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DINNER HILL WIND FARM
DETAILED ACOUSTIC ASSESSMENT

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Project: **DINNER HILL WIND FARM**

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SUMMARY

This report presents the results of an assessment of environmental noise associated with the proposed Dinner Hill Wind Farm (Project) being developed by Dinner Hill Wind Farm Pty Ltd (ACN 660 596 556, Proponent), a subsidiary of OX2 AB and an affiliate of OX2 Holdings Pty Ltd.

The proposed project comprises up to 131 wind turbines and ancillary infrastructure. The proposed ancillary infrastructure relevant to the environmental noise assessment comprises a Battery Energy Storage System (BESS) and substations.

The development application for the Project seeks permission to develop, construct and operate wind turbines with a maximum tip height of 270 m. The turbine layout has been designed to control noise impacts, with a minimum setback of 1.5 km applied to all but one host dwelling (with approval in place from the landowner), and 2 km applied to non-host dwellings.

The actual wind turbine model which would be used for the Project would be determined during the detailed design stage, following determination of the Project. The final selection would be based on a range of design requirements including achieving compliance with the development consent noise limits at surrounding receivers. In advance of a final selection, the assessment considers a candidate wind turbine model that is representative of the size and type of wind turbine that could be used at the site. For this purpose, the Vestas V172-7.2MW model has been nominated by the Proponent for this assessment.

Policy framework

The *Western Australian Planning Commission's Position Statement: Renewable energy facilities* dated March 2020 (the Position Statement) sets out requirements to support the consistent consideration of renewable energy facilities within Western Australia (WA) and provides guidance on wind farm noise. In relation to wind turbine noise, the Position Statement confirms the *Environmental Protection (Noise) Regulations 1997* (WA Noise Regulations) as the applicable legislation in WA. The Position Statement also states that the *South Australian Environmental Protection Authority – Wind Farms Environmental Noise Guidelines (2009)* should be referenced for assessment purposes, and notes that these guidelines acknowledge the potential for operation in the presence of higher wind-induced background noise levels. In August 2026, the Department of Planning, Lands and Heritage (DPLH) published an updated interpretation of the Position Statement, clarifying that the SA guidelines can only be used to the extent that they do not conflict with the requirements of the WA Noise Regulations.¹

It is understood that WA noise policy for wind turbine noise is under review and may be subject to change. This assessment has been undertaken with reference to the WA Noise Regulations and the DPLH clarification of the Position Statement. Predicted noise levels have been compared with the regulation 8 assigned levels for each time period. The SA guidelines have been used as a supporting methodology, only for matters specific to wind turbine noise for which the WA Noise Regulations do not prescribe a method. Section 4.4 sets out each use of the SA guidelines and how it relates to the WA Noise Regulations. The design stage assessment methodology has been developed having regard to DWER's pre-lodgement technical advice for wind farms.² Compliance during operation would be determined using practical testing methods consistent with the WA Noise Regulations, to be set out in an Operational Noise Management Plan.

Background monitoring

Background noise monitoring for the Project has not been carried out at this stage. While this is not consequential for the current Project assessment conclusions, it is intended that a monitoring survey would be carried out prior to construction. The pre-construction noise level data would be referenced in the

¹ <https://www.wa.gov.au/government/publications/planning-position-statement-renewable-energy-facilities>

² Department of Water and Environmental Regulation, *Noise – Pre-Lodgement Technical Advice – Wind farms*, July 2026 (DWER memo).

Operational Noise Management Plan, and would be used as part of the operational noise compliance monitoring to inform the assessment of noise levels attributable to the operation of the wind farm.

Noise assessment

Manufacturer specifications for the candidate wind turbine model have been used as the basis for the assessment. The specifications for each wind turbine include noise emission data in accordance with the international standard referenced in the SA guidelines.³ The noise emission data used is consistent with the range of values expected for comparable types of multi-megawatt wind turbine models that may be considered for the site.

The noise emission data has been used with international standard ISO 9613-2 to predict wind turbine noise levels at neighbouring receivers.⁴ 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. In accordance with the guidance in the DWER memo, the manufacturer sound power levels have been increased by 2 dB to allow for modelling uncertainty. This, together with other modelling assumptions described in Section 5.0, is considered to result in conservative predicted noise levels. The predictions are also based on the candidate wind turbine operating in its unconstrained mode without noise curtailment.

The predicted noise levels in this assessment, including those for the Project and nearby developments, are calculated as L_{Aeq} levels, consistent with the noise emission data and the prediction methods. The assigned levels in regulation 8 are expressed as L_{A10} levels. In this assessment, the predicted L_{Aeq} levels are compared directly with the L_{A10} assigned levels. This is considered reasonable because wind turbines, BESS and substations are quasi-steady sources of noise, and the prediction methods include conservative assumptions appropriate to each source type. In practice, the L_{Aeq} and L_{A10} levels will not be identical. The comparison is intended solely to indicate whether the predicted noise levels exceed the assigned levels for planning purposes, and whether operational strategies are likely to be required for the control of noise.

Assessment outcomes

The noise modelling for the Project indicates that the predicted noise levels for the proposed wind turbine layout are below the day and evening assigned levels (45 dB and 40 dB L_{A10} respectively) at all non-host receivers, without curtailment. The predicted noise levels are above the night-time assigned level (35 dB L_{A10}) at 7 non-host receivers (329, 77, 113, 88, 103, 32, and 91), by up to 2.5 dB, noting that this includes the +2 dB modelling uncertainty referred to above. An example curtailment strategy has been developed to show that the predicted noise levels can be reduced so that they do not exceed the night-time assigned level, using sound optimised modes for a limited range of wind conditions during the night period. The example curtailment strategy is specific to the current layout and candidate wind turbine model, and is not intended to be specified as a condition of development approval. A project-specific strategy would be documented in an Operational Noise Management Plan, and any condition relating to curtailment would more appropriately refer to that plan (see Section 7.5)

The WA Noise Regulations require adjustments to be applied where noise exhibits tonality, modulation or impulsiveness (regulation 9). Analysis of the noise emission frequency data for the candidate wind turbine model indicates the noise of the Project is not expected to be characterised by tonality. Modulation and impulsiveness cannot be predicted at the planning stage. However, evidence from operational wind farms in Australia indicates that the occurrence of tonality, amplitude modulation and impulsiveness at receivers is limited and atypical. Accordingly, adjustments for these characteristics have not been applied to the predicted noise levels. The potential for these characteristics would be revisited during detailed design and evaluated as part of post-construction compliance monitoring.

³ IEC 61400-11:2012 *Wind turbines - Part 11: Acoustic noise measurement techniques*

⁴ ISO 9613-2:2024 *Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors*

The assessment has also considered operational noise associated with the proposed BESS and 3 substation sites. Predicted noise levels from the BESS and substations are below the most stringent (night-time) assigned level at all non-host receivers. As the night-time assigned level is the most stringent, predicted noise levels from the BESS and substations are also below the day and evening assigned levels.

The total predicted noise levels from the Project (wind turbines, BESS and substations) do not exceed the assigned levels at any non-host receiver in any time period, with the example night-time curtailment strategy implemented. The curtailment strategy is targeted, requiring the curtailment of specific wind turbines under specific wind conditions. Noise from the BESS and substations makes a minor contribution to the total predicted noise levels at receivers.

Cumulative noise from nearby developments, Parron Maam Marang Wind Farm and the Harvest BESS, has also been considered. A screening assessment was undertaken using the significant contribution threshold, determined with reference to the WA Noise Regulations. A quantitative assessment was then completed for the receivers identified as potentially at risk. The predicted cumulative noise levels do not exceed the assigned levels at any non-host receiver in any time period, except at receiver 325 during the night period. Receiver 325 is also a non-host receiver for Parron Maam Marang Wind Farm. The predicted cumulative level at this receiver is 36.0 dB L_{Aeq} , including the 2 dB modelling uncertainty margin applied to the wind turbines, 1.0 dB above the night-time assigned level. This prediction is based on the conservative assumption that the receiver is downwind of all sources at the same time, with all sources producing their highest noise emissions. The example curtailment strategy presented in this report does not rely on curtailment of the Dinner Hill turbines nearest to receiver 325. Night-time curtailment of these turbines therefore remains available as an additional measure, if required. On this basis, cumulative noise from the Project and the nearby developments is expected to be manageable.

The findings of this assessment indicate that the Project (wind turbines, BESS and substations) can be designed and operated so that noise levels do not exceed the assigned levels at any non-host receiver in any time period, with wind turbine curtailment likely to be required during the night period. The assessment is based on predicted noise levels that include conservative assumptions, using an approach appropriate to a planning stage assessment. Compliance would need to be verified through testing of actual noise levels following construction, based on the policies and procedures applicable at that time and a method defined in an Operational Noise Management Plan. This would provide a practical basis for the Council and DWER to assess compliance during operation. The results of that testing would also provide the basis for defining any ongoing curtailment strategies required.

Recommendations

Prior to construction, the predicted noise levels should be updated for the final Project configuration and equipment selections (including the turbine model), to confirm the findings of this assessment. Background noise monitoring should also be carried out prior to construction, to characterise typical baseline conditions in the vicinity of the Project and to support future compliance testing. An operational noise management plan should be prepared for the Project prior to operation. The plan should include:

- confirmation of the noise limits, based on the policy requirements at the time
- confirmation of the locations at which the noise limits apply
- the compliance testing procedures
- a program of early sound power level testing of selected wind turbines, to verify consistency with the design modelling
- details of all noise controls (the curtailment strategy), including those for the wind turbines, BESS and substations
- a requirement to update the plan following post-construction compliance monitoring, if the results indicate that adjustments to noise controls are required.

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1.0 INTRODUCTION

Dinner Hill Wind Farm Pty Ltd (ACN 660 596 556) (Proponent) proposes to develop the Dinner Hill Wind Farm (Project) comprising up to 131 wind turbines and ancillary infrastructure which includes a BESS and substations. Throughout this report, the term 'Project' refers to the Dinner Hill Wind Farm BESS & substations, and the Dinner Hill Wind Farm wind turbines.

This report presents the results of an assessment of operational noise for the proposed project undertaken with reference to the Western Australia Environmental Protection (Noise) Regulations 1997 (WA Noise Regulations), which are the prescribed standard for noise emissions in WA. The South Australia EPA Wind farms environmental noise guidelines, issued July 2009 and revised November 2021 (SA guidelines), have been used as a supporting methodology where the WA Noise Regulations do not prescribe a method specific to wind turbine noise. This approach is consistent with the Western Australian Planning Commission Position Statement: Renewable energy facilities, dated March 2020 (Position Statement), and the DPLH clarification of its interpretation (Section 4.2). Compliance during operation would be verified through post-construction compliance testing, as set out in an Operational Noise Management Plan (Section 10.0).

Noise associated with the operation of the proposed BESS and substations has been assessed with reference to the WA Noise Regulations. Further discussion regarding the methodology and its alignment with legislative requirements is provided in Section 5.0.

The noise assessment presented in this report is based on:

- predicted wind turbine noise levels, based on the proposed site layout and an indicative wind turbine model
- predicted noise levels from the BESS and substations, based on assumed noise emission data.

Acoustic terminology used in this report is presented in Appendix A. Throughout this report, the term *receiver* is used to identify the location of any residential dwellings (existing or proposed) identified by the Proponent in the vicinity of the Project. Receivers are grouped into two categories: *host receivers*, where the owner of the receiver premises has an agreement with the Proponent to accommodate project infrastructure on their premises; and *non-host receivers*, which comprise all remaining receivers who do not have an agreement with the Proponent to accommodate project infrastructure on their premises.

General information about the definition of sound and the ways that different sound characteristics are described is presented in Appendix B. The effects of wind turbine noise on health and amenity are discussed in Appendix H.

2.0 PROJECT OVERVIEW

The Project is proposed to be located approximately 200 km north of Perth, within the Dandaragan Shire, Western Australia.

The Project would involve the construction, operation and decommissioning of the following key components:

- up to 131 wind turbines with a maximum tip height of 270 metres and a hardstand area at the base of each wind turbine
- BESS with capacity to deliver up to 300 megawatts (MW) of power for 4–8 hours, comprising:
 - 360 battery units
 - 90 inverters and accompanying medium voltage (MV) transformers
- a BESS substation comprising 2 x 200 MVA HV transformers (co-located with the BESS)
- 3 wind farm substations spread across the project site as follows:
 - a western substation comprising 1 x 200 MVA HV transformer (co-located with the BESS)
 - a central substation comprising 2 x 200 MVA HV transformers
 - an eastern substation comprising 3 x 200 MVA HV transformers
- electrical infrastructure, including underground cables from the wind turbines to the transformers located in substations
- other permanent on-site ancillary infrastructure:
 - permanent operation and maintenance facilities
 - at least one meteorological mast (location details to be determined)
- access track network:
 - access and egress points from public roads
 - operational access tracks on private property.

The coordinates of the wind turbines are presented in tabular format in Appendix C and the proposed candidate wind turbine model is discussed in Section 7.2.

3.0 STUDY AREA

The study area for the noise assessment extends to 5 km from the proposed locations of the wind turbines. This is a nominal distance selected to enable a complete account of operational noise considerations associated with the Project.

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

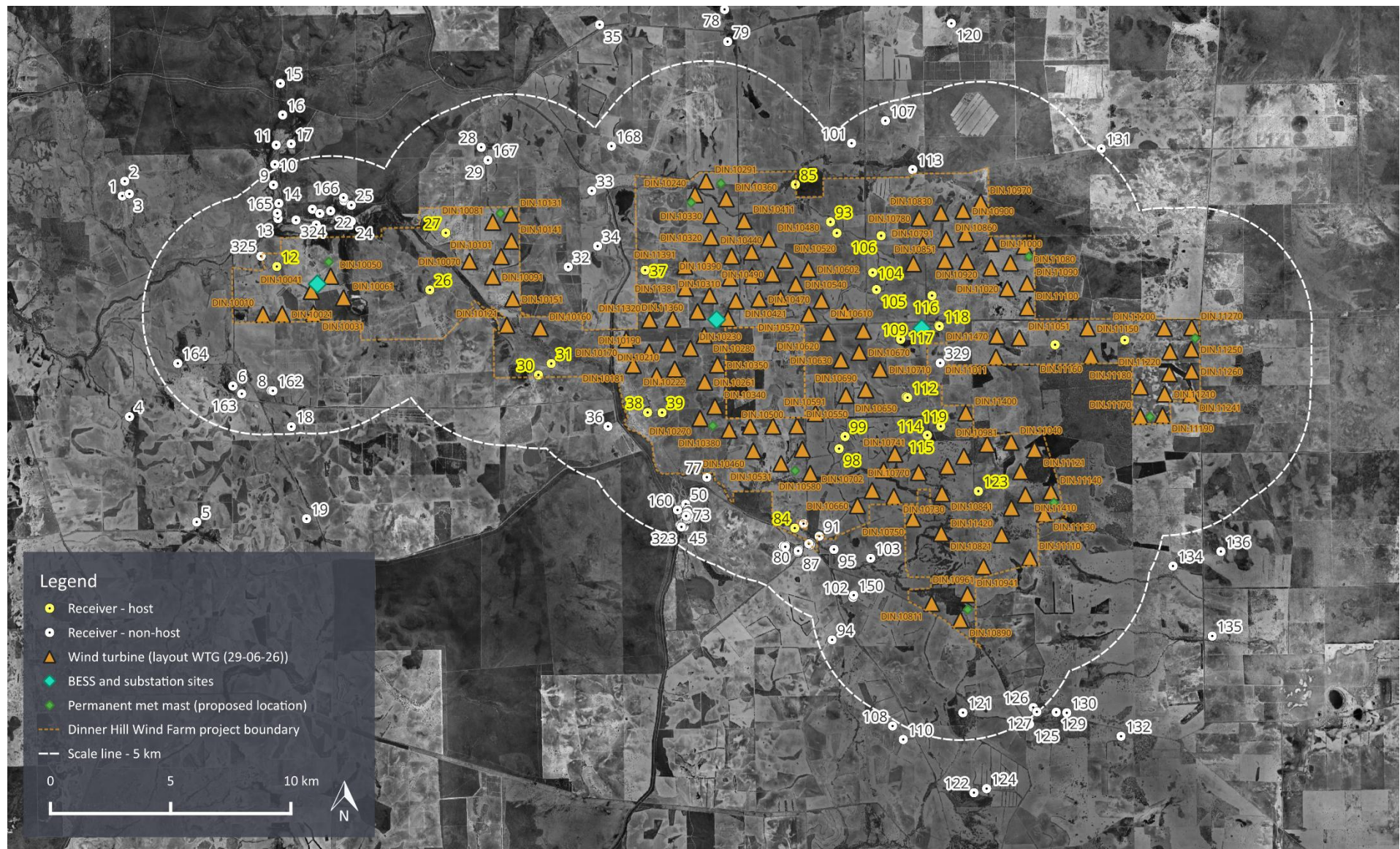
The topography of the site and surrounding area is depicted in the elevation map provided in Appendix D.

A total of 127 receivers have been identified by the Proponent within 5 km of the proposed locations of the wind turbines comprising:

- 30 host receivers
- 97 non-host receivers.

The coordinates of the receivers are tabulated in Appendix E.

Figure 1: Project layout (layout WTG (29-06-26))



4.0 WESTERN AUSTRALIA LEGISLATION, POLICY & RELATED GUIDELINES

The environmental noise assessment requirements for the Project are defined by the following publications:

- *Environmental Protection (Noise) Regulations 1997* (WA Noise Regulations), made under the Environmental Protection Act 1986 (EP Act) as the principal Act
- Western Australian Planning Commission *Position Statement: Renewable energy facilities*, dated March 2020 (Position Statement)
- South Australian Environmental Protection Authority publication *Wind Farms Environmental Noise Guidelines* issued July 2009 and revised November 2021 (SA guidelines).

This section summarises the requirements and guidance of the above publications.

As outlined below, the assessment presented in this report has been prepared with reference to the WA Noise Regulations, which define the assigned levels relevant to the Project. The SA guidelines have been used as a supporting methodology only for matters specific to wind turbine noise where the WA Noise Regulations do not prescribe a method, consistent with the Position Statement and the DPLH clarification described in Section 4.2.

The Department of Water and Environmental Regulation (DWER) has also issued pre-lodgement technical advice for wind farm noise assessment.⁵ The DWER memo covers a range of matters, including specific modelling inputs for wind turbines and BESS infrastructure. It is not a statutory instrument, but it sets out DWER's expectations for noise modelling and has been considered in this assessment.

The wind turbine noise modelling in this assessment adopts the wind farm modelling inputs in the DWER memo, including the +2 dB adjustment to manufacturer sound power levels, and is considered to result in conservative predicted noise levels. For the BESS and substations, prediction methods considered more appropriate on technical grounds have been adopted, as described in 5.0.

4.1 Environmental Protection (Noise) Regulations

The WA Noise Regulations operate as a prescribed standard under the *Environment Protection Act 1986* and set limits on noise emissions.

The WA Noise Regulations refers to several Australian Standards on the subject of noise and defines assessment procedures for a range of different noise sources including noise generated on industrial, commercial and residential premises. However, the WA Noise Regulations does not define or refer to assessment requirements that are specific to wind turbine noise.

Regulation 7 provides prescribed standards for general noise emissions:

7. Prescribed standard for noise emissions

(1) Noise emitted from any premises or public place when received at other premises —

(a) must not cause, or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) must be free of —

(i) tonality; and

⁵ Department of Water and Environmental Regulation, *Noise – Pre-Lodgement Technical Advice – Wind farms*, July 2026 (DWER memo).

(ii) impulsiveness; and

(iii) modulation,

when assessed under regulation 9.

(2) For the purposes of subregulation (1)(a), a noise emission is taken to significantly contribute to a level of noise if the noise emission as determined under subregulation (3) exceeds a value which is 5 dB below the assigned level at the point of reception.

(3) A level of a noise emission may be determined by —

(a) measurement at its point of reception when, to the extent practicable, other noises that would contribute to the measured noise level are not present; or

(b) calculation of the level at its point of reception based on measurement of the noise emission at a reference point determined by the inspector or authorised person to be a point where the relationship between the noise emission as measured at the reference point and at the point of reception can be established.

Regulation 8 additionally provides ‘assigned levels’ which are noise levels that must not be exceeded from the use of a premises when received at other premises. The assigned levels are defined in terms of three descriptors:

- L_{A10} — the sound level exceeded for 10 % of the measurement period, calculated by statistical analysis
- L_{A1} — the sound level exceeded for 1 % of the measurement period, calculated by statistical analysis
- L_{Amax} - the maximum sound level, during a measurement period or a noise event.

Non-host receivers located around the Project would be classed as a ‘highly sensitive area’ as described in the WA Noise Regulations. The assigned levels applicable to highly noise sensitive areas have been extracted from the regulation and are reproduced in Table 1.

On the basis that host receivers are classified as noise emitting premises, the assigned noise levels would not apply under the WA Noise Regulations provisions.

