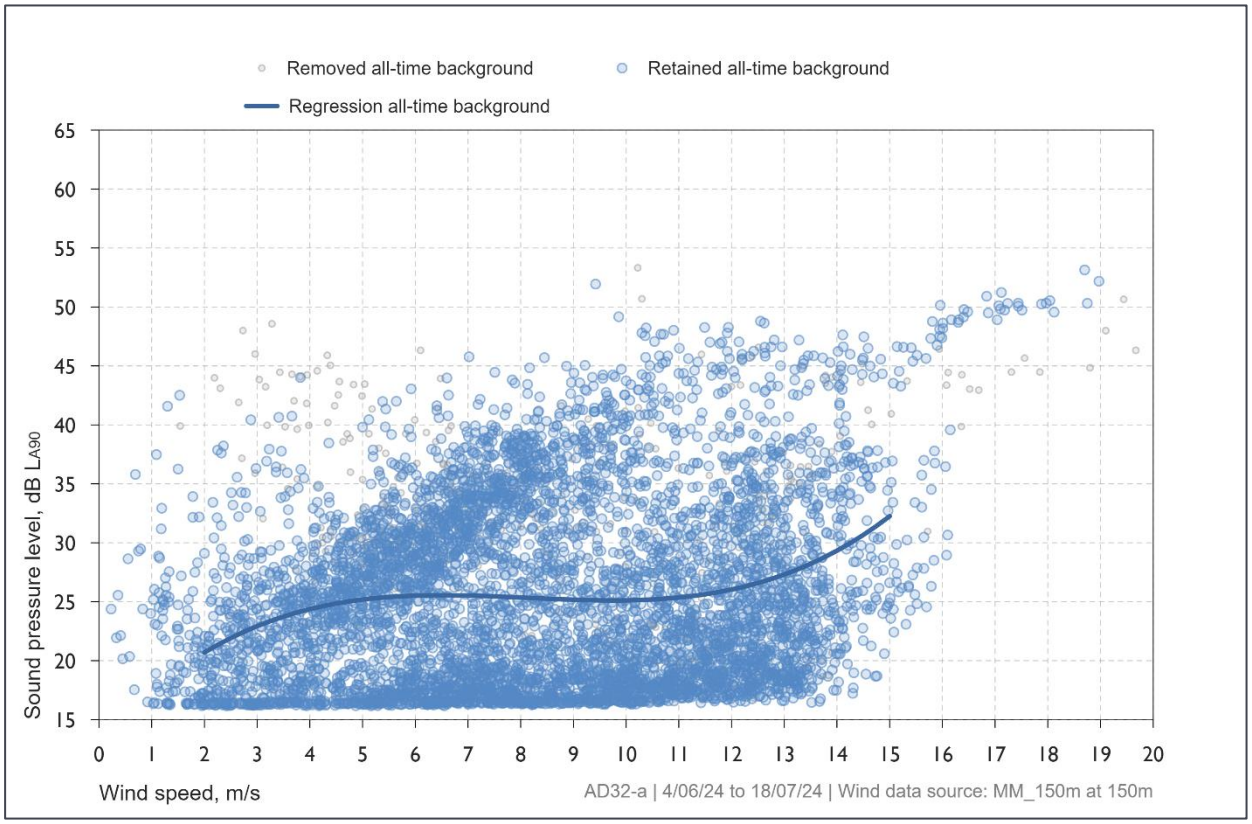
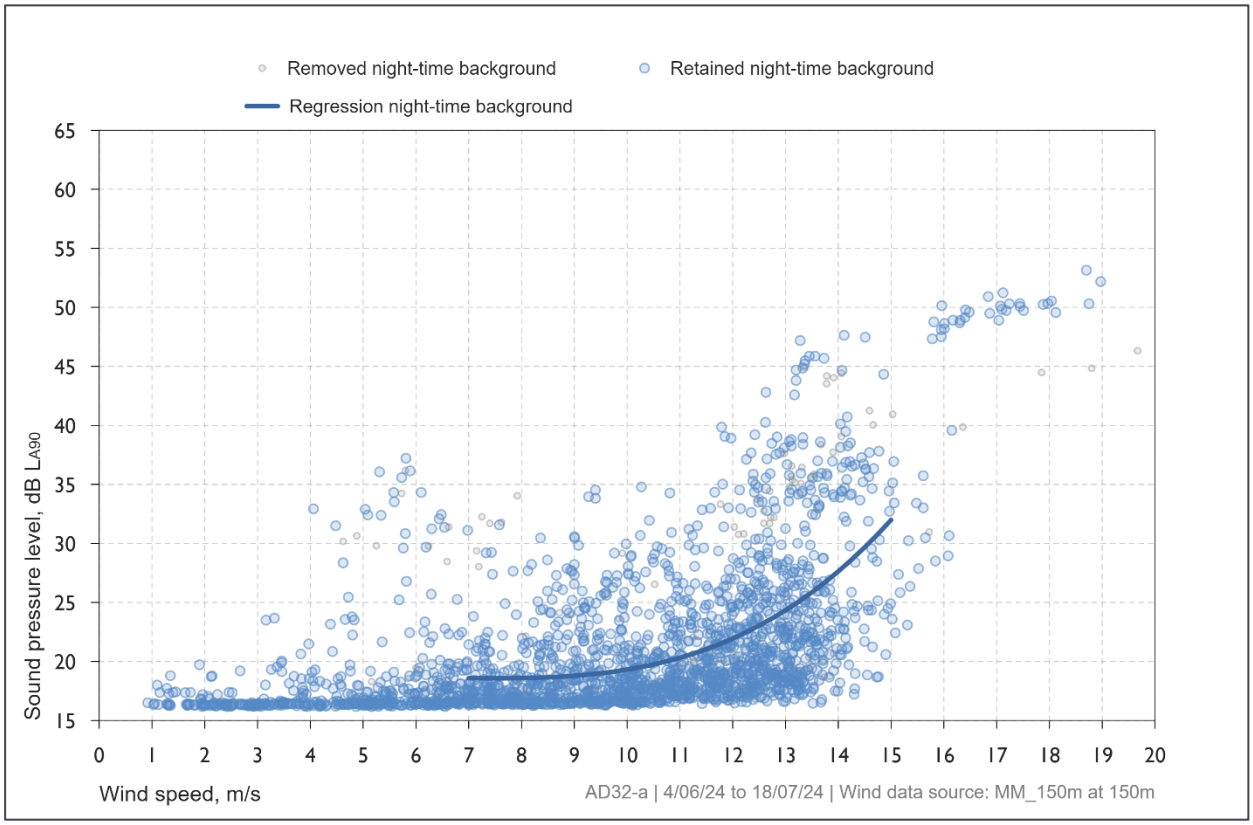


