# Winterbourne Wind Farm

## Noise and Vibration Assessment

October 2022

S6207C14

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## GLOSSARY

| | |
|---|---|
| A-weighting | Frequency adjustment applied to measured noise levels to replicate the frequency response of the human ear. |
| AGL | Above Ground Level. |
| Ambient noise level | The noise level of all existing noise sources in the environment (in the absence of the wind farm). |
| Background noise level | The ambient noise level which excludes intermittent noise sources. |
| BESS | Battery Energy Storage System |
| C-weighting | Frequency adjustment applied to measured noise levels to indicate low frequency content. |
| CONCAWE | The oil companies' international study group for conservation of clean air and water - Europe, *The propagation of noise from petrochemical complexes to neighbouring communities* (May 1981). |
| dB(A) | A-weighted noise in decibels. |
| dB(C) | C-weighted noise in decibels. |
| DEC 2006 | New South Wales Department of Environment and Conservation *Assessing Vibration: a technical guideline* (2006). |
| Construction Noise Guideline | New South Wales Department of Environment and Climate Change *Interim Construction Noise Guideline* (2009). |
| NSW Road Noise Policy | Department of Environment, Climate Change and Water *NSW Road Noise Policy* (2011). |
| EPA | Environment Protection Authority. |
| Equivalent noise level | Energy averaged noise level over a period of time. |
| Intermittent noise sources | Noise caused by infrequently occurring events such as from aircraft , dogs barking, mobile farm machinery and the occasional vehicle movements. |
| Involved dwelling | Any dwelling where the landowner has reached a financial or in kind agreement in relation to the wind farm (except where the agreement excludes noise impacts). |
| $L_{A90, \text{ time period}}$ | A-weighted noise level exceeded for 90% of defined time period. Represents the background noise level for the defined time period. |
| $L_{Aeq, \text{ time period}}$ | A-weighted equivalent noise level over a defined time period. |
| RBL | The Rating Background Level is an overall, single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period |
| SA 2009 | South Australian Environment Protection Authority *Wind Farms Environmental Noise Guidelines* (2009). |
| SEARs | Secretary's Environmental Assessment Requirements. |
| Sound power level | A measure of the sound energy emitted from a source of noise. |
| NPI | New South Wales Environment Protection Authority *Noise Policy for Industry* (2017). |
| The Project | Winterbourne Wind Farm |
| The Bulletin | New South Wales Planning and Environment *Wind Energy: Noise Assessment Bulletin* (2016). |
| Non-involved dwelling | Not an Involved dwelling. |
| Weather category 6 | The CONCAWE weather conditions which is most conducive for the propagation of noise, resulting in highest predicted noise levels. |
| WHO Guidelines | *World Health Organisation Guidelines for Community Noise.* |
| Worst-case | Operational and weather conditions which result in the highest noise level at a dwelling |
| WTG | Wind turbine generator. |

## 1 INTRODUCTION

A noise and vibration assessment has been made of the construction and operation of the proposed Winterbourne Wind Farm (the **Project**). The Project is located approximately 6.5km northeast of Walcha in the Northern Tablelands region of New South Wales (**NSW**).

The proposed wind farm consists of up to 119 wind turbine generators (**WTGs**) with a maximum tip height of 230m and ancillary infrastructure, including substations, a battery energy storage system (**BESS**), new and upgraded roads, overhead cabling and underground cabling. Temporary construction facilities, including batching and crushing facilities will also operate during the construction period.

The NSW Department of Planning, Industry and Environment has provided *Secretary's Environmental Assessment Requirements* (**SEARs**) for the assessment of noise and vibration from the Project. The noise and vibration related sections of the SEARs are provided in Appendix A of this report and seek the following assessment framework:

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

This noise and vibration assessment addresses each of the SEARs.

## 2 PROJECT LAYOUT

### 2.1 Wind Turbines

The coordinates of the 119 WTG layout are provided in Table 1 and the locations of the ancillary infrastructure and batching and crushing facilities are provided in Table 2.

**Table 1: Coordinates of WTGs**

| Turbine ID | Turbine Coordinates (UTM WGS84 56J) | |
|---|---|---|
| | Easting | Northing |
| B001 | 375828 | 6590869 |
| B002 | 375652 | 6590371 |
| B003 | 375618 | 6589834 |
| B004 | 375275 | 6589423 |
| B005 | 374739 | 6589304 |
| B006 | 374432 | 6588438 |
| B007 | 374100 | 6588076 |
| B011 | 368111 | 6585525 |
| B012 | 368647 | 6585231 |
| B013 | 369137 | 6584946 |
| B014 | 369259 | 6584381 |
| B015 | 369652 | 6583823 |
| B016 | 369731 | 6583321 |
| B018 | 370123 | 6582740 |
| B019 | 370091 | 6582074 |
| B020 | 369781 | 6581508 |
| B021 | 369712 | 6580984 |
| B023 | 365590 | 6583241 |
| B024 | 365941 | 6582729 |
| B025 | 366255 | 6582233 |
| B026 | 366405 | 6581690 |
| B027 | 366643 | 6580825 |
| B028 | 367018 | 6580394 |
| B029 | 367163 | 6579707 |
| B030 | 367362 | 6579162 |
| B032 | 367273 | 6578380 |
| B033 | 367523 | 6577620 |
| B034 | 367601 | 6577111 |
| B036 | 368799 | 6578041 |
| B037 | 368677 | 6577562 |
| B038 | 369072 | 6577273 |
| B039 | 369053 | 6576781 |
| B044 | 369592 | 6578929 |
| B045 | 369428 | 6579887 |
| B046 | 378440 | 6584091 |
| B047 | 378880 | 6583793 |
| B048 | 378894 | 6583005 |
| B051 | 380341 | 6585758 |
| B052 | 380240 | 6585140 |
| B053 | 380324 | 6584604 |
| B054 | 379855 | 6584419 |
| B056 | 387034 | 6586730 |

| Turbine ID | Turbine Coordinates (UTM WGS84 56J) | |
|---|---|---|
| | Easting | Northing |
| B057 | 386533 | 6586241 |
| B060 | 386061 | 6586007 |
| B061 | 385968 | 6585507 |
| B062 | 385649 | 6584921 |
| B063 | 387183 | 6583063 |
| B064 | 387660 | 6582642 |
| B065 | 388015 | 6582186 |
| B066 | 388232 | 6581633 |
| B068 | 388996 | 6581504 |
| B069 | 388829 | 6580914 |
| B070 | 389165 | 6580513 |
| B071 | 380089 | 6580147 |
| B072 | 380924 | 6580571 |
| B073 | 380194 | 6581346 |
| B074 | 380608 | 6581057 |
| B076 | 380784 | 6582284 |
| B078 | 381488 | 6581778 |
| B079 | 381814 | 6581381 |
| B081 | 382630 | 6580415 |
| B082 | 382731 | 6579838 |
| B083 | 381991 | 6582601 |
| B086 | 384507 | 6582082 |
| B087 | 384243 | 6581492 |
| B088 | 383962 | 6581030 |
| B092 | 384964 | 6580578 |
| B093 | 385212 | 6579852 |
| B100 | 384128 | 6578295 |
| B101 | 383821 | 6577802 |
| B102 | 383689 | 6577341 |
| B105 | 386072 | 6579831 |
| B107 | 386685 | 6579594 |
| B108 | 386693 | 6578782 |
| B109 | 386401 | 6578341 |
| B110 | 387581 | 6577821 |
| B111 | 386332 | 6577759 |
| B112 | 386377 | 6577011 |
| B113 | 386308 | 6576515 |
| B115 | 386941 | 6575797 |
| B116 | 387272 | 6574897 |
| B118 | 386619 | 6573827 |
| B119 | 386566 | 6573253 |
| B120 | 386875 | 6572842 |

| Turbine ID | Turbine Coordinates (UTM WGS84 56J) | |
|---|---|---|
| | Easting | Northing |
| B121 | 386483 | 6572440 |
| B122 | 388916 | 6572121 |
| B123 | 389233 | 6571684 |
| B124 | 387721 | 6571856 |
| B127 | 391240 | 6570525 |
| B128 | 390760 | 6570151 |
| B129 | 390556 | 6569657 |
| B130 | 391120 | 6569366 |
| B131 | 391132 | 6568970 |
| B132 | 391059 | 6568461 |
| B138 | 386216 | 6568123 |
| B139 | 386653 | 6567836 |
| B140 | 386442 | 6567135 |
| B141 | 386426 | 6566677 |
| B142 | 386479 | 6566208 |
| B144 | 387968 | 6566691 |
| B145 | 388261 | 6565947 |
| B146 | 389118 | 6566222 |
| B149 | 391317 | 6567314 |
| B151 | 393063 | 6566094 |
| B152 | 393594 | 6565827 |
| B153 | 393480 | 6565306 |
| B154 | 394106 | 6565126 |
| B160 | 370523 | 6584164 |
| B161 | 370454 | 6583408 |

| Turbine ID | Turbine Coordinates (UTM WGS84 56J) | |
|---|---|---|
| | Easting | Northing |
| B168 | 381631 | 6579452 |
| B167 | 369125 | 6581617 |
| B169 | 381631 | 6578923 |
| B170 | 381578 | 6578013 |
| B171 | 381842 | 6577595 |
| B172 | 369147 | 6580330 |
| B173 | 379245 | 6588702 |
| B174 | 379266 | 6588197 |
| B175 | 379314 | 6587679 |
| B176 | 375067 | 6588639 |

**Table 2: Coordinates of Ancillary Infrastructure**

| ID | Approximate Coordinates (UTM WGS84 56J) | |
|---|---|---|
| | Easting | Northing |
| **Substations/BESS** | | |
| *North* | 373619 | 6583711 |
| *BESS* | 373619 | 6583711 |
| *South* | 386963 | 6575283 |
| **Switching Station** | | |
| *Uralla* | 356058 | 6601369 |
| **Temporary Batching & Crushing Plant** | | |
| *Plant 1* | 371815 | 6582879 |
| *Plant 2* | 383431 | 6579158 |
| *Plant 3* | 386687 | 6569454 |

## 2.2 Dwellings in the Vicinity of the Wind Farm

All dwellings located in the vicinity of the wind farm site[1] are listed in Appendix B, as well as their status as either involved or non-involved and the distance to the closest wind turbine. The closest background noise monitoring location to each dwelling is also noted (refer to the background noise monitoring section of this assessment for further detail).

Appendix C provides the address of dwellings where the $L_{Aeq,\ 10min}$ noise level from operation of wind turbines is predicted to be greater than 30 dB(A) (refer to Section 4 of this report).

[1] Dwellings within approximately 9 kilometres of the nearest WTG

## 3 ASSESSMENT METHODOLOGY

The noise related SEARs for the Project establish the following assessment framework:

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

Each of the above assessment elements is described in further detail below.

### 3.1 Wind Turbines

The SEARs reference the New South Wales Planning and Environment *Wind Energy: Noise Assessment Bulletin* (the **Bulletin**) for the assessment of operational noise from the wind turbine generators.

The Bulletin adopts the South Australian Environment Protection Authority *Wind Farms – Environmental Noise Guidelines* (**SA 2009**) as the basis of the regulatory noise standard and assessment methodology in NSW.

The SA Noise Guidelines was developed with the "*core objective……to balance the advantage of developing wind energy projects ... with protecting the amenity of the surrounding community from adverse noise impacts"*.

The Bulletin states that:

> [The] *NSW Government recognises that rural land use zones in NSW are often more densely settled than those of South Australia and that there is a relatively high density of rural residential living in parts of regional NSW with reliable wind resources.*
>
> *Therefore only the lower base noise criteria in [the SA Noise Guidelines] will be applied in NSW. This Criteria is defined as:*

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

*Non-involved Dwellings*

Based on the Bulletin, noise from the wind farm at non-involved dwellings should not exceed an outdoor $L_{Aeq,\ 10min}$ noise level of 35 dB(A) or the background noise ($L_{A90,\ 10\ min}$) by more than 5 dB(A), whichever is the greater.

*Involved Dwellings*

Where a landowner has formed a commercial agreement with the developer, the Bulletin enables less onerous noise criteria to be used.

The noise criteria at involved dwellings have not been specified and therefore this report provides predicted noise levels at the involved residences, but does not consider objective criteria.

### 3.1.1 Special Noise Characteristics

The Bulletin prescribes a 5 dB(A) penalty adjustment (added to the measured or predicted noise level) for the presence of repeated and excessive tonality and/or low frequency which occurs for more than 10 percent of an assessment period. Excessive tonality and low frequency are determined as follows:

**Tonality**

The Bulletin references the methodology described in *ISO 1996.2: 2007 Acoustics - Description, measurement and assessment of environmental noise – Determination of environmental noise levels (Annex D – Objective method for assessing the audibility of tones in noise – Simplified method)*. Excessive tonality is present at a particular one-third octave band level if the band level exceeds the adjacent bands on both sides by at least:

- 5 dB , if the centre frequency of the band is in the range 500 Hz to 10,000 Hz;
- 8 dB, if the centre frequency of the band is in the range 160 Hz to 400 Hz; and/or
- 15 dB, if the centre frequency of the band is in the range 25 Hz to 125 Hz.

The penalty for tonality only applies if the tone from the wind farm is audible at the receiver location. The absence of a tone at a location in the vicinity of a WTG (where noise from the WTG is dominant in

comparison to the ambient environment) will be sufficient to demonstrate that the wind farm noise at the relevant receiver location is non-tonal.

**Low Frequency Noise**

Excessive low frequency noise is present if the low frequency $L_{Ceq,\ 10min}$ noise levels at non-involved dwellings exceed 60 dB(C).

### 3.2 Ancillary Infrastructure

The SEARs reference the New South Wales Environment Protection Authority's *Noise Policy for Industry* (the **NPI**) for the assessment of noise from ancillary infrastructure such as substations.

The NPI establishes *noise trigger levels,* which if exceeded, require management measures to be considered to reduce the noise level. The *noise trigger levels are* based on either the:

- existing background noise environment (intrusiveness noise levels); or,
- the amenity for particular land uses (amenity noise levels).

The *noise trigger levels* are the lower of the values provided by the two methods, which in a rural environment will generally be the *intrusiveness noise levels* given their link to the background noise level.

In accordance with the NPI, the Rating Background Level (**RBL**) is used to determine the *intrusiveness noise levels* for each of the day, evening and night periods. The RBL is determined from the lower tenth percentile of the measured background noise level ($L_{A90,\ 15\ minute}$) in the environment, effectively representing the quietest periods of the noise monitoring. The NPI also provides minimum RBL levels for quiet environments.

Further detail is provided regarding the existing background noise environment and resulting criteria in the Ancillary Infrastructure Section of this report.

### 3.3 Construction

The SEARs reference the New South Wales Department of Environment & Climate Change *Interim Construction Noise Guideline* (**Construction Noise Guideline**) for the assessment of construction noise.

The construction of a wind farm comprises activities such as road construction, civil works, excavation, foundation construction, electrical infrastructure works and turbine erection. These construction activities require processes such as heavy vehicle movements, crushing and screening, concrete batching, use of mobile plant and equipment (such as loaders, excavators, generators, cranes) and potentially blasting subject

to site conditions.

The Construction Noise Guideline provides an emphasis on implementing "feasible" and "reasonable" noise reduction measures and does not establish mandatory objective criteria. However, the Construction Noise Guideline does establish different "management levels" based on the existing RBL.

For the assessment of any blasting which is required, the Construction Noise Guideline references the *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration,* (ANZEC 1990) (the **ANZEC Guidelines**). The ANZEC Guidelines provide objective limits to be achieved at sensitive receivers for overpressure and ground vibration from blasting.

### 3.4 Traffic

The SEARs reference the New South Wales Department of Environment, Climate Change and Water *NSW Road Noise Policy* (**NSW Road Noise Policy**) for the assessment of traffic noise.

Whilst there is no specific category for a wind farm and its construction activities, the most appropriate classification for traffic associated with the wind farm within the NSW Road Noise Policy is considered to be provided by "*Local Roads - Existing dwellings affected by additional traffic on existing local roads generated by land use developments*".

The traffic associated with the wind farm will predominantly occur during construction. However, it should be noted that the NSW Road Noise Policy criterion / classification applies to an ongoing operation, as distinct to a temporary process and as such provides a conservative criterion for comparison with the predicted noise levels during construction. When taking this factor into account, the criterion can therefore be exceeded without unreasonable impacts to non-involved landowners, provided suitable noise reduction measures and work practices are implemented.

### 3.5 Vibration

The SEARs reference the New South Wales Department of Environment and Conservation *Assessing Vibration: a technical guideline* (**DEC 2006**) for the assessment of vibration.

DEC 2006 provides an emphasis on construction activity implementing feasible and practicable vibration reduction measures and establishes goal vibration levels for continuous, intermittent and impulsive vibration based on human response.

For construction activity occurring during the day time, the DEC 2006 can be interpreted to provide goal vibration levels criteria at the dwellings based on the British Standard *BS 6472-1992 "Evaluation of human exposure to vibration in buildings (1-80Hz)".*

### 3.6 National Parks

In addition to the noise impact at dwellings, the SEARs require consideration of the impact on amenity/recreational uses within the Oxley Wild Rivers National Park (including walking tracks, campgrounds and lookouts). The requirements reference the *NSW Noise Policy for Industry* (EPA, 2017).