Table 1: WA Noise Regulations - Assigned levels, dB

Type of premises receiving noise	Time of day	L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area	0700 to 1900 hours Monday to Saturday	45 + IF	55 + IF	65 + IF
	0900 to 1900 hours Sunday and public holidays	40 + IF	50 + IF	65 + IF
	1900 to 2200 hours All days	40 + IF	50 + IF	55 + IF
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35 + IF	45 + IF	55 + IF

IF: influencing factor

The above levels include the application of an influencing factor (IF) as described in Schedule 3 of the WA Noise Regulations. The influencing factor is a modification to the assigned level that is developed through consideration of the planning zone for the noise sensitive area and its surrounds as well as traffic volumes on nearby road. Reference to the Local Planning Scheme indicates land surrounding the Project is zoned 'Rural' and would be classified as 'Rural premises' under the WA Noise Regulations Schedule 1.⁶ Road traffic counts provided by Main Roads Western Australia⁷ show traffic volumes below the thresholds that affect the influencing factor. On this basis influencing factors would be equal to 0 and the minimum assigned noise levels would apply.

Regulation 9 defines the requirements in relation to 'intrusive or dominant noise characteristics' which comprise tonality, impulsiveness, and modulation. Adjustment to the noise emission is applied where intrusive or dominant noise characteristics are found to be present.

Regulation 7(2) of the WA Noise Regulations provides a practical basis for assessing individual premises compliance in cumulative noise situations. Under the commonly accepted interpretation of the WA Noise Regulations, a source is not considered to significantly contribute to an exceedance of the assigned level where its contribution, assessed in isolation, is at least 5 dB below the assigned level at the receiver.

4.2 Position Statement: Renewable energy facilities

The Position Statement is a policy outlining the Western Australian Planning Commission requirements to support the consistent consideration and provision of renewable energy facilities within Western Australia. The Position Statement provides guidance on a range of matters that are relevant to the development of renewable energy facilities in Western Australia, which are noted to principally include wind turbines and solar array systems. The Position Statement includes guidance for the assessment of noise related to renewable energy projects and states:

Noise emissions from renewable energy facilities, including wind turbines, are required to meet the standards prescribed under the Environmental Protection (Noise) Regulations 1997. The South Australian Environmental Protection Authority – Wind Farms Environmental Noise Guidelines (2009) should also be referenced for assessment purposes. These guidelines acknowledge the potential for operation in the presence of higher wind-induced background noise levels.

The Position Statement refers to the 2009 version of the South Australian Environmental Protection Authority publication *Wind Farms Environmental Noise Guidelines*. In November 2021, after the Position Statement was published, this publication was revised with updated guidance and technical procedures.

Core procedures for both versions of the publication are broadly equivalent in terms of noise limits and assessment requirements. Changes primarily relate to technical procedures, such as the appropriate method of determining a relationship between noise levels and wind speeds. As the 2021 version of the publication is an update of the 2009 version of the publication referenced in the Position Statement, the 2021 version is referenced in this assessment.

In August 2026, the Department of Planning, Lands and Heritage (DPLH) published an updated interpretation of the Position Statement, clarifying that the SA guidelines can only be used to the extent that they do not conflict with the requirements of the WA Noise Regulations.⁸

Accordingly, this assessment is undertaken with reference to the WA Noise Regulations as the prescribed standard, and draws on the SA guidelines only where the WA Noise Regulations do not

⁶ Shire of Dandaragan Scheme No. 7

⁷ <https://trafficmap.mainroads.wa.gov.au/map>

⁸ <https://www.wa.gov.au/government/publications/planning-position-statement-renewable-energy-facilities>

prescribe a method that is specific to wind turbine noise. Section 4.4 sets out each such use and how it relates to the WA Noise Regulations.

4.3 SA guidelines

This section summarises the noise limits in the SA guidelines for reference, and to allow comparison with the WA Noise Regulations. The assessment approach applied in this assessment are set out in Section 4.4.

4.3.1 Non-host receivers

On the subject of noise limits applying to new wind farm developments the SA guidelines state:

The predicted equivalent noise level ($L_{Aeq,10}$), adjusted for tonality in accordance with these guidelines, should not exceed:

- 35dB(A) at relevant receivers in localities which are primarily intended for rural living

OR

- 40dB(A) at relevant receivers in localities in other zones

OR

- the background noise ($L_{A90,10}$) by more than 5dB(A).

whichever is the greater, at all relevant receivers for wind speeds from cut-in to rated power of the WTG [Wind Turbine Generator] and each integer wind speed in between. These criteria apply for both day and night time hours, but have been based on conservative night time levels.

In relation to rural living the following is included:

A rural living zone is for an area intended as rural-residential 'lifestyle' with high amenity requirements. This area should not be used for primary production purposes other than to produce food, crops or keep animals solely for the occupier's own use, consumption and/or enjoyment. It is expected that these zones have amenity that is quieter than urban residential and land uses that promote primary production.

A review of planning data published on the DPLH spatial register⁹ shows that the wind farm site and surrounding land are generally within a Rural zone (not Rural Residential), which is unlikely to correspond to a rural living zone under the SA guidelines. On this basis, the base (minimum) noise limit under the SA guidelines would be 40 dB.

The noise limits in the SA guidelines are not applied in this assessment. The assigned levels of the WA Noise Regulations are applied at non-host receivers, as set out in Section 4.4.

4.3.2 Host receivers

The SA guidelines acknowledge that different noise criteria can apply at the noise sensitive premises where the landowner has entered into an agreement with the Proponent (host receivers).

For the night period criterion at host receivers, the SA guidelines refer to the WHO Guidelines and recommends a 30 dB L_{Aeq} indoor level.¹⁰ On the basis that the noise reduction from outside to inside, with a window open, is 15 dB – the assumption used in the WHO Guidelines – the derived outdoor noise criterion would be 45 dB L_{Aeq} . This is consistent with the 2009 version of the SA guidelines and the limits for host receivers used in other jurisdictions in Australia.

⁹ <https://espatial.dplh.wa.gov.au/planwa/Index.html?viewer=planwa>

¹⁰ World Health Organization publication *Guidelines for community noise* (1999) (WHO Guidelines)

For other times, the SA guidelines refer to the South Australian *Environment Protection (Commercial & Industrial Noise) Policy 2023* (the SA Noise Policy) for the recommended criterion at host receivers. For residential dwellings on farms, the derived base level criterion using the SA guidelines approach would be 47 dB L_{Aeq} .

Noise levels at host receivers will ultimately need to be managed in accordance with the commercial agreements established between the Proponent and the landowners.

4.4 Proposed assessment criteria

The overarching legislative requirement for the assessment of environmental noise is the WA Noise Regulations. While the WA Noise Regulations are not specific to renewable projects, they set general provisions in the form of assigned levels.

The assigned levels represent limits which are applicable to the Project, including wind turbines and any ancillary infrastructure. This interpretation is reflected in the Position Statement which reiterates that renewable projects must comply with the requirements of the WA Noise Regulations.

However, operational wind turbine noise characteristics are complex and unique, exhibiting variations in noise levels with both wind speed and direction. Measurement and assessment of background and wind turbine noise across the range of conditions in which a wind farm operates is therefore complex, and normally involves the use of dedicated measurement and assessment methods which are specific to wind turbine noise. These complexities are recognised in the Position Statement through the reference to the SA guidelines for wind turbine noise assessment procedures.

The SA guidelines provide the benefit of being a publication which is specific to wind turbine noise and provides a comprehensive assessment method for addressing wind turbine noise at each stage of a project's development and operation. The core assessment methods of the SA 2021 Guidelines are consistent with procedures used throughout Australia and New Zealand for wind turbine noise.

Consistent with the DPLH clarification of the Position Statement, predicted noise levels are compared with the regulation 8 assigned levels of the WA Noise Regulations for each time period. The SA guidelines are used as a supporting methodology only where the WA Noise Regulations do not prescribe a method specific to wind turbine noise. Each element of the assessment approach, and how it relates to the WA Noise Regulations, is summarised below:

- Assigned levels: 45 dB L_{A10} (day), 40 dB L_{A10} (evening), and 35 dB L_{A10} (night) are applied at all non-host receivers. These are the Regulation 8 assigned levels for highly sensitive areas, with an influencing factor of 0 dB (Section 4.1).¹¹
- Wind speed dependency: the WA Noise Regulations do not specify how a source whose noise emissions vary with wind speed is to be assessed. Consistent with the SA guidelines, noise levels are predicted at each integer hub height wind speed from cut-in to rated power, and the highest predicted level is compared with the assigned level. This tests the predicted levels across the full operating range of the wind turbines and does not conflict with the WA Noise Regulations.
- Background noise: the background noise dependent limit in the SA guidelines (background L_{A90} plus 5 dB) is not applied. This is consistent with the WA Noise Regulations, under which the assigned levels are fixed and independent of background noise levels.
- Noise descriptor: the regulation 8 assigned levels are expressed as L_{A10} levels, and wind turbine noise is predicted as an L_{Aeq} level, consistent with ISO 9613-2 and the SA guidelines. The

¹¹ For simplicity, this report refers to the time periods in Table 1 as day, evening and night. Day refers to 0700 to 1900 hours Monday to Saturday. Evening refers to 1900 to 2200 hours on all days, and also includes 0900 to 1900 hours on Sundays and public holidays, when the same assigned level applies. Night refers to all other times. The assigned levels for each period are set out in Table 1.

predicted L_{Aeq} levels are compared directly with the L_{A10} assigned levels, on the basis that wind turbine noise is quasi-steady and the prediction method includes conservative assumptions, including a receiver height of 4 m and a modelling uncertainty margin of 2 dB. In practice, the L_{Aeq} and L_{A10} levels will not be identical. The comparison is intended solely to indicate whether the predicted noise levels exceed the assigned levels for planning purposes, and whether operational strategies are likely to be required for the control of noise.

- Noise agreements: No agreements are relied on at non-host receivers, and the assigned levels are applied at all non-host receivers. This is consistent with the WA Noise Regulations.
- Host receivers: host receivers are assumed to form part of the noise emitting premises, so the assigned levels do not apply under the WA Noise Regulations. Predicted levels are compared to a reference level of 45 dB L_{Aeq} , derived from the SA guidelines, for information only.
- Intrusive or dominant characteristics: Regulation 9 requires adjustments where tonality, modulation or impulsiveness is present in the received noise. No such adjustments have been applied to the predicted levels in this assessment (Section 7.3). The SA guidelines and IEC 61400-11 are referenced only for evaluating manufacturer tonality data for the candidate wind turbine.
- Assessment period: the WA Noise Regulations assess noise over a representative assessment period of between 15 minutes and 4 hours. The predicted levels represent typical upper levels for downwind conditions at each wind speed, consistent with the SA guidelines approach, under which compliance is evaluated using wind speed binned data collected over an extended monitoring period. The predictions do not account for the variation in noise levels that can occur within an individual 15 minute to 4 hour period.

The use of the SA guidelines for the specific matters described above is not considered to conflict with the requirements of the WA Noise Regulations, and the approach is considered consistent with the Position Statement as clarified by DPLH. The assessment approach has been adopted for practical reasons appropriate to a planning stage assessment of wind turbine noise, and provides an indication of whether predicted noise levels exceed the assigned levels. Matters that depend on measurement, including the L_{A10} level over a representative assessment period and any adjustments under regulation 9, would be addressed through compliance testing following construction, as recommended in Section 10.0.

Noise from the BESS and substations are assessed under the WA Noise Regulations using the assigned noise levels outlined in Table 1.

5.0 NOISE PREDICTION METHOD

Operational wind farm noise levels are predicted using:

- noise emission data for the wind turbines
- a 3D digital terrain 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 ISO 9613-2:2024 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors* (ISO 9613-2). The prediction method has been shown to provide a reliable method of predicting the typical upper levels of the noise expected to occur in practice.

The ISO 9613-2 method is used in conjunction with a set of input choices and procedural modifications that are specific to wind farm noise assessment, based on international research and guidance.

The noise prediction method is summarised in Table 2. Further discussion of the method and the calculation choices is provided in Appendix F.

Table 2: Noise prediction method summary

Detail	Description
Software	Proprietary noise modelling software SoundPLANnoise version 9.1
Method	International Standard ISO 9613-2:2024 <i>Acoustics - Attenuation of sound during propagation outdoors - Part 2: Engineering method for the prediction of sound pressure levels outdoors</i> (ISO 9613-2), Annex D <i>Calculation of sound pressure levels caused by wind turbines</i>. The adjustments are applied within the SoundPLANnoise modelling software and relate to the influence of terrain screening and ground effects on sound propagation.
Source characterisation	<i>Wind turbines:</i> Each wind turbine is modelled as a point source of sound. The total sound of the wind farm is then calculated on the basis of simultaneous operation of all wind turbines and summing the contribution of each. Calculations of turbine to receptor 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 turbine. Calculations of terrain related screening are made on the basis of the point source being located at the maximum tip height of each turbine. Further discussion of terrain screening effects is provided below. <i>BESS:</i> Each battery unit is modelled as an industrial building to capture the directionality of emissions as reflected in data provided by the Proponent. Other ancillary equipment is modelled as a point source of sound. The total sound of the BESS is then calculated on the basis of simultaneous operation of all BESS equipment and summing the contribution of each. Substations are modelled as a point source.
Terrain data	A digital model of the terrain for the site and surrounding areas has been generated using 1 arc-second (~30 m) SRTM DEM downloaded from Geoscience Australia's ELVIS portal.

Detail	Description
Ground conditions	<i>Wind turbines:</i> Ground factor of $G = 0.5$ as per ISO 9613-2, Annex D. 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 of the site. <i>BESS and substation:</i> Ground factor of $G = 0$ within BESS facility boundary and $G = 1$ elsewhere
Atmospheric conditions	The calculations are based on sound speed profiles which increase the propagation of sound from each turbine to each receptor, whether as a result of thermal inversions or wind directed toward each calculation point.¹² <i>Wind turbines:</i> Temperature 10 °C, and relative humidity 70 % These represent conditions which result in relatively low levels of atmospheric sound absorption, as specified as specified in the DWER memo and consistent with the UK Institute of Acoustics guidance.¹³ <i>BESS and substation:</i> Temperature 10°C and relative humidity 70%. These represent default inputs which are typically adopted for the assessment of commercial and industrial noise sources.
Receptor heights	<i>Wind turbines assessment:</i> 4 m above ground level (as per ISO 9613-2 Annex D) <i>BESS and substation assessment:</i> 1.5 m above ground level (to align with WA Noise Regulations assessment height)

¹² The sound speed profile defines the rate of change in the speed of sound with increasing height above ground.

¹³ 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*.

6.0 EXISTING NOISE ENVIRONMENT

The Project is located in a rural area with no significant nearby industrial noise sources and limited road noise impacts. In such environments, background noise is typically dominated by natural sources such as wind generation noise and wildlife, with additional contributions from rural activities such as farm machinery and vehicle movements. On this basis, background noise levels are expected to be low, consistent with a quiet rural setting.

Under the WA Noise Regulations, the assigned levels are fixed and do not depend on background noise levels. Background noise monitoring is therefore not needed to define the assigned levels for this assessment. Background noise monitoring is recommended prior to construction to support future compliance testing, where wind turbine noise needs to be distinguished from wind-related ambient noise.

7.0 OPERATIONAL NOISE ASSESSMENT – WIND TURBINES

7.1 Noise limits

7.1.1 Non-host receivers

The assigned levels applied at non-host receivers are 45 dB L_{A10} in the day, 40 dB L_{A10} in the evening and 35 dB L_{A10} at night. These are derived from the WA Noise Regulations (Table 1) with an influencing factor of 0 dB.

Predicted L_{Aeq} wind turbine noise levels are compared with these assigned levels, as described in Section 4.4. The predicted wind turbine noise levels represent the highest predicted levels across the operating wind speed range, and apply independently of time of day, because turbine noise emissions depend on wind speed rather than the time period. The night-time assigned level of 35 dB is the most stringent, so it sets the maximum extent of any curtailment needed. Curtailment requirements would be reduced, or not required, during the day and evening periods, when less stringent assigned levels apply. The predicted wind turbine noise levels, and therefore the extent of curtailment in the example strategy, include the 2 dB modelling uncertainty margin.

7.1.2 Host receivers

As detailed in Section 4.4, a base reference level of 45 dB L_{Aeq} is applied to all host receivers. Comparisons between the predicted noise levels and the 45 dB reference level are provided for informative purposes only. Noise levels at these locations will ultimately need to be managed in accordance with the commercial agreements established between the Proponent and the landowners.

7.2 Candidate wind turbine model

The wind turbine model ultimately selected for the Project would be determined based on a range of design requirements.

Accordingly, to assess the proposed Project at this stage, 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 model is to assess the viability of the Project in relation to the assigned levels, 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 considered the candidate wind turbine model detailed in Table 3.

The candidate model is a variable speed wind turbine, with the speed of rotation and the amount of power generated being regulated by control systems that vary the pitch of the blades (the angular orientation of the blade relative to its axis).

Table 3: Candidate wind turbine model specifications

Item	Details
Make	Vestas
Model	V172
Rated power, MW	7.2
Rotor diameter, m	181
Hub height, m	168
Operating mode	PO7200 ^[1]
Blade serrations	Yes
Highest sound power ^[2] , dB L _{WA}	109.8
Cut-in wind speed (hub height), m/s	3
Cut-out wind speed (hub height), m/s	24

- 1 'PO7200' is a manufacturer designation which indicates an unconstrained, Power Optimised mode of operation to achieve a rated power of 7.2 MW (i.e. without noise curtailment)
- 2 Specification sound power level, including a 2 dB margin to account for modelling uncertainty, consistent with the DWER memo.

The candidate wind turbine model is considered appropriate to represent the class of wind turbine being considered for the Project.

The modelled hub height detailed above is suitable for noise assessment purposes however the final hub height of the selected wind turbine model may differ slightly. The magnitude of any changes is expected to be minor and inconsequential with respect to predicted noise levels at receivers. Irrespective, revised noise modelling would be conducted for the final wind 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.

Unless specified otherwise, this assessment has been based on all wind turbine models using unconstrained generation modes (i.e. no sound optimised operating modes) and with blade serrations. Blade serrations are now routinely used to reduce wind turbine noise emissions, and we understand that their use is now the market standard for wind turbines being offered in the Australian market. A range of sound optimised modes are also available reducing the maximum power output and sound power levels.

7.3 Wind turbine noise emissions

7.3.1 Sound power levels

The noise emissions of a wind turbine 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 model, including sound frequency characteristics, has been sourced from Vestas document 0128-4336_01 *Third octave noise emission EnVentus™ V172-7.2MW 50/60 Hz*, dated 29 November 2024.

Based on the data sourced from the above specification, the noise modelling conducted for this assessment involved conversion of third octave band levels to octave band levels and adjustment by

addition of +2.0 dB at each wind speed to provide an overall margin for modelling uncertainty, consistent with the DWER memo.

The overall A-weighted sound power levels (including the +2 dB addition) as a function of hub height wind speed are presented in Table 4. These represent the total noise emissions of the wind turbine, including the secondary contribution of ancillary plant associated with each turbine (e.g. cooling fans). Sound power levels are presented for the uncurtailed operating mode (PO7200) and curtailment modes (SO1 - SO6) which have been referenced in the assessment below.

Table 4: Sound power levels versus hub height wind speed, dB L_{WA}

Operating mode	Hub height wind speed, m/s								
	4	5	6	7	8	9	10	11	≥12
PO7200	99.6	99.7	101.5	104.2	107.0	109.1	109.8	109.8	109.8
SO1	99.6	99.7	101.5	104.2	107.0	107.0	107.0	107.0	107.0
SO2	99.6	99.7	101.5	104.2	106.0	106.0	106.0	106.0	106.0
SO3	99.6	99.7	101.5	104.2	105.0	105.0	105.0	105.0	105.0
SO4	99.6	99.7	101.5	104.0	104.0	104.0	104.0	104.0	104.0
SO5	99.6	99.7	101.5	103.0	103.0	103.0	103.0	103.0	103.0
SO6	99.6	99.7	101.5	102.0	102.0	102.0	102.0	102.0	102.0

Note: Other sound optimised modes are available

The reference octave band values used as the basis for this assessment are presented in Table 5 and were adjusted to the overall A-weighted noise levels detailed in Table 4.

Table 5: Octave band sound power levels, dB L_{WA}

	Octave band centre frequency, Hz									
Operating mode	31.5	63	125	250	500	1000	2000	4000	8000	Total
PO7200 ^[1]	80.3	91.8	98.8	103.4	102.4	103.0	101.9	100.3	87.5	109.8
SO1 ^[2]	78.5	90.6	98.3	101.5	101.7	100.0	95.3	87.7	76.9	107.0
SO2 ^[2]	77.5	89.6	97.2	100.4	100.7	99.0	94.4	86.7	76.0	106.0
SO3 ^[3]	76.7	88.7	96.2	99.4	99.6	98.0	93.5	86.0	75.4	105.0
SO4 ^[3]	75.6	87.6	95.2	98.4	98.6	97.0	92.5	85.0	74.5	104.0
SO5 ^[3]	75.5	87.1	94.1	97.0	97.7	96.3	91.8	84.3	73.9	103.0
SO6 ^[3]	74.4	86.0	93.0	96.0	96.7	95.3	90.8	83.4	72.9	102.0

- 1 Based on one-third octave band levels at 10 m/s, being the wind speed at which the maximum source sound power level occurs (taking into account energy in frequencies below 125 Hz)
- 2 Based on one-third octave band levels at a hub height wind speed of 12 m/s
- 3 Based on one-third octave band levels at a hub height wind speed of 13 m/s

The values presented above are considered typical of the range of noise emissions associated with comparable multi-megawatt wind turbines.