Figure 13: Receiver AD32 - a background noise levels - Night period



APPENDIX I RECEIVER AE32 - a DATA

I1 Receiver AE32 - a location data

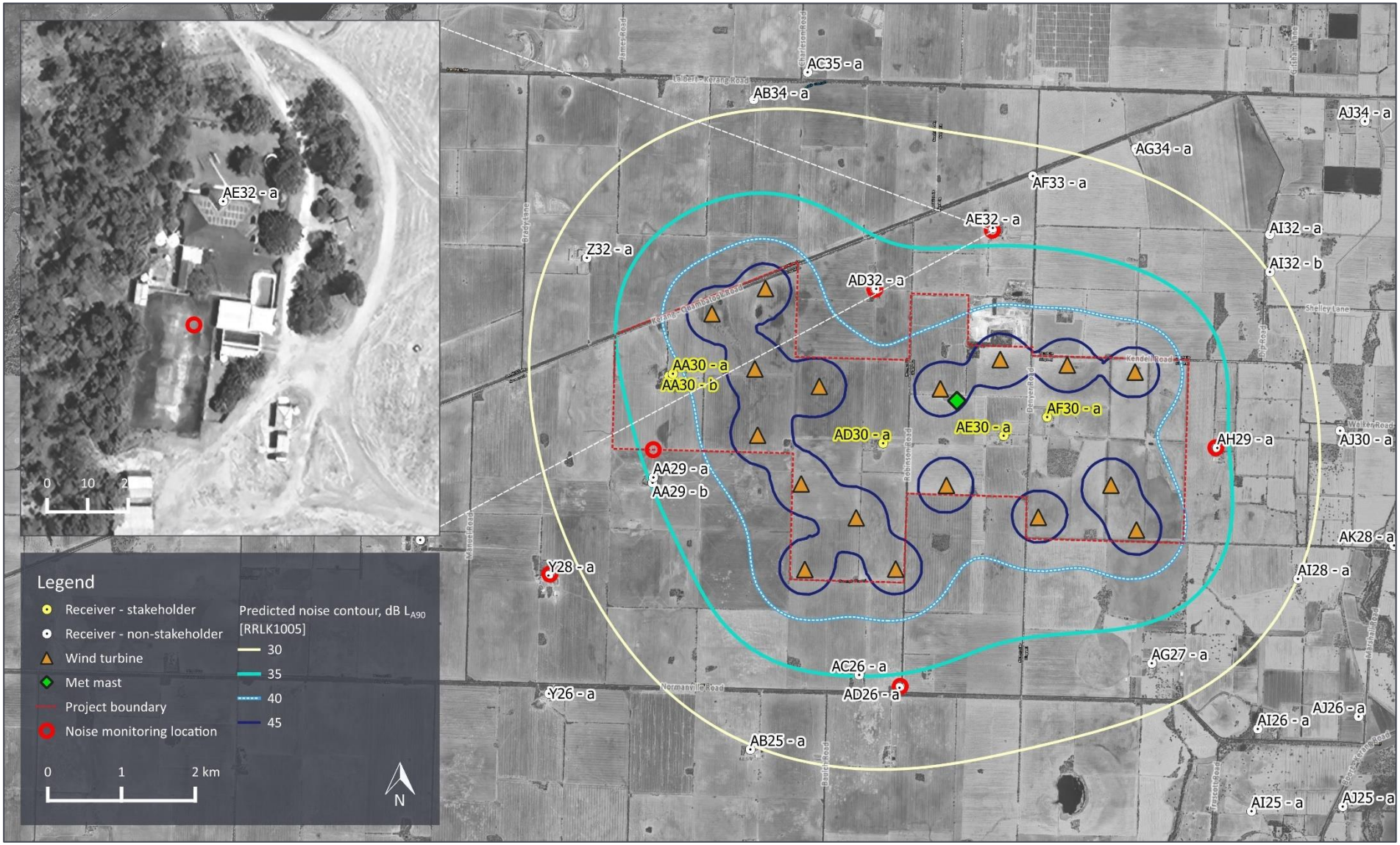
Table 21: Receiver AE32 - a noise monitor coordinates - MGA 2020 zone 54

Location	Easting	Northing
Dwelling location	750,649	6,039,950
Background noise monitoring location	750,642	6,039,920

Table 22: Receiver AE32 - a monitor installation photos

Looking North	Looking East
	
Looking South	**Looking West**
	

Figure 14: Receiver AE32 - a - dwelling and noise monitor locations

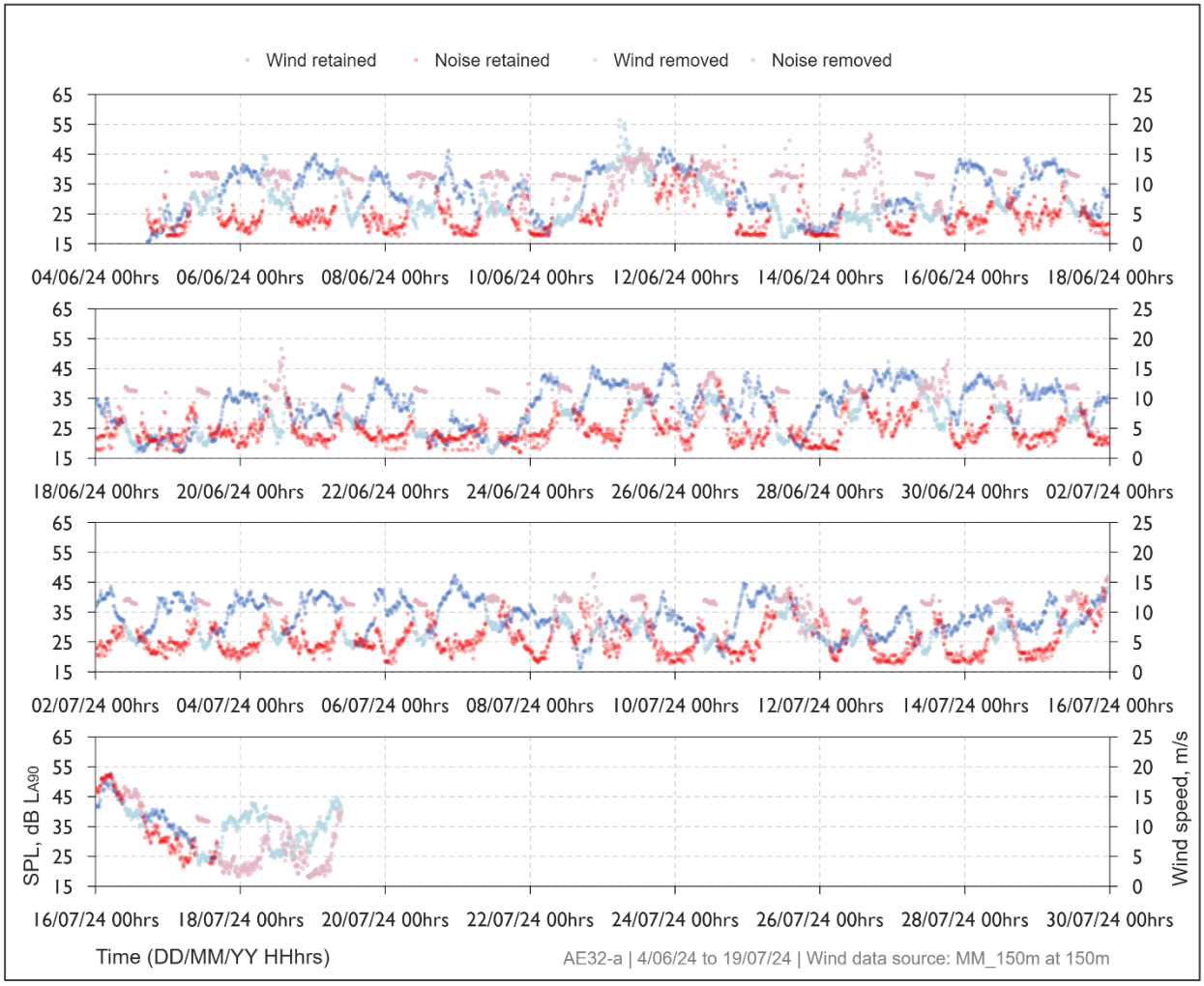


I2 Receiver AE32 - a measurement data summary

Table 23: Receiver AE32 - a background noise level analysis summary

Item	All-time period	Night period
Number of data points collected	6,298	2,351
Number of data points removed	1,780	173
Number of data points for analysis	4,518	2,178