# 4 WIND TURBINE OPERATION

## 4.1 Background Noise Monitoring

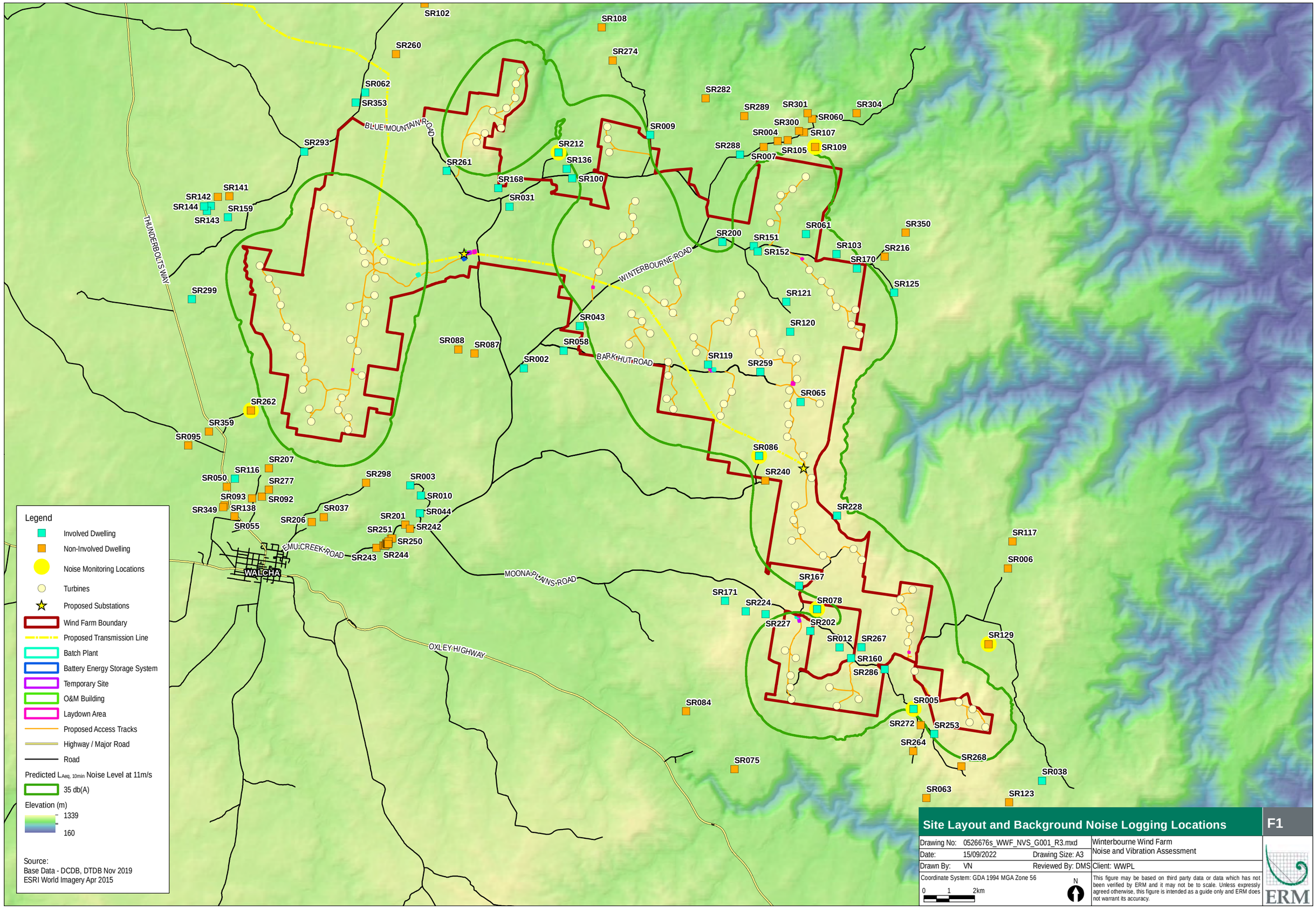
Background noise monitoring has been conducted at seven dwellings in the vicinity of the proposed wind farm, between 28 November 2020 and 1 February 2021. The monitoring was conducted in accordance with SA 2009.

The 7 monitoring locations, as summarised in Table 3 and shown in the figure below, were selected based on preliminary noise predictions of the initial wind farm layout[2]. Preference was given to dwellings with the highest predicted noise levels in each direction of the wind farm and without agreement at the time of the monitoring, subject to permission being granted by the landowner to place equipment.

**Table 3: Monitoring locations and periods**

| Dwelling ID | Coordinates (UTM WGS84 56J) | | Monitoring Period |
|---|---|---|---|
| | Easting | Northing | |
| SR005 | 391269 | 6565826 | 28/11/2020 - 1/2/2021 |
| SR078 | 387492 | 6569749 | 28/11/2020 - 1/2/2021 |
| SR086 | 385205 | 6575756 | 28/11/2020 - 1/2/2021 |
| SR109 | 387413 | 6587897 | 1/2/2021 – 18/3/2021 |
| SR129 | 394221 | 6568377 | 28/11/2020 - 29/1/2021 |
| SR212 | 377321 | 6587671 | 28/11/2020 - 29/1/2021 |
| SR262 | 365240 | 6577539 | 28/11/2020 - 1/2/2021 |

[2] It is noted that the figure shows the turbine layout and predictions at the time of the background noise monitoring (showing why specific residences were selected), but the status of dwellings has since been updated and these changes are included.




## Site Layout and Background Noise Logging Locations

F1

| | | | |
|---|---|---|---|
| Drawing No: | 0526676s_WWF_NVS_G001_R3.mxd | | Winterbourne Wind Farm<br>Noise and Vibration Assessment |
| Date: | 15/09/2022 | Drawing Size: A3 | |
| Drawn By: | VN | Reviewed By: DMS | Client: WWPL |

Coordinate System: GDA 1994 MGA Zone 56

0 1 2km

N



ERM

The background noise was measured with *Rion Type 2* sound level meters, with a noise floor of less than 20 dB(A), calibrated at the beginning and end of the measurement period with a *Rion NC74* calibrator (negligible drift observed). All microphones were fitted with weatherproof windshields having a diameter of greater than 150mm, with the microphone positioned approximately 1500mm above ground level. Each noise logger was placed in accordance with SA 2009 (e.g., at an equivalent distance from the facade of the dwelling as any significant trees whilst minimising the influence of fixed noise sources such as air conditioning units) and placed on the wind farm side of the dwellings.

The background $L_{A90,\ 10min}$ noise level was measured in 10 minute intervals at each of the monitoring locations. Photographs of the noise monitoring equipment are provided in Appendix D.

During the background noise monitoring regime, wind speed was measured by the developer at four wind masts located within the wind farm site. The wind speed was measured in 10 minute intervals at various measurement heights on each wind mast and has been sheared up by the developer to a reference height of 155m. A height of 155m was considered equivalent to the hub height under consideration at the time of the monitoring regime, in accordance with SA 2009.

Wind speed increases with height above ground, and therefore a higher reference hub height results in a higher wind speed for the same measured background noise level. As the noise from wind turbines increases with wind speed, a higher assumed hub height (and therefore reference wind speed) results in more onerous criteria. Therefore, noise criteria determined based on the 155m hub height provide a conservative assessment approach (more onerous criteria) for lower hub heights, such as the representative candidate turbine used for this assessment (149m hub height). That is, if the background noise levels were correlated to wind speeds referenced at 149m, the resulting criteria would be marginally higher.

Table 4 provides details of the wind masts.

**Table 4: Wind mast details**

| Mast ID | Coordinates (UTM WGS84 56J) | |
|---|---|---|
| | Easting | Northing |
| Walcha Mast | 385152 | 6580287 |
| Winterbourne Mast 1 | 380230 | 6584873 |
| Winterbourne Mast 2 | 367324 | 6579314 |
| Winterbourne Mast 3 | 390761 | 6570087 |

Local weather loggers were also deployed, which measured rainfall and wind speed at approximately 1.5m above ground level. The rainfall and wind speed data were collected to determine the periods when weather directly on the microphone may have influenced the measured background noise levels in the vicinity. Table 5 summarises the location and monitoring period of the local weather loggers, with rain fall collected at all locations and wind speed at locations SR109 and SR129.

**Table 5: Local weather logger details**

| Dwelling ID | Monitoring Period |
|---|---|
| SR109 | 1/2/2021 – 18/3/2021 |
| SR129 | 28/11/2020 – 29/1/2021 |
| SR262 | 28/11/2020 – 1/2/2021 |

The noise data corresponding to any periods of measured rainfall and/or measured wind speed exceeding 5 m/s at the microphone height for more than 90% of the measurement period were discarded. These periods correspond to times when rain on the wind shield or the excessive wind on the microphone may have artificially increased the noise level.

In addition, data corresponding to periods with an average wind speed below the cut-in wind speed (i.e. 3m/s) and above the rated power wind speed (approximately 12m/s) were also discarded.

Table 6 summarises the number of data points at each monitoring location before and after the removal of data points, as well as the number of data points collected in the downwind (worst case) wind direction.

**Table 6: Data points**

| Dwelling ID | Closest Wind Mast | Number of Data Points | | |
|---|---|---|---|---|
| | | Total Collected | Total Collected In The Downwind Direction | Remaining After Removal (included in correlations) |
| SR005 | Mast 3 | 9351 | 1628 | 6852 |
| SR078 | Mast 3 | 9353 | 1052 | 6852 |
| SR086 | Walcha Mast | 9351 | 3548 | 7236 |
| SR109 | Mast 1 | 6500 | 513 | 5584 |
| SR129 | Mast 3 | 8948 | 753 | 6496 |
| SR212 | Mast 1 | 8885 | 4766 | 7167 |
| SR262 | Mast 2 | 9317 | 4201 | 6887 |

Following data removal, the background noise data were correlated with the wind speed at 155m above ground level, measured at the closest wind mast (as provided in Table 6). Any extraneous noise identified in each graph (clear outlying points or clusters of data) has been removed. A least squares regression analysis of the data was undertaken to determine the line of best fit for the correlations in accordance with SA 2009. The data and the regression curves are shown in Appendix E. Based on the regression analysis, the

background $L_{A90,10min}$ noise level at a range of wind speeds within the operating range of the wind turbine is provided in the following table.

**Table 7: Background noise level $L_{A90, 10min}$ (dB(A))**

| Dwelling ID | Integer Wind Speeds at 155m Above Ground Level | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 3m/s | 4m/s | 5m/s | 6m/s | 7m/s | 8m/s | 9m/s | 10m/s | 11m/s | 12m/s |
| SR005 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 38 | 38 |
| SR078 | 30 | 30 | 31 | 32 | 33 | 34 | 34 | 35 | 36 | 36 |
| SR086 | 32 | 32 | 33 | 33 | 34 | 34 | 34 | 35 | 35 | 34 |
| SR109 | 26 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 |
| SR129 | 30 | 30 | 31 | 31 | 32 | 33 | 34 | 35 | 36 | 36 |
| SR212 | 27 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 34 |
| SR262 | 27 | 28 | 28 | 29 | 30 | 30 | 31 | 32 | 33 | 34 |

The correlation coefficient of each regression curve in Appendix E indicates the relationship between the background noise at the dwelling and the wind speed at the wind farm site. A low correlation co-efficient indicates a limited relationship, as will naturally occur in many circumstances including locations that are shielded from the wind across the wind farm site, rather than indicating any deficiency in the data analysis.

It is noted that high noise levels have been measured across the entire wind speed range. This indicates that background noise levels in the vicinity of the dwellings are not entirely controlled by the wind speed. Other factors which are independent of wind speed such as insects are likely to also contribute to the background noise levels.

At residence SR005, the measured noise levels are significantly higher at low wind speeds. There were no fixed noise sources in the vicinity of the noise logger noted at the time of placement or collection and therefore the data is still considered representative of the environment at this location. Notwithstanding, given the discrepancy with noise levels at other logging locations, it is reasonable to not assign these background noise levels to represent of locations where logging was not conducted.

### 4.2 Criteria

*Non-involved Dwellings*

The operational noise criteria for non-involved dwellings have been determined from the results at each relevant noise monitoring location as provided in Table 8. The closest non-involved dwelling to the monitoring location has been assigned the relevant criteria from Table 8 (refer to Appendix B for further details). SR005 is an exception, which has not been assigned to any nearby dwellings as being the representative logging location.

**Table 8: Project Noise Criteria $L_{Aeq, 10min}$ – Wind Turbine Noise**

| Dwelling ID | Integer Wind Speeds at 155m Above Ground Level | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| SR005* | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 |
| SR078 | 35 | 35 | 36 | 37 | 38 | 39 | 39 | 40 | 41 | 41 |
| SR086 | 37 | 37 | 38 | 38 | 39 | 39 | 39 | 40 | 40 | 39 |
| SR109 | 35 | 35 | 35 | 35 | 35 | 35 | 36 | 37 | 38 | 39 |
| SR129 | 35 | 35 | 36 | 36 | 37 | 38 | 39 | 40 | 41 | 41 |
| SR212 | 35 | 35 | 35 | 35 | 35 | 36 | 37 | 38 | 39 | 39 |
| SR262 | 35 | 35 | 35 | 35 | 35 | 35 | 36 | 37 | 38 | 39 |

** Although the background noise levels at SR005 would result in a higher criterion at low wind speeds, the lowest integer wind speed background noise level has been used to determine the criterion for all wind speeds. The approach has been taken given the results indicate background noise levels are not controlled by wind speed.*

### 4.3 Assessment

*Noise Sources*

The assessment of WTG noise has been made based on the following:

- A representative contemporary WTG selection comprising a *Vestas V162-6.2MW* with serrated blade edges and a hub height of 149m*; and*
- Sound Power Levels as provided in Table 9 for the "Normal" operating mode.

**Table 9: Vestas V162-6.2MW Sound Power Levels: Normal Operating Mode (with serrated blade edges)**

| SWL (dB(A)) for each One-third Octave Band Centre Frequency | Hub Height (149m) Wind Speed (m/s) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 25 Hz | 54.6 | 54.7 | 56.4 | 59.5 | 62.4 | 64.8 | 65.4 | 65.6 | 65.3 |
| 31.5Hz | 58.9 | 59.1 | 60.8 | 63.9 | 66.7 | 69.1 | 69.7 | 69.9 | 69.6 |
| 40 Hz | 63.0 | 63.2 | 65.0 | 68.0 | 70.9 | 73.3 | 73.8 | 73.9 | 73.7 |
| 50 Hz | 66.5 | 66.8 | 68.5 | 71.6 | 74.4 | 76.8 | 77.4 | 77.4 | 77.2 |
| 63 Hz | 69.8 | 70.1 | 71.9 | 75.0 | 77.8 | 80.1 | 80.7 | 80.7 | 80.5 |
| 80 Hz | 72.9 | 73.2 | 75.0 | 78.1 | 80.9 | 83.2 | 83.7 | 83.7 | 83.5 |
| 100 Hz | 75.4 | 75.8 | 77.6 | 80.6 | 83.4 | 85.8 | 86.3 | 86.3 | 86.0 |
| 125 Hz | 77.7 | 78.0 | 79.9 | 82.9 | 85.7 | 88.0 | 88.5 | 88.5 | 88.3 |
| 160 Hz | 79.8 | 80.1 | 82.0 | 85.0 | 87.8 | 90.1 | 90.6 | 90.6 | 90.4 |
| 200 Hz | 81.3 | 81.7 | 83.6 | 86.6 | 89.4 | 91.7 | 92.2 | 92.1 | 91.9 |
| 250 Hz | 82.6 | 82.9 | 84.8 | 87.8 | 90.6 | 92.9 | 93.4 | 93.3 | 93.2 |
| 315 Hz | 83.6 | 83.9 | 85.8 | 88.8 | 91.6 | 93.9 | 94.4 | 94.3 | 94.2 |
| 400 Hz | 84.2 | 84.5 | 86.4 | 89.4 | 92.2 | 94.5 | 95.0 | 94.9 | 94.8 |
| 500 Hz | 84.5 | 84.8 | 86.7 | 89.7 | 92.5 | 94.7 | 95.2 | 95.2 | 95.2 |
| 630 Hz | 84.5 | 84.7 | 86.6 | 89.6 | 92.4 | 94.7 | 95.2 | 95.2 | 95.2 |
| 800 Hz | 84.1 | 84.3 | 86.2 | 89.2 | 92.0 | 94.3 | 94.8 | 94.8 | 94.8 |
| 1 kHz | 83.4 | 83.5 | 85.4 | 88.4 | 91.2 | 93.5 | 94.0 | 94.1 | 94.2 |
| 1.25 kHz | 82.4 | 82.5 | 84.4 | 87.4 | 90.2 | 92.5 | 93.0 | 93.1 | 93.2 |
| 1.6 kHz | 80.9 | 80.9 | 82.8 | 85.8 | 88.6 | 91.0 | 91.5 | 91.6 | 91.8 |
| 2 kHz | 79.3 | 79.2 | 81.1 | 84.1 | 86.9 | 89.3 | 89.8 | 89.9 | 90.2 |
| 2.5 kHz | 77.3 | 77.1 | 79.0 | 82.0 | 84.9 | 87.2 | 87.8 | 87.9 | 88.3 |
| 3.15 kHz | 75.0 | 74.7 | 76.5 | 79.6 | 82.4 | 84.8 | 85.3 | 85.6 | 86.0 |
| 4 kHz | 72.2 | 71.7 | 73.6 | 76.7 | 79.5 | 81.9 | 82.5 | 82.7 | 83.3 |
| 5 kHz | 69.2 | 68.7 | 70.5 | 73.6 | 76.5 | 78.9 | 79.5 | 79.8 | 80.4 |
| 6.3 kHz | 65.9 | 65.2 | 67.0 | 70.1 | 73.0 | 75.4 | 76.0 | 76.4 | 77.1 |
| 8 kHz | 62.0 | 61.2 | 63.0 | 66.1 | 69.1 | 71.5 | 72.1 | 72.6 | 73.4 |
| 10 kHz | 58.1 | 57.2 | 58.9 | 62.1 | 65.0 | 67.5 | 68.1 | 68.7 | 69.5 |
| **Total SWL (dB(A))** | 94.1 | 94.3 | 96.2 | 99.2 | 102.0 | 104.3 | 104.8 | 104.8 | 104.8 |

The Bulletin requires that the WTG noise level be adjusted where excessive levels of tonality and/or low frequency noise is identified to a maximum adjustment of 5 dB(A).

This assessment has been made based on the assumption that the turbine model selected for the project will be free of any excessive levels of tonality. The assumption has been confirmed for the representative wind turbine model by reviewing the 1/3 octave band data. The application of a penalty for the noise character of low frequency is discussed further in the following sections.

*Noise Propagation Model*

The predictions of environmental noise from the Project have been based on the CONCAWE noise propagation model and SoundPLAN noise modelling software. The CONCAWE noise propagation model is

one of the recommended models under SA 2009 for the prediction of wind turbine noise. The sound propagation model considers the following influences:

- sound power levels of each individual noise source;
- the locations of noise sources;
- separation distances between noise sources and dwellings;
- local topography;
- influence of the ground;
- air absorption; and,
- meteorological conditions.

The CONCAWE model divides meteorological conditions into six separate “weather categories”, depending on wind speed, wind direction, time of day and level of cloud cover. Weather Category 1 provides the weather conditions associated with the “lowest” propagation of noise, whilst Weather Category 6 provides “worst-case” (i.e. highest noise level) conditions. Weather Category 4 provides “neutral” weather conditions for noise propagation (that is, conditions which do not account for the effects of temperature inversion or wind on propagation).

The assessment has been based on the following widely accepted input conditions:

- weather category 6 (representing a temperature inversion and wind conditions that assist with the propagation of noise);
- atmospheric conditions at 10°C and 80% relative humidity (representing conditions that result in low levels of noise absorption from the atmosphere);
- wind direction from all noise sources to the particular dwelling under consideration, even in circumstances where sources are located in opposite directions from the dwelling (representing the absolute worst-case noise propagation from the wind). This will overestimate the predicted noise level where dwellings have WTGs located around them in more than a singular direction or quadrant as multiple wind directions cannot occur concurrently;
- acoustically soft ground (representing the pastoral nature of the land); and,
- maximum barrier attenuation from topography of 2 dB(A) (representing a conservative assessment of any shielding provided by topography).

The inputs are generally in accordance with the recommendations of SA 2009 to provide conservative predictions of the noise level from turbine operation, with the exception of using soft ground (G=1.0). SA

2009 recommends the use of hard ground (G=0.0), however this often results in significantly over predicting the noise level from similar wind farm developments. The CONCAWE model recommends the use of soft ground for areas which are not concrete or water, such as the pastures in the vicinity of the proposed project. In addition the noise level from a significant number of wind farms has been predicted using the CONCAWE model using the inputs described above and compliance monitoring has demonstrated that the model has slightly over predicted the noise level at critical locations where compliance is marginal.

*Noise Predictions*

The noise level from operation of wind turbines has been predicted outside each dwelling for all integer wind speeds from cut in to rated power. The following tables are restricted to dwellings where the predicted $L_{Aeq, 10min}$ noise level is greater than 30 dB(A) for a hub height wind speed of 11m/s.