Some of the larger turbines presently on the market indicate the potential for higher noise emissions. However, the options for larger turbines are currently limited and the data is insufficient to reach conclusions about representative emissions. In this respect, industry research into the noise emission characteristics of a range of wind turbine models has shown that there isn't a clear relationship

between sound power levels and a wind turbine's size or power output.¹⁴ In practice, the sound power levels of a wind turbine are influenced by 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. Therefore, while wind turbine sizes and power ratings of contemporary wind turbines have increased, the noise emissions of the wind turbines have remained generally comparable to, or lower than, previous generations of wind turbines as a result of design improvements (notably, measures to reduce the speed of rotation of the wind turbines, and enhanced blade design features such as serrations for noise control).

Based on the above, the noise emissions presented in Table 4 and Table 5 are suitable for a planning stage assessment of the wind farm. However, if the Project is ultimately approved, the noise modelling would need to be updated to:

- reflect the sound power levels of the final layout and wind turbine selected for the Project
- assess compliance with the noise limits specified in the conditions of approval
- determine the mitigation strategies which would apply with the selected wind turbine, if required.

7.3.2 Tonality

Information concerning potential tonality is often limited at the planning stage of a project, and narrow band test data for tonality (in the form of IEC 61400-11 tonality data, as referenced in the SA guidelines) is presently unavailable for the candidate wind turbine model. 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.

On this basis, adjustments for tonality have not been applied to the predicted noise levels presented in this assessment. Notwithstanding this, the potential for tonality would be subject to further review and controls (i.e. contractual performance specifications) during the wind turbine procurement stage of the project and again following the construction.

7.3.3 Modulation

The WA Noise Regulations define modulation by reference to the measured variation in a noise at a receiver, assessed under regulation 9. The test requires measurement of the noise at a receiver and cannot be applied to a predicted noise level. The WA Noise Regulations do not provide a method for determining at the design stage whether the definition would be met.

The characteristic of concern for noise assessment is elevated amplitude modulation, which has been observed at some operational wind farms under particular combinations of turbine, terrain and atmospheric conditions. Elevated amplitude modulation cannot be predicted at the planning stage. It depends on site specific interactions that are not represented in noise prediction methods, and the current industry consensus is that no reliable predictive method exists. International guidance for wind turbine noise reflects this position, directing that adjustments for amplitude modulation be determined from compliance measurements rather than applied at the assessment stage.

On this basis, adjustments for modulation have not been applied to the predicted noise levels presented in this assessment. The potential for elevated amplitude modulation would be subject to further review and controls following construction. In the unlikely event that atypical modulation is identified in the noise of the wind farm after commissioning, mitigation options include adjustment

¹⁴ Van den Berg, Frits & Koppen, Erik & Boon, Jaap & Ekelschot-Smink, Madelon. - *Sound power of onshore wind turbines and its spectral distribution. Sound & Vibration. 59 - 2025*

of wind turbine operating parameters and, where necessary, operation in noise reduced modes to lower the overall noise level at affected receivers.

7.3.4 Impulsiveness

The WA Noise Regulations define impulsiveness by reference to a single representative event where the difference between L_{Apeak} and L_{A5max} exceeds 15 dB. Impulsive noise of this kind is associated with sources such as hammering and piling.

Wind turbine noise is a continuous broadband source and does not contain discrete impulsive events of this nature. Impulsiveness is not a recognised characteristic of contemporary multi-megawatt wind turbine designs, and evidence from operational wind farms in Australia does not indicate its occurrence at receivers.

On this basis, adjustments for impulsiveness have not been applied to the predicted noise levels presented in this assessment.

7.4 Predicted noise levels

This section of the report presents the predicted A-weighted wind turbine noise levels at surrounding receivers, and a comparison with the assigned levels.

Wind turbine noise levels have been predicted using the selected candidate wind turbine model and sound power level data detailed in Section 7.3.1 for the wind speed which results in the highest predicted noise levels.

Predicted noise levels are presented in Table 6 for non-host receivers and Table 7 for host receivers and tabulated in Appendix I for each integer wind speed. Results are presented for existing receivers within 3 km of the nearest turbine and where the highest predicted noise levels are greater than or equal to 30 dB L_{Aeq} .

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 project 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.

Table 6: Highest predicted noise level and margin to the day, evening and night assigned levels at non-host receivers (unconstrained operation), dB L_{Aeq}

Receiver	Highest predicted noise level (unconstrained operation)	Margin to day assigned level (45 dB L_{A10})	Margin to evening assigned level (40 dB L_{A10})	Margin to night assigned level (35 dB L_{A10})
329	37.5	7.5	2.5	-2.5
77	36.3	8.7	3.7	-1.3
113	35.9	9.1	4.1	-0.9
88	35.9	9.1	4.1	-0.9
103	35.8	9.2	4.2	-0.8
32	35.6	9.4	4.4	-0.6
91	35.4	9.6	4.6	-0.4

Receiver	Highest predicted noise level (unconstrained operation)	Margin to day assigned level (45 dB L _{A10})	Margin to evening assigned level (40 dB L _{A10})	Margin to night assigned level (35 dB L _{A10})
95	35.0	10.0	5.0	0.0
155	34.2	10.8	5.8	0.8
36	34.1	10.9	5.9	0.9
89	34.1	10.9	5.9	0.9
90	34.1	10.9	5.9	0.9
325	32.9	12.1	7.1	2.1
29	32.4	12.6	7.6	2.6
167	32.3	12.7	7.7	2.7
330	32.2	12.8	7.8	2.8
24	31.5	13.5	8.5	3.5
324	30.8	14.2	9.2	4.2
21	30.7	14.3	9.3	4.3
22	30.4	14.6	9.6	4.6
20	30.0	15.0	10.0	5.0

Note: shaded value(s) indicate where the predicted level is above the assigned level

It can be seen from Table 6 that the predicted wind turbine noise levels from the Project, including the 2 dB modelling uncertainty margin, are below the day and evening assigned levels at all non-host receivers, with a minimum margin of 2.5 dB to the evening assigned level (receiver 329). The predicted levels are at or below the night-time assigned level of 35 dB L_{A10} at all but 7 non-host receivers (329, 77, 113, 88, 103, 32, and 91), where predicted levels are up to 2.5 dB above the assigned level. To address this, an example noise curtailment strategy has been developed for the night period, using sound optimised modes for a limited range of wind conditions. This strategy is an example only and would be revised once the layout and wind turbine model are finalised. Details of the example curtailment strategy are presented in Section 7.5.

Predicted noise levels at host receivers are provided in Table 7 for information.

It can be seen from Table 7 that the predicted wind turbine noise levels from the Project are below the reference level of 45 dB L_{Aeq} for all host receivers by at least 3.7 dB.

Table 7: Highest predicted noise level and margin to reference level at host receivers (unconstrained operation), dB L_{Aeq}

Receiver	Highest predicted noise level (unconstrained operation)	Margin to host reference level (45 dB)
123	41.3	3.7
97	40.6	4.4
98	40.6	4.4
114	40.6	4.4
119	40.6	4.4
115	40.5	4.5
99	40.5	4.5
116	39.8	5.2
39	39.6	5.4
128	39.6	5.4
105	39.5	5.5
109	39.5	5.5
133	39.5	5.5
111	39.1	5.9
37	39.1	5.9
112	39.0	6.0
104	38.9	6.1
106	38.6	6.4
38	38.5	6.5
96	37.7	7.3
117	37.8	7.2
118	37.8	7.2
93	37.1	7.9
27	36.4	8.6
31	36.0	9.0
12	36.0	9.0
85	35.9	9.1
84	35.0	10.0
30	34.5	10.5
26	34.2	10.8

7.5 Example curtailment strategy

Predicted noise levels at the non-host receivers at which wind turbine noise levels were calculated to be above the night-time assigned level of 35 dB have been tabulated above in Table 6.

To demonstrate that noise levels can be reduced, an example curtailment strategy has been developed. It is provided for demonstration purposes only and is specific to the current layout and candidate wind turbine model, taking into account the +2 dB recommended by DWER for modelling uncertainty. The strategy is targeted, applying curtailment to specific wind turbines under specific wind conditions. The example uses noise curtailed modes of operation for 47 turbines, as detailed in Table 8, and was developed to achieve a level of ≤ 35 dB at non-host receivers during the night period, consistent with the night-time assigned level.

The example curtailment strategy is based on hub height wind speeds of 10 m/s and above, where the highest noise levels are predicted. Curtailment would also be required at some lower wind speeds, but would involve fewer turbines and less curtailment. These details would be established as part of the detailed design.

No curtailment is required during the day or evening periods.

Table 8: Example curtailment strategy

Vestas V172 operating mode	Count	Turbine ID
SO1	31	DIN.10091, DIN.10101, DIN.10131, DIN.10141, DIN.10151, DIN.10160, DIN.10340, DIN.10430, DIN.10531, DIN.10580, DIN.10620, DIN.10630, DIN.10640, DIN.10650, DIN.10660, DIN.10702, DIN.10721, DIN.10730, DIN.10741, DIN.10750, DIN.10760, DIN.10770, DIN.10791, DIN.10851, DIN.10880, DIN.10920, DIN.10992, DIN.11030, DIN.11040, DIN.11090, DIN.11100
SO2	5	DIN.10270, DIN.10780, DIN.10830, DIN.10931, DIN.10981
SO3	2	DIN.10380, DIN.10460
SO4	3	DIN.10680, DIN.11020, DIN.11051
SO6	6	DIN.10670, DIN.10690, DIN.10710, DIN.11011, DIN.11400, DIN.11470
PO7200	84	All other turbines

The location of the total predicted 30 dB, 35 dB, 40 dB, and 45 dB L_{Aeq} noise contours is illustrated in Figure 2 for the day and evening periods (no curtailment) and in Figure 3 for the night period (with the example curtailment strategy).

The curtailment strategy in this report is an example only. It has been developed to show that the predicted noise levels can be reduced so that they do not exceed the night-time assigned level, based on the current layout of 131 turbines and the candidate wind turbine model. The strategy is specific to these assumptions. The Proponent has advised that the layout will be subject to a further design iteration in response to the wind monitoring campaign, geotechnical investigations, heritage surveys and grid studies, and that wind turbine selection is pending. The selected model may have noise emission characteristics that differ from those assumed in this assessment. The Proponent has advised that, once the layout and wind turbine model are confirmed, a project-specific curtailment strategy will be developed and documented in an Operational Noise Management Plan for review by the Council and DWER. Accordingly, the example curtailment strategy in this report is not intended to be specified as a condition of approval. Any condition relating to curtailment would more appropriately refer to the Operational Noise Management Plan.

The above findings indicate that the Project can be designed and operated so that wind turbine noise levels do not exceed the assigned levels in any time period.

Figure 2: Highest predicted noise level contours (no curtailment) – applicable for day and evening periods

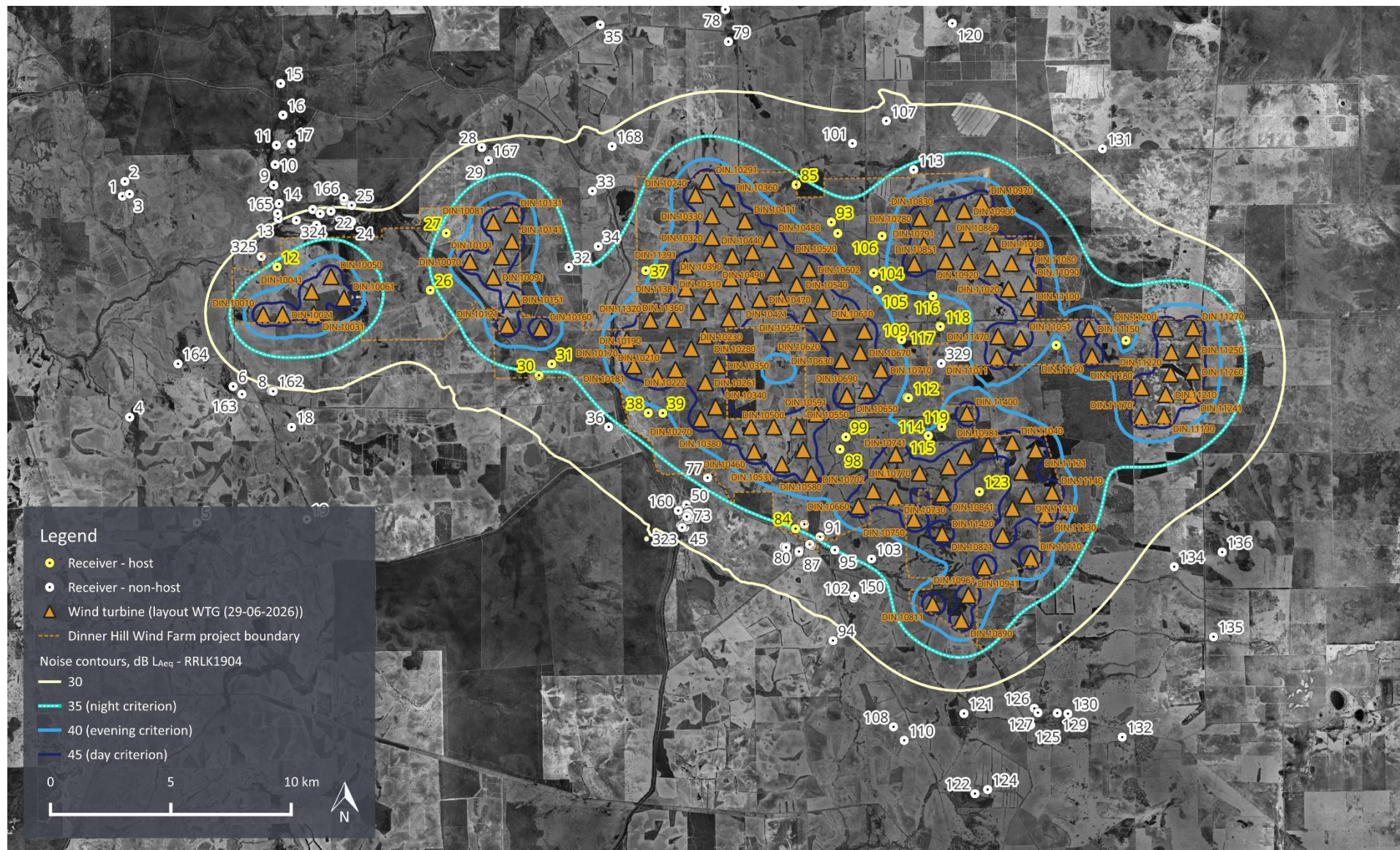
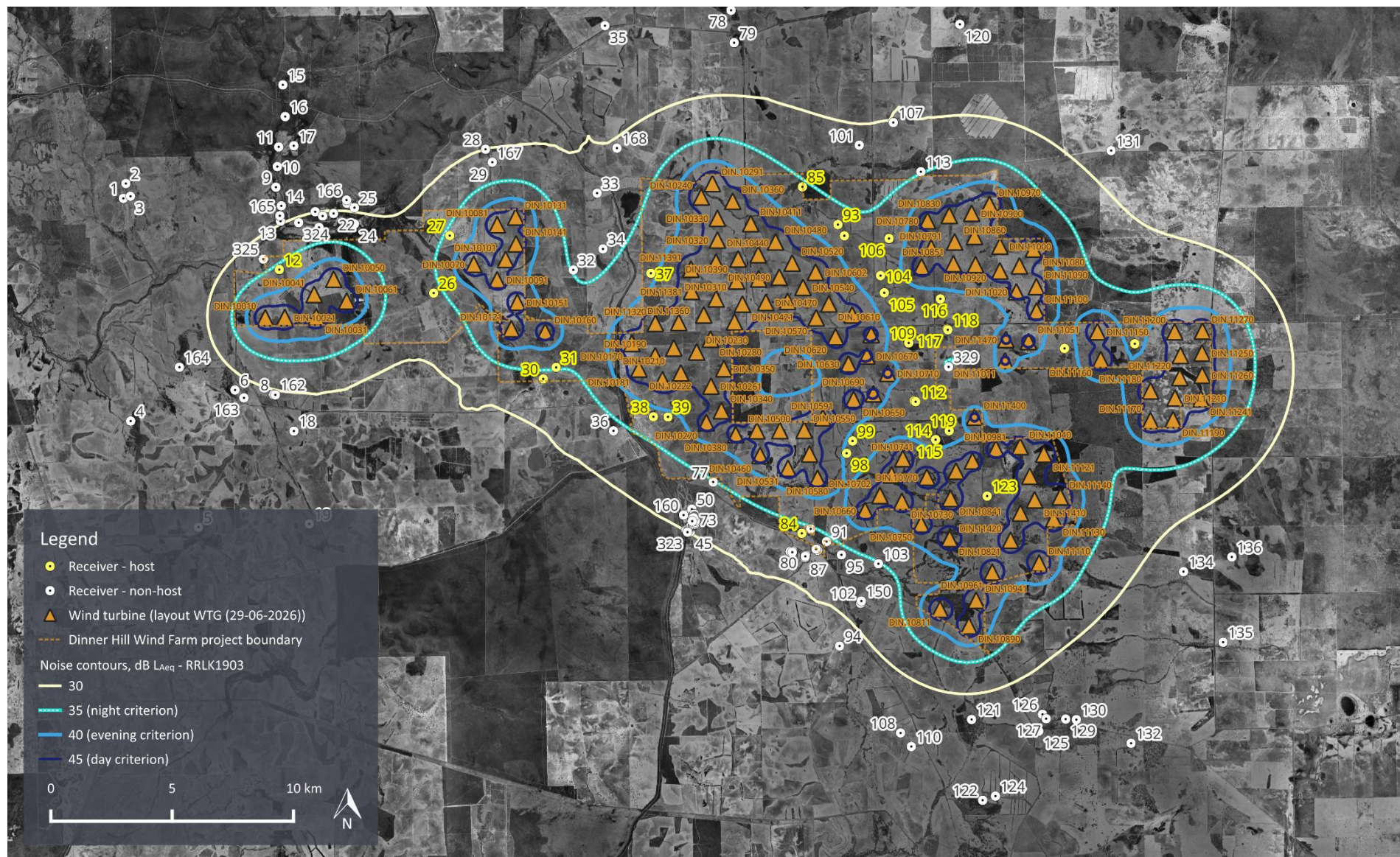


Figure 3: Highest predicted noise level contours (accounting for the example curtailment) – applicable for night-time period



8.0 OPERATIONAL NOISE ASSESSMENT – DINNER HILL BESS AND SUBSTATIONS

This section presents an assessment of operational noise from the Dinner Hill Wind Farm substations and BESS. All references to substations and BESS in this section are those included with the Dinner Hill Wind Farm.

The substations and the BESS are located within the Project area. A site layout plan illustrating the wind farm substations, BESS facility and receivers is provided in Figure 1 of Section 3.0.

8.1 Assessment criteria

The relevant criteria for the assessment of noise from the BESS and substations are the assigned levels under the WA Noise Regulations as defined in Section 4.1.

The noise sources associated with the BESS and substations typically give rise to steady noise levels i.e. transformer and battery noise is not typically characterised by brief momentary increases in noise levels. Accordingly, the relevant assessment metric is the L_{A10} assigned level.

8.2 Noise emissions

8.2.1 Equipment details

The concept design of the BESS comprises a layout of separate inverters, medium voltage (MV) transformers, HV transformers, and battery modules. The concept layouts indicating the number and position of each equipment item for the BESS and substations are shown in Figure 4 and Figure 5. A summary of the relevant information is shown in Table 9.

Table 9: Equipment details

Equipment	Infrastructure	Quantity	Equipment height (m)
Battery units	BESS	360	2
Inverters	BESS	90	2
Medium voltage (MV) transformer	BESS	90	2
High voltage (HV) transformer	BESS	2	5
High voltage (HV) transformer	Wind farm substation	6	5

8.2.2 Sound power level data

Sound power levels for individual equipment items, as used in the noise model, are detailed in Table 10. Data is provided as unweighted (linear) octave band spectra and A-weighted overall sound power level.

Third-octave sound power levels for the nominated candidate batteries and inverters have been provided by the client. In the absence of measured sound power level data for a specific transformer model, reduced maximum sound power levels have been estimated, based on the nominated power rating, using the method described in Annex ZA of AS 60076-10:2009¹⁵.

Octave band spectral data for each transformer was then estimated by applying Bies & Hansen corrections from Table 11.27 to the determined overall sound power level. Further detail is provided in Table 11.

¹⁵ Australian Standard 60076-10:2009 Power transformers – Part 10: Determination of sound levels (AS 60076-10:2009).

Data are presented for typical worst-case operating modes with fan speeds at 100% and no noise reduction kits.

The nominated equipment has been modelled for preliminary assessment purposes only, with final equipment specification subject to considerations in the detailed design process.