Figure 15: Receiver AE32 - a noise level and wind speed time history



During the equipment deployment, a pool pump was identified in the vicinity of the noise monitor. The analysis indicated the presence of extraneous noise associated with the pool pump, based on review of selected audio samples. Affected data points were filtered out of the analysis, based on the following time periods when this extraneous noise was identified:

- between 0740 hrs to 1630 hrs each day from the start of the survey until the 16 June 2024
- between 0940 hrs and 1330 hrs from 17 June 2024 until the end of the survey.

In addition to the filtering detailed in Section 2.3, the data was filtered to exclude a period of uncharacteristically high wind speeds and high noise levels on the morning of 11 June 2024. This approach is considered conservative.

Figure 16: Receiver AE32 - a background noise levels - All-time period

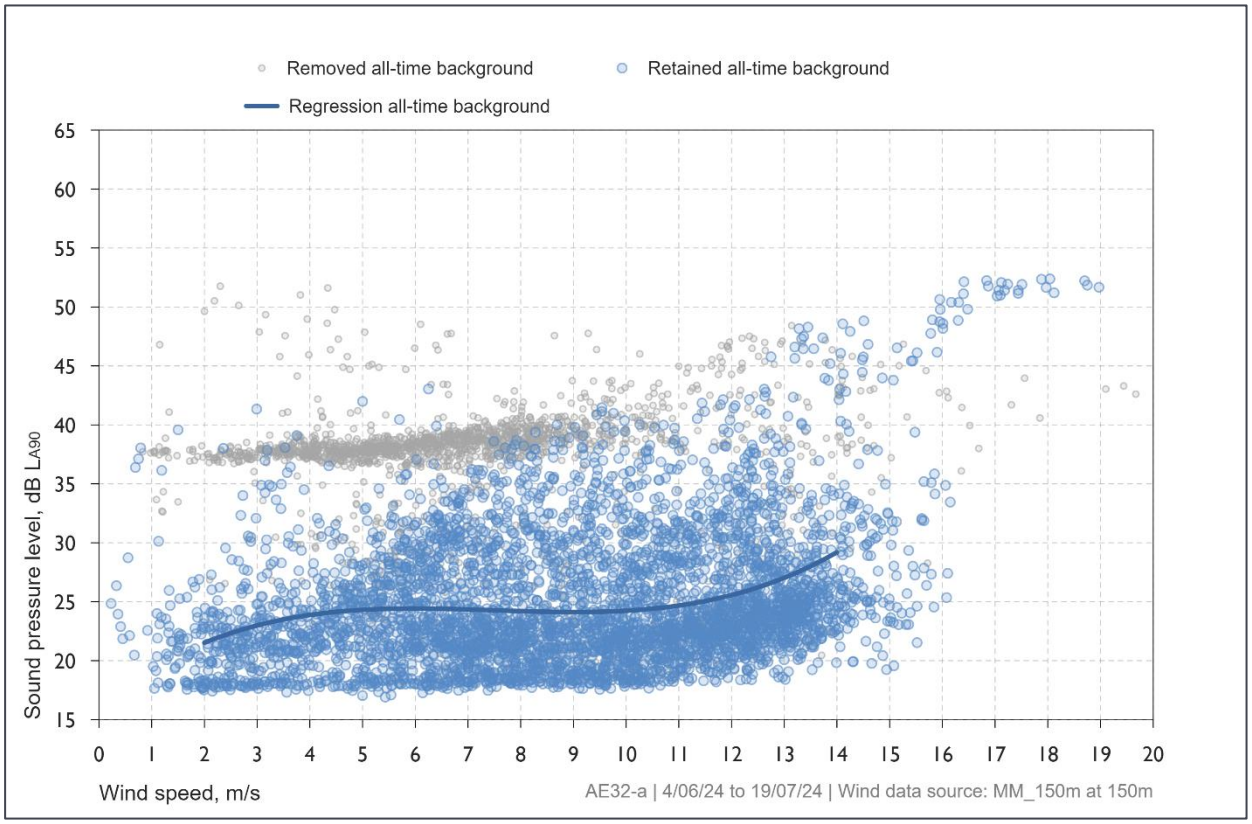
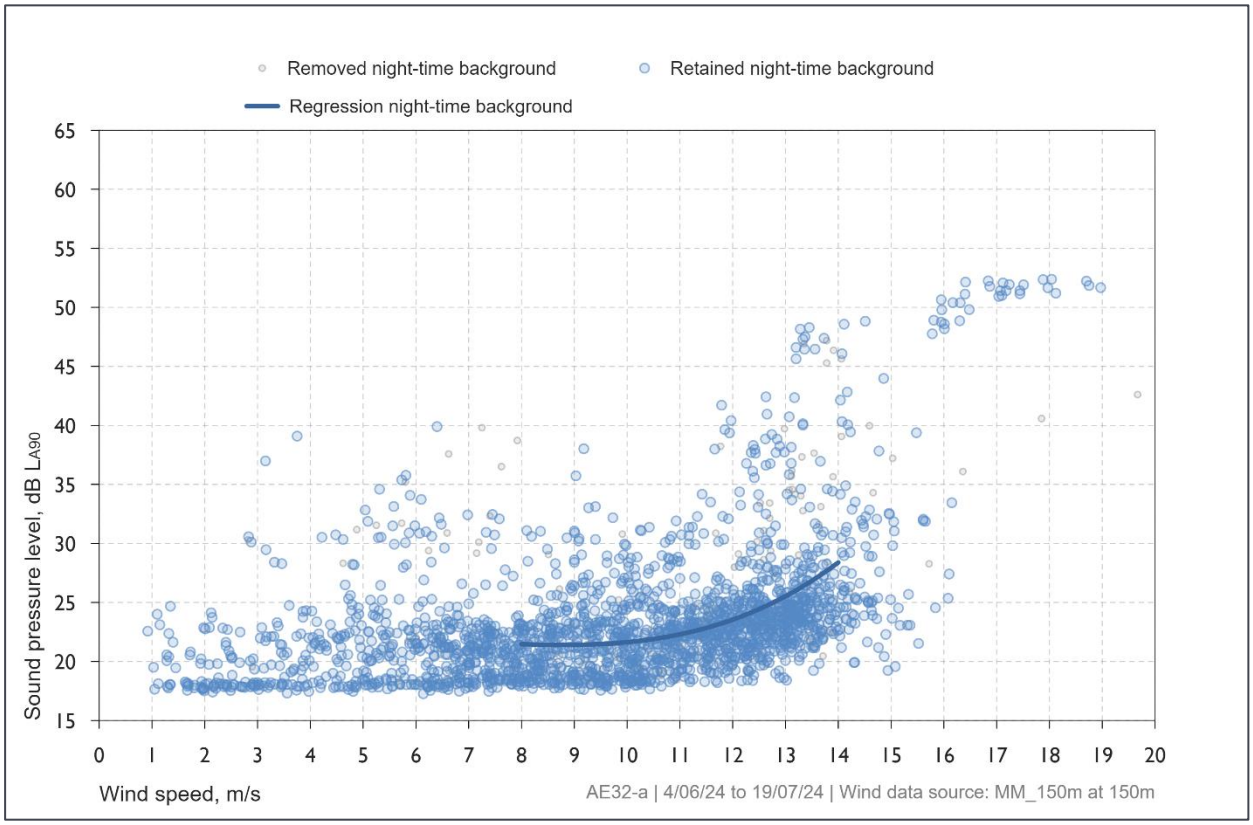