**Table 10: Wind Farm Noise $L_{Aeq, 10min}$ Predictions (dB(A)) at Involved Dwellings**

| Dwelling ID | Hub Height integer wind speeds, 149m AGL (dB(A)) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 4 m/s | 5 m/s | 6 m/s | 7 m/s | 8 m/s | 9 m/s | 10 m/s | 11 m/s | 12 m/s |
| | Prediction | Prediction | Prediction | Prediction | Prediction | Prediction | Prediction | Prediction | Prediction |
| **Involved Dwellings** | | | | | | | | | |
| SR005 | 25 | 25 | 27 | 30 | 33 | 35 | 36 | 36 | 35 |
| SR009 | 24 | 24 | 26 | 29 | 32 | 34 | 35 | 34 | 34 |
| SR012 | 26 | 26 | 28 | 31 | 34 | 36 | 37 | 37 | 37 |
| SR043 | 23 | 23 | 25 | 28 | 31 | 33 | 34 | 34 | 34 |
| SR061 | 27 | 28 | 29 | 32 | 35 | 38 | 38 | 38 | 38 |
| SR065 | 35 | 35 | 37 | 40 | 43 | 45 | 46 | 46 | 46 |
| SR078 | 24 | 24 | 26 | 29 | 32 | 34 | 35 | 35 | 34 |
| SR086 | 27 | 27 | 29 | 32 | 35 | 37 | 37 | 37 | 37 |
| SR091 | 32 | 33 | 35 | 38 | 40 | 43 | 43 | 43 | 43 |
| SR100 | 24 | 24 | 26 | 29 | 32 | 34 | 35 | 35 | 35 |
| SR103 | 27 | 28 | 29 | 32 | 35 | 38 | 38 | 38 | 38 |
| SR119 | 32 | 32 | 34 | 37 | 40 | 42 | 42 | 42 | 42 |
| SR120 | 30 | 30 | 32 | 35 | 38 | 40 | 41 | 41 | 41 |
| SR121 | 28 | 28 | 30 | 33 | 36 | 38 | 39 | 39 | 39 |
| SR125 | 23 | 24 | 25 | 28 | 31 | 34 | 34 | 34 | 34 |
| SR136 | 23 | 24 | 26 | 29 | 31 | 34 | 34 | 34 | 34 |
| SR151 | 26 | 27 | 29 | 32 | 34 | 37 | 37 | 37 | 37 |
| SR152 | 26 | 27 | 28 | 31 | 34 | 37 | 37 | 37 | 37 |
| SR160 | 27 | 27 | 29 | 32 | 34 | 37 | 37 | 37 | 37 |
| SR167 | 25 | 25 | 27 | 30 | 33 | 35 | 36 | 36 | 35 |
| SR168 | 22 | 22 | 24 | 27 | 30 | 32 | 32 | 32 | 32 |
| SR170 | 27 | 27 | 29 | 32 | 35 | 37 | 37 | 37 | 37 |
| SR200 | 24 | 24 | 26 | 29 | 32 | 34 | 34 | 34 | 34 |
| SR202 | 27 | 27 | 29 | 32 | 35 | 37 | 37 | 37 | 37 |
| SR212 | 24 | 24 | 26 | 29 | 32 | 34 | 34 | 34 | 34 |
| SR227 | 23 | 23 | 25 | 28 | 31 | 33 | 34 | 34 | 33 |
| SR228 | 27 | 28 | 29 | 32 | 35 | 38 | 38 | 38 | 38 |
| SR253 | 25 | 25 | 27 | 30 | 33 | 35 | 36 | 36 | 36 |

| Dwelling ID | Hub Height integer wind speeds, 149m AGL (dB(A)) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 4 m/s | 5 m/s | 6 m/s | 7 m/s | 8 m/s | 9 m/s | 10 m/s | 11 m/s | 12 m/s |
| | Prediction | Prediction | Prediction | Prediction | Prediction | Prediction | Prediction | Prediction | Prediction |
| **Involved Dwellings** | | | | | | | | | |
| SR259 | 31 | 32 | 34 | 37 | 39 | 42 | 42 | 42 | 42 |
| SR261 | 22 | 22 | 24 | 27 | 30 | 32 | 33 | 33 | 33 |
| SR267 | 26 | 26 | 28 | 31 | 34 | 36 | 37 | 37 | 37 |
| SR286 | 27 | 28 | 30 | 33 | 35 | 38 | 38 | 38 | 38 |
| SR288 | 20 | 21 | 23 | 26 | 28 | 31 | 31 | 31 | 31 |

**Table 11: Wind Farm Noise $L_{Aeq, 10min}$ Predictions (dB(A)) at Non-Involved Dwellings**

| Dwelling ID | Hub Height integer wind speeds, 149m AGL (dB(A)) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 m/s | | 5 m/s | | 6 m/s | | 7 m/s | | 8 m/s | | 9 m/s | | 10 m/s | | 11 m/s | | 12 m/s | |
| | Criterion | Prediction | Criterion | Prediction | Criterion | Prediction | Criterion | Prediction | Criterion | Prediction | Criterion | Prediction | Criterion | Prediction | Criterion | Prediction | Criterion | Prediction |
| **Non-Involved Dwellings** | | | | | | | | | | | | | | | | | | |
| SR004 | 35 | 22 | 35 | 22 | 35 | 24 | 35 | 27 | 35 | 30 | 36 | 32 | 37 | 32 | 38 | 32 | 39 | 32 |
| SR007 | 35 | 22 | 35 | 22 | 35 | 24 | 35 | 27 | 35 | 30 | 36 | 32 | 37 | 33 | 38 | 33 | 39 | 33 |
| SR105 | 35 | 22 | 35 | 22 | 35 | 24 | 35 | 27 | 35 | 30 | 36 | 32 | 37 | 33 | 38 | 33 | 39 | 33 |
| SR107 | 35 | 21 | 35 | 21 | 35 | 23 | 35 | 26 | 35 | 29 | 36 | 31 | 37 | 31 | 38 | 31 | 39 | 31 |
| SR109 | 35 | 23 | 35 | 23 | 35 | 25 | 35 | 28 | 35 | 31 | 36 | 33 | 37 | 34 | 38 | 34 | 39 | 34 |
| SR129 | 35 | 20 | 36 | 20 | 36 | 22 | 37 | 25 | 38 | 28 | 39 | 30 | 40 | 31 | 41 | 31 | 41 | 31 |
| SR216 | 35 | 21 | 35 | 21 | 35 | 23 | 35 | 26 | 35 | 29 | 36 | 31 | 37 | 31 | 38 | 31 | 39 | 31 |
| SR240 | 37 | 26 | 38 | 26 | 38 | 28 | 39 | 31 | 39 | 34 | 39 | 36 | 40 | 37 | 40 | 37 | 39 | 37 |
| SR262 | 35 | 22 | 35 | 22 | 35 | 24 | 35 | 27 | 35 | 30 | 36 | 32 | 37 | 33 | 38 | 32 | 39 | 32 |
| SR264 | 35 | 20 | 36 | 20 | 36 | 22 | 37 | 25 | 38 | 28 | 39 | 30 | 40 | 30 | 41 | 30 | 41 | 30 |
| SR268 | 35 | 22 | 36 | 23 | 36 | 25 | 37 | 28 | 38 | 30 | 39 | 33 | 40 | 33 | 41 | 33 | 41 | 33 |
| SR272 | 35 | 24 | 36 | 24 | 36 | 26 | 37 | 29 | 38 | 32 | 39 | 34 | 40 | 35 | 41 | 35 | 41 | 34 |
| SR300 | 35 | 20 | 35 | 20 | 35 | 22 | 35 | 25 | 35 | 28 | 36 | 30 | 37 | 31 | 38 | 31 | 39 | 31 |

The highest predicted low frequency $L_{Ceq, 10min}$ noise level at non-involved dwellings is less than 53 dB(C) (at SR240), which is less than the 60 dB(C) criterion. The following table provides the low frequency $L_{Ceq, 10min}$ noise level at the closest non-involved dwellings, being those with a level of 45 dB(C) or more.

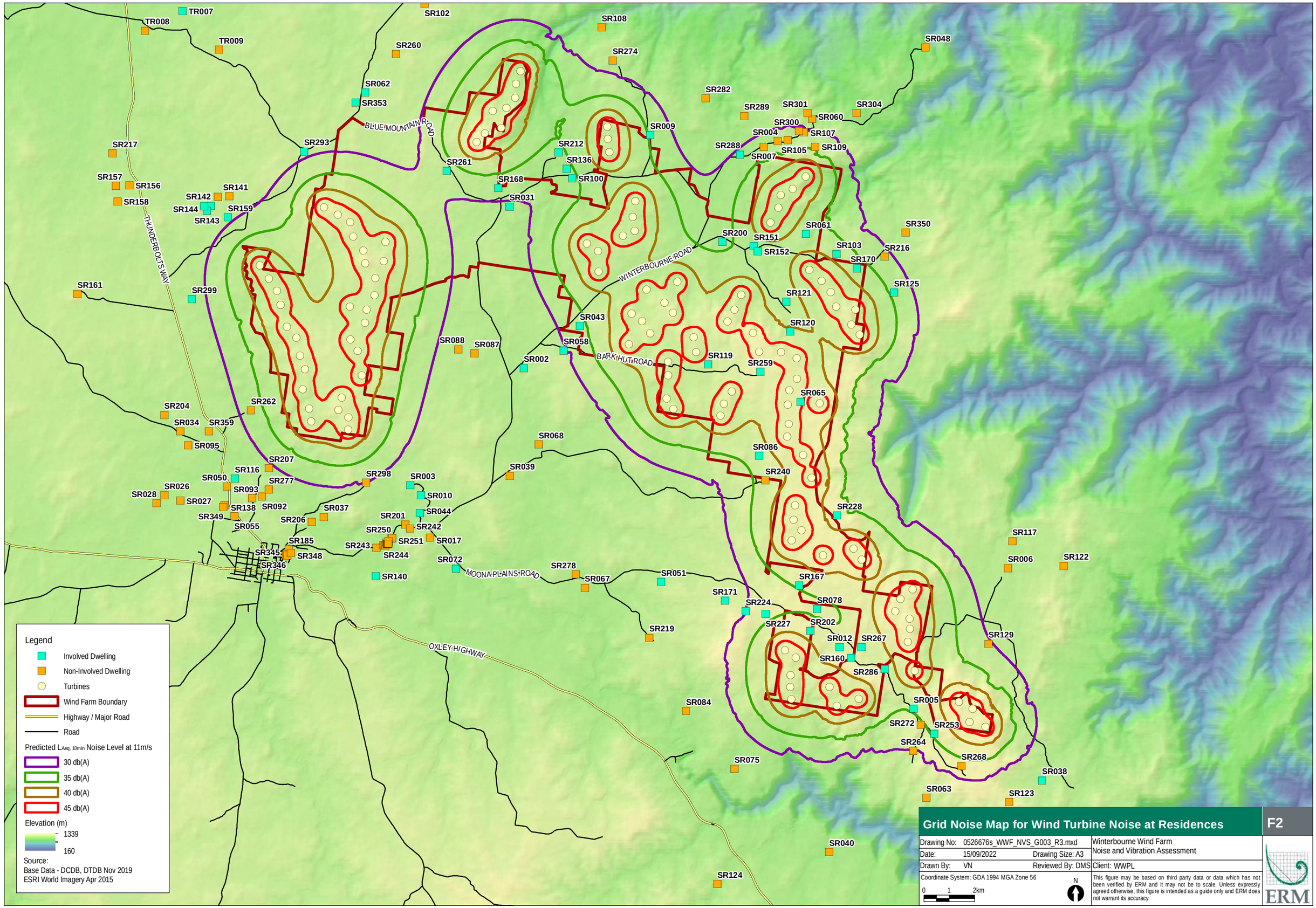
**Table 12: Wind Farm Low Frequency Noise Predictions at Non-Involved Dwellings**

| Dwelling ID | Noise Level $L_{Aeq, 10min}$ (dB(A)) | Low Frequency Noise Level $L_{Ceq, 10min}$ (dB(C)) |
|---|---|---|
| SR240 | 37 | 53 |
| SR272 | 35 | 51 |
| SR268 | 33 | 49 |
| SR007 | 33 | 49 |
| SR262 | 32 | 49 |
| SR216 | 31 | 49 |
| SR109 | 34 | 48 |
| SR004 | 32 | 48 |
| SR105 | 33 | 48 |
| SR129 | 31 | 48 |
| SR264 | 30 | 47 |

Based on the above, a penalty for excessive low frequency noise is not applicable and no adjustment has been made to the predictions provided above.

Based on the predictions above, without any noise mitigation measures, the noise from the 119 WTGs will achieve the operational noise criteria at all dwellings in the vicinity of the wind farm.

Predicted $L_{Aeq, 10min}$ noise level contours at a wind speed corresponding to the WTG maximum sound power level (11m/s) are provided in the following figure.


TR007
TR008
TR009
SR102
SR108
SR260
SR274
SR048
SR062
SR353
SR282
SR289
SR301
SR304
SR060
SR300
SR107
SR004
SR105
SR109
SR288
SR007
SR009
SR212
SR136
SR100
SR261
SR293
BLUE MOUNTAIN ROAD
SR217
SR157
SR156
SR158
SR141
SR142
SR144
SR143
SR159
SR168
SR031
THUNDERBOLTS WAY
SR161
SR299
SR200
SR151
SR152
SR061
SR350
SR103
SR216
SR170
WINTERBOURNE ROAD
SR125
SR121
SR120
SR043
SR088
SR087
SR058
SR002
BARKHUT ROAD
SR119
SR259
SR065
SR204
SR262
SR034
SR359
SR095
SR068
SR086
SR207
SR116
SR050
SR277
SR298
SR003
SR039
SR240
SR026
SR028
SR027
SR093
SR092
SR138
SR010
SR044
SR037
SR349
SR206
SR201
SR242
SR055
SR250
SR251
SR017
SR185
SR243
SR244
SR345
SR348
SR346
SR072
SR140
MOONA PLAINS ROAD
SR278
SR067
SR051
SR228
SR117
SR006
SR122
SR167
SR171
SR224
SR078
SR227
SR202
SR219
SR012
SR267
SR129
SR160
SR286
OXLEY HIGHWAY
SR084
SR005
SR272
SR253
SR264
SR268
SR075
SR038
SR063
SR123
SR040
SR124
Legend
Involved Dwelling
Non-Involved Dwelling
Turbines
Wind Farm Boundary
Highway / Major Road
Road
Predicted LAeq, 10min Noise Level at 11m/s
30 db(A)
35 db(A)
40 db(A)
45 db(A)
Elevation (m)
1339
160
Source:
Base Data - DCDB, DTDB Nov 2019
ESRI World Imagery Apr 2015
Grid Noise Map for Wind Turbine Noise at Residences
F2
Drawing No: 0526676s_WWF_NVS_G003_R3.mxd
Winterbourne Wind Farm
Noise and Vibration Assessment
Date: 15/09/2022
Drawing Size: A3
Drawn By: VN
Reviewed By: DMS
Client: WWPL
Coordinate System: GDA 1994 MGA Zone 56
0 1 2km
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

*Recommendations*

To ensure the project achieves the noise criteria, it is recommended that a pre-construction noise assessment be made based on the final turbine selection, layout and turbine specific sound power levels which are guaranteed by the manufacturer for the project. In addition, operational noise monitoring will be carried out following commissioning of the Project to verify compliance with the noise criteria.

# 5 ANCILLARY INFRASTRUCTURE – SUBSTATIONS/BESS

## 5.1 Criteria

The NPI establishes *noise trigger levels* based on lower of the following two methods;

1. the existing background noise environment (*intrusiveness noise levels*); and,
2. the amenity for particular land uses (*amenity noise levels*).

To provide a conservative assessment approach, the minimum RBL under the NPI has been applied, being 30 dB(A) during the evening and night and 35 dB(A) during the day.

As such, for activity occurring during the day, evening and night, the noise trigger level is based on the *project intrusiveness noise level* of 35 dB(A) (*Method 1* above). This level is lower than the *project amenity noise level* of 40 dB(A) (*Method 2* above) that applies in a rural area during the night.

If noise assessed under the NPI is found to have a character that has the potential to be annoying, such as tonality, modulation or dominant low-frequency content, a modifying correction factor is to be applied to the predicted noise levels at the dwelling before comparison with the project *noise trigger levels*.

## 5.2 Assessment

*Noise Sources*

The Project will comprise of two substations and a switching station, in the locations provided in Section 2 of this report and shown in Figure 1.

Noise at the proposed substations will include transformers and at the northern location the BESS facility. These sources have been assessed against the objective noise criteria under the NPI. The switching station does not propose any significant noise generating equipment and has not been considered as a noise source.

The predictions have been made based on a high-voltage transformer with an overall capacity of 350MVA at each substation location. The sound power level for the prediction has been derived from the Australian/New Zealand Standard AS/NZS60076.10:2009, *Power transformers - Determination of sound levels (IEC 60076-10, Ed. 1(2001) MOD)* and is summarised in Table 13.

**Table 13: 270MVA substation transformer sound power levels**

| Octave Band Centre Frequency (Hz) | Sound Power Level (dB(A) re 1 pW) |
|---|---|
| 63 Hz | 81 |
| 125 Hz | 89 |
| 250 Hz | 96 |
| 500 Hz | 99 |
| 1,000 Hz | 91 |
| 2,000 Hz | 88 |
| 4,000 Hz | 81 |
| **Total** | **102** |

The noise from the BESS facility has been predicted based on a capacity of 100MW / 200MWhr (2 hour facility). The facility is proposed to consist of containerised batteries with associated inverters, transformers and cooling systems which operate at variable fan speeds. The noise level assumed for the facility has been based on Tesla "Megapacks" with the total sound power level for all units provided below. The assessment has been based on the units operating at full capacity (100% fan speed) at all times. Notwithstanding, based on the manufacturer's information for similar projects, these operating conditions are unlikely to occur and therefore lower noise levels would result, particularly at night.

**Table 14: Megapack sound power levels for 100% fan speed**

| Octave Band Centre Frequency (Hz) | Sound Power Level (dB(A) re 1 pW) |
|---|---|
| 100 Hz | 85 |
| 125 Hz | 87 |
| 160 Hz | 89 |
| 200 Hz | 89 |
| 250 Hz | 88 |
| 315 Hz | 92 |
| 400 Hz | 103 |
| 500 Hz | 100 |
| 630 Hz | 102 |
| 800 Hz | 106 |
| 1000 Hz | 98 |
| 1250 Hz | 104 |
| 1600 Hz | 101 |
| 2000 Hz | 102 |
| 2500 Hz | 100 |
| 3150 Hz | 98 |
| 4000 Hz | 97 |
| 5000 Hz | 100 |
| 6300 Hz | 98 |
| 8000 Hz | 92 |
| 10000 Hz | 86 |
| **Total (Overall)** | **113** |

It is noted that although the assessment has been based on the sound power levels provided above, it should not preclude the project from selecting an alternate manufacturer or containerised battery solution as the

design progresses. The design and the sound power levels in this report have been used to demonstrate that a facility of this size can achieve the environmental noise criteria at nearby residences. The project should not be restricted from using newer technology, where it is developed between the time of approval and construction.