Table 10: Sound power levels for each individual equipment item, dB L_w

Item	Octave band centre frequency, Hz							
	63	125	250	500	1000	2000	4000	L _{WA}
Wind farm substation								
HV transformer (200 MVA)	93	95	90	90	84	79	74	90
BESS								
Battery unit	78	92	84	80	78	77	74	85
Inverter	99	96	98	93	88	87	84	95
MV transformer (4.4 MVA)	70	72	67	67	61	56	51	67
HV transformer (200 MVA)	93	95	90	90	84	79	74	90

Figure 4: Dinner Hill Wind Farm BESS layout

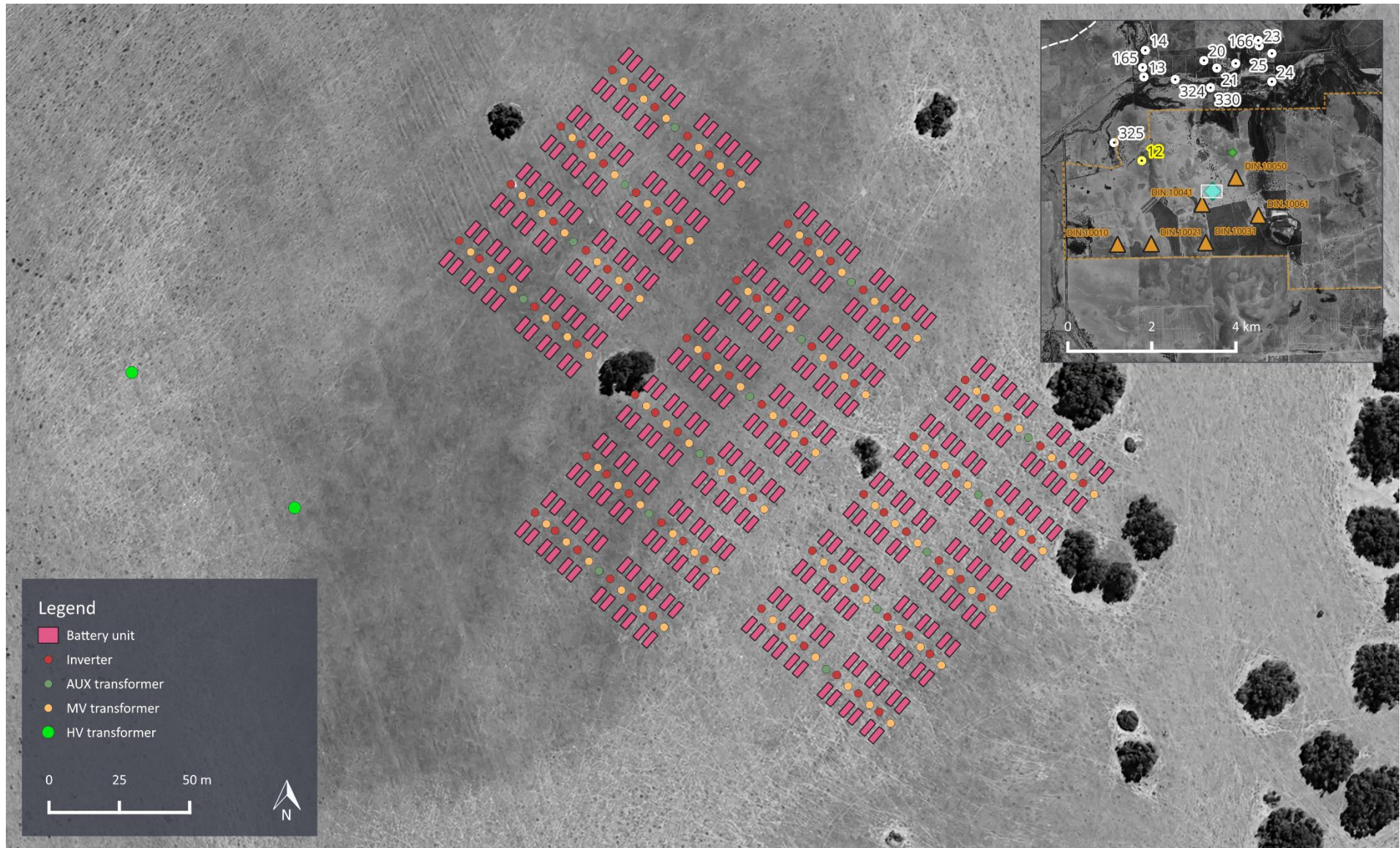


Figure 5: Wind farm substations layout

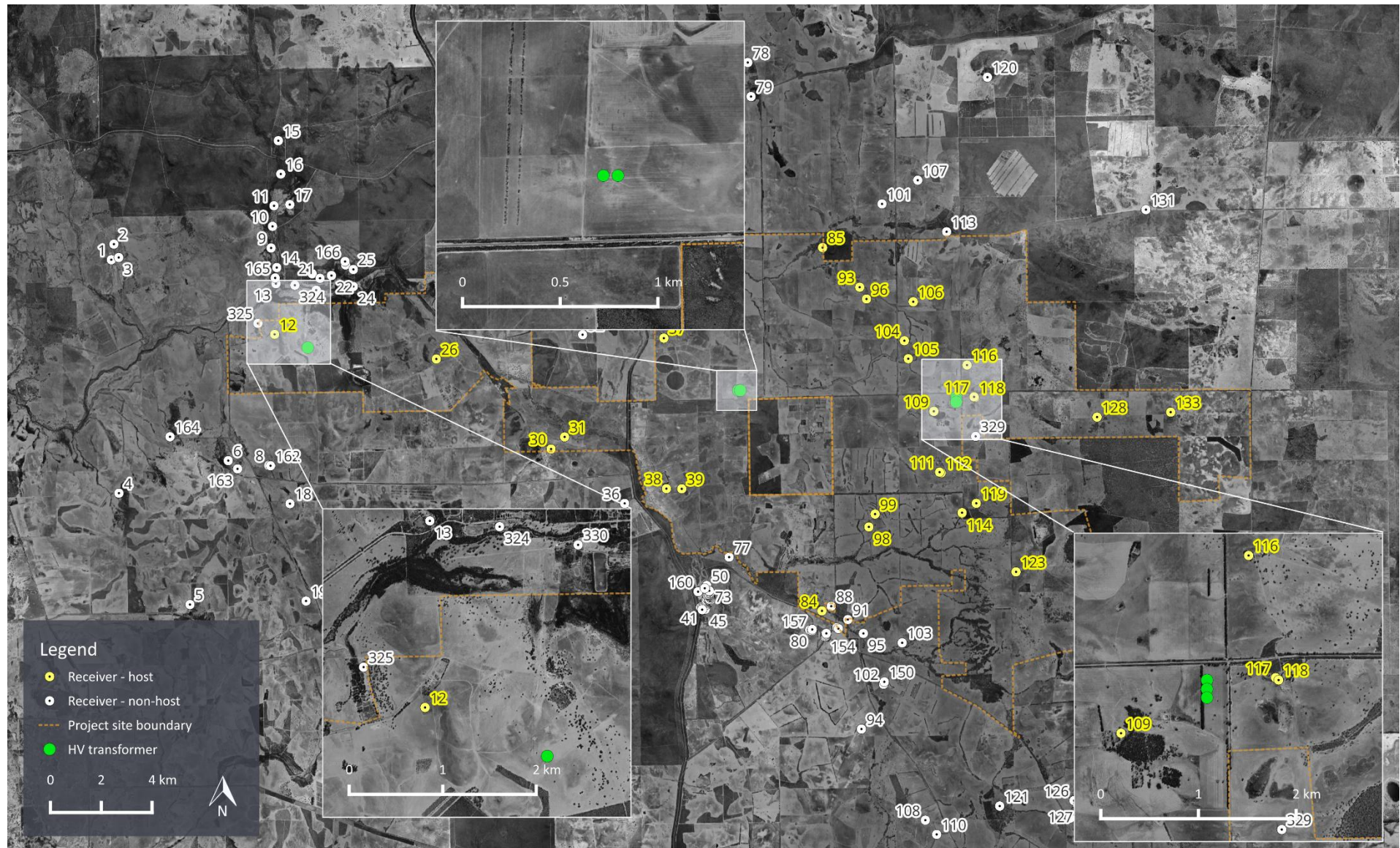


Table 11: Sound power level data description

Item	Description
<i>Substation</i>	
HV transformer (200 MVA)	At this stage of the Project, specific details of the transformer makes and models are yet to be finalised. Based on information provided by the Proponent, MDA understands that 6 HV transformers are proposed for the Project, each expected to be rated at 200 MVA. These are distributed across 3 wind farm substations spread across the Project site as follows: • a western substation comprising 1 x 200 MVA HV transformer (co-located with the BESS) • a central substation comprising 2 x 200 MVA HV transformers • an eastern substation comprising 3 x 200 MVA HV transformers In the absence of measured sound power level data for a specific transformer model, reduced maximum sound power levels have been estimated, based on the nominated power rating, using the method described in Annex ZA of AS 60076-10:2009. Octave band spectral data for each transformer was then estimated by applying Bies & Hansen corrections from Table 11.27, (<i>Location 1a for outdoor transformer noise</i>) to the determined overall sound power level.
<i>BESS</i>	
Battery	Manufacturer overall sound power levels measured in accordance with ISO 3746:2010 associated with the battery cooling system have been provided by the Proponent. Based on the information provided within the supplied OEM datasheet it is understood that the adopted sound power levels are associated with the cooling system operating at 100%. The Proponent has advised that this is the worst case cooling system operation for the battery unit in the Project. Frequency/spectral information related to component sound pressure level measurements is also provided in the OEM noise datasheet and referenced within the noise model.
Inverter	Manufacturer third octave band sound power levels measured in accordance with ISO 3744:2010 have been provided by the Proponent.¹⁶ The noise data aligns with 100% operation of the subject inverter, i.e. worst-case sound power level and no noise reduction kits.

¹⁶ ISO 3744:2010 Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane

Item	Description
MV transformer	At this stage of the Project, specific details of the transformer makes and models are yet to be finalised. Based on information provided by the Proponent, MDA understands that the MV transformers proposed for the Project are expected to be rated at approximately 4.4 MVA. In the absence of measured sound power level data for a specific transformer model, reference has been made to the reduced maximum method for estimating overall transformer sound power levels for a given power rating described in AS 60076-10:2009.¹⁷ Octave band spectral data for each transformer was then estimated by applying Bies & Hansen corrections from Table 11.27, (<i>Location 1a for outdoor transformer noise</i>) to the determined overall sound power level.¹⁸

Due to commercial sensitivities, specific manufacturers and models are not detailed in this report. However, the Proponent has confirmed the equipment to be representative of the specification required for the Project.

8.3 Predicted noise levels (BESS and substations only)

Noise levels associated with the operation of the BESS and substations alone have been predicted at the nearest non-host and host receivers based on the method detailed in Section 5.0.

The predicted noise levels at the nearest receivers of the BESS and substations are shown in Table 12. Results are presented for existing receivers where the highest predicted noise levels are greater than or equal to 25 dB L_{Aeq} .

Predicted noise level contours are shown in Appendix G.

Table 12: Highest predicted noise levels - BESS and substations, dB L_{Aeq}

Receiver	Predicted noise level, dB L_{Aeq}
<i>Non-host receivers</i>	
330	29
324	28
21	27
24	26
20	26
22	26
13	26
165	25
325	25
<i>Host receivers</i>	
12	31

¹⁷ AS 60076-10:2009 *Power transformers – Part 10: Determination of sound levels*

¹⁸ Bies, D. H. & Hansen, C. H. (2009). *Engineering noise control: theory and practice (Fourth edition.)*. p. 601

It is noted that the sound power is provided as equivalent continuous noise levels (L_{Aeq}). Since noise from transformers, inverters, and battery units can be characterised as being steady state, for assessment purposes, the L_{Aeq} noise level metric has been used for comparison with the L_{A10} assigned levels.

The results in Table 12 show that predicted noise levels from the BESS and substations are below the assigned levels applicable at all nearby non-host receivers, including the most stringent night period limit of 35 dB L_{A10} .

In accordance with the WA Noise Regulations, a +5 dB adjustment applies where noise levels at the receiver are found to have tonal characteristics. Noting the separation distances between the proposed BESS and substations and receivers, and the magnitude of the predicted noise levels, it is considered unlikely that tonality would be present at non-host receivers.

Notwithstanding the above, should tonality present at receivers and a +5 dB adjustment was applied, predicted noise levels would remain below the assigned levels at all non-host receivers.

Other intrusive or dominant characteristics (modulation and impulsiveness) are not typically associated with BESS and substation equipment. In consideration of this and the other factors listed above, it is unlikely that these characteristics would be present at receivers and no adjustments have been applied.

9.0 CUMULATIVE NOISE ASSESSMENT

In this report, total noise refers to the combined noise from the Project's wind turbines, BESS and substations, and cumulative noise refers to the combined noise from the Project and other developments. Both are relevant to the noise assessment.

The following considerations apply to the Project:

- The total noise due to the Project wind turbines, BESS and substations.
- The cumulative noise due to the Project and the proposed Harvest BESS that is located within the Project area.
- The cumulative noise due to the approved Parron Maam Marang Wind Farm located to the south of the Project area.
- The cumulative noise from the Project and all nearby projects.

In relation to cumulative noise assessment requirements, the SA guidelines provide instruction for the determination of background noise levels in areas of cumulative development. However, they do not explicitly require assessment of combined noise from multiple wind farm projects (or BESS infrastructure), nor do they define criteria that directly apply to cumulative noise.

Similarly, the Position Statement does not set out explicit requirements on this matter, although it indicates that noise from renewable energy developments, including wind farms, should be considered on a cumulative basis, with reference to the WA Noise Regulations.

The WA Noise Regulations address cumulative noise through 2 considerations:

1. Whether the overall received noise level at a receiver exceeds the assigned level.
2. Whether any individual noise emitting premises has significantly contributed to that exceedance.

Under the commonly accepted interpretation, a source is not considered to significantly contribute to an exceedance of the assigned level where its contribution, assessed in isolation, is at least 5 dB below that level at the receiver.

The above tests provide a practical basis for assessing compliance risk in cumulative noise situations. Provided a source's individual contribution remains below the assigned level minus 5 dB, it cannot be found to have significantly contributed to an exceedance regardless of the combined noise. Where multiple projects are operating in proximity, Regulation 7(2) therefore establishes a clear threshold against which the compliance risk of each individual source can be assessed independently.

The following sections address the total noise from the wind turbine, BESS and substation sources within the Project, as well as the cumulative noise from the Project and other nearby projects.

9.1 Total Project noise

The calculated noise levels due to the Dinner Hill BESS and substations are below the calculated noise levels from the Dinner Hill Wind Farm wind turbines at all receivers and noise from the Project is predominantly due to the noise of wind turbines at most receivers. As outlined in Section 7.4, curtailment of selected turbines is required so that predicted wind turbine noise levels do not exceed the night-time assigned level.

The total predicted noise levels from the Dinner Hill Wind Farm wind turbines, BESS and substations are shown in Table 13. Results are presented for non-host receivers where the highest predicted noise levels from the BESS are greater than or equal to 25 dB L_{Aeq} . For reference, the tables also include the non-host receivers with the highest predicted noise levels from the wind farm only, specifically those where curtailment is required (see Section 7.4).

The results show that, using the night-time wind turbine curtailment example presented in Section 7.5, the total noise from the Dinner Hill wind turbines, BESS and substations does not exceed the

assigned levels at any non-host receiver in any time period. As noted above, the example strategy is for demonstration purposes only and would be updated for the final layout and wind turbine model.

Noise levels in this section are reported to the nearest whole decibel. As noted in Section 7.4, sound levels in environmental assessment work are typically reported to the nearest integer. The finer resolution used for the wind turbine predictions is specific to layout design and has not been applied to the combined project levels.

Table 13: Highest predicted Project noise levels at non-host receivers, dB L_{Aeq}

Receiver	Predicted noise level, dB L _{Aeq}		
	Dinner Hill BESS and substations	Dinner Hill Wind Farm turbines	Total
330	29	32	34
324	28	31	32
21	27	31	32
24	26	31	32
20	26	30	31
22	26	30	32
13	26	30	31
165	25	29	30
325	25	33	33
<i>Receivers with highest predicted noise levels from the wind farm only</i>			
329	< 25	35	35
77	< 25	35	35
113	< 25	35	35
88	< 25	35	35
103	< 25	35	35
32	< 25	35	35
91	< 25	34	34

9.2 Other projects

The following sections provide a description of nearby projects and commentary in regards to the cumulative noise risk.

To identify receivers where cumulative noise may present a compliance risk, the 30 dB noise level overlap from individual projects was determined. Figure 6 shows the 30 dB noise contour for each project considered in the cumulative assessment.¹⁹ The 30 dB contour represents the Regulation 7(2) significant contribution threshold, being 5 dB below the most stringent night-time assigned level of 35 dB.

¹⁹ The contours presented for the Project are for the wind turbines only. For technical and practical reasons, incorporating the noise contribution from the Project BESS options into the contours is problematic and is not essential the purposes of the risk assessment screening process.

Receivers located within the 30 dB contour of more than one project are those where the individual contribution of each project may be sufficient to warrant further assessment of the combined noise level against the assigned level.

Where receivers are identified as potentially at risk through this screening process, a quantitative assessment of the combined noise level is undertaken and presented in the following sections.

9.2.1 Harvest BESS

This proposed project, also being developed by OX2 AB, includes a BESS and substations. The Harvest BESS is sited within the broader Dinner Hill Wind Farm project area, but is not connected to the Project and is being developed separately.

MDA is assisting OX2 AB with the Harvest BESS project and therefore has access to the noise assessment information, including noise predictions and contours.

The contours in Figure 6 show there are no non-host receivers located within the 30 dB contours of both the Project and the Harvest BESS and therefore the cumulative noise compliance risk for these projects is low.

Despite the low risk, quantitative assessment has been carried out and shows the following:

- The calculated noise levels from the Harvest BESS are more than 6 dB below the night-time assigned level of 35 dB.
- The calculated noise levels from the Harvest BESS are below the corresponding calculated noise levels from the Dinner Hill Wind Farm wind turbines at all assessed receivers.
- Using the night-time curtailment example presented in Section 7.5, the predicted cumulative noise from the Dinner Hill Wind Farm (wind turbines, BESS and substations) and Harvest BESS does not exceed the night-time assigned level of 35 dB at any non-host receiver.

9.2.2 Parron Maam Marang Wind Farm

Parron Maam Marang Wind Farm (formerly Parron Wind Farm) is an approved wind farm project being jointly developed by Atmos Renewables and Parron Developments with a capacity of up to 489 MW. The Parron Wind Farm is located to the south of the Dinner Hill Wind Farm project area and is currently under construction.

The noise assessment for the Parron Maam Marang Wind Farm was based on a wind farm layout comprising 79 turbines.²⁰ The Parron noise assessment includes details of the wind turbine locations, wind turbine sound power levels, modelling approach and other relevant information. The modelling approach adopted in the Parron noise assessment is different from approach used by MDA in this report. For consistency and comparison purposes, MDA has carried out noise modelling of the Parron Maam Marang Wind Farm based on the input data provided in the Parron noise assessment but using the same modelling approach as outlined in Section 5.0 above.

The contours in Figure 6 show there is only one non-host receiver (325) located within the 30 dB contours for the Project and the Parron Maam Marang Wind Farm. Further analysis of this receiver is provided in the following section.

9.3 Quantitative cumulative assessment

A single non-host receiver in the study area, receiver 325, is located within the significant contribution threshold (30 dB contour) of more than one project.