Figure 17: Receiver AE32 - a background noise levels - Night period



APPENDIX J RECEIVER AH29 - a DATA

J1 Receiver AH29 - a location data

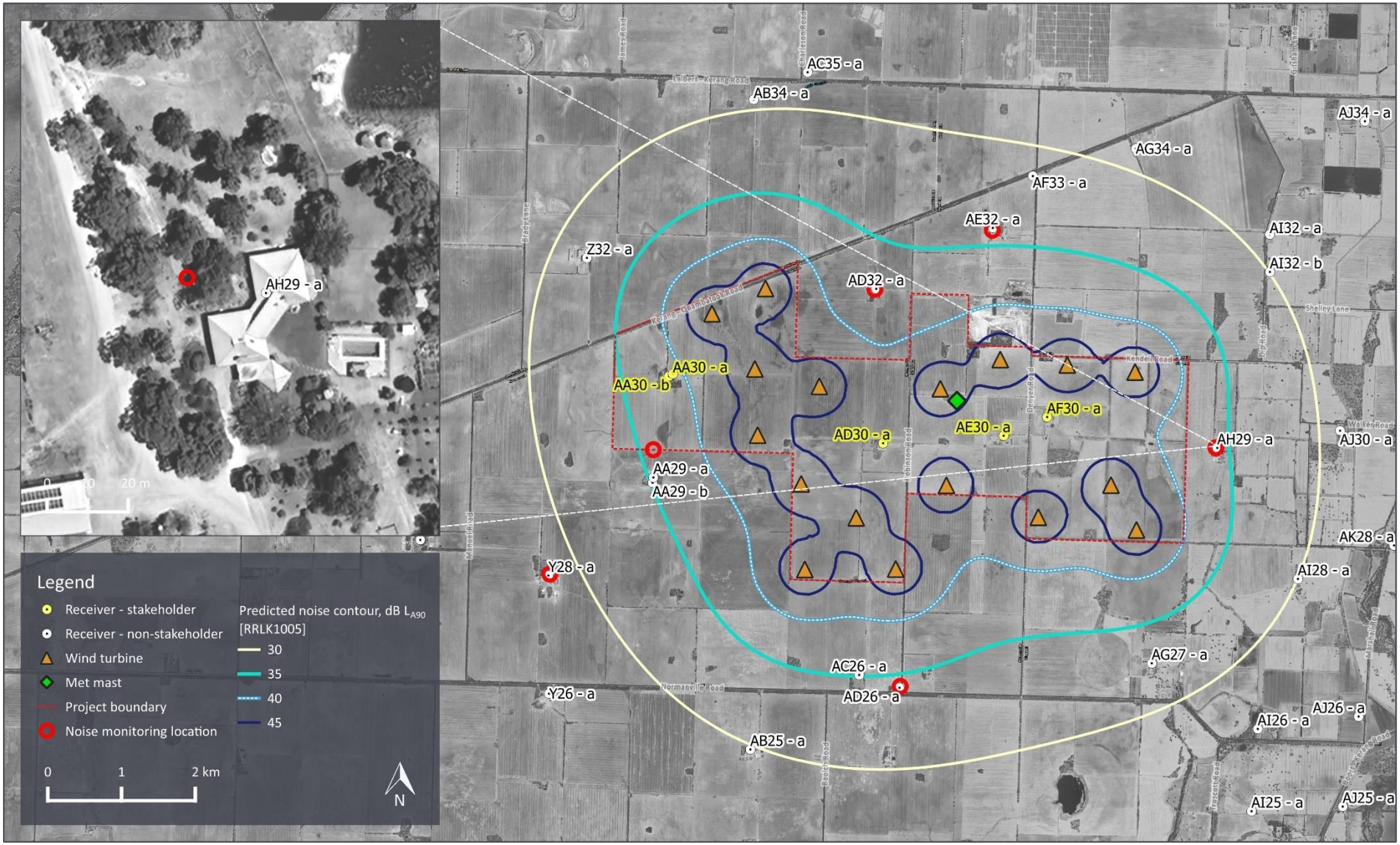
Table 24: Receiver AH29 - a noise monitor coordinates - MGA 2020 zone 54

Location	Easting	Northing
Dwelling location	753,693	6,036,965
Background noise monitoring location	753,674	6,036,969