*Noise Predictions*

A $L_{Aeq}$ noise level of less than 20 dB(A) is predicted for the non-involved dwelling with the highest prediction (SR088) under worst case weather conditions, therefore easily achieving the criteria.

Transformers will often have audible tonality in close proximity, although the potential for it to be a dominant characteristic is diminished at the separation distances to the dwellings. Given the low predicted noise levels, it is unlikely that a penalty would apply to the noise level, however if a 5 dB(A) adjustment were to be conservatively applied, the 35 dB(A) criterion would still easily be achieved.

*Recommendations*

In order to demonstrate compliance with the SEARs, it is recommended that the assessment of noise from the substations and BESS facility be updated if the size of the BESS or substation transformer(s) is increased or the sound power level change from that assumed in this report.

Any updates to the predictions should ensure that the highest equivalent noise level at a non-involved dwelling from operation of the substation transformers will comply with the criteria established by the SEARs, under conditions most conducive to noise propagation (such as temperature inversions).

# 6 CONSTRUCTION (EXCLUDING BLASTING)

## 6.1 Criteria

The Construction Noise Guideline provides an emphasis on implementing "feasible" and "reasonable" noise reduction measures and does not set mandatory objective criteria. The Construction Noise Guideline establishes "management levels" based on the existing RBL. As noted in Section 5.1 the minimum RBL is 30 dB(A) for the evening and night and 35 dB(A) for the day.

Based on the above, the framework to address construction activity is provided in Table 15:

**Table 15: Construction Noise Guideline Requirements**

| **Time of Day** | **Management level** $L_{Aeq\ (15\ min)}$ | **How to apply** |
|---|---|---|
| **Recommended standard hours:**<br><br>Monday to Friday<br>7 am to 6 pm<br><br>Saturday<br>8 am to 1 pm<br><br>No work on Sundays or public holidays | Noise affected<br>**RBL + 10 dB = 45dB(A)** | The noise affected level represents the point above which there may be some community reaction to noise.<br><br>• Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>• The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details. |
| | Highly noise affected<br>**75 dB(A)** | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br><br>• Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:<br>1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near dwellings<br>2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |
| **Outside recommended standard hours** | Noise affected<br>**RBL + 5 dB = 35dB(A)** | A strong justification would typically be required for works outside the recommended standard hours.<br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. |

It is noted that the proposed work hours on Saturday extend outside of that recommended by the Construction Noise Guideline (1pm to 6pm). Works during these hours are addressed in the Scheduling component of Section 6.2 below.

### 6.2 Assessment

*Noise Predictions*

The equipment and activities on site will vary throughout the project, depending on various stages of construction, required processes and specific equipment used over the planned 30 month construction and commissioning period. The predicted noise from construction activity is presented as a typical worst case (highest noise level) scenario for the various stages of construction.

The predictions are based on weather conditions that are the most conducive for the propagation of noise, being CONCAWE Category 6 conditions (receivers being down wind of noise sources and light to no cloud cover prior to sunrise or after sunset). Other weather conditions would result in lower noise levels than those predicted for day-time construction.

All non-involved dwellings are:

- Separated by 1225m or more from the closest proposed WTG location (with SR109 being approximately 1227m from turbine B056); and,
- Separated by 3320m or more from the closest temporary concrete batching and crushing plants (with SR088 being approximately 3326m to the closest plant location).

The predicted noise level from activities undertaken during the day period at the WTG location sites (at a separation distance of 1225m to SR109) and the batching and crushing plants (at a separation distance of 3320m to SR088) are provided in Table 16. The required separation distance in order to achieve the *noise affected level* of 45 dB(A) during standard hours (the day period) is also provided. The table provides the estimated time that each project phase will occur for during the project construction, noting that the time at each turbine site will be a fraction of that estimated for the whole project. Predictions for each “Phase” are based on the assumption that all equipment stated is being operated concurrently and cumulatively.

**Table 16: Predicted $L_{Aeq, 15min}$ construction noise levels during standard hours**

| Phase | Noise Management Level | Main Plant and Equipment | Predicted $L_{Aeq, 15min}$ Noise Level at Closest Dwelling (1225m to activity) | Outcome/Action |
|---|---|---|---|---|
| Site Set-Up and Civil Works<br><br>(10 Months) | 45 dB(A) | Generator<br>Transport truck<br>Excavator<br>Low loader | 43 dB(A) | Achieves criterion at all non-involved dwellings. |
| Road Construction<br><br>(External Road Upgrades 9 Months)<br><br>(Internal Roads 14 Months) | | Mobile crushing and screening plant<br>Dozer<br>Roller<br>Low loader<br>Tipper truck<br>Excavator<br>Scraper<br>Transport truck | 49 dB(A) | Predicted to exceed criterion at dwellings within 1,800m of the construction activity<br>(7 non-involved dwellings, SR004, SR105, SR107, SR109, SR240, SR268, SR272).<br><br>Implement "feasible and reasonable" noise control strategies to minimise noise during construction in accordance with the recommendations below. |
| Excavation and foundation construction<br><br>(13 Months) | | Excavator<br>Front end loader<br>Mobile crushing and screening plant<br>Truck-mounted concrete pump<br>Concrete mixer truck<br>Mobile crane<br>Transport truck<br>Tipper truck | 48 dB(A) | Predicted to exceed criterion at dwellings within 1,700m of the construction activity<br>(3 non-involved dwellings, SR105, SR109, SR240).<br><br>Implement "feasible and reasonable" noise control strategies to minimise noise during construction in accordance with the recommendations below. |
| Electrical Installation<br><br>(16 Months) | | Rock trencher<br>Concrete mixer truck<br>Low loader<br>Tipper truck<br>Mobile crane | 49 dB(A) | Predicted to exceed criterion at dwellings within 1,800m of the construction activity<br>(7 non-involved dwellings, SR004, SR105, SR107, SR109, SR240, SR268, SR272).<br><br>Implement "feasible and reasonable" noise control strategies to minimise noise during construction in accordance with the recommendations below. |

| **Phase** | **Noise Management Level** | **Main Plant and Equipment** | **Predicted $L_{Aeq, 15min}$ Noise Level at Closest Dwelling** (1225m to activity) | **Outcome/Action** |
|---|---|---|---|---|
| Turbine Delivery and Erection (at the turbine locations)<br><br>(16 Months) | 45 dB(A) | Extendable trailer truck<br>Low loader<br>Mobile crane<br>Support crane<br>Grinder<br>Rattle Gun | 43 dB(A) | Achieves criterion at all non-involved dwellings. |
| Concrete Batching and Crushing<br><br>(13 Months) | | Mobile crushing and screening plant<br>Front end loader<br>Truck | 31 dB(A)<br>(3320m to activity) | Achieves criterion at all non-involved dwellings. |

In addition to construction activities during the day period, some low noise impact works may occur on Saturday afternoons outside of the "standard hours" and a small number of activities may need to be undertaken early in the mornings. The activities which may occur early in the morning may include the operation of a batching plant and concrete pouring at WTG sites or cranes lifting turbine components early in the morning during low wind speed conditions. The predicted noise level for these activities is provided in Table 17, noting that for the batching plant locations, rock crushing has not been included outside of "standard hours". The required separation distance in order to achieve the noise affected level of 35 dB(A) for activity outside of standard hours is also provided. Predictions will be made of any low noise impact works undertaken on Saturday afternoons once the processes and equipment have been proposed by the construction contractor.

**Table 17: Predicted construction noise levels outside of standard hours**

| Phase | Noise Management Level | Main Plant and Equipment | Predicted $L_{Aeq, 15min}$ Noise Level at Closest Dwelling | Outcome/Action |
|---|---|---|---|---|
| Batching | 35 dB(A) | Front end loader<br>Truck | 30 dB(A)<br><br>(3320m from Dwelling) | Achieves criterion at all non-involved dwellings. |
| Concrete Pour | | Generator<br>Truck<br>Concrete pump | 38 dB(A)<br><br>(1200m from Dwelling) | Predicted to exceed criterion at dwellings within 1,900m of the construction activity<br>(8 non-involved Dwellings, SR004, SR105, SR107, SR109, SR240, SR268, SR272, SR300).<br><br>Implement "feasible and reasonable" noise control strategies to minimise noise during construction in accordance with the recommendations below. |
| Turbine Delivery and Erection (at the turbine locations) | | Extendable trailer truck<br>Low loader<br>Mobile crane<br>Support crane<br>Grinder<br>Rattle Gun | 43 dB(A)<br><br>(1200m from Dwelling) | Predicted to exceed criterion at dwellings within 3,000m of the construction activity<br>(19 non-involved Dwellings, SR004, SR007, SR060, SR105, SR107, SR109, SR129, SR141, SR207, SR216, SR240, SR262, SR264, SR268, SR272, SR274, SR298, SR300, SR301).<br><br>Implement "feasible and reasonable" noise control strategies to minimise noise during construction in accordance with the recommendations below. |

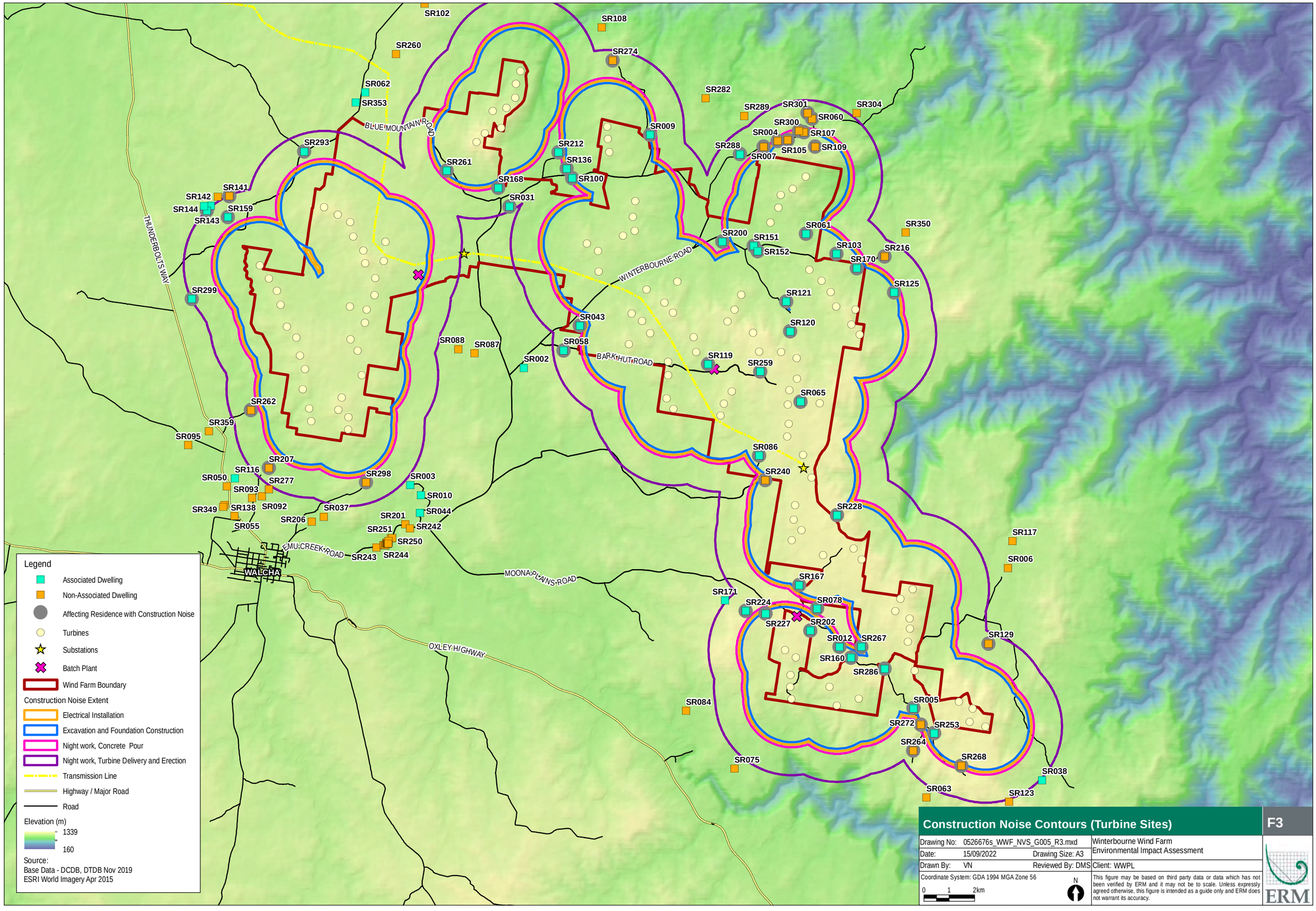
In accordance with the Construction Noise Guideline, if the noise is "particularly annoying" to nearby residents, a modifying correction factor is to be applied to the measured level. The noise associated with construction activity can exhibit annoying characteristics on occasion and therefore a 5 dB(A) correction (increase to the predicted level) has been applied to the noise predictions.

It is noted that separation distances greater than the distances presented in the above tables will result in lower noise levels.

Based on the predicted noise levels, it is expected that construction:

- during standard hours will potentially be at noise levels of greater than 45 dB(A) for some activities at a limited number of non-involved dwellings (7 locations). However, the predicted noise levels are significantly less than 75 dB(A) (the point where there may be strong community reaction to noise).
- Outside of standard hours will potentially be at noise levels of greater than 35 dB(A) for some activities. That is, the noise from temporary batching, concrete pouring and turbine erection may exceed 35 dB(A) at up to 19 non-involved dwellings.

The following figures can be used to identify the project areas within the separation distances where specific phases are predicted to exceed the noise affected level of 45 dB(A) during the day period or 35 dB(A) during the night period.




Legend

- Associated Dwelling
- Non-Associated Dwelling
- Affecting Residence with Construction Noise
- Turbines
- Substations
- Batch Plant
- Wind Farm Boundary

Construction Noise Extent

- Electrical Installation
- Excavation and Foundation Construction
- Night work, Concrete Pour
- Night work, Turbine Delivery and Erection
- Transmission Line
- Highway / Major Road
- Road

Elevation (m)

1339
160

Source:
Base Data - DCDB, DTDB Nov 2019
ESRI World Imagery Apr 2015

# Construction Noise Contours (Turbine Sites)

F3

| | | | |
|---|---|---|---|
| Drawing No: | 0526676s_WWF_NVS_G005_R3.mxd | | Winterbourne Wind Farm<br>Environmental Impact Assessment |
| Date: | 15/09/2022 | Drawing Size: A3 | |
| Drawn By: | VN | Reviewed By: DMS | Client: WWPL |

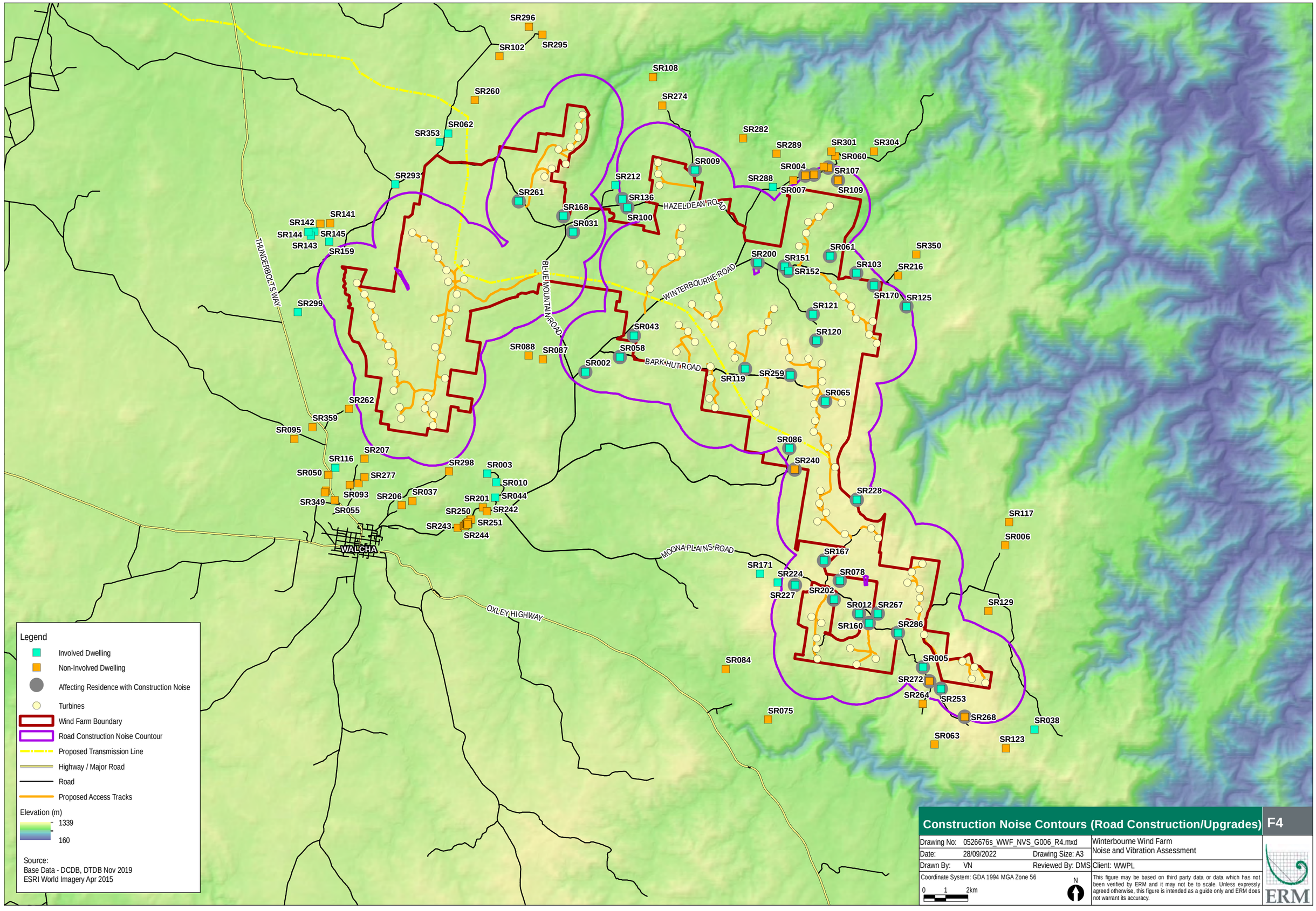
Coordinate System: GDA 1994 MGA Zone 56

0 1 2km

N



ERM




Legend

- Involved Dwelling
- Non-Involved Dwelling
- Affecting Residence with Construction Noise
- Turbines
- Wind Farm Boundary
- Road Construction Noise Countour
- Proposed Transmission Line
- Highway / Major Road
- Road
- Proposed Access Tracks

Elevation (m)

1339

160

Source:
Base Data - DCDB, DTDB Nov 2019
ESRI World Imagery Apr 2015

## Construction Noise Contours (Road Construction/Upgrades)

F4

| | | | |
|---|---|---|---|
| Drawing No: | 0526676s_WWF_NVS_G006_R4.mxd | | Winterbourne Wind Farm<br>Noise and Vibration Assessment |
| Date: | 28/09/2022 | Drawing Size: A3 | |
| Drawn By: | VN | Reviewed By: DMS | Client: WWPL |

Coordinate System: GDA 1994 MGA Zone 56

0 1 2km

N



ERM

It is noted that there may be road upgrades in the vicinity of the Walcha township, which may affect additional residences. The noise from these upgrades will be predicted once the extent of the upgrades is known and the processes to undertake them are designed. The activities will be assessed in accordance with the framework in this section and affected residences identified.