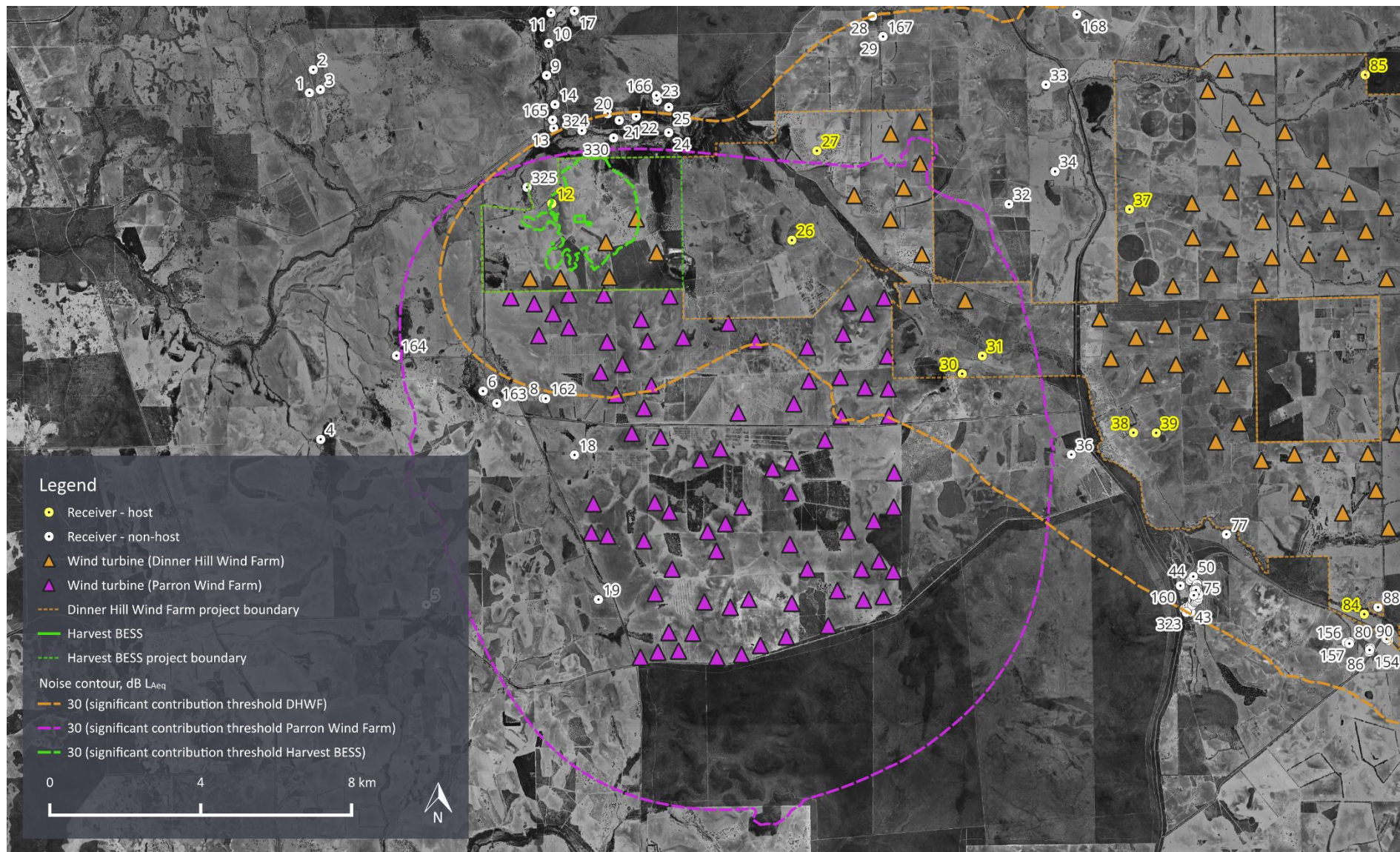
²⁰ DA submission *Appendix G Noise Impact Assessment* Herring Storer Acoustics ref: 33167-5-24117-06 dated November 2024 (Parron noise assessment)

Quantitative assessment based on MDA modelling shows that the calculated cumulative noise level at receiver 325 – taking into account the combined noise from the Dinner Hill Wind Farm (uncurtailed wind turbines, BESS and substation), Harvest BESS and Parron Maam Marang Wind Farm – is 36.0 dB L_{Aeq} . This is below the day and evening assigned levels, and 1.0 dB above the night-time assigned level. The result assumes that receiver 325 is downwind of all sources at the same time, with all sources operating at full capacity. In practice this may not be the case.

The example curtailment strategy in Section 7.5 does not rely on curtailment of the Dinner Hill Wind Farm turbines nearest to receiver 325. Night-time curtailment of these turbines therefore remains available as an additional measure, if required. Further evaluation of cumulative noise at this receiver may be warranted during detailed design, including directional analysis and curtailment measures. Given the magnitude of the predicted level above the night-time assigned level, these measures are expected to be able to address cumulative noise at this receiver.

As noted above, noise modelling of the Parron Maam Marang Wind Farm was conducted by MDA for the purposes of the cumulative study. To confirm the findings of the screening process, cross checking of the results was conducted against the results in the Parron noise assessment. This check did not reveal any additional non-host receivers above the significant contribution threshold.

Figure 6: Predicted 30 dB L_{Aeq} noise contour map for the Parron Maam Marang Wind Farm, Harvest BESS and the Project



10.0 RECOMMENDED OPERATIONAL NOISE MANAGEMENT MEASURES

In order to appropriately manage operational noise from the Project during subsequent stages of development, the following is recommended:

- The predicted operational wind turbine noise levels should be updated with the final layout and sound power levels of the final wind turbine selected for the Project to verify compliance with the approval criteria, if they vary from what has been modelled in this assessment.
- Where the updated assessment indicates a continued requirement for curtailment, the curtailment strategy should be updated accordingly and should remain targeted to address specific wind turbines under certain wind conditions.
- The predicted operational BESS and substation noise levels should be updated with the final design and sound power levels of the final equipment selection to verify compliance with the limits in accordance with the WA Noise Regulations.
- An operational noise management plan, incorporating the project-specific curtailment strategy, should be prepared which identifies how compliance with the Project's operational noise limits will be demonstrated, including details of testing procedures and reporting time frames following commencement of operation of the Project. Any condition of approval relating to curtailment would more appropriately refer to this plan rather than to the example strategy in this report.
- Following construction, compliance monitoring should be conducted in accordance with the procedure outlined in the operational noise management plan including sound power testing of selected wind turbines and evaluation of tonality.

The assessment indicates that the Project can be designed and operated so that wind turbine noise levels do not exceed the assigned levels. Notwithstanding this, consideration has been given to available contingency strategies to reduce noise levels if required.

The following summarises the two key measures available to reduce the noise:

- Procurement contract: the procurement contract for the supply of wind turbines to the Project will typically include specifications concerning the allowable total noise emissions from the wind turbine, and the permissible characteristics of the wind turbine. In the event that wind turbine emissions are found to exceed the contracted values, the supplier will be required to implement measures to reduce the noise to the contracted value. This can include measures to rectify manufacturing defects or appropriate control settings.
- Noise reduction management strategy: modern wind farms include control systems which enable the operation of the wind turbines to be varied according to environmental constraints. Specifically, variable pitch wind turbines as proposed for the Project include control functions which enable the noise emissions to be selectively controlled; by adjusting the pitch of blade, the noise emissions can be reduced. In addition, where required, the wind turbines can be selectively shut down under relevant wind speeds and directions. These types of control measures can be used separately, or in combination, to achieve noise reductions for predetermined wind speed ranges and directions.

11.0 SUMMARY

An assessment of operational noise for the proposed Project has been carried out with reference to the WA Noise Regulations, using the SA guidelines as a supporting methodology where the WA Noise Regulations do not prescribe a method specific to wind turbine noise. This approach is consistent with the Western Australian Planning Commission Position Statement, as clarified by DPLH in August 2026. Predicted noise levels have been compared with the regulation 8 assigned levels for each time period.

The assessment is based on the proposed Project layout comprising 131 wind turbines, BESS and substations.

The predicted noise levels in this assessment, including those for the Project and nearby developments, are calculated as L_{Aeq} levels, consistent with the noise emission data and the prediction methods. The assigned levels in regulation 8 are expressed as L_{A10} levels. In this assessment, the predicted L_{Aeq} levels are compared directly with the L_{A10} assigned levels. This is considered reasonable because wind turbines, BESS and substations are quasi-steady sources of noise, and the prediction methods include conservative assumptions appropriate to each source type. In practice, the L_{Aeq} and L_{A10} levels will not be identical. The comparison is intended solely to indicate whether the predicted noise levels exceed the assigned levels for planning purposes, and whether operational strategies are likely to be required for the control of noise.

Noise modelling was carried out based on a candidate wind turbine model (Vestas V172-7.2MW) which has been selected by the Proponent as being representative of the size and type of wind turbines that could be used for this project. The predicted noise levels for the proposed wind turbine layout are below the day and evening assigned levels at all non-host receivers, without curtailment. The predicted noise levels are above the night-time assigned level at 7 non-host receivers (329, 77, 113, 88, 103, 32, and 91), by up to 2.5 dB, including the 2 dB modelling uncertainty margin. An example curtailment strategy has been developed to show that the predicted noise levels can be reduced so that they do not exceed the night-time assigned level, using sound optimised modes for a limited range of wind conditions during the night period. The example curtailment strategy requires the curtailment of specific turbines under specific wind conditions. It is presented for demonstration purposes only and is specific to the current layout and candidate wind turbine model. It would be revised to be project specific once the layout and wind turbine selection are finalised.

The WA Noise Regulations require adjustments to be applied where noise exhibits tonality, modulation or impulsiveness (regulation 9). Analysis of the noise emission frequency data for the candidate wind turbine model indicates the noise of the Project is not expected to be characterised by tonality. Modulation and impulsiveness cannot be predicted at the planning stage. However, evidence from operational wind farms in Australia indicates that the occurrence of tonality, amplitude modulation and impulsiveness at receivers is limited and atypical. Accordingly, adjustments for these characteristics have not been applied to the predicted noise levels. The potential for these characteristics would be revisited during detailed design and evaluated as part of post-construction compliance monitoring.

The assessment has also considered operational noise associated with the proposed BESS and 3 substation sites. Predicted noise levels from the BESS and substations are below the most stringent (night-time) assigned level at all non-host receivers. As the night-time assigned level is the most stringent, predicted noise levels from the BESS and substations are also below the day and evening assigned levels.

The total predicted noise levels from the Project (wind turbines, BESS and substations) do not exceed the assigned levels at any non-host receiver in any time period, with the example night-time curtailment strategy implemented. The curtailment strategy is targeted, requiring the curtailment of specific wind turbines under specific wind conditions. Noise from the BESS and substations makes a minor contribution to the total predicted noise levels at receivers.

Cumulative noise from nearby developments, Parron Maam Marang Wind Farm and the Harvest BESS, has also been considered. A screening assessment was undertaken using the significant contribution threshold, determined with reference to the WA Noise Regulations. A quantitative assessment was then completed for the receivers identified as potentially at risk. The predicted cumulative noise levels do not exceed the assigned levels at any non-host receiver in any time period, except at receiver 325 during the night period. Receiver 325 is also a non-host receiver for Parron Maam Marang Wind Farm. The predicted cumulative level at this receiver is 36.0 dB L_{Aeq} , including the 2 dB modelling uncertainty margin applied to the wind turbines, 1.0 dB above the night-time assigned level. This prediction is based on the conservative assumption that the receiver is downwind of all sources at the same time, with all sources producing their highest noise emissions. The example curtailment strategy does not rely on curtailment of the Dinner Hill turbines nearest to receiver 325. Night-time curtailment of these turbines therefore remains available as an additional measure, if required. On this basis, cumulative noise from the Project and the nearby developments is expected to be manageable.

The findings of this assessment indicate that the Project (wind turbines, BESS and substations) can be designed and operated so that noise levels do not exceed the assigned levels at any non-host receiver in any time period, with wind turbine curtailment likely to be required during the night period. The assessment is based on predicted noise levels that include conservative assumptions, using an approach appropriate to a planning stage assessment. Compliance would need to be verified through testing of actual noise levels following construction, based on the policies and procedures applicable at that time and a method defined in an Operational Noise Management Plan. This would provide a practical basis for the Council and DWER to assess compliance during operation. The results of that testing would also provide the basis for defining any ongoing curtailment strategies required.

Prior to construction, the predicted noise levels should be updated for the final Project configuration and equipment selections, to confirm the findings of this assessment. Background noise monitoring should also be carried out prior to construction, to characterise typical baseline conditions in the vicinity of the Project and to support future compliance testing. An operational noise management plan should be prepared for the Project prior to operation and should incorporate a project-specific curtailment strategy to replace the example in this report, as recommended in Section 10.0.

APPENDIX A GLOSSARY OF TERMINOLOGY

Term	Definition	Abbreviation
A-weighted 10 th centile	The sound level exceeded for 10 % of the measurement period, calculated by statistical analysis	L _{A10}
A-weighted 1 st centile	the sound level exceeded for 1 % of the measurement period, calculated by statistical analysis	L _{A1}
A-weighted 90 th 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. This is commonly referred to as the average noise level.	L _{Aeq}
A-weighted maximum noise level	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.	L _{Amax}
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.
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	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.	-
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
Annoying Characteristics	Annoying characteristics that are not fundamental to a typical well-maintained wind farm. Such characteristics may include infrasound (low frequency noise below the audible frequency range) or adverse mechanical 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 part of direct quotes of external documents.

APPENDIX B DESCRIPTION OF SOUND

Sound is an important feature of the environment in which we live; it provides information about our surroundings and influences our overall perception of amenity and environmental quality.

While sound is a familiar concept, its description can be complex. A glossary of terms and abbreviations is provided in Appendix A.

This appendix provides general information about the definition of sound and the ways that different sound characteristics are described.

B1 Definition of sound

Sound is a term used to describe very small and rapid changes in the pressure of the atmosphere. Importantly, for pressure fluctuations to be considered sound, the rise and fall in pressure needs to be repeated at rates ranging from tens to thousands of times per second.

These small and repetitive fluctuations in pressure can be caused by many things such as a vibrating surface in contact with the air (e.g. the cone of a speaker) or turbulent air movement patterns. The common feature is a surface or region of disturbance that displaces the adjacent air, causing a very small and localised compression of the air, followed by a small expansion of the air.

These repeated compressions and expansions then spread into the surrounding air as waves of pressure changes. Upon reaching the ear of an observer, these waves of changing pressure cause structures within the ear to vibrate; these vibrations then generate signals which can be perceived as sounds.

The waves of pressure changes usually occur as complex patterns, comprising varied rates and magnitudes of pressure changes. The pattern of these changes will determine how a sound spreads through the air and how the sound is ultimately perceived when it reaches the ear of an observer.

B2 Physical description of sound

There are many situations where it can be useful to objectively describe sound, such as the writing or recording of music, hearing testing, measuring the sound environment in an area or evaluating new man-made sources of sound.

Sound is usually composed of complex and varied patterns of pressure changes. As a result, several attributes are used to describe sound. Two of the most fundamental sound attributes are:

- sound pressure
- sound frequency.

Each of these attributes is explained in the following sections, followed by a discussion about how each of these attributes varies.

B2.1 Sound pressure

The compression and expansion of the air that is associated with the passage of a sound wave results in changes in atmospheric pressure. The pressure changes associated with sound represent very small and repetitive variations that occur amidst much greater pressures associated with the atmosphere.

The magnitude of these pressure changes influences how quiet or loud a sound will be; the smaller the pressure change, the quieter the sound, and vice versa. The perception of loudness is complex though, and different sounds can seem quieter or louder for reasons other than differences in pressure changes.

To provide some context, Table 14 lists example values of pressure associated with the atmosphere and different sounds. The key point from these example values is that even an extremely loud sound equates to a change in pressure that is thousands of times smaller than the typical pressure of the atmosphere.

Table 14: Atmospheric pressure versus sound pressure – example values of pressure

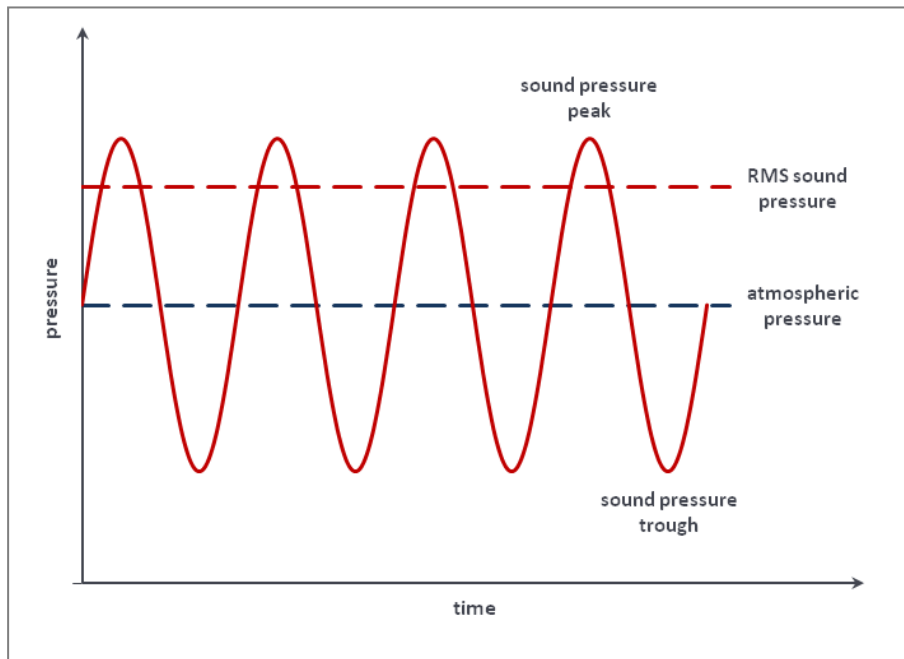
Example	Pascals	Bars	Pounds per Square Inch (PSI)
Atmospheric pressure	100,000	1	14.5
Pressure change due to weather front	10,000	0.1	1.5
Pressure change associated with sound at the threshold of pain	20	0.0002	0.003
Pressure change associated with sound at the threshold of hearing	0.00002	0.0000000002	0.000000003

The pressure values in Table 14 also show that the range of pressure changes associated with quiet and loud sounds span over a very large range, albeit still very small changes compared to atmospheric pressure. To make the description of pressure changes more practical, sound pressure is expressed in decibels or dB.

To illustrate the pressure variation associated with sound, Figure 7 shows the repetitive rise and fall in pressure of a very simple and steady sound. This figure illustrates the peaks and troughs of pressure changes relative to the underlying pressure of the atmosphere in the absence of sound. The magnitude of the change in pressure caused by the sound is then described as the sound pressure level. Since the magnitude of the change is constantly varying, the sound pressure may be defined in terms of:

- Peak sound pressure levels: the maximum change in pressure relative to atmospheric pressure i.e. the amplitude as defined by the maximum depth or height of the peaks and troughs respectively; or
- Root Mean Square (RMS) sound pressure levels: the average of the amplitude of pressure changes, accounting for positive changes above atmospheric pressure, and negative pressure changes below atmospheric pressure.

Figure 7: Pressure changes relative to atmospheric pressure associated with sound



B2.2 Frequency

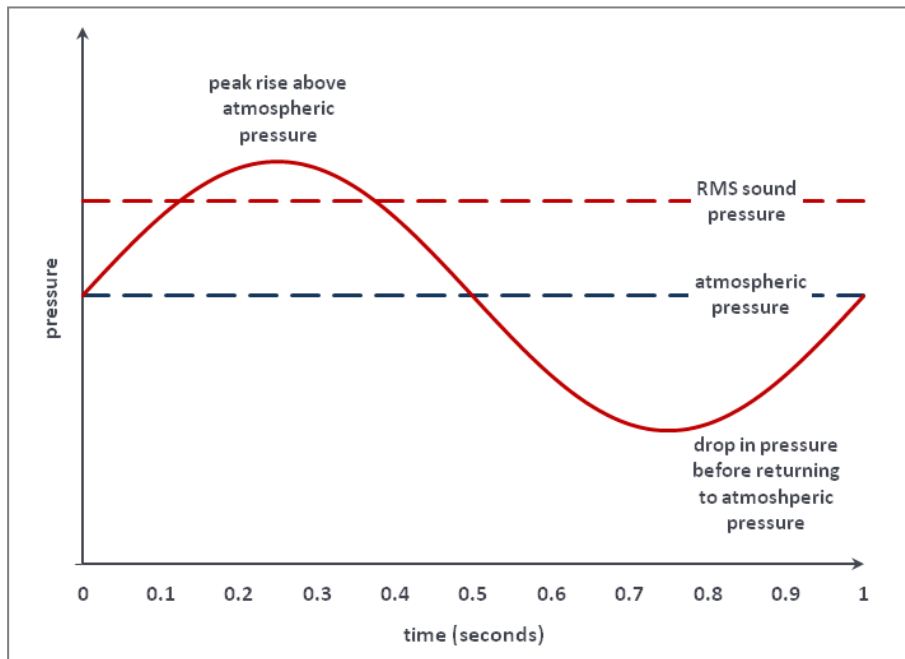
Frequency is a term used to describe the number of times a sound causes the pressure to rise and fall in a given period. The rate of change in pressure is an important feature that determines whether it can be perceived as a sound by the human ear.

Repetitive changes in pressure can occur as a result of a range of factors with widely varying rates of fluctuation. However, only a portion of these fluctuations can be perceived as sound. In many cases, the rate of fluctuation will either be too slow or too fast for the human ear to detect the pressure change as a sound. For example, local fluctuations in atmospheric pressure can be created by someone waving their hands back and forth through the air; the reason this cannot be perceived as a sound is the rate of fluctuation is too slow.

At the rates of fluctuation that can be detected as sound, the rate will influence the character of the sound that is perceived. For example, slow rates of pressure change correspond to rumbling sounds, while fast rates correspond to whistling sounds.