Table 25: Receiver AH29 - a monitor installation photos

Looking North	Looking East
	
Looking South	**Looking West**
	

Figure 18: Receiver AH29 - a - dwelling and noise monitor locations

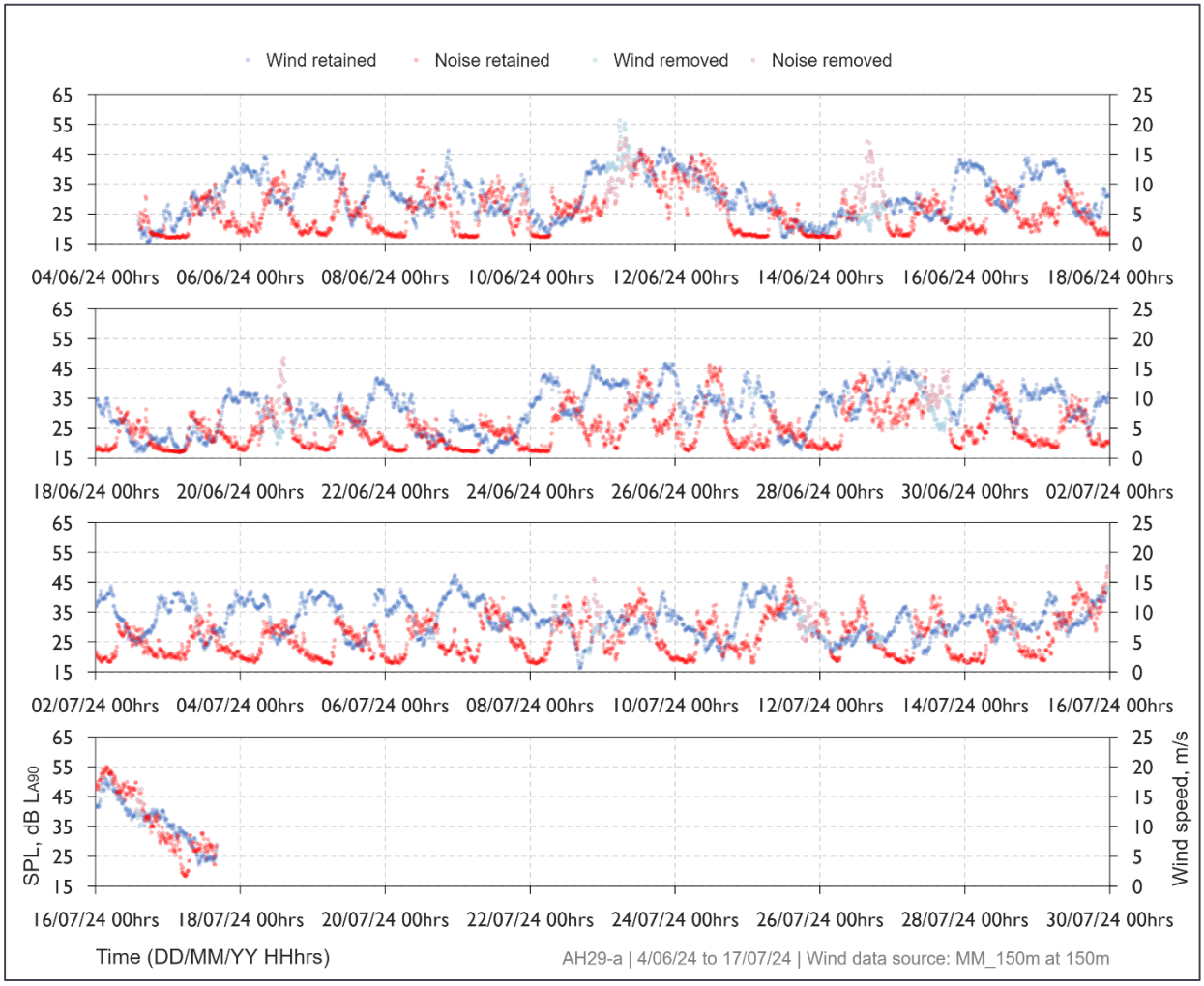


J2 Receiver AH29 - a measurement data summary

Table 26: Receiver AH29 - a background noise level analysis summary

Item	All-time period	Night period
Number of data points collected	6,073	2,247
Number of data points removed	270	67
Number of data points for analysis	5,803	2,180

Figure 19: Receiver AH29 - a noise level and wind speed time history



In addition to the filtering detailed in Section 2.3, the data was filtered to exclude a period of uncharacteristically high wind speeds and high noise levels on the morning of 11 June 2024. This approach is considered conservative.

Figure 20: Receiver AH29 - a background noise levels - All-time period

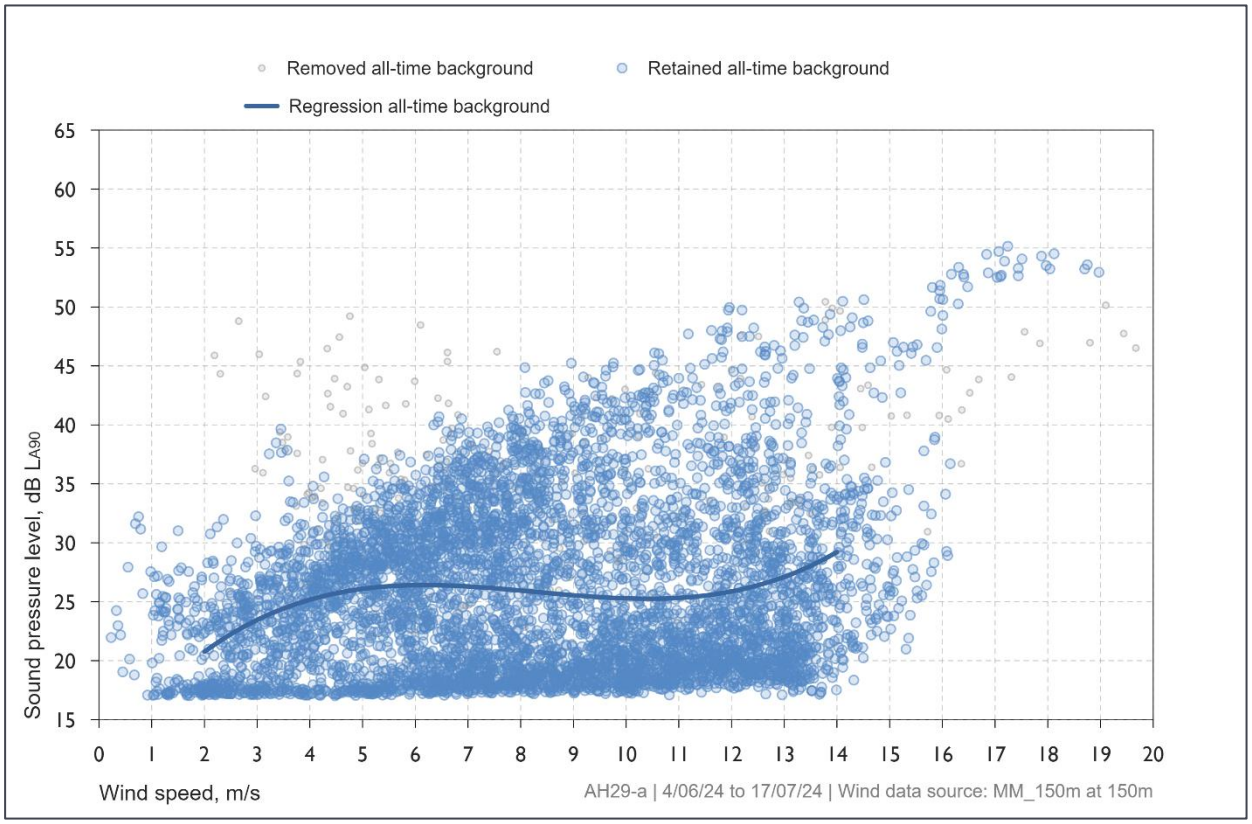
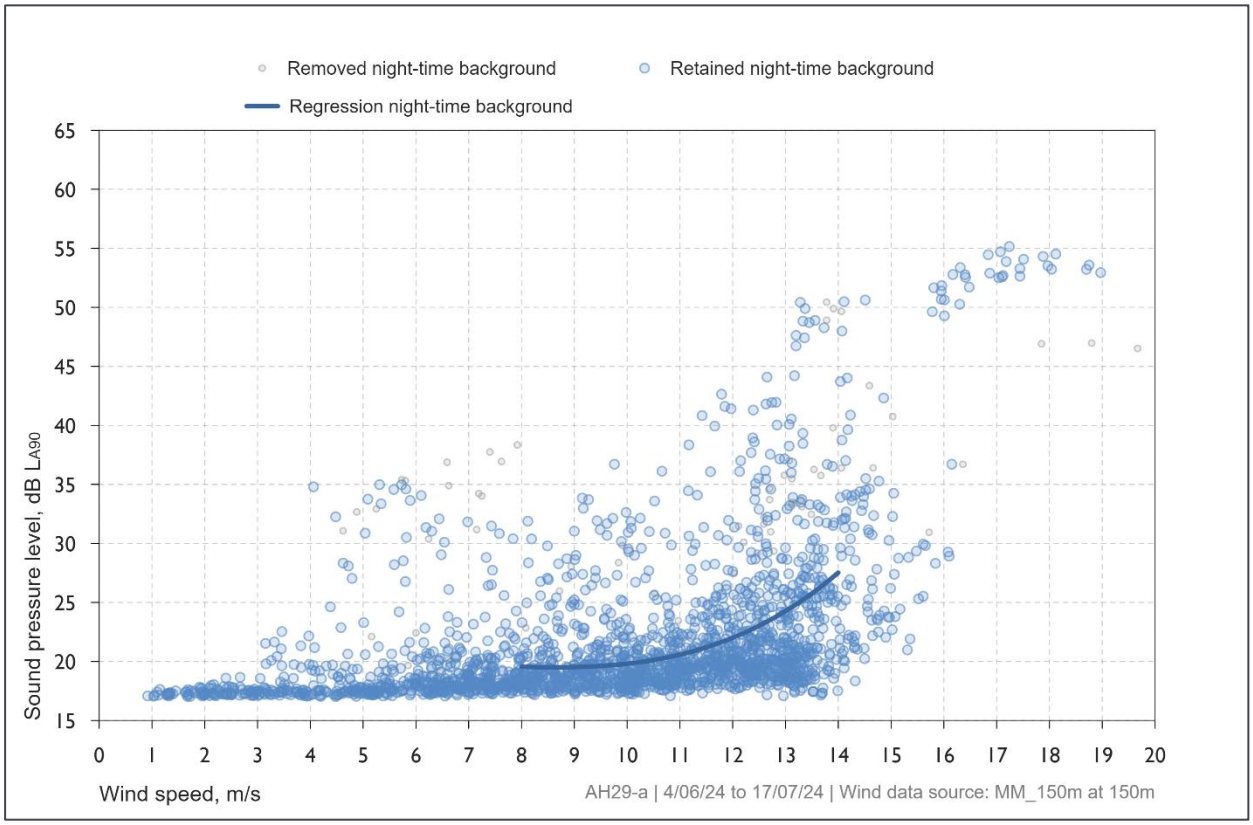