*Recommendations*

For construction with $L_{Aeq,\ 15min}$ noise levels greater than 45 dB(A) and 35 dB(A) during standard hours and outside of standard hours respectively, the Construction Noise Guidelines requires the developer to apply all feasible and reasonable work practices, and to inform the residents of the proposed construction work.

"Feasible and reasonable" noise control strategies to minimise noise during construction may include engineering measures such as the construction of temporary acoustic barriers, the use of proprietary enclosures around machines, the use of silencers, the substitution of alternative construction processes and the fitting of broadband reversing signals. It may also include administrative measures such as inspections, scheduling and providing training to establish a noise minimisation culture for the works.

The following mitigation measures are recommended to be implemented for the construction works by the construction team once the final construction methods, timing, locations and equipment has been determined.

*Scheduling*

Construction works, including heavy vehicle movements into and out of the site, will generally be restricted to the standard hours of 7am to 6pm Monday to Friday, and between 8am and 1pm on Saturdays. An exception to these hours is Saturdays when work is proposed to occur until 6:00pm.

Works carried out outside of the standard hours will be limited to:

- works that do not cause noise emissions above 35 dB(A) at any nearby non-involved dwellings not located on the site; or,
- the delivery of materials as requested by Police or other authorities for safety reasons; or,
- emergency work to avoid the loss of lives, property, and/or to prevent environmental harm; or
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

If any other works are required outside of the specified hours, they will only be carried out with the prior consent of the relevant authority.

*Location of Fixed Noise Sources*

Locate fixed noise sources such as crushing and screening plant, concrete batching plant, generators and compressors at the maximum practicable distance to the nearest dwellings, and where possible, use existing topography (or raw or processed materials) to block line of sight between the fixed noise source and the dwelling.

*Provide Acoustic Screens around Fixed Noise Sources*

Provide acoustic screens or mounding for *fixed* crushing and screening plant and concrete batching plant wherever these noise sources are located within 2400m of a non-involved dwelling and do not have direct line of sight blocked by site topography to that dwelling, in accordance with the following requirements:

- Locate the acoustic screens or mounding as close as practicable to the noise source;
- Construct from mounding using excavated soil from the site or a material with a minimum surface density of 10 kg/m$^2$, such as 1.2mm thick sheet steel or 9mm thick compressed fibre cement sheeting, or use proprietary barriers such as the *FlexShield* "Sonic Quilt";
- Construct to a minimum height that blocks direct line of sight between the noise source and any dwellings within 2400m; and,
- Construct such that air gaps or openings at joints between sections of the acoustic screens are minimised.

*Enclose Generators and Compressors*

Provide proprietary acoustic enclosures for site compressors and generators located within 2400m of a non-involved dwelling.

*Alternative Processes*

Investigate and implement alternative processes where feasible and reasonable, such as hydraulic or chemical splitters as an alternative to impact rock breaking, or the use of broadband reversing alarms in lieu of the high-pitched alarms. A broadband reversing alarm emits a sound which addresses the annoyance from the high-pitched alarms. The fitting of a broadband alarm should be subject to an appropriate risk assessment, with the construction team being responsible for ensuring the alarms are installed and operated in accordance with all relevant occupational, health and safety legislative requirements.

*Site Management*

- Select and locate centralised site activities and material stores as far from dwellings as practicable;
- Care should be taken not to excessively drop materials such as rock, to cause peak noise events, including materials from a height into a truck. Site personnel should be directed as part of a training regime to consider such practices;
- Plant known to emit noise strongly in one direction, such as the exhaust outlet of generator set, shall be orientated so that the noise is directed away from noise sensitive areas if practicable;
- Machines that are used intermittently shall be shut down in the intervening periods between works or throttled down to a minimum; and,
- Implement worksite induction training, educating staff.

*Equipment and Vehicle Management*

- Ensure equipment has Original Equipment Manufacturer (OEM) mufflers (or better) installed;
- Ensure equipment is well maintained and fitted with adequately maintained silencers which meet the OEM design specifications. This inspection should be part of a monitoring regime;
- Ensure silencers and enclosures are intact, rotating parts are balanced, loose bolts are tightened, frictional noise is reduced through lubrication and cutting noise reduced by keeping equipment sharp. These items should be part of a monitoring regime;
- Use only necessary power to complete the task; and,
- Inspect, as part of a monitoring regime, plant and equipment to determine if it is noisier than other similar machines, and replace or rectify as required.

*Community Consultation*

Implement the following noise related elements into the overall community consultation process. The aim of the consultation is to ensure adequate community awareness and notice of expected construction noise.

The minimum elements should include:

- Community Information newsletters, providing details of the construction plan and duration of the construction phases;
- A site notice board in a community location providing copies of the newsletters, updated construction program details, and contact details of relevant project team members;

- A feedback mechanism for the community to submit questions to the construction team, and for the construction team to respond;
- Regular updates on the construction activities to local authorities to assist in complaint management if necessary; and,
- Contact details of the project manager and/or site "Environmental Representative".

In addition, prior to any construction activity outside of standard work hours occurring within 3000m of a non-involved dwelling, or significant construction traffic periods or impacts on local road conditions:

- Contact the local community potentially affected by the proposed works and inform them of the proposed work, the location of the work, the day(s) and date(s) of the work and the hours involved;
- This contact should be made a reasonable time before the proposed commencement of the work; and,
- Contact details of the project manager and / or site "Environmental Representative" should be provided.

The above measures should be incorporated and implemented through the construction phase. The mitigation measures should be determined by the construction team once the actual construction activities and schedule have been determined.

# 7 BLASTING

## 7.1 Criteria

The ANZEC Guidelines provide airblast overpressure and ground vibration objective criteria to minimise the annoyance and discomfort to residences from blasting activities which may be required during construction.

In addition to the criteria below, the ANZEC Guidelines also recommends that blasting be restricted to the hours of 9:00am to 5:00pm on Monday to Saturday, with no blasting activity on Sunday or public holidays.

*Airblast Overpressure*

To minimise the annoyance and discomfort from airblast overpressure the ANZEC Guidelines recommend:

- a maximum level for airblast overpressure is 115 dB (Lin, Peak).
- the level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but the level should not exceed 120 dB (Lin, Peak) at any time.

*Ground Vibration*

To minimise the annoyance and discomfort from ground vibration the ANZEC Guidelines recommend:

- a maximum level for ground vibration of 5mm/sec (peak particle velocity (ppv)).
- the ppv level of 5mm/sec may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but the level should not exceed 10mm/sec at any time.

## 7.2 Assessment

The relationship between the airblast overpressure and ground vibration from blasting for a given site is dependent on a number of variables specific to that site. The magnitude of the airblast overpressure and ground vibration decreases with increasing distance from the blast and from decreasing the charge weight per delay. Other variables such as particular source to receiver geometries, rock type and formation and the local geology of the site also influence the result of blasting. It is therefore common practice for the blasting specialist to design each blast to achieve the project criterion, once the locations and the requirement for blasting are known.

The separation distances between any potential blasting activity associated with the Project and the nearest dwellings are of the order of magnitude for which ground vibration and airblast levels have been adequately controlled at other sites by limiting the charge size.

*Recommendations*

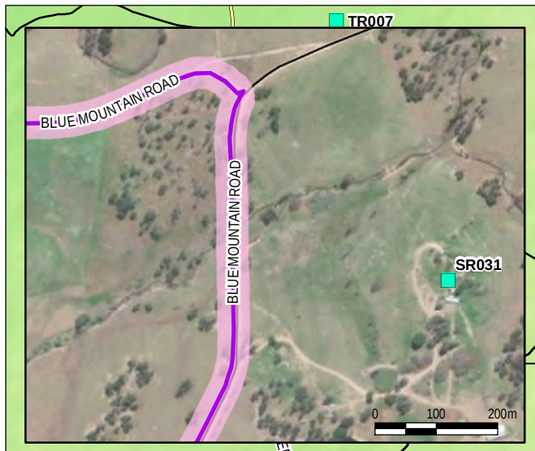
Given the range of factors associated with both the generation and control of blasting, it is recommended that in the event that blasting is necessary, the blasting specialist design each blast to achieve the project criterion and a monitoring regime is implemented to ensure compliance with the blasting criteria provided above.

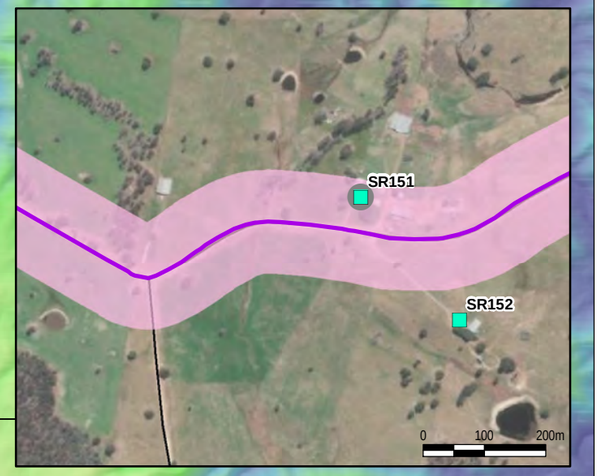
A monitoring regime at the closest dwellings may include both noise and vibration measurements to confirm the blast specialist's design and ensure that the criteria are achieved.

# 8 TRAFFIC

The traffic associated with the wind farm will predominantly occur during construction and will include semi-trailers, low loaders, trucks, mobile cranes, water tankers, four-wheel-drive vehicles and passenger vehicles.

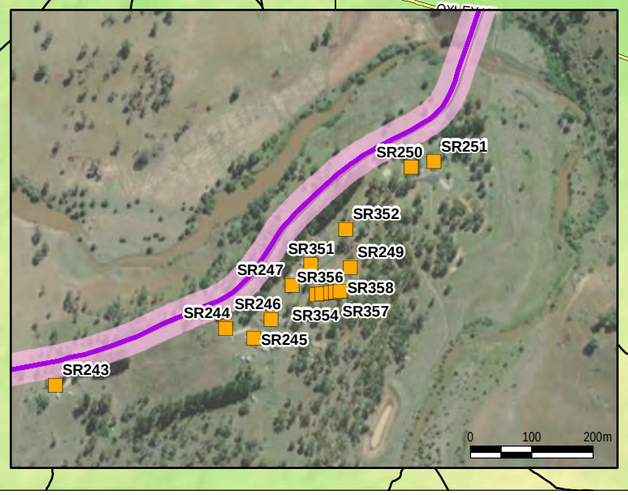
An assessment of access to the wind farm is provided in Amber Traffic & Transportation Direction report titled "Winterbourne Wind Farm Traffic Impact Assessment", *Reference: 100 rep 220601 final* (Amber, 2022). The preferred access routes includes the Golden Highway followed by access to the New England Highway, via Bengalla Road, Wybong Road, Kayuga Road, Invermein Street, Stair Street, and the Dartbrook Mine access road to bypass Muswellbrook. Other vehicles would use Thomas Mitchell Drive, Bell Street, Victoria Street, and Market Street to access the New England Highway. The following figure shows the preferred access rout to the wind farm.


BLUE MOUNTAIN ROAD
BLUE MOUNTAIN ROAD
SR031
0
100
200m


SR151
SR152
0
100
200m


SR259
BARK HUT ROAD
0
100
200m


SR160
MOONA PLAINS ROAD
0
100
200m


SR250
SR251
SR352
SR351
SR249
SR247
SR356
SR358
SR246
SR244
SR354
SR357
SR245
SR243
0
100
200m

TR007
SR102
SR108
SR260
SR274
SR048
SR062
SR353
SR282
SR289
SR301
SR304
SR060
SR300
SR107
SR004
SR109
SR105
SR288
SR007
SR009
SR293
SR212
SR136
SR100
SR261
SR168
SR031
SR061
SR350
SR200
SR151
SR152
SR103
SR216
SR170
SR125
SR121
SR120
SR161
SR299
SR043
SR088
SR087
SR058
SR002
SR119
SR259
SR065
SR204
SR262
SR034
SR359
SR095
SR068
SR039
SR086
SR240
SR207
SR116
SR050
SR277
SR093
SR026
SR028
SR027
SR138
SR092
SR037
SR298
SR003
SR010
SR044
SR349
SR206
SR201
SR242
SR250
SR251
SR017
SR055
SR185
SR243
SR244
SR345
SR348
SR346
SR072
SR140
SR278
SR067
SR051
SR228
SR167
SR171
SR224
SR078
SR227
SR202
SR219
SR012
SR267
SR160
SR286
SR084
SR005
SR272
SR253
SR264
SR268
SR075
SR063
SR123
SR040
SR124
BLUE MOUNTAIN ROAD
WINTERBOURNE ROAD
BARK HUT ROAD
MOONA PLAINS ROAD
ERBOLTS WAY
Legend
Involved Dwelling
Non-Involved Dwelling
Affecting Residence with Noise
Turbines
Wind Farm Boundary
Road Noise Buffer
Proposed Access Route
Highway / Major Road
Road
Elevation (m)
1339
160
Source:
Base Data - DCDB, DTDB Nov 2019
ESRI World Imagery Apr 2015
Preferred Access Route to the wind farm
F5
Drawing No: 0526676s_WWF_NVS_G008_R3.mxd
Winterbourne Wind Farm
Noise and Vibration Assessment
Date: 15/09/2022
Drawing Size: A3
Drawn By: VN
Reviewed By: DMS
Client: WWPL
Coordinate System: GDA 1994 MGA Zone 56
0
1
2km
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Once on the New England Highway, all vehicles are proposed to travel through Tamworth to reach the Oxley Highway, then on to Saleyard Road and Darjeeling Road to access Thunderbolts Way and subsequently Jamieson Street. Once vehicles reach Jamieson Street they would access the wider local road network and the individual access locations throughout the site.

### 8.1 Criteria

The NSW Road Noise Policy provides criteria for additional traffic noise generated by land use developments. The following table summarises the criteria for both Local Roads and arterial/sub-arterial roads.

**Table 18: Road traffic noise criteria**

| ***Existing residences on:*** | ***Day-time (7am to 10pm)*** | ***Night-time (10pm to 7am)*** |
|---|---|---|
| *Arterial/Sub-arterial roads* | 60 dB(A) ($L_{eq,15hour}$) | 55 dB(A) ($L_{eq,9hour}$) |
| *Local Roads* | 55 dB(A) ($L_{eq,1hour}$) | 50 dB(A) ($L_{eq,1hour}$) |

The noise levels are to be achieved outside, at a distance of 1m from the facade of a dwelling and at a height of 1.5m.

The preferred access route consists predominantly of arterial (freeway) and sub-arterial roads, which have a 60 dB(A) day time criterion (15 hour average noise level). There may also be some local roads used near townships, which are assessed against the more onerous 55 dB(A) day time criterion (1 hour average noise level).

### 8.2 Assessment

The traffic noise assessment considers the specific residences between Walcha and the Project, as well as a more general assessment based on worst case (closest) setback distances for the remainder of the route.

#### 8.2.1 Residences between Walcha and the Project

The residences from where the access route reaches Walcha and proceeds to the wind farm have been considered and the following table summarises the minimum setback distances between a dwelling and the access route. Roads have been divided into high speed (>60km/hr) such as outside townships and low speed areas being within townships, such as Walcha:

**Table 19: Distances between roads and dwellings**

| Road Type | Noise Criterion | Within / Outside Township | Minimum Distance Between Access Route and Dwelling |
|---|---|---|---|
| Arterial/Sub-Arterial Roads | 60 dB(A) (15 Hour) | Within | 14m |
| | | Outside | 17m |
| Local Roads | 55 dB(A) (1 Hour) | Within | 40m |
| | | Outside | 40m |

During the peak of construction, daily traffic levels are expected to reach 270 light vehicle trips (workers accessing site) and 288 large vehicles. The peak one hour traffic volume during this period is predicted to be 105 light vehicles and 32 heavy vehicles. The following table provides the predicted noise level for these traffic levels and corresponding to the distances provided above:

**Table 20: Road traffic noise predictions and distances to achieve criteria**

| Road Type | Number of Passenger Vehicle Movements | Number of Heavy Vehicle Movements | Noise Criterion | Minimum Distance of Residences from the Road | Predicted Noise Level | Minimum Distance to Achieve Criterion |
|---|---|---|---|---|---|---|
| Arterial / Sub-Arterial Roads | 270 over a 15 hour period | 288 over a 15 hour period | 60 dB(A) (15 Hour) | 14m from Township Road | 58 dB(A) | 9m |
| | | | | 17m from other Roads | 59 dB(A) | 16m |
| Local Roads | 105 within 1 hour | 32 within 1 hour | 55 dB(A) (1 Hour) | 40m from Township Road | 56 dB(A) | 50m |
| | | | | 40m from other Roads | 58 dB(A) | 80m |

Based on the above, there is the potential the traffic noise criteria to be exceeded at any residence within:

- 80m of a Local Road outside of townships; or,
- 50m of a Local Road within townships.

For the area between Walcha and the wind farm, the following non-associated residences have the potential to result in the criteria being exceeded:

**Table 21: Locations where the road traffic noise criteria may be exceeded**

| Residence ID | Road Type | Distance to the Road | Predicted Noise Level |
|---|---|---|---|
| *Residences without identity in the Wind Farm Assessment on Saleyard Road and Darjeeling Road* | Local Road | 40m | 56-58 dB(A) |

For residences further from the roads and at times other than the peak of construction, the noise level from traffic will be less than that provided in the tables above.

### 8.2.2 Other Residences

Further from the Project, residences within other townships may be as close as 10m from roads and as close as 15m from roads outside of townships. The following table provides the predicted noise level for these distances based on the peak traffic volumes.

**Table 22: Road traffic noise predictions at "other residences" and distances to achieve criteria**

| Road Type | Number of Passenger Vehicle Movements | Number of Heavy Vehicle Movements | Criterion | Minimum Distance of Residences from the Road | Predicted Noise Level | Minimum Distance to Achieve Criterion |
|---|---|---|---|---|---|---|
| Arterial / Sub-Arterial Roads | 270 over a 15 hour period | 288 over a 15 hour period | 60 dB(A) (15 Hour) | 10m from Township Road | 59 dB(A) | 9m |
| | | | | 15m from other Roads | 60 dB(A) | 16m |
| Local Roads | 105 within 1 hour | 32 within 1 hour | 55 dB(A) (1 Hour) | 10m from Township Road | 62 dB(A) | 50m |
| | | | | 15m from other Roads | 62 dB(A) | 80m |

Outside of the peak of construction, the noise level will be 3 dB(A) less for every halving of the traffic volume. That is, for 50% of the traffic volume provided above, the noise level will be 3 dB(A) less, for 25% it would be 6 dB(A) less and for 12.5% of the traffic volume above it would be 9 dB(A) less than in the tables.