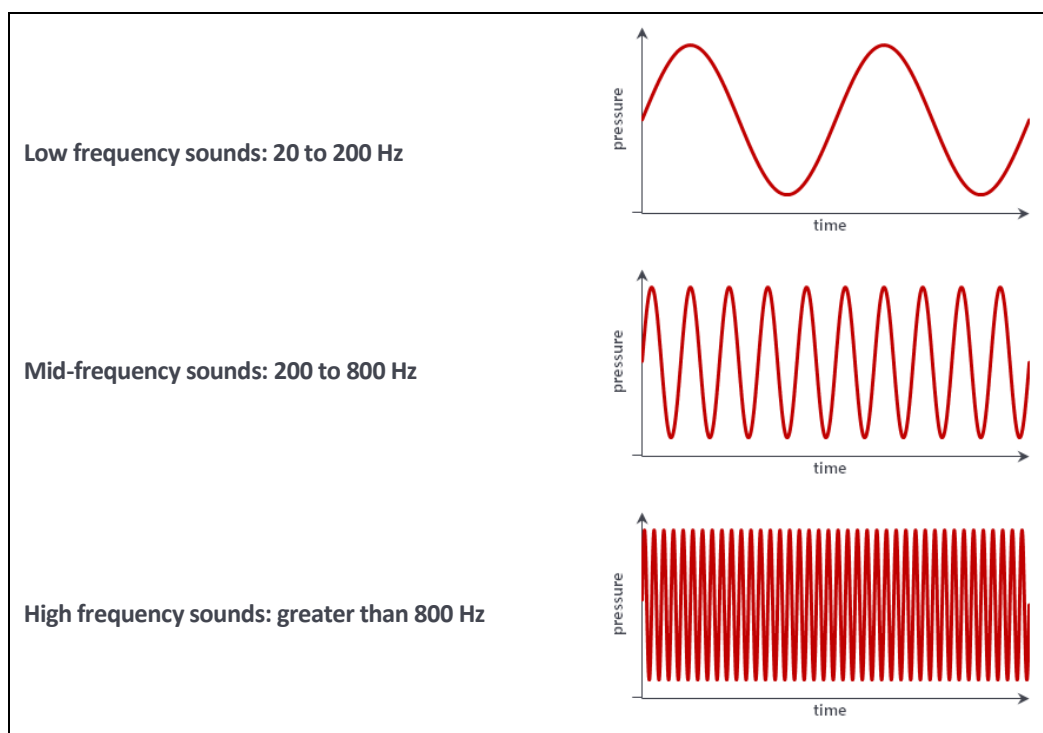
The rate of fluctuation is numerically described in terms of the number of pressure fluctuations that occur in a single second. Specifically, it is the number of cycles per second of the pressure rising above, falling below, and then returning to atmospheric pressure. The number of these cycles per second is expressed in Hertz (Hz). This concept of cycles per second is illustrated in Figure 8 which illustrates a 1 Hz pressure fluctuation. The figure provides a simple illustration of a single cycle of pressure rise and fall occurring in a period of a single second.

Figure 8: Illustration of a pressure fluctuation with a frequency of 1 Hz



The rate that sound pressure rises and falls will vary depending on the source of the sound. For example, the surface of a tuning fork vibrates at a specific rate, in turn causing the pressure of the adjacent air to fluctuate at the same rate. Recalling the idea of pressure fluctuations from someone waving their hands, the pressure would fluctuate at the same rate as the hands move back and forth; a few times a second translating to a very low frequency below our hearing range (termed an infrasonic frequency). Examples of low and high frequency sound are easily recognisable, such as the low frequency sound of thunder, and the high frequency sound of crashing cymbals. To demonstrate the differences in the patterns of different frequencies of sound, Figure 9 illustrates the relative rates of pressure change for low, mid and high frequency sounds. Note that in each case the amplitude of the pressure changes remains the same; the only change is the number of fluctuations in pressure that occur over time.

Figure 9: Examples of the rate of change in pressure fluctuations for low, mid and high frequencies



B2.3 Sound pressure and frequency variations

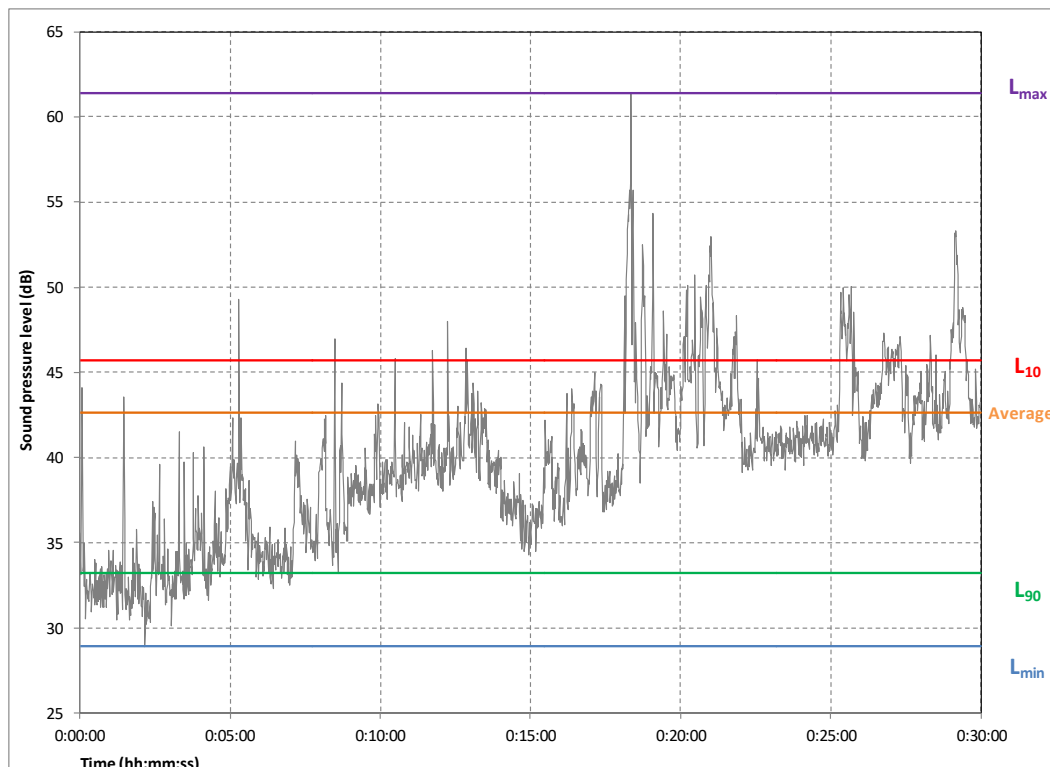
The preceding sections describe important aspects of the nature of sound, the changes in pressure and the changes in the rate of pressure fluctuations.

The simplest type of sound comprises a single constant sound pressure level and a single constant frequency. However, most sounds are made up of many frequencies, and may include low, mid and high frequencies. Sounds that are made up of a relatively even mix of frequencies across a broad range of frequencies are referred to as being 'broad band'. Common examples of broad band sounds include flowing water, the rustling of leaves, ventilation fans and traffic noise.

Further, sound quite often changes from moment to moment, in terms of both pressure levels and frequencies. The time varying characteristics of sound are important to how we perceive sound. For example, rapid changes in sound level produced by voices provide the component of sound that we interpret as intelligible speech. Variations in sound pressure levels and frequencies are also features which can draw our attention to a new source of sound in the environment.

To demonstrate this, Figure 10 illustrates an example time-trace of total sound pressure levels which varies with time. This variation presents challenges when attempting to describe sound pressure levels. As a result, multiple metrics are generally needed to describe sound pressure, such as the average, minimum or maximum noise levels. Other ways of describing sound include statistics for describing how often a defined sound pressure level is exceeded; for example, typical upper sound levels are often described as an L_{10} which refers to the sound pressure exceeded for 10 % of the time, or typical lower levels or lulls which are often described as an L_{90} which refers to the sound exceeded for 90 % of the time.

Figure 10: Example of noise metrics that may be used to measure a time-varying sound level



This example illustrates variations in terms of just total sound pressure levels, but the variations can also relate to the frequency of the sound, and frequently the number of sources affecting the sound.

These types of variations are an inherent feature of most sound fields and are an important point of context in any attempt to describe sound.

B3 Hearing and perception of sound

This section provides a discussion of:

- the use of the decibel to practically describe sound levels in a way that corresponds to the pressure levels the human ear can detect as sounds
- the relationship between sound frequency and human hearing.

The section concludes with a discussion of some of the complicating non-acoustic factors that influence our perception of sound.

B3.1 Sound pressure and the decibel

Previous sections discussed the wide range of small pressure fluctuations that the ear can detect as sound. Owing to the wide range of these fluctuations, the way we hear sound is more practically described using the decibel (dB). The decibel system serves two key purposes:

- Compressing the numerical range of the quietest and loudest sounds commonly experienced
As an indication of this benefit, the pressure of the loudest sound that might be encountered is around a million times greater than the quietest sound that can be detected. In contrast, the decibel system reduces this to a range of approximately 0-120 dB.
- Consistently representing sound pressure level changes in a way that correlate more closely with how we perceive sound pressure level changes

For example, a 10 dB change from 20-30 dB will generally be subjectively like a 10 dB change from 40-50 dB. However, expressed in units of pressure as Pascals, the 40-50 dB change is ten times greater than the 20-30 dB change. For this reason, sound pressure changes cannot be meaningfully communicated in terms of units of pressure such as Pascals.

Sound pressure levels in most environments are highly variable, so it can be misleading to describe what different ranges of sound pressure levels correspond to. However, as a broad indication, Table 15 provides some example ranges of sound pressure levels, expressed in both dB and units of pressure.

Table 15: Example sound pressure levels that might be experienced in different environments

Environment	Example sound pressure level	
Outside in an urban area with traffic noise	50-70 dB	0.006-0.06 Pa
Outside in a rural area with distant sounds or moderate wind rustling leaves	30-50 dB	0.0006-0.006 Pa
Outside in a quiet rural environment in calm conditions	20-30 dB	0.0002-0.0006 Pa
Inside a quiet bedroom at night	<20 dB	0.0002 Pa

The impression of how much louder or quieter a sound is, will be influenced by the magnitude of the change in sound pressure. Other important factors will also influence this, such as the frequency of the sound which is discussed in the following section. However, to provide a broad indication, Table 16 provides some examples of how changes in sound pressure levels, for a sound with the same character, can be perceived.

Table 16: Perceived changes in sound pressure levels

Sound pressure level change	Indicative change in perceived sound
1 dB	Unlikely to be noticeable
2-3 dB	Likely to be just noticeable
4-5 dB	Clearly noticeable change
10 dB	Distinct change - often subjectively described as halving or doubling the loudness

The example sound pressure level changes in Table 16 are based on side-by-side comparison of a steady sample of sound heard at different levels. In practice, changes in sound pressure levels may be more difficult to perceive for a range of reasons, including the presence of other sources of sound, or gradual changes which occur over a longer period.

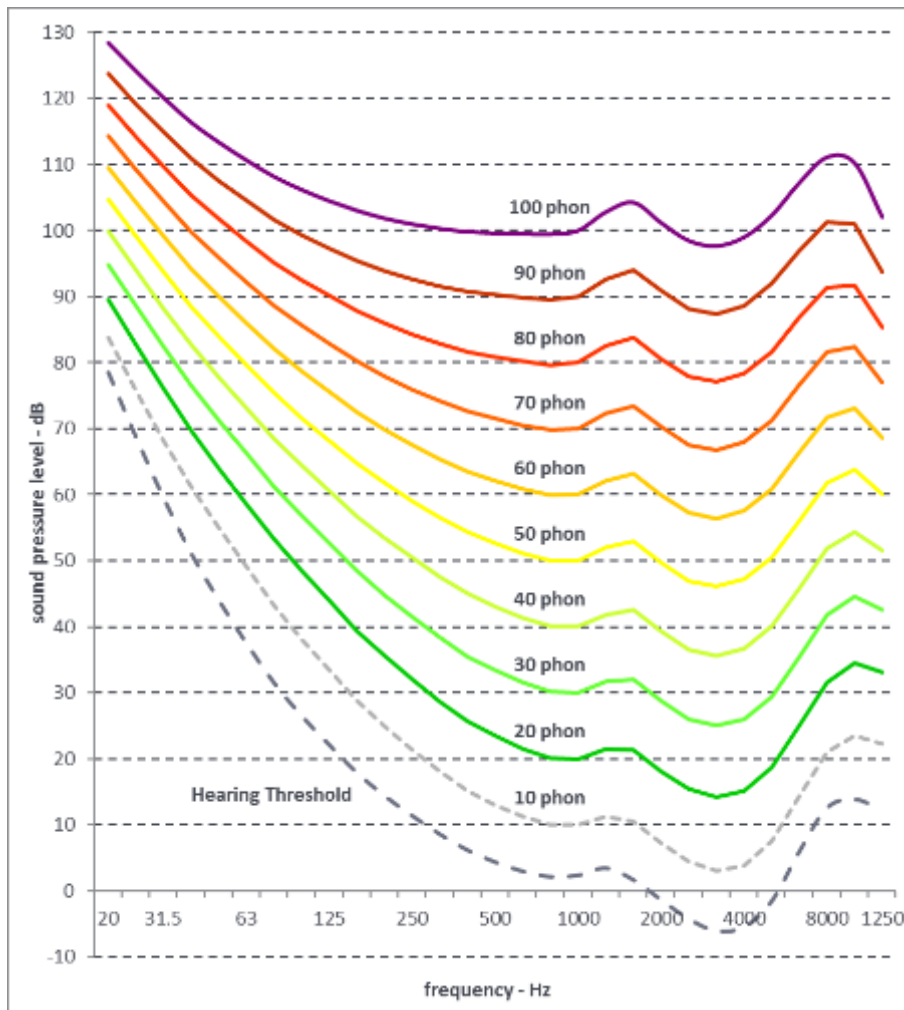
B3.2 Sound frequency and loudness

Although sound pressure level and the sensation of loudness are related, the sound pressure level is not a direct measure of how loud a sound appears to humans. Human perception of sound varies and depends on a number of physical attributes, including frequency, level and duration.

An example of the relationship between the sensation of loudness and frequency is demonstrated in Figure 11. The chart presents equal loudness curves for sounds of different frequencies expressed in 'phons'. Each point on the phon curves represents a sound of equal loudness. For example, the 40 phon curve shows that a sound level of 100 dB at 20 Hz (a very low frequency sound) would be of equal loudness to a level of 40 dB at 1,000 Hz (a whistling sound) or approximately 50 dB at just under 8,000 Hz (a very high pitch sound). The information presented is based on an international standard²¹ that defines equal loudness levels for sounds comprising individual frequencies. In practice, sound is usually composed of many different frequencies, so this type of data can only be used as an indication of how different frequencies of sound may be perceived. An individual's perceptions of sound can also vary significantly. For example, the lower dashed line in Figure 11 shows the threshold of hearing, which represents the sounds an average listener could correctly identify at least 50 % of the time. However, these thresholds represent the average of the population. In practice, an individual's hearing threshold can vary significantly from these values, particularly at the low frequencies.

²¹ ISO 226:2003 *Acoustics - Normal equal-loudness-level contours*

Figure 11: Equal loudness contours for pure tone sounds



The noise curves in Figure 11 demonstrate that human hearing is most sensitive at frequencies from 500 to 4,000 Hz, which usefully corresponds to the main frequencies of human speech. The contours also demonstrate that sounds at low frequencies must be at much higher sound pressure levels to be judged equally loud as sounds at mid to high frequencies.

To account for the sensitivity of the ear to different frequencies, a set of adjustments were developed to enable sound levels to be measured in a way that more closely aligns with human hearing. Sound levels adjusted in this way are referred to as A-weighted sound levels.

B3.3 Interpretation of sound and noise

Human interpretation of sound is influenced by many factors other than its physical characteristics, such as how often the sound occurs, the time of day it occurs and a person's attitude towards the source of the sound.

For example, the sound of music can cause very different reactions, from relaxation and pleasure through to annoyance and stress, depending on individual preferences, the type of music and the circumstances in which the music is heard. This example illustrates how sound can sometimes be considered noise; a term broadly used to describe unwanted sounds or sounds that have the potential to cause negative reactions.

The effects of excess environmental sound are varied and complicated and may be perceived in various ways including sensations of loudness, interference with speech communication, interference with working concentration or studying, disruption of resting/leisure periods, and disturbance of sleep. These effects can give rise to behavioural changes such as avoiding the use of exposed external spaces, keeping windows closed, or timing restful activities to avoid the most intense periods of disruption. Prolonged annoyance or interference with normal patterns can lead to possible effects on mental and physical health. In this respect, the World Health Organization (preamble to the *Constitution of the World Health Organization*, 1946) defines health in the following broad terms:

A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity

The World Health Organization Guidelines for Community Noise (Berglund, Lindvall, & Schwela, 1999) documents a relationship between the definition of health and the effects of community noise exposure by noting that:

This broad definition of health embraces the concept of well-being, and thereby, renders noise impacts such as population annoyance, interference with communication, and impaired task performance as 'health' issues.

The reaction that a community has to sound is highly subjective and depends on a range of factors including:

- the hearing threshold of individuals across the audible frequency range
These thresholds vary widely across the population, particularly at the lower and upper ends of the audible frequency range. For example, at low frequencies the distribution of hearing thresholds varies above and below the mean threshold by more than 10 dB.
- the attitudes and sensitivities of individuals to sound, and their expectations of what is considered an acceptable level of sound or intrusion
This in turn depends on a range of factors such as general health and the perceived importance of sound amongst other factors relevant to overall amenity perception.
- the absolute sound pressure level of the sound in question
The threshold for the onset of community annoyance varies according to the type of sound; above such thresholds, the percentage of the population annoyed generally increases with increasing sound pressure level.
- the sound pressure level of the noise relative to background noise conditions in the area, and the extent to which general background noise may offer beneficial masking effects
- the characteristics of the sound in question such as whether the sound is constant, continually varies, or contains distinctive audible features such as tones, low frequency components or impulsive sound which may draw attention to the noise
- the site location and the compatibility of the source in question with other surrounding land uses
For example, whether the source is in an industrial or residential area.

- the attitudes of the community to the source of the sound

This may be influenced by factors such as the extent to which those responsible for the sound are perceived to be adopting reasonable and practicable measures to reduce their emissions, whether the activity is of local or national significance and whether the noise producer actively consults and/or liaises with the community.

- the times when the sound is present, the duration of exposure to increased sound levels, and the extent of respite periods when the sound is reduced or absent (for example, whether the sound ceases at weekends).

The combined influence of the above considerations means that physical sound levels are only one factor influencing community reaction to sound. Importantly, this means that individual reactions and attitudes to the same type and level of sound will vary within a community.

APPENDIX C WIND TURBINE COORDINATES

Table 17 sets out the coordinates of the proposed wind turbine layout (WTG 29-06-2026).

Table 17: Wind turbine coordinates (layout WTG (29-06-2026)) - CRS: GDA2020 MGA zone 50

Wind turbine	Easting, m	Northing, m	Terrain elevation, m
DIN.10021	339,331	6,645,500	182
DIN.10081	348,090	6,649,325	217
DIN.10010	338,528	6,645,488	153
DIN.10031	340,629	6,645,526	181
DIN.10050	341,346	6,647,073	137
DIN.10070	347,123	6,647,692	142
DIN.10091	348,085	6,647,053	148
DIN.10101	348,436	6,647,892	190
DIN.10121	348,674	6,645,037	143
DIN.10131	348,852	6,649,641	240
DIN.10141	348,867	6,648,536	220
DIN.10151	348,918	6,646,127	155
DIN.10160	350,068	6,644,908	171
DIN.10170	353,640	6,644,433	178
DIN.10190	354,603	6,643,923	205
DIN.10201	354,902	6,642,932	204
DIN.10210	355,370	6,644,241	220
DIN.10222	355,661	6,643,212	230
DIN.10230	356,313	6,644,076	247
DIN.10240	356,501	6,650,466	191
DIN.10250	356,606	6,645,602	209
DIN.10270	356,715	6,641,163	260
DIN.10280	356,883	6,644,606	228
DIN.10300	357,110	6,647,780	220
DIN.10310	357,115	6,646,269	228
DIN.10320	357,170	6,648,691	201
DIN.10330	357,170	6,649,591	193
DIN.10340	357,335	6,641,657	272
DIN.10350	357,437	6,643,390	260
DIN.10360	357,799	6,650,293	193