Figure 21: Receiver AH29 - a background noise levels - Night period



APPENDIX K RECEIVER Y28 - a DATA

K1 Receiver Y28 - a location data

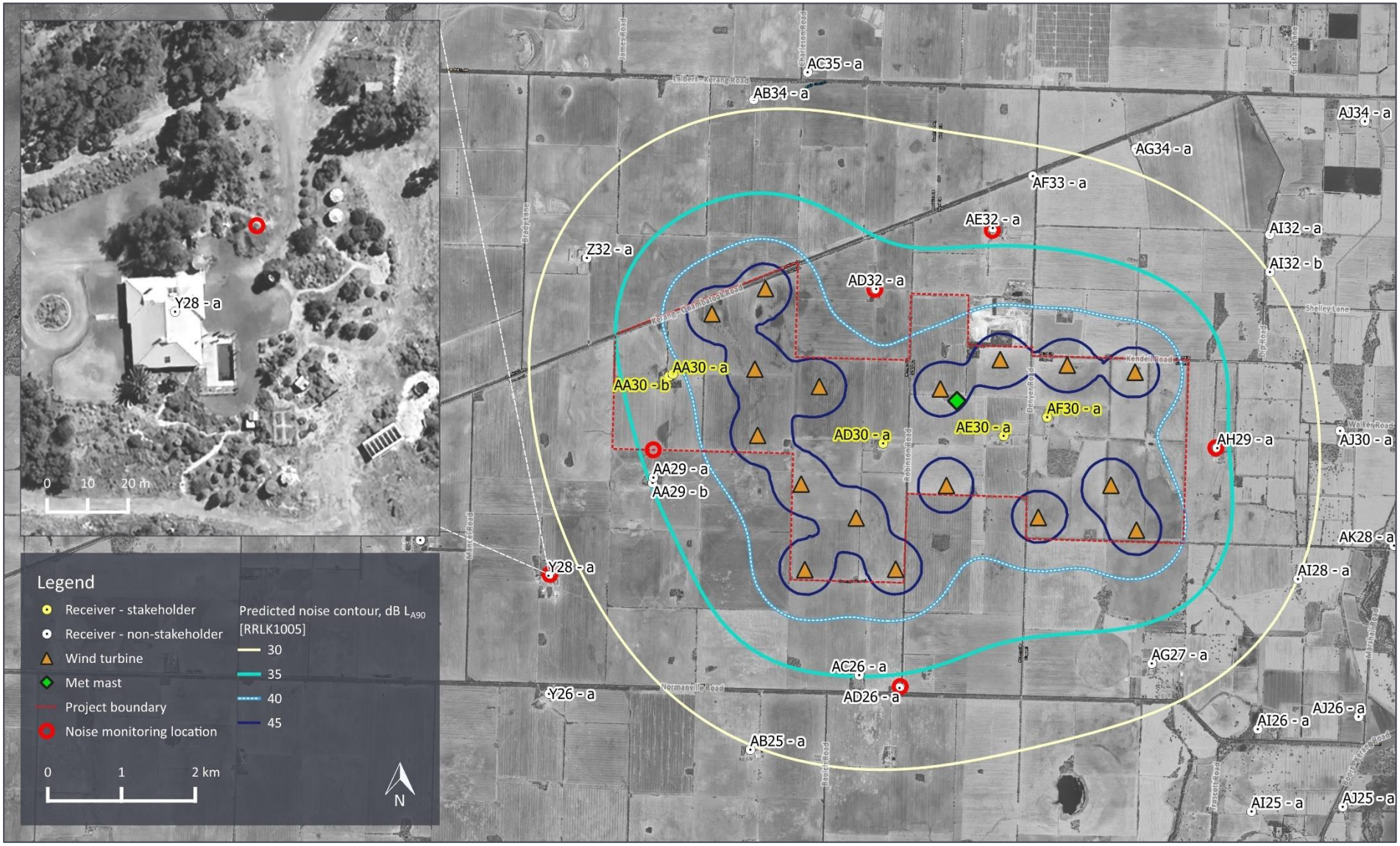
Table 27: Receiver Y28 - a noise monitor coordinates - MGA 2020 zone 54

Location	Easting	Northing
Dwelling location	744,621	6,035,234
Background noise monitoring location	744,641	6,035,255

Table 28: Receiver Y28 - a monitor installation photos

Looking North	Looking East
	
Looking South	**Looking West**
	

Figure 22: Receiver Y28 - a - dwelling and noise monitor locations



K2 Receiver Y28 - a measurement data summary

Table 29: Receiver Y28 - a background noise level analysis summary

Item	All-time period	Night period
Number of data points collected	6,258	2,309
Number of data points removed	935	272
Number of data points for analysis	5,323	2,037

Figure 23: Receiver Y28 - a noise level and wind speed time history

During the equipment deployment, water pumps were identified in the vicinity of the noise monitor. The analysis indicated the presence of extraneous noise associated with the water pumps, based on review of selected audio samples. Data points affected by this extraneous noise were filtered out of the analysis based on prominent levels identified at 315 Hz and 1.25 kHz.