### 8.2.3 Recommendations

In accordance with the general principles of dealing with temporary construction noise impacts, where the NSW Road Noise Policy criteria are exceeded (during the peak construction period), the following mitigation measures are recommended to be employed to reduce construction traffic noise:

- Communicate with the affected community;
- Establish and maintain a route into the site so that heavy vehicles do not enter noise sensitive areas for access where practicable;
- Incorporate information regarding the route to all drivers prior to accessing the site and the need to minimise impacts through driver operation at certain locations;
- Schedule construction traffic deliveries such that it is as evenly dispersed as practicable; and,
- Restrict heavy vehicle deliveries to the day-time where practical, subject to the justifications for activity outside of this time as detailed in the construction management plan;
- Implement driver training as part of the induction process. The training should include the requirement to avoid excessive acceleration of trucks and the use of truck engine brakes in close proximity to dwellings.

# 9 CONSTRUCTION VIBRATION

## 9.1 Criteria

For construction activity occurring during the day time, the DECC 2006 can be interpreted to provide the vibration criteria in the Table 23 at the dwellings, based on the core document used as the technical basis for the Technical Guideline, the British Standard *BS 6472-1992 "Evaluation of human exposure to vibration in buildings (1-80Hz)".*

**Table 23: Vibration Criteria**

| Continuous Vibration Vertical (rms) | | Impulsive Vibration Vertical (rms) | | Vibration Dose Value for Intermittent Vibration | |
|---|---|---|---|---|---|
| Preferred | Maximum | Preferred | Maximum | Preferred | Maximum |
| 0.01 $m/s^2$ | 0.02 $m/s^2$ | 0.3 $m/s^2$ | 0.6 $m/s^2$ | 0.2 $m/s^{1.75}$ | 0.4 $m/s^{1.75}$ |

Continuous vibration is uninterrupted for an extended period of time. Intermittent vibration is an interrupted form of continuous vibration, and impulsive vibration is a sudden event or events.

## 9.2 Assessment

It is expected that the main sources of construction vibration will be the rock trenching equipment and roller operation during the road and hard stand construction. The level of vibration at a distance will be subject to the input of the equipment and the local ground conditions. Typically, the distances required to achieve the construction vibration criteria provided in DECC 2006 are in the order of 20m. At a distance of 100m, vibration from these activities is unlikely to be detectable.

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

If construction activities producing high levels of vibration occur within 100m of a dwelling, such as upgrading existing roads (which may be within 25m of the closest dwelling), it is recommended that a monitoring regime is implemented during these times to ensure compliance with DECC 2006.

# 10 NATIONAL PARKS

## 10.1 Criteria

In addition to the noise impact at dwellings, the SEARs require consideration of the impact on amenity/recreational uses within the Oxley Wild Rivers National Park (including walking tracks, campgrounds and lookouts).

Indirect impacts of noise on fauna is included in the 'Biodiversity Development Assessment Report' (NGH, 2022).

The SEARs reference the *NSW Noise Policy for Industry* (EPA, 2017) when considering the potential impact, however the NPI specifically excludes the assessment of wind farm noise. An exception to this is the noise from ancillary infrastructure, which is assessed in accordance with this policy in Section 5.

In addition, under SA 2009, a relevant receiver location is “where someone resides or has development approval to build a residential dwelling”. The recreational, physical and transient use of walking trails and lookouts do not fall under this definition.

Based on the above, and in the absence of any tailored legislative objective requirements for National Parks, and based on camp grounds being more aligned with the amenity expected at permanent dwellings, the noise level at the closest camp grounds have been considered against wind farm assessment criteria which would otherwise apply at dwellings.

That is, a baseline noise criterion of 35 dB(A) has been considered at the camp grounds to satisfy the SEARs.

## 10.2 Assessment

Based on the wind turbine noise predictions in Section 4, a 35 dB(A) and 40 dB(A) noise contour (for the highest noise level wind speed, being 11m/s) have been overlaid on a map of the Oxley Wild Rivers National Park.

The map shown below demonstrates that the closest camp ground to the wind farm (Apsley Falls) is well outside of the 35 dB(A) contour, easily achieving the baseline criterion which would apply at a land use such as a dwelling.

BLUE MOUNTAIN ROAD
WINTERBOURNE ROAD
BARK HUT ROAD
THUNDERBOLTS WAY
EMU CREEK ROAD
MOONA PLAINS ROAD
OXLEY HIGHWAY
WALCHA
OXLEY WILD RIVERS
OXLEY WILD RIVERS
Riverside Campground
Budds Mare Campground
Apsley Falls

Legend
- Turbines
- Campground and Day Use Areas
- Wind Farm Boundary
- Highway / Major Road
- Road
- Path/Track
- World Heritage Area
- National Parks

Predicted $L_{Aeq, 10min}$ Noise Level at 11m/s
- 35 dB(A)
- 40 dB(A)

Elevation (m)
- 1339
- 160

Source:
Base Data - DCDB, DTDB Nov 2019
ESRI World Imagery Apr 2015

# Predicted Wind Turbine $L_{Aeq, 10min}$ Noise Level at National Park Locations

F6

| | | | |
|---|---|---|---|
| Drawing No: | 0526676s_WWF_NVS_G002_R4.mxd | | Winterbourne Wind Farm<br>Noise and Vibration Assessment |
| Date: | 15/09/2022 | Drawing Size: A3 | |
| Drawn By: | VN | Reviewed By: DMS | Client: WWPL |

Coordinate System: GDA 1994 MGA Zone 56

0 1 2km

N



ERM

Noise levels within the national park are 40 dB(A) or less at areas commonly used, such as along walking trails and at lookout locations, which indicates wind farm noise levels will be well within the rise and fall of the ambient environment (due to sources such as wind in trees, birdsong and insects).

Based on the above, it is considered that the Project will not impact on amenity/recreational uses within the Oxley Wild Rivers National Park (including walking tracks, campgrounds and lookouts).

## 11 RECOMMENDATIONS

The following summarises the recommendations made to address potential noise and vibration impacts associated with all aspects of the project:

*Wind Turbine Operation*

A pre-construction noise assessment is recommended to be undertaken based on the final turbine selection, layout and guaranteed sound power levels. Predictions will be compared against the criteria and if exceeded, the need for an operating strategy (consisting of operating specific turbines in "noise reduced" modes) will be determined.

Operational noise monitoring is also recommended following the commissioning of the Project to verify compliance with the noise criteria.

*Ancillary Infrastructure*

In order to ensure compliance with the SEARs, the assessment of noise from the substations and BESS facility is recommended to be updated should the size of the BESS or substation transformer(s) be increased or the sound power level change from that assumed in this report.

Any updates to the predictions should ensure that the highest equivalent noise level at a non-involved dwelling from operation of the substation transformers will comply with the criteria established by the SEARs, under conditions most conducive to noise propagation (such as temperature inversions).

*Construction*

For construction activities with noise levels greater than 45 dB(A) and 35 dB(A) during standard hours and outside of standard hours respectively, the Construction Noise Guidelines requires the developer to apply all feasible and reasonable work practices, and to inform the residents of the proposed construction work.

It is recommended that all "feasible and reasonable" construction noise mitigation measures as detailed in Section 6 of this report be implemented by the construction team once final construction methods, timing, locations and equipment have been determined.

These measures may include engineering measures such as the construction of temporary acoustic barriers, the use of proprietary enclosures around machines, the use of silencers, the substitution of alternative

construction processes and the fitting of broadband reversing signals. It may also include administrative measures such as inspections, scheduling and providing training to establish a noise minimisation culture for the works.

*Blasting*

It is recommended that in the event that blasting is necessary, the blasting specialist design each blast to achieve the project criterion and a monitoring regime is implemented to ensure compliance with the blasting criteria provided above.

*Traffic*

In accordance with the general principles of dealing with temporary construction noise impacts as compared to permanent operational noise, where the NSW Road Noise Policy criteria are exceeded (during the peak construction period), the following mitigation measures are recomended to reduce construction traffic noise:

- Communicate with the affected community in accordance with the provisions above;
- Establish and maintain a route into the site so that heavy vehicles do not enter noise sensitive areas for access where practicable;
- Incorporate information regarding the route to all drivers prior to accessing the site and the need to minimise impacts through driver operation at certain locations;
- Schedule construction traffic deliveries such that it is as evenly dispersed as practicable; and,
- Restrict construction to the day-time operating hours for the construction site, subject to the justifications for activity outside of this time as detailed in the construction management plan.

## 12 CONCLUSION

A noise and vibration assessment has been made of the construction and operation of the Winterbourne Wind Farm.

The Project will generally involve up to 119 wind turbine sites and ancillary infrastructure, including electricity substation, BESS facility, access tracks and temporary batching and rock crushing facilities during construction.

The noise and vibration assessment addresses the "Secretary's Environmental Assessment Requirements" (SEARs) issued for the Project (SS-10471) dated 17 September 2020.

Noise predictions have been made of the wind turbine operation, the potential substation transformers and BESS, traffic on local roads and construction activities including batching. Vibration predictions have also been made for construction activities.

Although there are no mandatory criteria for the assessment of wind farm noise within national parks, consideration has also been given to the potential impact from operation of turbines at locations such as camping grounds, walking trails and lookouts.

Based on the predictions, the relevant noise and vibration criteria will be achieved under conditions most conducive to noise propagation at all dwellings. Construction and traffic will also achieve the general intent of the NSW policies where activity is managed in accordance with the recommendations within this report.

Based on the above, the Project satisfies the noise related aspects of the SEARs.

**APPENDIX A: Environmental Assessment Requirements**

***Secretary's Environmental Assessment Requirements (SEARs)***

## Planning Secretary's Environmental Assessment Requirements

### Section 4.12(8) of the *Environmental Planning and Assessment Act 1979* Schedule 2 of the Environmental Planning and Assessment Regulation 2000

| | |
|---|---|
| **Application Number** | SSD-10471 |
| **Project** | Winterbourne Wind Farm, which includes:<br>• the construction, operation and decommissioning of a wind farm with an estimated capacity of 700 megawatts (MW), a maximum of 126 turbines and a maximum height of 250 metres (to blade tip); and<br>• ancillary infrastructure including access tracks, road upgrades, underground and overhead electricity cabling, substations, transmission lines and grid connection to the TransGrid transmission network. |
| **Location** | Approximately 6.5 km north east of Walcha and 7 km south east of Uralla within the Walcha and Uralla Shire local government areas. |
| **Applicant** | Winterbourne Wind Pty Ltd |
| **Date of Issue** | 17 September 2020 |

...

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

## APPENDIX B: Noise Sensitive locations

**Non-involved Dwelling Locations**

| Dwelling ID | Coordinates (UTM WGS84 56J) | | Rep' Logging Location | Distance to Closest Turbine |
|---|---|---|---|---|
| | Easting | Northing | | |
| SR004 | 385929 | 6588126 | SR109 | 1780 |
| SR006 | 394987 | 6571349 | SR129 | 3837 |
| SR007 | 385382 | 6587897 | SR109 | 2008 |
| SR011 | 367342 | 6571758 | SR262 | 5306 |
| SR017 | 372277 | 6572542 | SR262 | 5326 |
| SR026 | 361833 | 6574211 | SR262 | 6456 |
| SR027 | 362459 | 6574004 | SR262 | 6008 |
| SR028 | 361527 | 6573901 | SR262 | 6870 |
| SR034 | 362460 | 6576713 | SR262 | 5094 |
| SR037 | 368103 | 6573364 | SR262 | 3547 |
| SR039 | 375407 | 6574970 | SR086 | 6607 |
| SR040 | 387964 | 6560198 | SR078 | 5757 |
| SR048 | 391739 | 6591800 | SR109 | 6917 |
| SR050 | 364294 | 6574551 | SR262 | 4182 |
| SR055 | 364584 | 6573394 | SR262 | 4787 |
| SR057 | 364336 | 6573063 | SR262 | 5201 |
| SR060 | 387285 | 6588997 | SR109 | 2281 |
| SR063 | 391784 | 6562332 | SR129 | 3424 |
| SR066 | 380076 | 6597682 | SR212 | 8029 |
| SR067 | 378363 | 6570579 | SR086 | 7831 |
| SR068 | 376546 | 6576208 | SR086 | 5298 |
| SR073 | 364749 | 6570193 | SR262 | 7483 |
| SR075 | 384236 | 6563459 | SR078 | 3548 |
| SR083 | 382159 | 6562801 | SR078 | 5502 |
| SR084 | 382329 | 6565743 | SR078 | 4176 |
| SR087 | 374027 | 6579791 | SR212 | 4477 |
| SR088 | 373385 | 6579947 | SR262 | 3817 |
| SR092 | 365669 | 6574165 | SR262 | 3523 |
| SR093 | 365275 | 6574097 | SR262 | 3807 |
| SR094 | 369486 | 6595281 | SR212 | 7726 |
| SR095 | 362766 | 6576176 | SR262 | 4925 |
| SR101 | 381462 | 6596434 | SR212 | 7919 |
| SR102 | 372060 | 6593523 | SR212 | 4609 |
| SR105 | 386330 | 6588153 | SR109 | 1588 |
| SR107 | 386974 | 6588461 | SR109 | 1732 |
| SR108 | 379024 | 6592585 | SR212 | 3628 |
| SR109 | 387413 | 6587897 | SR109 | 1227 |
| SR117 | 395162 | 6572402 | SR129 | 4348 |
| SR122 | 397179 | 6571437 | SR129 | 6009 |
| SR123 | 395024 | 6562160 | SR129 | 3105 |
| SR124 | 383570 | 6558934 | SR078 | 7834 |
| SR129 | 394221 | 6568377 | SR129 | 2560 |
| SR131 | 371571 | 6594231 | SR212 | 5424 |
| SR132 | 367836 | 6568781 | SR262 | 8092 |
| SR133 | 365608 | 6569713 | SR262 | 7662 |

| Dwelling ID | Coordinates (UTM WGS84 56J) | | Rep' Logging Location | Distance to Closest Turbine |
|---|---|---|---|---|
| | Easting | Northing | | |
| SR137 | 376943 | 6567024 | SR078 | 9338 |
| SR138 | 364202 | 6573828 | SR262 | 4726 |
| SR139 | 369400 | 6570628 | SR262 | 6163 |
| SR141 | 364389 | 6585954 | SR262 | 2967 |
| SR145 | 363939 | 6585930 | SR262 | 3155 |
| SR156 | 360458 | 6586384 | SR262 | 6018 |
| SR157 | 359931 | 6586365 | SR262 | 6464 |
| SR158 | 359992 | 6585748 | SR262 | 6134 |
| SR161 | 358423 | 6582109 | SR262 | 7256 |
| SR172 | 383451 | 6560905 | SR078 | 6107 |
| SR173 | 374743 | 6598118 | SR212 | 7330 |
| SR174 | 368473 | 6571731 | SR262 | 5083 |
| SR175 | 364842 | 6572306 | SR262 | 5541 |
| SR176 | 366063 | 6572278 | SR262 | 5072 |
| SR179 | 366158 | 6572260 | SR262 | 5061 |
| SR180 | 366220 | 6572240 | SR262 | 5063 |
| SR181 | 366292 | 6572195 | SR262 | 5087 |
| SR182 | 366343 | 6572191 | SR262 | 5078 |
| SR183 | 366341 | 6572175 | SR262 | 5094 |
| SR184 | 366337 | 6572151 | SR262 | 5119 |
| SR185 | 366718 | 6572078 | SR262 | 5110 |
| SR186 | 365400 | 6572581 | SR262 | 5036 |
| SR187 | 366834 | 6572075 | SR262 | 5094 |
| SR188 | 367074 | 6572183 | SR262 | 4956 |
| SR190 | 367218 | 6572088 | SR262 | 5038 |
| SR191 | 367522 | 6572091 | SR262 | 4934 |
| SR192 | 365425 | 6572548 | SR262 | 5055 |
| SR193 | 365440 | 6572540 | SR262 | 5056 |
| SR194 | 365517 | 6572412 | SR262 | 5140 |
| SR195 | 365804 | 6572309 | SR262 | 5127 |
| SR196 | 365885 | 6572295 | SR262 | 5113 |
| SR197 | 365832 | 6572294 | SR262 | 5132 |
| SR198 | 365882 | 6572264 | SR262 | 5143 |
| SR201 | 371307 | 6573062 | SR262 | 4349 |
| SR204 | 361839 | 6577359 | SR262 | 5529 |
| SR206 | 367628 | 6573167 | SR262 | 3885 |
| SR207 | 365941 | 6575274 | SR262 | 2476 |
| SR208 | 365154 | 6573265 | SR262 | 4558 |
| SR216 | 390137 | 6583586 | SR109 | 2374 |
| SR217 | 359795 | 6587634 | SR262 | 7272 |
| SR219 | 380893 | 6568618 | SR078 | 5346 |
| SR240 | 385447 | 6574786 | SR086 | 1514 |
| SR242 | 371487 | 6572902 | SR262 | 4579 |
| SR243 | 370164 | 6572155 | SR262 | 4758 |
| SR244 | 370443 | 6572247 | SR262 | 4742 |

| Dwelling ID | Coordinates (UTM WGS84 56J) | | Rep' Logging Location | Distance to Closest Turbine |
|---|---|---|---|---|
| | Easting | Northing | | |
| SR245 | 370488 | 6572232 | SR262 | 4770 |
| SR246 | 370516 | 6572261 | SR262 | 4751 |
| SR247 | 370551 | 6572317 | SR262 | 4709 |
| SR248 | 370606 | 6572304 | SR262 | 4739 |
| SR249 | 370646 | 6572346 | SR262 | 4712 |
| SR250 | 370744 | 6572509 | SR262 | 4595 |
| SR251 | 370782 | 6572519 | SR262 | 4599 |
| SR256 | 375269 | 6598303 | SR212 | 7455 |
| SR260 | 370936 | 6591535 | SR212 | 4409 |
| SR262 | 365240 | 6577539 | SR262 | 2200 |
| SR264 | 391259 | 6564166 | SR129 | 2496 |
| SR268 | 393159 | 6563576 | SR129 | 1760 |
| SR270 | 365407 | 6569570 | SR262 | 7854 |
| SR272 | 391556 | 6565190 | SR129 | 1757 |
| SR273 | 364283 | 6572187 | SR262 | 5938 |
| SR274 | 379445 | 6591286 | SR212 | 2592 |
| SR276 | 376604 | 6566486 | SR078 | 9750 |
| SR277 | 365938 | 6574439 | SR262 | 3147 |
| SR278 | 378009 | 6571101 | SR086 | 7541 |
| SR280 | 378483 | 6566746 | SR078 | 7855 |
| SR281 | 379210 | 6565070 | SR078 | 7358 |
| SR282 | 383109 | 6589801 | SR109 | 4017 |
| SR289 | 384624 | 6589109 | SR109 | 3386 |
| SR295 | 373999 | 6594493 | SR212 | 4059 |
| SR296 | 373393 | 6594860 | SR212 | 4675 |
| SR297 | 379398 | 6561010 | SR078 | 8784 |
| SR298 | 369766 | 6574701 | SR262 | 2199 |
| SR300 | 386776 | 6588517 | SR109 | 1806 |
| SR301 | 387117 | 6589217 | SR109 | 2488 |
| SR302 | 367550 | 6572384 | SR262 | 4647 |
| SR303 | 383325 | 6561989 | SR078 | 5268 |
| SR304 | 389044 | 6589217 | SR109 | 3198 |
| SR305 | 365757 | 6572149 | SR262 | 5294 |
| SR306 | 365794 | 6572193 | SR262 | 5239 |
| SR307 | 365726 | 6572183 | SR262 | 5273 |
| SR308 | 365782 | 6572207 | SR262 | 5230 |
| SR309 | 365774 | 6572227 | SR262 | 5215 |
| SR310 | 365718 | 6572201 | SR262 | 5259 |
| SR311 | 365758 | 6572244 | SR262 | 5204 |
| SR312 | 365707 | 6572215 | SR262 | 5250 |
| SR313 | 365747 | 6572259 | SR262 | 5194 |
| SR314 | 365680 | 6572253 | SR262 | 5224 |
| SR315 | 365729 | 6572290 | SR262 | 5172 |
| SR316 | 365817 | 6572177 | SR262 | 5247 |
| SR317 | 365871 | 6572171 | SR262 | 5234 |
| SR318 | 365818 | 6572218 | SR262 | 5208 |
| SR319 | 365875 | 6572196 | SR262 | 5209 |