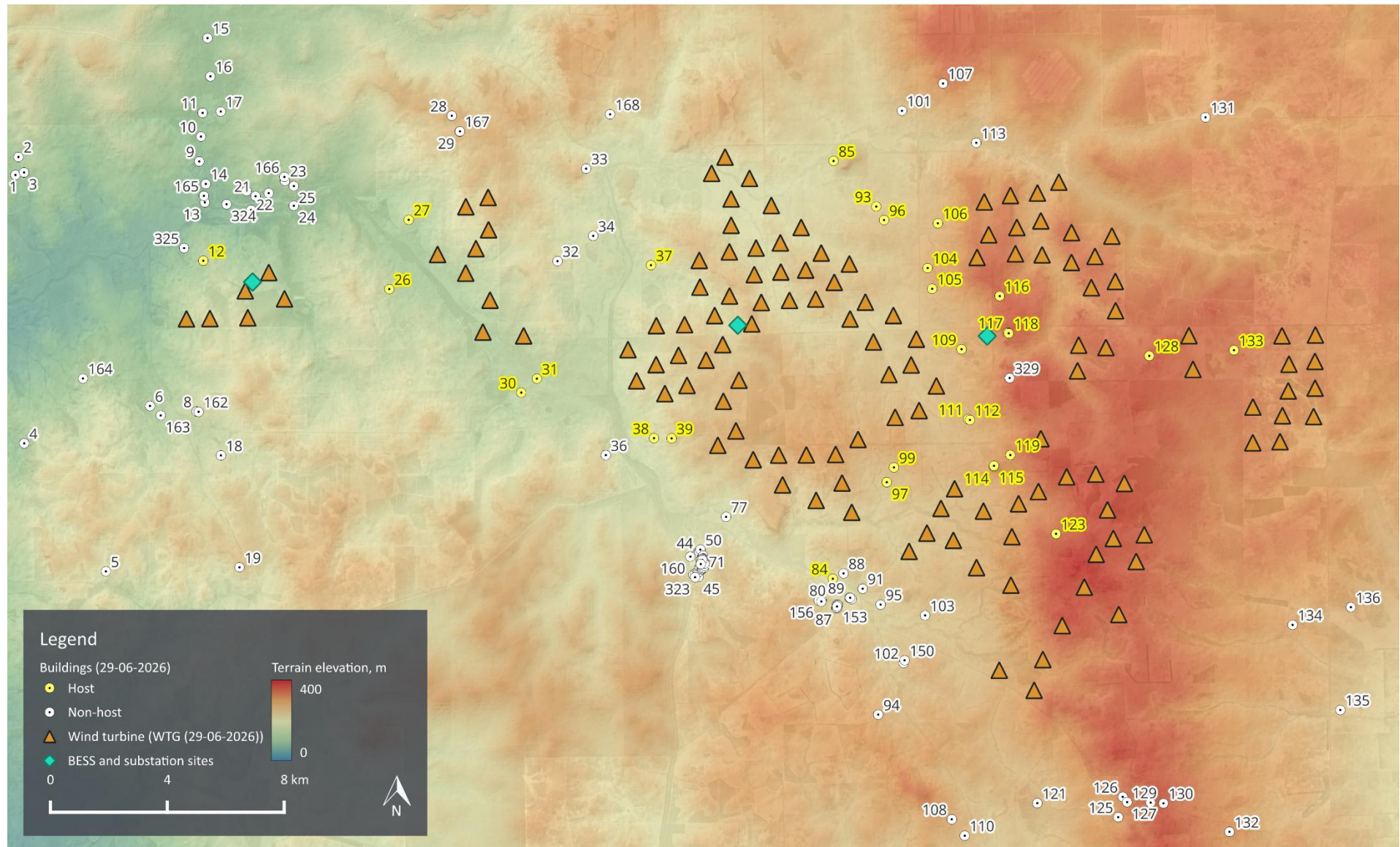
Wind turbine	Easting, m	Northing, m	Terrain elevation, m
DIN.10370	357,875	6,645,318	253
DIN.10380	357,926	6,640,671	252
DIN.10390	357,962	6,647,003	221
DIN.10400	358,024	6,647,912	202
DIN.10411	358,544	6,649,369	200
DIN.10421	358,202	6,646,051	225
DIN.10430	358,797	6,640,828	270
DIN.10440	358,854	6,648,088	222
DIN.10450	358,870	6,647,091	222
DIN.10460	358,930	6,639,810	253
DIN.10470	359,167	6,646,120	218
DIN.10480	359,566	6,648,616	213
DIN.10490	359,721	6,647,160	251
DIN.10500	359,744	6,640,835	290
DIN.10510	360,064	6,646,166	243
DIN.10520	360,253	6,647,741	225
DIN.10531	360,080	6,639,279	227
DIN.10540	360,699	6,646,738	243
DIN.10550	360,747	6,640,852	288
DIN.10560	360,966	6,639,873	263
DIN.10570	361,241	6,645,483	221
DIN.10580	361,298	6,638,871	226
DIN.10591	361,513	6,641,363	275
DIN.10602	361,217	6,647,366	228
DIN.10610	361,764	6,646,060	240
DIN.10620	362,039	6,644,700	234
DIN.10630	362,573	6,643,582	239
DIN.10640	362,724	6,645,605	234
DIN.10650	362,784	6,642,120	273
DIN.10660	363,261	6,637,535	234
DIN.10670	363,331	6,643,913	241
DIN.10680	363,509	6,644,796	245
DIN.10690	363,605	6,642,353	250

Wind turbine	Easting, m	Northing, m	Terrain elevation, m
DIN.10702	363,872	6,638,160	247
DIN.10710	364,196	6,643,195	249
DIN.10721	364,352	6,639,005	245
DIN.10730	364,775	6,637,913	250
DIN.10741	364,817	6,639,677	255
DIN.10750	365,569	6,636,979	266
DIN.10760	365,588	6,647,591	333
DIN.10770	365,805	6,638,912	266
DIN.10780	365,834	6,649,488	302
DIN.10791	365,985	6,648,367	323
DIN.10811	366,349	6,633,467	283
DIN.10821	366,745	6,636,379	304
DIN.10830	366,730	6,649,708	322
DIN.10860	366,950	6,648,615	313
DIN.10880	367,008	6,639,164	295
DIN.10890	367,541	6,632,782	299
DIN.10900	367,654	6,649,793	271
DIN.10910	367,770	6,648,841	290
DIN.10920	367,813	6,647,680	287
DIN.10931	367,687	6,639,582	326
DIN.10941	367,838	6,633,833	307
DIN.10961	368,503	6,634,996	362
DIN.10970	368,387	6,650,164	275
DIN.10981	368,654	6,640,087	363
DIN.10992	368,818	6,647,419	317
DIN.11000	368,820	6,648,441	328
DIN.11011	369,026	6,643,710	326
DIN.11020	369,498	6,646,557	329
DIN.11030	369,623	6,647,625	331
DIN.11040	369,652	6,640,177	361
DIN.11051	369,997	6,644,508	342
DIN.11061	370,050	6,638,954	369
DIN.11080	370,202	6,648,321	308

Wind turbine	Easting, m	Northing, m	Terrain elevation, m
DIN.11090	370,319	6,646,769	319
DIN.11100	370,329	6,645,766	328
DIN.11110	370,436	6,635,375	352
DIN.11121	370,627	6,639,859	359
DIN.11130	371,034	6,637,189	352
DIN.11140	371,310	6,638,103	348
DIN.11150	372,839	6,644,913	338
DIN.11160	372,976	6,643,760	338
DIN.11170	375,025	6,641,249	322
DIN.11180	375,028	6,642,473	324
DIN.11190	375,956	6,641,287	314
DIN.11200	376,023	6,644,909	326
DIN.11210	376,038	6,642,177	314
DIN.11220	376,237	6,643,024	312
DIN.11230	376,262	6,643,937	311
DIN.11241	377,106	6,642,148	292
DIN.11250	377,152	6,644,034	313
DIN.11260	377,157	6,643,120	307
DIN.11270	377,168	6,644,935	313
DIN.10061	341,883	6,646,175	144
DIN.10181	353,934	6,643,370	199
DIN.10261	356,904	6,642,668	256
DIN.10291	356,962	6,651,024	216
DIN.10841	366,779	6,638,038	305
DIN.10851	366,900	6,647,715	322
DIN.11400	367,771	6,641,389	343
DIN.11410	370,251	6,637,976	361
DIN.11420	369,258	6,636,313	365
DIN.11461	369,664	6,637,435	368
DIN.11470	369,066	6,644,589	335
DIN.11320	354,611	6,645,257	209
DIN.11360	355,576	6,645,290	222
DIN.11381	356,103	6,646,576	195

Wind turbine	Easting, m	Northing, m	Terrain elevation, m
DIN.11391	356,080	6,647,489	243
DIN.10041	340,541	6,646,446	143

APPENDIX D SITE TOPOGRAPHY



APPENDIX E RECEIVER COORDINATES

Table 18 sets out the 127 receivers identified by the Proponent within 5 km of the proposed wind turbines considered in the environmental noise assessment, together with their respective distance to the nearest wind turbine.

This includes 30 host receivers where a noise agreement has been formalised between the landowners and the Proponent.

Data supplied by the Proponent on 1 July 2026.

Table 18: Receivers within 5 km of the proposed wind turbines – GDA2020 MGA Zone 50

Receiver	Easting, m	Northing, m	Terrain elevation, m	Nearest wind turbine	Distance to the nearest wind turbine, m
<i>Non-host receiver</i>					
6	337,280	6,642,508	146	DIN.10010	3,236
8	338,874	6,642,320	187	DIN.10010	3,192
9	338,966	6,650,873	97	DIN.10050	4,486
13	339,156	6,649,471	94	DIN.10050	3,251
14	339,189	6,650,103	92	DIN.10050	3,722
18	339,708	6,640,816	194	DIN.10021	4,703
20	340,585	6,649,860	113	DIN.10050	2,893
21	340,893	6,649,682	107	DIN.10050	2,652
22	341,342	6,649,790	112	DIN.10050	2,721
23	341,900	6,650,208	128	DIN.10050	3,187
24	342,203	6,649,357	102	DIN.10050	2,444
25	342,204	6,650,029	131	DIN.10050	3,081
28	347,609	6,652,436	263	DIN.10131	3,062
29	347,872	6,651,886	258	DIN.10131	2,454
32	351,228	6,647,461	216	DIN.10141	2,600
33	352,208	6,650,627	218	DIN.10131	3,501
34	352,450	6,648,327	192	DIN.10141	3,593
36	352,883	6,640,825	206	DIN.10181	2,759
40	355,878	6,636,734	206	DIN.10460	4,337
41	355,949	6,636,779	207	DIN.10460	4,255
42	356,001	6,636,788	208	DIN.10460	4,212
43	356,031	6,636,830	209	DIN.10460	4,161
44	356,037	6,637,489	203	DIN.10380	3,705
45	356,051	6,636,657	211	DIN.10460	4,274

Receiver	Easting, m	Northing, m	Terrain elevation, m	Nearest wind turbine	Distance to the nearest wind turbine, m
46	356,072	6,637,534	204	DIN.10380	3,648
47	356,087	6,636,840	210	DIN.10460	4,115
48	356,101	6,637,026	210	DIN.10460	3,973
49	356,104	6,636,971	211	DIN.10460	4,010
50	356,116	6,637,595	205	DIN.10380	3,573
51	356,139	6,637,192	209	DIN.10460	3,831
52	356,163	6,637,047	212	DIN.10460	3,914
53	356,165	6,636,912	213	DIN.10460	4,010
54	356,167	6,637,008	213	DIN.10460	3,939
55	356,169	6,637,304	209	DIN.10460	3,733
56	356,171	6,637,191	210	DIN.10460	3,808
57	356,179	6,637,257	210	DIN.10460	3,757
58	356,182	6,636,981	213	DIN.10460	3,948
59	356,182	6,636,935	213	DIN.10460	3,981
60	356,186	6,637,344	210	DIN.10460	3,694
61	356,200	6,636,960	214	DIN.10460	3,951
62	356,203	6,637,375	211	DIN.10460	3,660
63	356,214	6,637,388	211	DIN.10460	3,643
64	356,215	6,637,295	211	DIN.10460	3,705
65	356,219	6,637,062	215	DIN.10460	3,864
66	356,221	6,637,032	215	DIN.10460	3,884
67	356,224	6,637,007	215	DIN.10460	3,900
68	356,230	6,637,274	212	DIN.10460	3,709
69	356,233	6,637,248	212	DIN.10460	3,724
70	356,235	6,637,226	213	DIN.10460	3,738
71	356,238	6,637,202	213	DIN.10460	3,752
72	356,239	6,636,981	215	DIN.10460	3,909
73	356,245	6,637,183	214	DIN.10460	3,761
74	356,251	6,637,152	216	DIN.10460	3,778
75	356,254	6,637,042	216	DIN.10460	3,854
76	356,259	6,637,120	217	DIN.10460	3,795
77	356,996	6,638,713	194	DIN.10380	2,174

Receiver	Easting, m	Northing, m	Terrain elevation, m	Nearest wind turbine	Distance to the nearest wind turbine, m
80	360,269	6,635,869	228	DIN.10580	3,179
86	360,771	6,635,586	226	DIN.10660	3,167
87	360,790	6,635,604	226	DIN.10660	3,141
88	361,017	6,636,781	225	DIN.10580	2,116
89	361,217	6,635,948	216	DIN.10660	2,594
90	361,297	6,635,901	217	DIN.10660	2,561
91	361,672	6,636,258	222	DIN.10660	2,046
94	362,205	6,631,950	282	DIN.10811	4,416
95	362,284	6,635,711	223	DIN.10660	2,077
101	363,016	6,652,606	245	DIN.10780	4,205
102	363,074	6,633,714	251	DIN.10811	3,288
103	363,809	6,635,343	243	DIN.10660	2,266
107	364,422	6,653,539	314	DIN.10780	4,292
113	365,558	6,651,510	245	DIN.10780	2,046
121	367,649	6,628,921	257	DIN.10890	3,867
126	370,573	6,629,135	322	DIN.10890	4,746
127	370,724	6,628,955	325	DIN.10890	4,981
150	363,106	6,633,807	249	DIN.10811	3,264
151	360,794	6,635,715	223	DIN.10660	3,070
152	360,822	6,635,713	224	DIN.10660	3,049
153	360,819	6,635,684	224	DIN.10660	3,069
154	360,793	6,635,649	225	DIN.10660	3,110
155	361,243	6,635,944	217	DIN.10660	2,575
156	360,170	6,635,849	228	DIN.10580	3,230
157	360,256	6,635,818	228	DIN.10580	3,230
158	356,140	6,637,229	208	DIN.10460	3,804
159	356,187	6,637,239	210	DIN.10460	3,763
160	355,775	6,637,353	200	DIN.10270	3,928
161	356,132	6,637,098	210	DIN.10460	3,900
162	338,944	6,642,307	189	DIN.10010	3,212
163	337,647	6,642,183	147	DIN.10010	3,424
164	334,986	6,643,448	136	DIN.10010	4,091

Receiver	Easting, m	Northing, m	Terrain elevation, m	Nearest wind turbine	Distance to the nearest wind turbine, m
165	339,126	6,649,694	86	DIN.10050	3,439
166	341,878	6,650,342	129	DIN.10050	3,316
167	347,889	6,651,902	259	DIN.10131	2,463
168	353,027	6,652,484	219	DIN.10240	4,021
323	355,936	6,636,647	210	DIN.10460	4,358
324	339,902	6,649,408	89	DIN.10050	2,750
325	338,447	6,647,908	93	DIN.10010	2,427
329	366,702	6,643,463	343	DIN.11400	2,339
330	340,742	6,649,214	94	DIN.10050	2,231
<i>Host receivers</i>					
12	339,105	6,647,477	143	DIN.10041	1,774
26	345,471	6,646,506	172	DIN.10070	2,041
27	346,134	6,648,875	161	DIN.10070	1,550
30	349,988	6,642,965	158	DIN.10160	1,953
31	350,521	6,643,442	152	DIN.10160	1,544
37	354,427	6,647,325	197	DIN.11391	1,669
38	354,530	6,641,406	200	DIN.10201	1,580
39	355,133	6,641,400	226	DIN.10201	1,559
84	360,651	6,636,597	212	DIN.10580	2,371
85	360,676	6,650,889	215	DIN.10480	2,534
93	362,137	6,649,330	227	DIN.10602	2,174
96	362,404	6,648,867	239	DIN.10602	1,920
97	362,495	6,639,900	244	DIN.10560	1,538
98	362,497	6,639,901	244	DIN.10560	1,540
99	362,742	6,640,406	255	DIN.10591	1,567
104	363,896	6,647,226	279	DIN.10760	1,739
105	364,050	6,646,517	267	DIN.10640	1,617
106	364,245	6,648,758	270	DIN.10780	1,757
109	365,056	6,644,449	273	DIN.10710	1,529
111	365,282	6,642,056	277	DIN.10710	1,583
112	365,344	6,642,028	277	DIN.10710	1,646
114	366,163	6,640,435	299	DIN.10880	1,534

Receiver	Easting, m	Northing, m	Terrain elevation, m	Nearest wind turbine	Distance to the nearest wind turbine, m
115	366,166	6,640,461	299	DIN.10880	1,554
116	366,362	6,646,267	347	DIN.10760	1,543
117	366,639	6,645,017	346	DIN.11470	2,469
118	366,669	6,644,993	346	DIN.11470	2,436
119	366,726	6,640,830	313	DIN.11400	1,197
123	368,291	6,638,133	340	DIN.10841	1,524
128	371,481	6,644,222	351	DIN.11051	1,520
133	374,380	6,644,416	334	DIN.11160	1,558

APPENDIX F NOISE PREDICTION MODEL

In Australia, wind turbine noise predictions are typically calculated using ISO 9613-2:2024, Annex D.²² The use of ISO 9613-2 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*, the South Australian EPA Wind farms environmental noise Planning guideline and the Queensland State code 23: *Wind farm development – Planning guideline*.

A computer model was created in the environmental noise modelling program SoundPLANnoise v9.1 to predict noise levels from the proposed development to relevant receptors in the vicinity of the subject site. The noise model has been used to calculate noise levels at the nearest receptors in accordance with ISO 9613-2

The noise model enables the calculation of noise levels over a wide area, and accounts for key considerations including site arrangement, terrain, and atmospheric conditions.

The ISO 9613-2 standard specifies an engineering method for calculating noise at a known distance from a variety of sources under meteorological conditions that are favourable to sound propagation. The standard defines favourable conditions as downwind propagation where the wind blows from the source to the noise-affected premises within an angle of +/-45 degrees from a line connecting the source to the receptors, 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.

Accordingly, predictions based on ISO 9613-2 account for the instances when local atmospheric conditions at the site favour the propagation of sound to surrounding receptor locations. Under alternative atmospheric conditions, such as when the wind is blowing from a noise-affected premises location to the development site, the noise levels would be lower than calculated.

To calculate far-field noise levels according to the ISO 9613-2, the noise emissions of each 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; and
- ground reflections.

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 noise sensitive receptors.

²² ISO 9613-2:2024 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors* (ISO 9613-2).

APPENDIX G BESS AND SUBSTATIONS PREDICTED NOISE LEVEL CONTOURS

Figure 12: BESS and substation predicted noise level contours

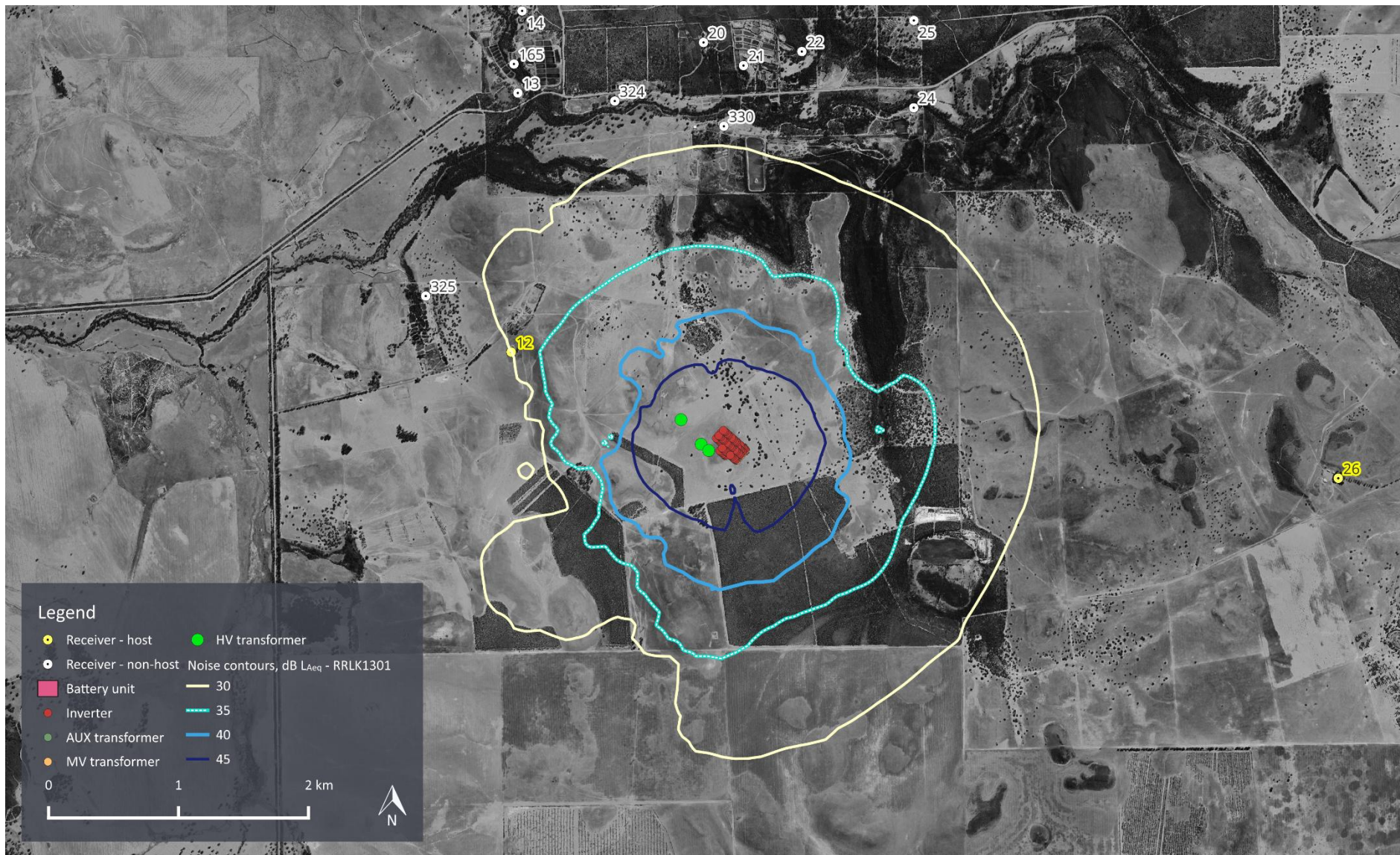


Figure 13: Additional substations predicted noise level contours



APPENDIX H EFFECTS OF WIND TURBINE NOISE

In terms of the effect of wind turbine noise, one of the most important consideration is how the sound is perceived. However, judging whether or not a sound is noisy is highly subjective, and depends on many factors including the setting where the sound is heard, the character of the sound, and factors that influence how an individual perceives the sound.