In addition to the filtering detailed above and in Section 2.3, the data was filtered to exclude a period of uncharacteristically high wind speeds and high noise levels on the morning of 11 June 2024. This approach is considered conservative.

Figure 24: Receiver Y28 - a background noise levels - All-time period

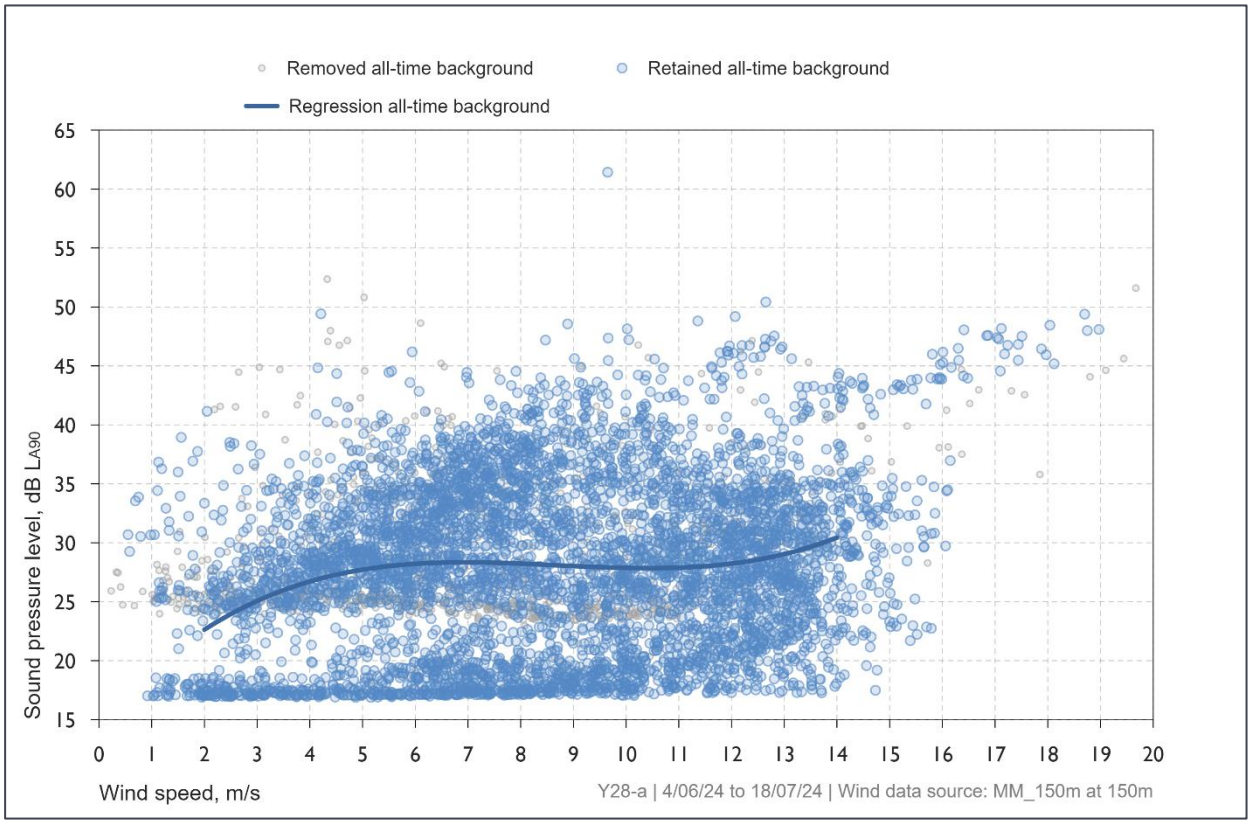
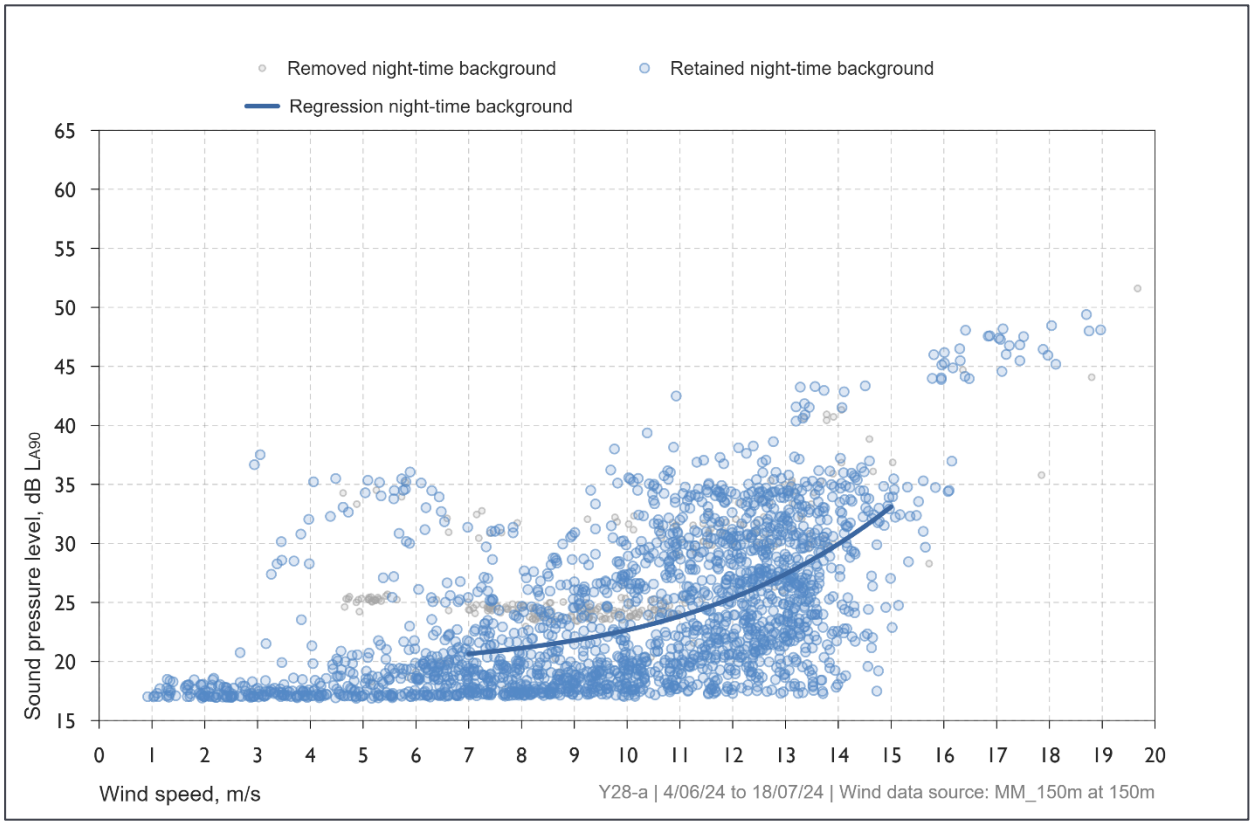
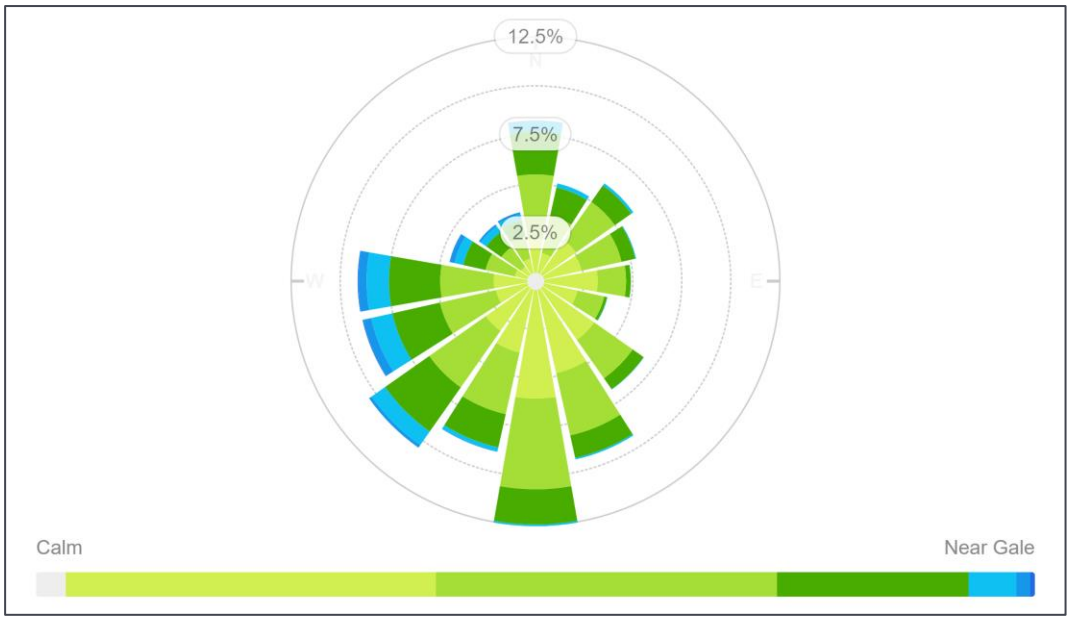