| Dwelling ID | Coordinates (UTM WGS84 56J) | | Rep' Logging Location | Distance to Closest Turbine |
|---|---|---|---|---|
| | Easting | Northing | | |
| SR320 | 365809 | 6572256 | SR262 | 5175 |
| SR321 | 365826 | 6572270 | SR262 | 5156 |
| SR322 | 365881 | 6572237 | SR262 | 5169 |
| SR323 | 365868 | 6572131 | SR262 | 5273 |
| SR324 | 365883 | 6572126 | SR262 | 5273 |
| SR325 | 365905 | 6572123 | SR262 | 5268 |
| SR326 | 365926 | 6572118 | SR262 | 5266 |
| SR327 | 366108 | 6572149 | SR262 | 5182 |
| SR328 | 366166 | 6572115 | SR262 | 5198 |
| SR329 | 366162 | 6571980 | SR262 | 5329 |
| SR330 | 366212 | 6572017 | SR262 | 5280 |
| SR331 | 366392 | 6571990 | SR262 | 5262 |
| SR332 | 366443 | 6571982 | SR262 | 5258 |
| SR333 | 366471 | 6571980 | SR262 | 5254 |
| SR334 | 366307 | 6571953 | SR262 | 5318 |
| SR335 | 366362 | 6571941 | SR262 | 5316 |
| SR336 | 366316 | 6572007 | SR262 | 5263 |
| SR337 | 366326 | 6572063 | SR262 | 5207 |
| SR338 | 366437 | 6571928 | SR262 | 5312 |
| SR339 | 366482 | 6571909 | SR262 | 5321 |
| SR340 | 366549 | 6571969 | SR262 | 5249 |
| SR341 | 366535 | 6571946 | SR262 | 5274 |
| SR342 | 366536 | 6571924 | SR262 | 5295 |
| SR343 | 366534 | 6571903 | SR262 | 5316 |
| SR344 | 366529 | 6571888 | SR262 | 5332 |
| SR345 | 366616 | 6571886 | SR262 | 5317 |
| SR346 | 366610 | 6571852 | SR262 | 5352 |
| SR347 | 366673 | 6571840 | SR262 | 5352 |
| SR348 | 366811 | 6571939 | SR262 | 5232 |
| SR349 | 364146 | 6573758 | SR262 | 4815 |
| SR350 | 390966 | 6584536 | SR109 | 3616 |
| SR351 | 370581 | 6572351 | SR262 | 4686 |
| SR352 | 370638 | 6572408 | SR262 | 4651 |
| SR354 | 370591 | 6572301 | SR262 | 4737 |
| SR355 | 370599 | 6572303 | SR262 | 4737 |
| SR356 | 370613 | 6572305 | SR262 | 4740 |
| SR357 | 370621 | 6572306 | SR262 | 4742 |
| SR358 | 370629 | 6572307 | SR262 | 4743 |
| SR359 | 363586 | 6576717 | SR262 | 4034 |
| TR003 | 357396 | 6599013 | SR262 | 17226 |
| TR006 | 359820 | 6596922 | SR212 | 14094 |
| TR008 | 361072 | 6592467 | SR262 | 9886 |
| TR009 | 363979 | 6591709 | SR212 | 7437 |
| TR011 | 366225 | 6594341 | SR212 | 9015 |
| TR012 | 356663 | 6593946 | SR262 | 13939 |

**Involved Dwelling Locations**

| Dwelling ID | Coordinates (UTM WGS84 56J) | | Rep' Logging Location | Distance to Closest Turbine |
|---|---|---|---|---|
| | Easting | Northing | | |
| SR002 | 375959 | 6579209 | SR212 | 4235 |
| SR003 | 371504 | 6574602 | SR262 | 3280 |
| SR005 | 391269 | 6565826 | SR129 | 1489 |
| SR009 | 380923 | 6588366 | SR212 | 1666 |
| SR010 | 371916 | 6574209 | SR262 | 3849 |
| SR012 | 388366 | 6568246 | SR078 | 1605 |
| SR031 | 375398 | 6585552 | SR212 | 2838 |
| SR038 | 396327 | 6563009 | SR129 | 3068 |
| SR043 | 378160 | 6580858 | SR212 | 2056 |
| SR044 | 371875 | 6573511 | SR262 | 4319 |
| SR051 | 381359 | 6570806 | SR078 | 5378 |
| SR058 | 377527 | 6579893 | SR212 | 2575 |
| SR061 | 387048 | 6584466 | SR109 | 1409 |
| SR062 | 369733 | 6590030 | SR212 | 4784 |
| SR065 | 386835 | 6577879 | SR086 | 517 |
| SR072 | 373293 | 6571329 | SR262 | 6907 |
| SR078 | 387492 | 6569749 | SR078 | 2067 |
| SR086 | 385205 | 6575756 | SR086 | 1339 |
| SR091 | 391501 | 6566924 | SR129 | 431 |
| SR100 | 377860 | 6586658 | SR212 | 1777 |
| SR103 | 388250 | 6583682 | SR109 | 1196 |
| SR116 | 364614 | 6574869 | SR262 | 3735 |
| SR119 | 383200 | 6579348 | SR086 | 678 |
| SR120 | 386425 | 6580639 | SR086 | 882 |
| SR121 | 386274 | 6581817 | SR086 | 1542 |
| SR142 | 363665 | 6585585 | SR262 | 3033 |
| SR143 | 363512 | 6585384 | SR262 | 2985 |
| SR144 | 363401 | 6585558 | SR262 | 3188 |
| SR125 | 390519 | 6582179 | SR109 | 1666 |
| SR136 | 377641 | 6587039 | SR212 | 1791 |
| SR140 | 370147 | 6571026 | SR262 | 5858 |
| SR151 | 384996 | 6583992 | SR109 | 1136 |

| Dwelling ID | Coordinates (UTM WGS84 56J) | | Rep' Logging Location | Distance to Closest Turbine |
|---|---|---|---|---|
| | Easting | Northing | | |
| SR152 | 385157 | 6583792 | SR109 | 1232 |
| SR159 | 364337 | 6585129 | SR262 | 2266 |
| SR160 | 388814 | 6567825 | SR078 | 1415 |
| SR167 | 386778 | 6570665 | SR078 | 1519 |
| SR168 | 374958 | 6586279 | SR212 | 1991 |
| SR170 | 389047 | 6583131 | SR109 | 1399 |
| SR171 | 383868 | 6570065 | SR078 | 3047 |
| SR189 | 367060 | 6572009 | SR262 | 5131 |
| SR200 | 383771 | 6584162 | SR109 | 2026 |
| SR202 | 387223 | 6568891 | SR078 | 1199 |
| SR212 | 377321 | 6587671 | SR212 | 1993 |
| SR224 | 384679 | 6569658 | SR078 | 2172 |
| SR227 | 385460 | 6569552 | SR078 | 1617 |
| SR228 | 388270 | 6573420 | SR078 | 1451 |
| SR253 | 392084 | 6564851 | SR129 | 1468 |
| SR259 | 385251 | 6579064 | SR086 | 789 |
| SR261 | 372931 | 6586956 | SR212 | 1619 |
| SR267 | 389226 | 6568250 | SR078 | 1845 |
| SR286 | 390138 | 6567387 | SR078 | 1181 |
| SR288 | 384455 | 6587591 | SR109 | 2256 |
| SR293 | 367331 | 6587711 | SR212 | 2321 |
| SR299 | 362913 | 6581916 | SR262 | 2987 |
| SR353 | 369353 | 6589632 | SR212 | 4291 |
| TR001 | 356408 | 6599732 | SR262 | 18406 |
| TR002 | 356871 | 6599176 | SR262 | 17683 |
| TR004 | 357756 | 6600502 | SR212 | 18208 |
| TR005 | 359497 | 6596041 | SR262 | 13594 |
| TR007 | 362551 | 6593234 | SR212 | 9505 |
| TR010 | 365013 | 6595725 | SR212 | 10660 |

*Dwelling ID's prefixed by "TR" are in the vicinity of the transmission corridor and "SR" are in the vicinity of wind turbines*

**APPENDIX C: Address of Dwellings with Predicted Noise Level Greater than 30 dB(A)**

| Dwelling ID | Dwelling Address |
|---|---|
| **Non-Involved Dwellings** | |
| SR004 | 1953 Winterbourne Rd, Walcha NSW 2354 |
| SR007 | 1878 Winterbourne Rd, Walcha NSW 2354 |
| SR105 | 1995 Winterbourne Rd, Walcha NSW 2354 |
| SR107 | Winterbourne Rd, Walcha NSW 2354 |
| SR109 | 2094 Winterbourne Road, Walcha NSW 2354 |
| SR129 | 16 Brooklyn Rd, Walcha NSW 2354 |
| SR216 | 790 Table Top Rd, Walcha NSW 2354 |
| SR240 | 784 Old Brookmount Rd, Walcha NSW 2354 |
| SR262 | 221 Ohio North Road, Walcha NSW 2354 |
| SR264 | 100 Echo Point Rd, Walcha NSW 2354 |
| SR268 | 549 Chinnocks Rd, Walcha NSW 2354 |
| SR272 | 332 Chinnocks Rd, Walcha NSW 2354 |
| SR300 | 2059 Winterbourne Road, Walcha NSW 2354 |
| **Involved Dwellings** | |
| SR005 | 245 Chinnocks Rd, Walcha NSW 2354 |
| SR009 | 156 Uruga Rd, Walcha NSW 2354 |
| SR012 | Moona Plains Rd, Walcha NSW 2354 |
| SR043 | 762 Winterbourne Road, Walcha NSW 2354 |
| SR061 | 629 Table Top Road, Walcha NSW 2354 |
| SR065 | 1007 Bark Hut Rd, Walcha NSW 2354 |
| SR078 | 36 Rowleys Creek Rd, Walcha NSW 2354 |
| SR086 | 1232 Old Brookmount Road, Walcha NSW 2354 |
| SR091 | 2210 Moona Plains Rd, Walcha NSW 2354 |
| SR100 | 316 Hazeldean Rd, Walcha NSW 2354 |
| SR103 | 629 Table Top Rd, Walcha NSW 2354 |
| SR119 | 701 Bark Hut Rd, Walcha NSW 2354 |
| SR120 | 323 Florida Road, Walcha NSW 2354 |
| SR121 | 323 Florida Road, Walcha NSW 2354 |
| SR125 | 754 Table Top Road, Walcha NSW 2354 |
| SR136 | 279 Hazeldean Rd, Walcha NSW 2354 |
| SR151 | 265 Table Top Rd, Walcha NSW 2354 |
| SR152 | 265 Table Top Rd, Walcha NSW 2354 |
| SR160 | 10 Lockyer Ln, Walcha NSW 2354 |
| SR167 | 93 Rowleys Creek Rd, Walcha NSW 2354 |
| SR168 | 1 Hazeldean Road, Walcha NSW 2354 |
| SR170 | 704 Table Top Rd, Walcha NSW 2354 |
| SR200 | 136 Table Top Rd, Walcha NSW 2354 |
| SR202 | 1672 Moona Plains Rd, Walcha NSW 2354 |
| SR212 | 111 Oorawilly Rd, Walcha NSW 2354 |
| SR227 | 1488 Moona Plains Rd, Walcha NSW 2354 |
| SR228 | 423 Rowleys Creek Rd, Walcha NSW 2354 |
| SR253 | 375 Chinnocks Rd, Walcha NSW 2354 |
| SR259 | 913 Bark Hut Rd, Walcha NSW 2354 |
| SR261 | Blue Mountain Rd, Walcha NSW 2354 |
| SR267 | 1889 Moona Plains Rd, Walcha NSW 2354 |
| SR286 | 2060 Moona Plains Rd, Walcha NSW 2354 |
| SR288 | Winterbourne Rd, Walcha NSW 2354 |