In recognition of the rural settings where wind farms are usually built, wind farms are required to adhere to strict noise controls. Wind farm policies in Australia are among the most stringent international standards and set limits using a combination of a base (or fixed value) limit and an allowable margin above the background.

H1 Health and amenity

Sound is an important feature of the environment in which we live; it provides information about our surroundings and is a key influence on our overall perception of amenity and environmental quality. Sound is therefore an environmental quality that must be considered as part of any proposal to develop new infrastructure that could influence the sound environment of neighbouring communities.

Excessive or unwanted sound is commonly referred to as noise and can have a range of effects on people, depending on a range of physical and contextual factors. The *Guidelines for Community Noise* 1999 prepared by the World Health Organisation (WHO) provides a health-based framework of guideline limits and values to address the broad definition of health given as:

A state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity

This broad definition means that effects ranging from community annoyance, sleep disturbance and speech interference, through to direct physiological impacts such as hearing damage, are all identified as potential health considerations. An important aspect of this range of considerations is that some effects will be highly dependent on the listener's perception and attitude to the noise in question, such as annoyance, while other effects are primarily related to the level of sound and the direct physiological risks these may represent, such as hearing damage.

Environmental noise policies, including those applied to wind farms, establish objective noise criteria to address these health considerations. In particular, environmental noise policies define criteria which are chosen to prevent direct physiological risks of sound and minimise as far as practically possible adverse health considerations such as annoyance and sleep disturbance.

Practically minimising the risks of noise effects related to annoyance and sleep disturbance requires the potential range of responses to sound to be considered. In this respect, it is important to note that individual attitudes and reactions to sound are highly variable and will depend on a complex set of acoustic and non-acoustic factors. These include the level and character of the sound in question, the time of day the sound occurs, the regularity of the sound, the environment in which the sound is heard, the individuals hearing acuity, and an individual's personal opinion and perception of the sound source or development in question. The latter will in turn depend on other complicating factors such as visual impressions of the source in question and the perceived community benefit, or otherwise, of the source in question.

Due to the complexity and range of potential responses to sound, it is not possible to define limits that will guarantee an audible sound will be acceptable to all individuals; this will always be a matter of personal judgement for each individual. Further, it is usually not feasible or practical to design new development or infrastructure to inaudible noise levels. As a result, minimising the risks of noise effects involves setting criteria which prevents the majority of people from being disturbed. This requires regulatory authorities to strike a balance between amenity and development, setting noise limits which are as stringent as can be practically achieved without preventing new development.

This type of approach to noise policy was outlined by the Victorian Department of Health in their 2013 publication on wind farm sound and health which states:

Noise standards are used not only for environmental noise (such as wind farms and traffic noise) but also for industry and even household appliances.

Noise standards are set to protect the majority of people from annoyance. The wide individual variation in response to noise makes it unrealistic to set standards that will protect everyone from annoyance. A minority of people may still experience annoyance even at sound levels that meet the standard. This is the case not only for wind farms, but for all sources of noise.

The subject of health effects related to operational wind farms in Australia has been extensively considered by the Commonwealth Government's National Health and Medical Research Council (NHMRC) and the Australian Medical Association; in particular, the NHMRC has undertaken and coordinated a systematic review of evidence related to wind farms and health. The research reviews²³ and public statements^{24, 25} produced by these peak health bodies support that, as with any audible sound, wind farm noise can represent a potential source of annoyance or sleep disturbance for some individuals. Their findings did however indicate that there was no reliable evidence to support a relationship between wind farm noise and direct adverse effects on human health.

In July 2012, Health Canada undertook a large-scale epidemiology study in response to community health concerns expressed in relation to wind turbines. The following conclusions²⁶ were made from this research.

The following were not found to be associated with [Wind Turbine Noise] exposure:

- *self-reported sleep (e.g., general disturbance, use of sleep medication, diagnosed sleep disorders);*
- *self-reported illnesses (e.g., dizziness, tinnitus, prevalence of frequent migraines and headaches) and chronic health conditions (e.g., heart disease, high blood pressure and diabetes); and*
- *self-reported perceived stress and quality of life.*

While some individuals reported some of the health conditions above, the prevalence was not found to change in relation to [Wind Turbine Noise] levels.

[...]

The following was found to be statistically associated with increasing levels of [Wind Turbine Noise]:

- *annoyance towards several wind turbine features (i.e. noise, shadow flicker, blinking lights, vibrations, and visual impacts).*

²³ Systematic review of the human health effects of wind farms 2013, Adelaide University, commissioned by the NHMRC

²⁴ NHMRC Information Paper: Evidence on Wind Farms and Human Health, February 2015, National Health and Medical Research Council

²⁵ AMA Position Statement – Wind Farms and Health 2014, Australian Medical Association

²⁶ <https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/everyday-things-emit-radiation/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html>

In 2018, the World Health Organization released the *Environmental Noise Guidelines for the European Region*²⁷ which concluded:

In accordance with the prioritization process, the GDG set a guideline exposure level of 45.0 dB L_{den} for average exposure, based on the relevant increase of the absolute %HA. The GDG stressed that there might be an increased risk for annoyance below this noise exposure level, but it could not state whether there was an increased risk for the other health outcomes below this level owing to a lack of evidence. As the evidence on the adverse effects of wind turbine noise was rated low quality, the GDG made the recommendation conditional.

[...]

Based on the low quantity and heterogeneous nature of the evidence, the GDG was not able to formulate a recommendation addressing sleep disturbance due to wind turbine noise at nighttime.

As detailed in the MDA paper *WHO Environmental Noise Guidelines for the European Region: conditional recommendation for wind turbine noise in the context of Australian regulations*²⁸, achieving compliance with NZS 6808 corresponds to noise levels that are consistent with the recommendations of the 2018 WHO European Noise Guidelines.

These findings lend support to the suitability of the wind farm noise controls applied in SA guidelines, which are intended to provide reasonable protection of health and amenity at noise sensitive locations.

Further discussions of specific noise considerations related low-frequency sound and infrasound are provided in the following section.

H2 Low frequency noise, infrasound and ground vibration

The limits adopted for the assessment of operational noise from wind farms represent relatively low levels which have been specified in recognition of the quieter rural environments in which wind farms are normally located.

However, consistent with noise policies applied to other forms of development, the criteria are not intended to restrict wind farm noise to inaudible levels. Accordingly, a wind farm which achieves compliance with the criteria may still be audible at surrounding receivers on some occasions; this will depend on a range of factors such as the time of day, the speed and direction of the wind, the proximity to wind turbines, the extent of vegetation around the dwelling, and the degree to which the dwelling is sheltered from prevailing wind conditions. Irrespective of the relatively low levels which operational wind farm noise is restricted to, an individual's judgement of the audible noise from a wind farm is highly subjective and will be influenced by a range of contextual factors.

The subject of wind farm noise and its characteristics has attracted considerable attention. Specific attention has been directed to alleged matters relating to low frequency sound as well as infrasound and vibration. Low frequency sounds are generally regarded as sounds above 20 Hz and extending upwards into the range of 100-200 Hz. The definition of infrasound often varies in different jurisdictions but is generally accepted to refer to frequencies of sound which lie below 20 Hz. While 20 Hz is commonly cited as the lower bound of audibility, frequencies below 20 Hz can still be audible, provided that the level of the sound is sufficiently high to exceed the threshold of audibility at those frequencies.

²⁷ <https://www.euro.who.int/en/health-topics/environment-and-health/noise/environmental-noise-guidelines-for-the-european-region>

²⁸ <http://tinyurl.com/WTN2019-Delaire>

In common with many other sources of noise, wind turbines emit infrasound, low frequency sound and ground vibrations. However, what is often overlooked is that these types of sound and vibration are a feature of the everyday environment in which we live and arise from a wide range of natural sources such as the wind and the ocean to man-made sources such as domestic appliances, transportation and agricultural equipment. The important point in relation to wind turbines is that the levels of these types of emissions are low and therefore, in many cases, cannot generally be reliably measured amidst normal background levels.

The NSW Noise Assessment Bulletin states the following concerning infrasound:

there is currently no consistent evidence supporting a link between wind energy projects and adverse health outcomes in humans relating to infrasound.

These types of emissions have been the subject of considerable misrepresentation in media commentary. Notably, the work of Dr Geoff Leventhall, a prominent UK consultant in the field of acoustics and vibration, and researcher in the field of low frequency noise is often cited in some documents which continue to claim concerns about infrasound and low frequency noise from wind turbines. However, Dr Leventhall has regularly made clear statements to assert that there is no significant infrasound from current designs of wind turbines and very little low frequency sound, neither of which are anywhere near the sorts of levels which would represent a direct health risk for neighbouring residents of modern wind farms. An example of such publication, co-authored by Dr Leventhall, was published in the UK Institute of Acoustics Bulletin in March 2009²⁹. This publication was prepared as an agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed by local councils and community groups campaigning against wind farm developments. The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern.

On the subject of infrasound and low frequency noise, the article notes:

Infrasound is the term generally used to describe sound at frequencies below 20Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles. Sounds at frequencies from about 20Hz to 200Hz are conventionally referred to as low frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view.

A Portuguese group has been researching 'Vibro-acoustic Disease' (VAD) for about 25 years. Their research initially focussed on aircraft technicians who were exposed to very high overall noise levels, typically over 120dB. A range of health problems has been described for the technicians, which the researchers linked to high levels of low frequency noise exposure. However other research has not confirmed this. Wind farms expose people to sound pressure levels orders of magnitude less than the noise levels to which the aircraft technicians were exposed. The Portuguese VAD group has not produced evidence to support their new hypothesis that infrasound and low frequency noise from wind turbines causes similar health effects to those experienced by the aircraft technicians.

²⁹ Institute of Acoustics Bulletin – Bowdler, Bullmore, Davis, Hayes, Jiggins, Leventhall, McKenzie - *Prediction and Assessment of Wind Turbine Noise* –March 2009

Another example of the misrepresentations made in relation to the environmental effects of wind turbines centred around work carried out by Keele University in the UK on ground vibration. Professor Peter Styles and his team at Keele University undertook a study of the effects of wind turbines on the seismic detection array at Eskdalemuir, Scotland. The results of this work were widely misinterpreted and resulted in a statement³⁰ from Professor Styles:

We are writing to clarify some misconceptions [...] about wind farm noise. Whilst it is technically correct that ‘vibrations can be picked up as far away as 10km’, to give the impression that they can be felt at this distance is highly misleading. The levels of vibration from wind turbines are so small that only the most sophisticated instrumentation and data processing can reveal their presence, and they are almost impossible to detect. The Dunlaw study was designed to measure effects of extremely low level vibration on one of the quietest sites (Eskdalemuir) in the world, and one which houses one of the most sensitive seismic installations in the world. Vibrations at this level and in this frequency range will be available from all kinds of sources such as traffic and background noise – they are not confined to wind turbines. To put the level of vibration into context, they are ground vibrations with amplitudes of about one millionth of a millimetre. There is no possibility of humans sensing the vibration and absolutely no risk to human health. It is, however, an issue for the Eskdalemuir seismic array, as it can detect this level of vibration. It is designed to detect explosions and earthquakes of a low magnitude from all over the world. The infrasound generated by wind turbines can only be detected by the most sensitive equipment, and again this is at levels far below that at which humans will detect the low frequency sound. There is no scientific evidence to suggest that infrasound has an impact on human health.

More recent measurements^{31, 32} have demonstrated that infrasound and low frequency sound produced by regularly encountered natural and man-made sources, such as the infrasound produced by the wind or distant traffic, is comparable to that of modern wind turbines, noting that:

Infrasound levels in the rural environment appear to be controlled by localised wind conditions. During low wind periods, levels as low as 40dB(G) were measured at locations both near to and away from wind turbines. At higher wind speeds, infrasound levels of 50 to 70dB(G) were common at both wind farm and non-wind farm sites.

Organised shutdowns of the wind farms adjacent to [sic: measurement locations] indicate that there did not appear to be any noticeable contribution from the wind farm to the G-weighted infrasound level measured at either house. This suggests that wind turbines are not a significant source of infrasound at houses located approximately 1.5 kilometres away from wind farm sites

³⁰ Keele University Rejects Renewable Energy Foundation’s Low Frequency Noise Research Claims

³¹ Sonus report for Pacific Hydro - Infrasound measurements from wind farms and other sources – November 2010
See http://www.pacifichydro.com.au/media/192017/infrasound_report.pdf

³² Evans, T., Cooper, J. & Lenchine, V., *Infrasound levels near wind farms and in other environments*, South Australian Environment Protection Authority, Adelaide, 2013 - See https://www.epa.sa.gov.au/files/477912_infrasound.pdf

In 2010, the UK Health Protection Agency published a report³³ on the health effects of exposure to ultrasound and infrasound. The exposures considered in the report related to medical applications and general environmental exposure. The report notes:

Infrasound is widespread in modern society, being generated by cars, trains and aircraft, and by industrial machinery, pumps, compressors and low speed fans. Under these circumstances, infrasound is usually accompanied by the generation of audible, low frequency noise. Natural sources of infrasound include thunderstorms and fluctuations in atmospheric pressure, wind and waves, and volcanoes; running and swimming also generate changes in air pressure at infrasonic frequencies.

[...]

For infrasound, aural pain and damage can occur at exposures above about 140 dB, the threshold depending on the frequency. The best-established responses occur following acute exposures at intensities great enough to be heard and may possibly lead to a decrease in wakefulness. The available evidence is inadequate to draw firm conclusions about potential health effects associated with exposure at the levels normally experienced in the environment, especially the effects of long-term exposures. The available data do not suggest that exposure to infrasound below the hearing threshold levels is capable of causing adverse effects.

Also, a State Government of Victorian Department of Health document³⁴ concludes the following in relation to infrasound from wind farms:

Infrasound is audible when the sound levels are high enough. The hearing threshold for infrasound is much higher than other frequencies. Infrasound from wind farms is at levels well below the hearing threshold and is therefore inaudible to neighbouring residents.

These studies all indicate that infrasound levels from the proposed project are anticipated to be comparable with existing ambient levels.

In February 2015, the National Health and Medical Research Council (NHMRC) released an information paper³⁵ addressing human health effects of wind farms which includes consideration of noise.

From well over 4,000 articles which were identified during the NHMRC review, only thirteen (13) studies across Europe, North America and Australia satisfied a set of pre-specified eligibility criteria for detailed review and therefore form the basis of the report, which concludes:

Examining whether wind farm emissions may affect human health is complex, as both the character of the emissions and individual perceptions of them are highly variable. After careful consideration and deliberation of the body of evidence, NHMRC concludes that there is currently no consistent evidence that wind farms cause adverse health effects in humans. Given the poor quality of current direct evidence and the concern expressed by some members of the community, high quality research into possible health effects of wind farms, particularly within 1,500 metres (m), is warranted.

These studies all indicate that infrasound levels are anticipated to be comparable with existing ambient levels and, as such, are not expected to represent an impact from the proposed wind farm. Similarly, vibration levels from wind turbines are well below perception thresholds, and low frequency levels are typically low.

³³ Health Protection Agency UK – *Health Effects of Exposure to Ultrasound and Infrasound – Report of the independent Advisory Group on Non-ionising Radiation* - 2010

³⁴ [Public Statement: Wind Turbines and Health - July 2010](#)

³⁵ *Information Paper - Evidence on Wind Farms and Human Health*, February 2015

APPENDIX I TABULATED PREDICTED NOISE LEVELS

Table 19: Predicted noise levels at non-host receivers (Dinner Hill Wind Farm only, no curtailment), dB L_{Aeq}

Receiver	Hub-height wind speed, m/s								
	4	5	6	7	8	9	10	11	≥12
329	27.3	27.4	29.2	31.9	34.7	36.8	37.5	37.5	37.5
77	26.1	26.2	28.0	30.7	33.5	35.6	36.3	36.3	36.3
113	25.7	25.8	27.6	30.3	33.1	35.2	35.9	35.9	35.9
88	25.7	25.8	27.6	30.3	33.1	35.2	35.9	35.9	35.9
103	25.6	25.7	27.5	30.2	33.0	35.1	35.8	35.8	35.8
32	25.4	25.5	27.3	30.0	32.8	34.9	35.6	35.6	35.6
91	25.2	25.3	27.1	29.8	32.6	34.7	35.4	35.4	35.4
95	24.8	24.9	26.7	29.4	32.2	34.3	35.0	35.0	35.0
155	24.0	24.1	25.9	28.6	31.4	33.5	34.2	34.2	34.2
90	23.9	24.0	25.8	28.5	31.3	33.4	34.1	34.1	34.1
89	23.9	24.0	25.8	28.5	31.3	33.4	34.1	34.1	34.1
36	23.9	24.0	25.8	28.5	31.3	33.4	34.1	34.1	34.1
325	22.7	22.8	24.6	27.3	30.1	32.2	32.9	32.9	32.9
29	22.2	22.3	24.1	26.8	29.6	31.7	32.4	32.4	32.4
167	22.1	22.2	24.0	26.7	29.5	31.6	32.3	32.3	32.3
330	22.0	22.1	23.9	26.6	29.4	31.5	32.2	32.2	32.2
24	21.3	21.4	23.2	25.9	28.7	30.8	31.5	31.5	31.5
324	20.6	20.7	22.5	25.2	28.0	30.1	30.8	30.8	30.8
21	20.5	20.6	22.4	25.1	27.9	30.0	30.7	30.7	30.7
22	20.2	20.3	22.1	24.8	27.6	29.7	30.4	30.4	30.4
20	19.8	19.9	21.7	24.4	27.2	29.3	30.0	30.0	30.0

Table 20: Predicted noise levels at host receivers (Dinner Hill Wind Farm only, no curtailment), dB L_{Aeq}

Receiver	Hub-height wind speed, m/s								
	4	5	6	7	8	9	10	11	≥12
123	31.1	31.2	33.0	35.7	38.5	40.6	41.3	41.3	41.3
98	30.4	30.5	32.3	35.0	37.8	39.9	40.6	40.6	40.6
97	30.4	30.5	32.3	35.0	37.8	39.9	40.6	40.6	40.6
114	30.4	30.5	32.3	35.0	37.8	39.9	40.6	40.6	40.6
119	30.4	30.5	32.3	35.0	37.8	39.9	40.6	40.6	40.6
115	30.3	30.4	32.2	34.9	37.7	39.8	40.5	40.5	40.5
99	30.3	30.4	32.2	34.9	37.7	39.8	40.5	40.5	40.5
116	29.6	29.7	31.5	34.2	37.0	39.1	39.8	39.8	39.8
39	29.4	29.5	31.3	34.0	36.8	38.9	39.6	39.6	39.6
128	29.4	29.5	31.3	34.0	36.8	38.9	39.6	39.6	39.6
105	29.3	29.4	31.2	33.9	36.7	38.8	39.5	39.5	39.5
109	29.3	29.4	31.2	33.9	36.7	38.8	39.5	39.5	39.5
133	29.3	29.4	31.2	33.9	36.7	38.8	39.5	39.5	39.5
111	28.9	29.0	30.8	33.5	36.3	38.4	39.1	39.1	39.1
37	28.9	29.0	30.8	33.5	36.3	38.4	39.1	39.1	39.1
112	28.8	28.9	30.7	33.4	36.2	38.3	39.0	39.0	39.0
104	28.7	28.8	30.6	33.3	36.1	38.2	38.9	38.9	38.9
106	28.4	28.5	30.3	33.0	35.8	37.9	38.6	38.6	38.6
38	28.3	28.4	30.2	32.9	35.7	37.8	38.5	38.5	38.5
117	27.6	27.7	29.5	32.2	35.0	37.1	37.8	37.8	37.8
118	27.6	27.7	29.5	32.2	35.0	37.1	37.8	37.8	37.8
96	27.5	27.6	29.4	32.1	34.9	37.0	37.7	37.7	37.7
93	26.9	27.0	28.8	31.5	34.3	36.4	37.1	37.1	37.1
27	26.2	26.3	28.1	30.8	33.6	35.7	36.4	36.4	36.4
31	25.8	25.9	27.7	30.4	33.2	35.3	36.0	36.0	36.0
85	25.7	25.8	27.6	30.3	33.1	35.2	35.9	35.9	35.9
12	25.8	25.9	27.7	30.4	33.2	35.3	36.0	36.0	36.0
84	24.8	24.9	26.7	29.4	32.2	34.3	35.0	35.0	35.0
30	24.3	24.4	26.2	28.9	31.7	33.8	34.5	34.5	34.5
26	24.0	24.1	25.9	28.6	31.4	33.5	34.2	34.2	34.2