Figure 25: Receiver Y28 - a background noise levels - Night period



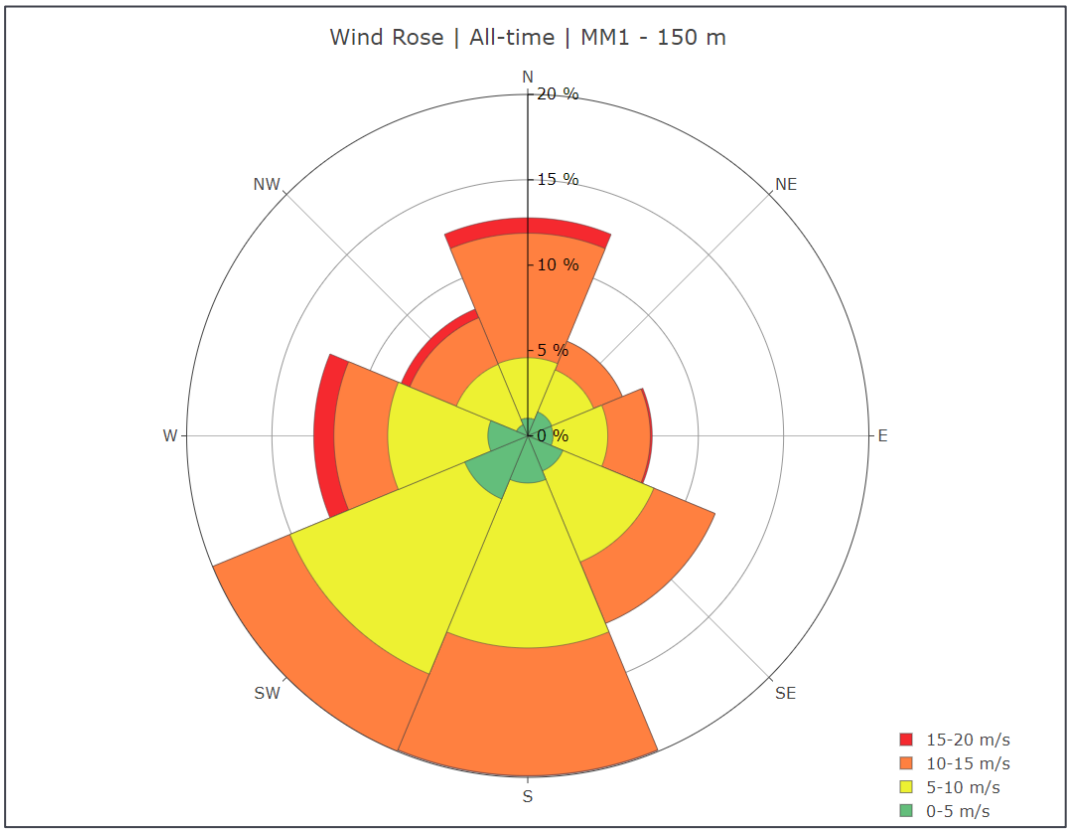
APPENDIX L WIND ROSE

L1 Wind rose – annual average



Bureau of Meteorology Swan Hill Station 5-year average (August 2019 to August 2024)
Data courtesy of willyweather.com

L2 Wind rose - background noise survey period



Project meteorological mast (3 June to 23 July 2024)

APPENDIX M DOCUMENTATION

Section 8.2 of NZS 6808 specifies the information to be included in a background noise measurement and assessment report. The information requirements, and the report section(s) where the information has been provided, are detailed below.

Table 30: NZS 6808 reporting requirements for background noise monitoring

Section 8.3 subclause	Reporting requirement	Report section
(a)	Description of the sound monitoring equipment including any ancillary equipment	Appendix C
(b)	The location of sound monitoring positions	Section 2.1
(c)	Description of the anemometry equipment including the height AGL of the anemometer	Section 2.2
(d)	Position of wind speed measurements	Section 2.2
(e)	Time and duration of monitoring period	Section 2.2
(f)	Averaging period for both sound and wind speed measurements	Section 2.1 and Section 2.2
(g)	Atmospheric conditions: the wind speed and direction at the wind farm position and rainfall shall be recorded	Data available upon request
(h)	Number of data pairs measured (wind speed in m/s, background sound in L_{90})	Appendix F to Appendix K
(i)	Description of the regression analysis	Section 2.2 and Appendix E
(j)	Graphical plots showing the data scatter and the regression curves	Appendix F to Appendix K