**APPENDIX D: Photographs of Logging Equipment at Dwellings**

**Noise and Weather Loggers at SR129**

**Noise Logger at SR005**

**Noise Logger at SR078**

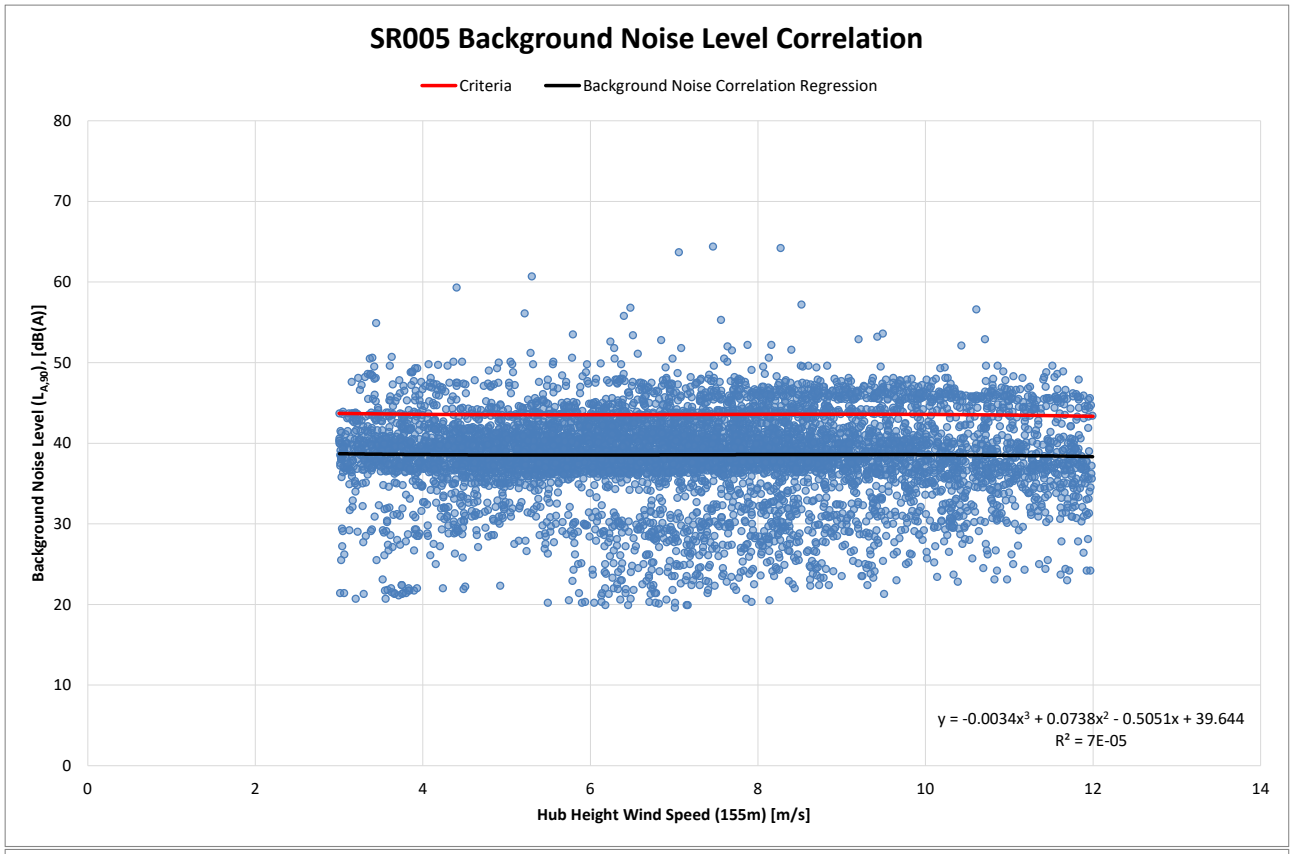
**Noise Logger at SR212**

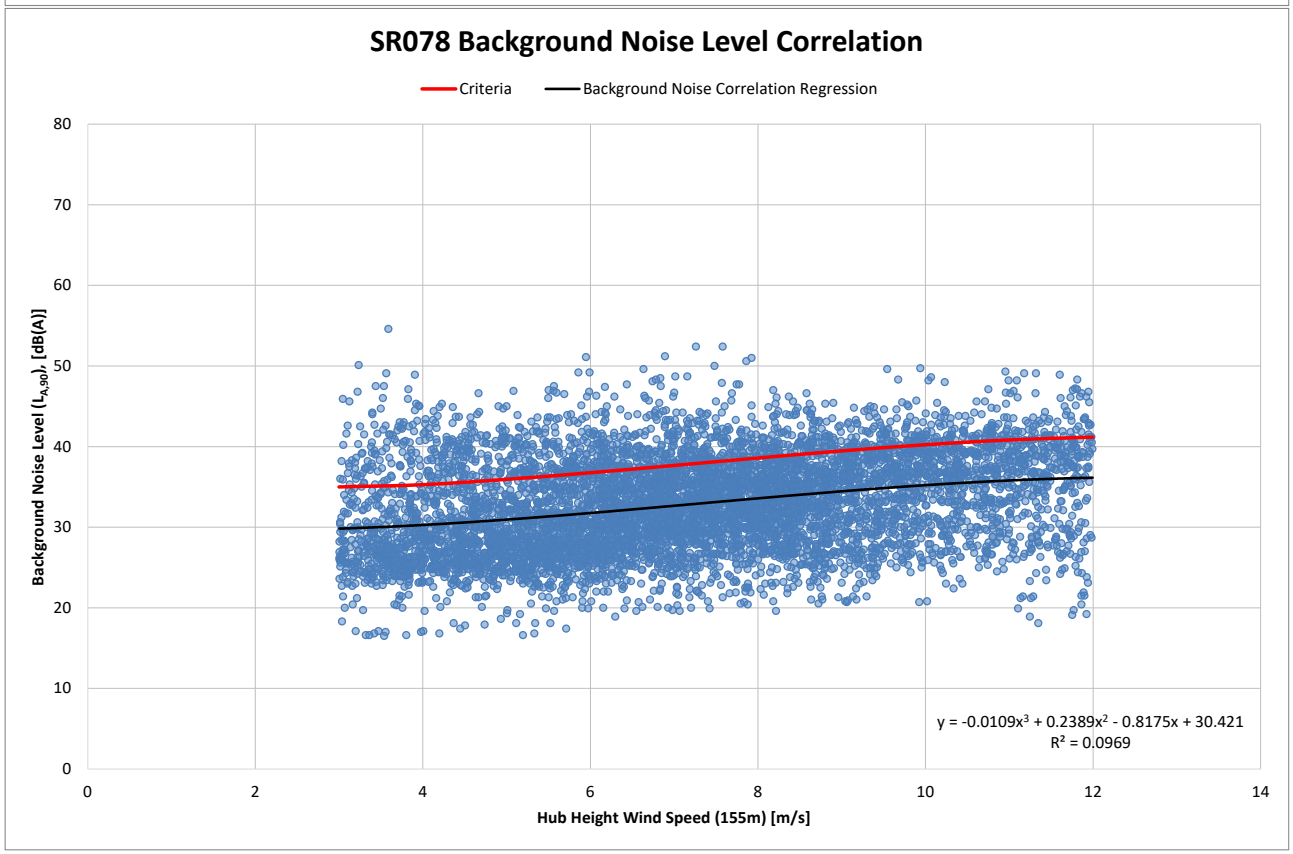
**Noise Logger at SR086**

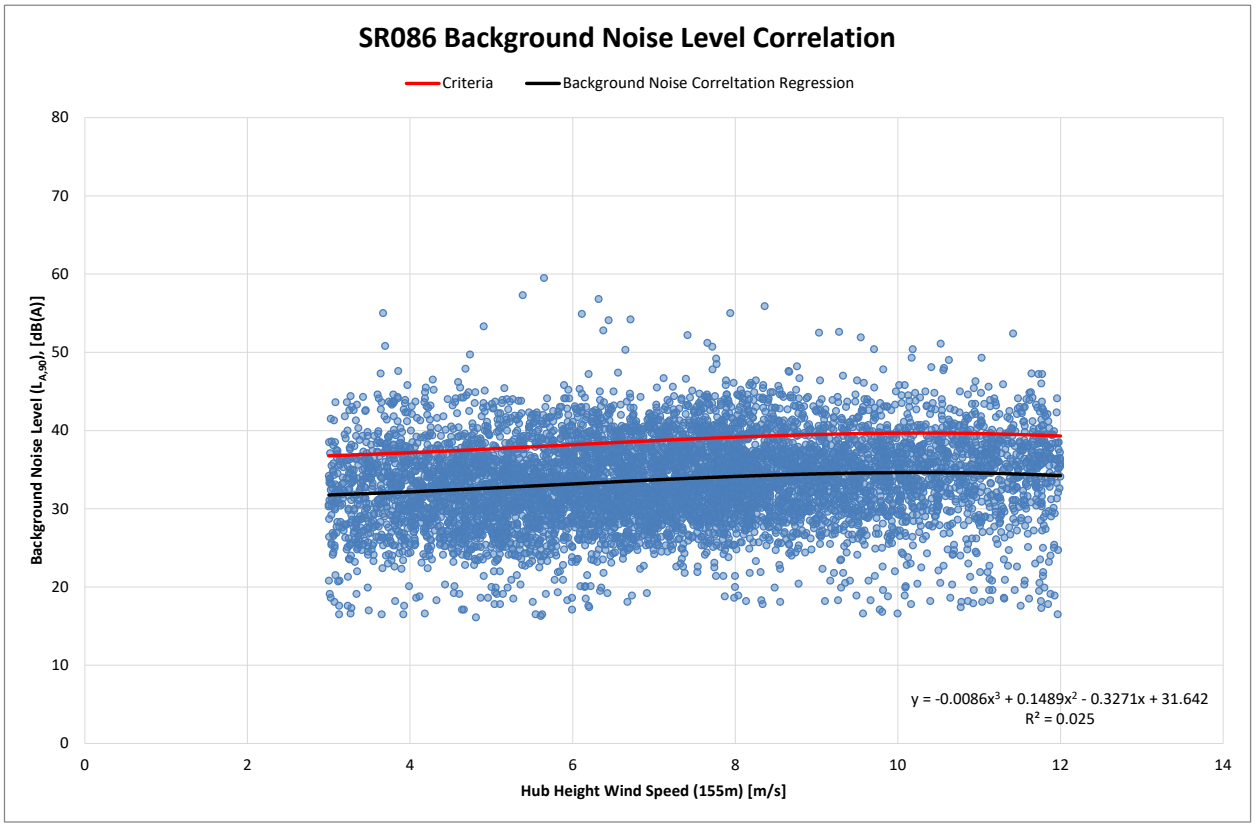
Noise and Weather Loggers at SR262

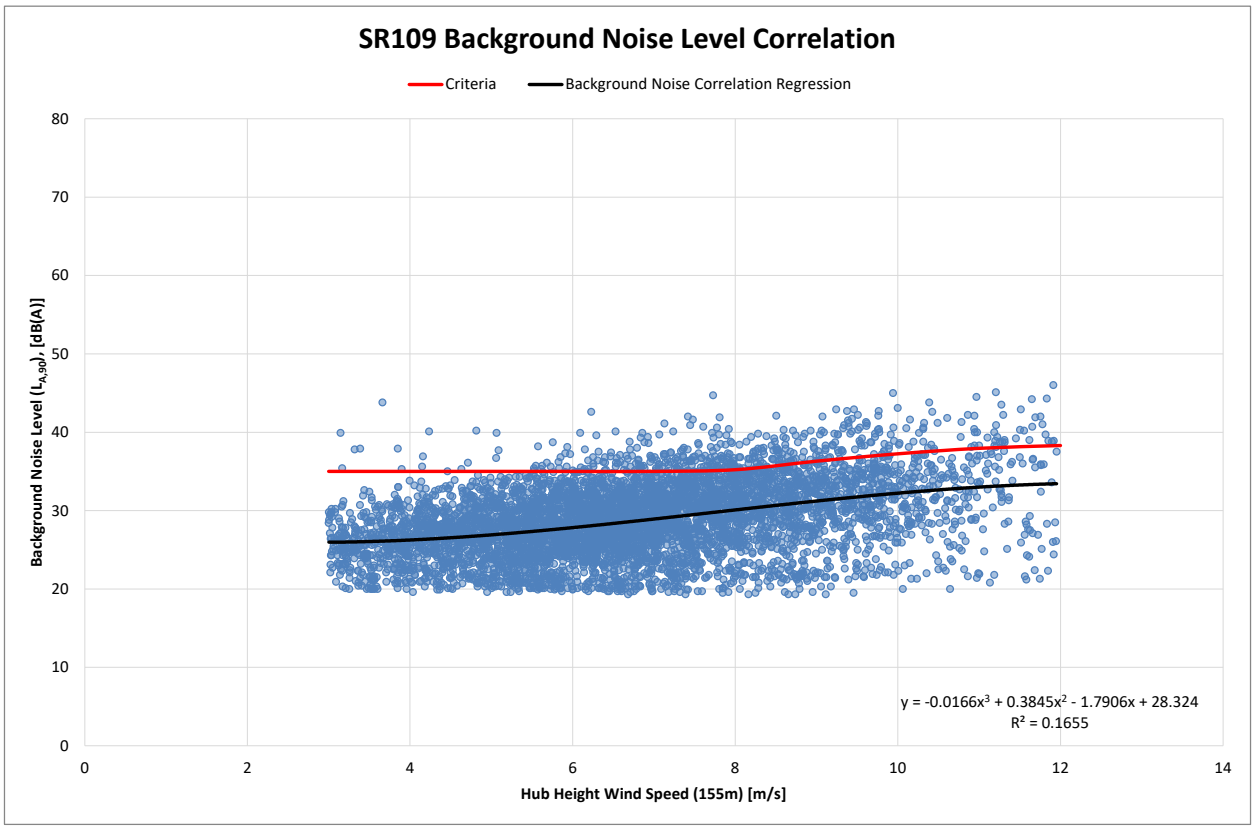
**Noise Logger at SR109**

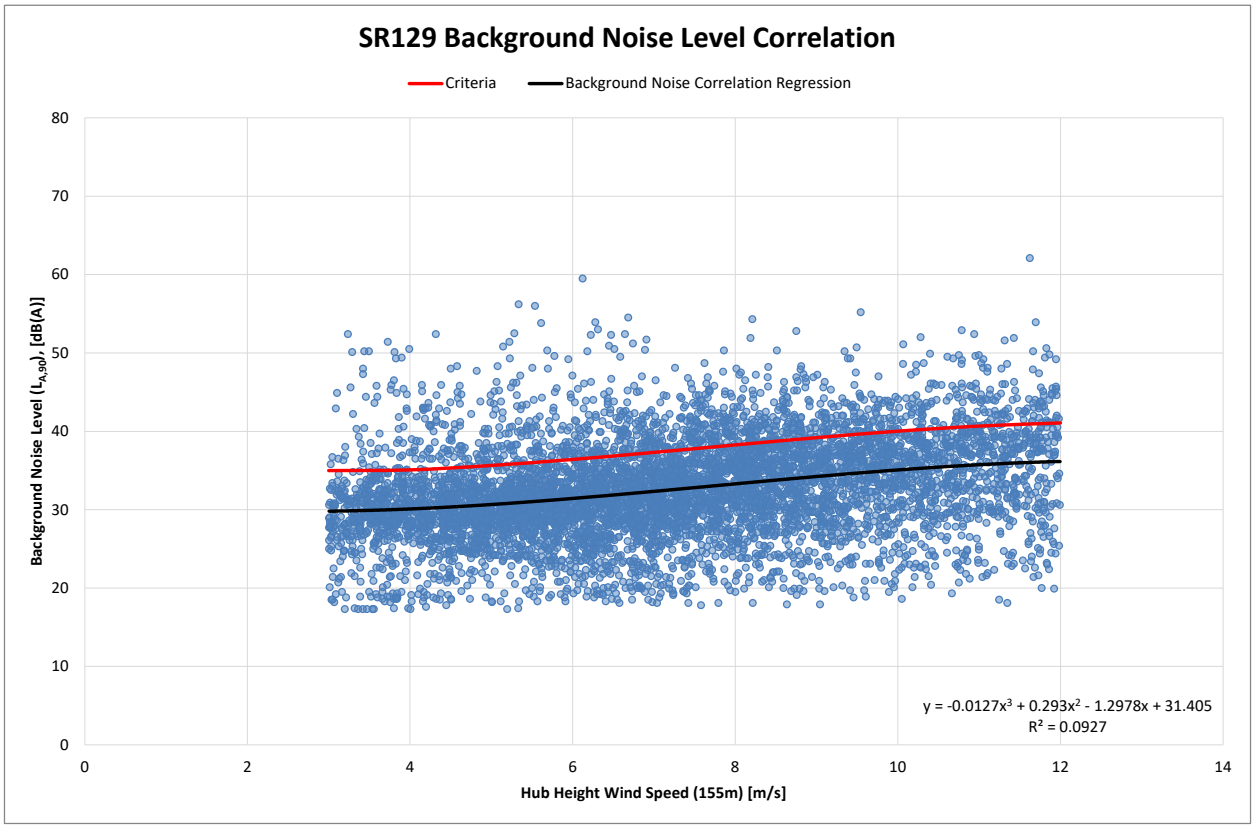
## APPENDIX E: Background Noise and Wind Speed Correlation Charts

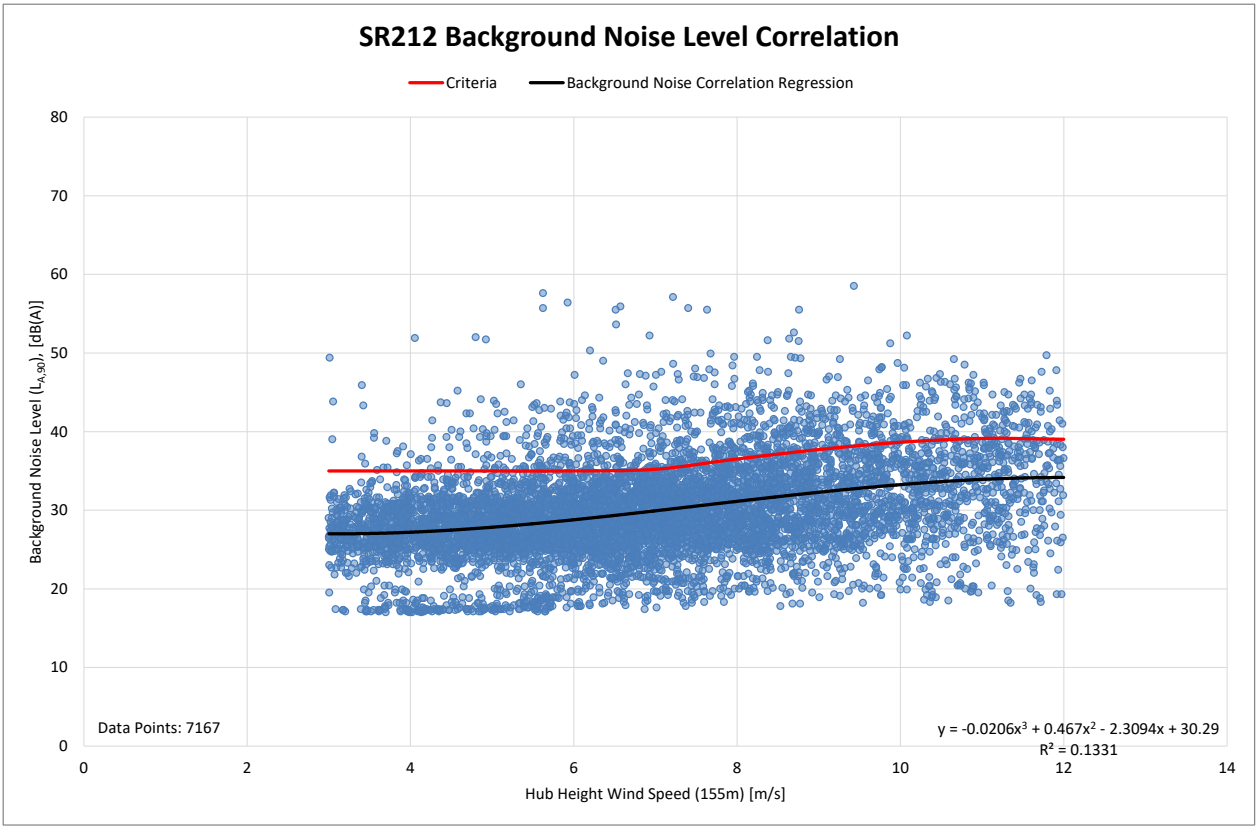


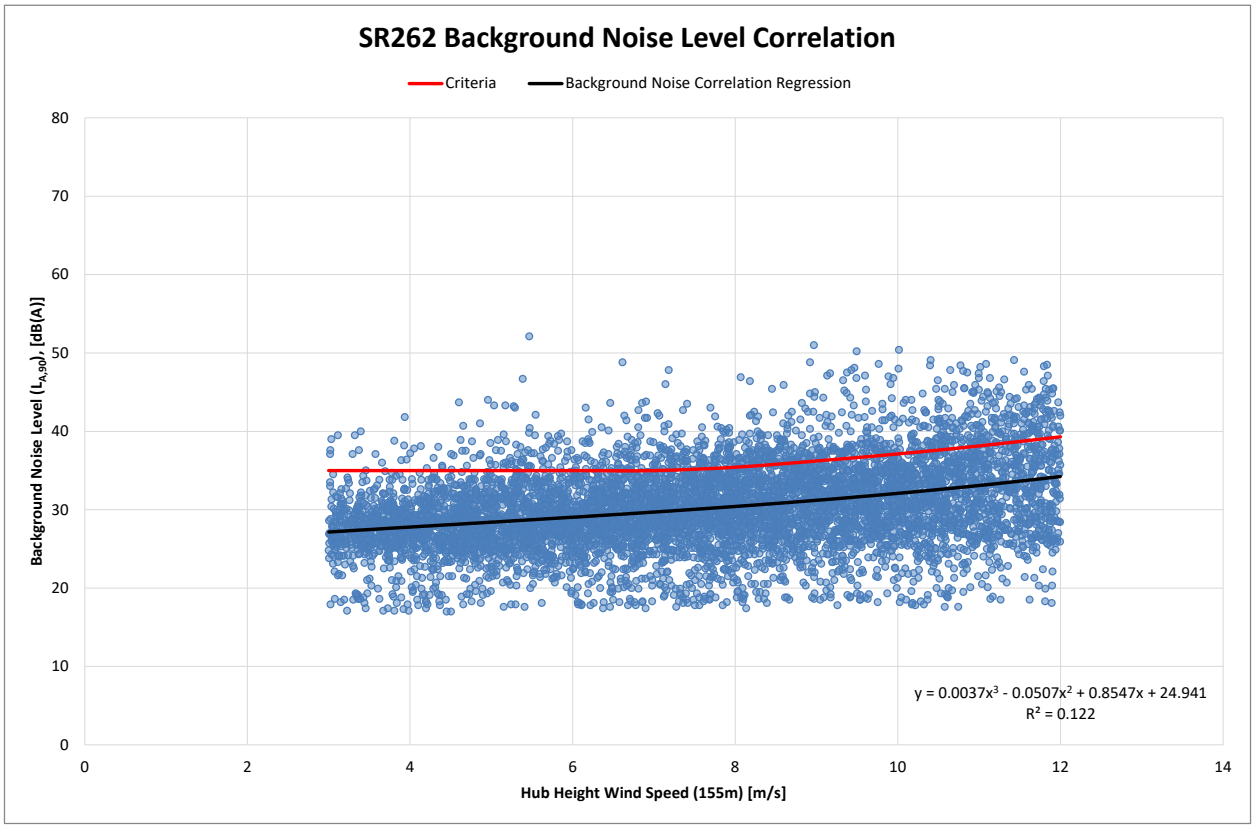




SR086 Background Noise Level Correlation
Criteria
Background Noise Correltation Regression
Background Noise Level ($L_{A90}$), [dB(A)]
Hub Height Wind Speed (155m) [m/s]
y = -0.0086x³ + 0.1489x² - 0.3271x + 31.642
R² = 0.025


SR109 Background Noise Level Correlation
Criteria
Background Noise Correlation Regression
Background Noise Level ($L_{A90}$), [dB(A)]
Hub Height Wind Speed (155m) [m/s]
y = -0.0166x³ + 0.3845x² - 1.7906x + 28.324
R² = 0.1655


SR129 Background Noise Level Correlation
Criteria
Background Noise Correlation Regression
Background Noise Level ($L_{A,90}$), [dB(A)]
Hub Height Wind Speed (155m) [m/s]
y = -0.0127x³ + 0.293x² - 1.2978x + 31.405
R² = 0.0927


SR212 Background Noise Level Correlation
Criteria
Background Noise Correlation Regression
Background Noise Level ($L_{A,90}$), [dB(A)]
Hub Height Wind Speed (155m) [m/s]
Data Points: 7167
y = -0.0206x³ + 0.467x² - 2.3094x + 30.29
R² = 0.1331


SR262 Background Noise Level Correlation
Criteria
Background Noise Correlation Regression
Background Noise Level ($L_{A,90}$), [dB(A)]
Hub Height Wind Speed (155m) [m/s]
y = 0.0037x³ - 0.0507x² + 0.8547x + 24.941
R² = 0.122
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14