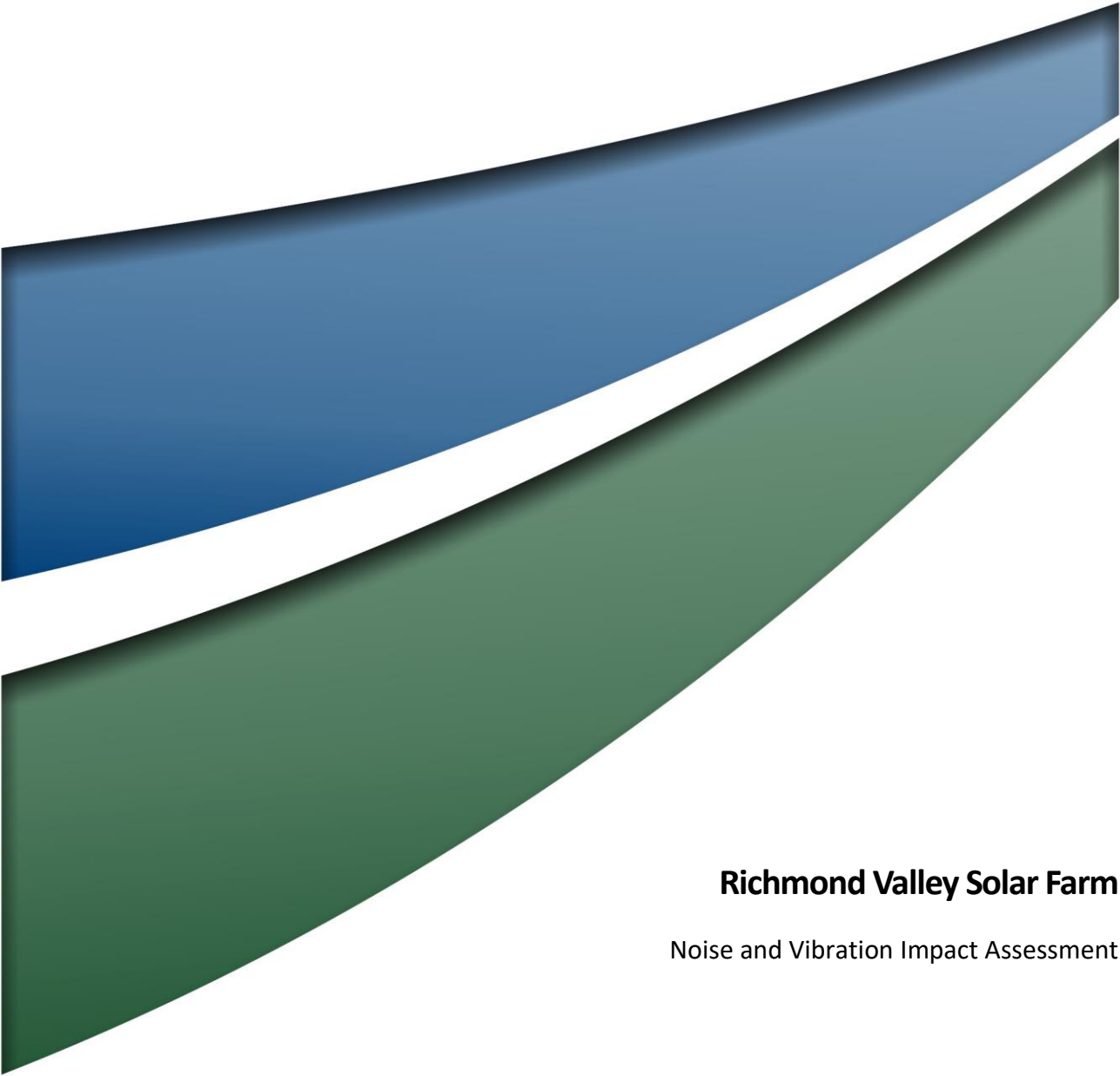


APPENDIX 19

Noise and Vibration Impact Assessment

This report has been prepared for Richmond Valley Solar & BESS Pty Ltd (ABN 43 672 993 869) a wholly owned special purpose vehicle of Ark Energy Projects Pty Ltd and the Proponent of the Project. Richmond Valley Solar & BESS Pty Ltd will herein be referred to as Ark Energy or Ark Energy Projects.



Richmond Valley Solar Farm
Noise and Vibration Impact Assessment

Final

April 2024

Richmond Valley Solar Farm

Noise and Vibration Impact Assessment

Final

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Ark Energy

Project Director: Malinda Facey
Project Manager: Jess Henderson-Wilson
Technical Director: Tim Procter
Technical Manager: Ben Carlyle
Report No. 23252/R08
Date: April 2024



QMS Certification Services

This report was prepared using
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Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final	Ben Carlyle	26/04/2024	Jess Henderson-Wilson	26/04/2024

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1.0 Introduction

Ark Energy Projects Pty Ltd (Ark Energy) proposes to develop the Richmond Valley Solar Farm (the Project) in the Northern Rivers region of New South Wales (NSW), approximately seven kilometres (km) to the east of the town of Rappville in the Richmond Valley Local Government Area (LGA). The location of the Project is presented in **Figure 1.1**.

The Project includes up to 500 megawatts (MW) of DC solar electricity generation with a Battery Energy Storage System (BESS) of approximately 2,200 MW hours (MWh) capacity. The Project will also include supporting infrastructure, inverters to convert DC to AC electricity, a substation, switching substation and transmission lines (approximately 2 km) to the nearby Transgrid transmission network. The Project involves the construction, operation and decommissioning phases.

This Noise and Vibration Impact Assessment (NVIA) has been prepared by Umwelt to assess the potential noise and vibration impacts associated with the construction, operation and decommissioning of the Project and to recommend mitigation measures where required.

1.1 Project Overview

The Project Area comprises two freehold properties that span across ten cadastral lots, covering an area of approximately 1,475 hectares (ha) with the Development Footprint occupying approximately 803 ha, refer to **Figure 1.2**. The Project Area is approximately 95 km north-east of the New England Renewable Energy Zone (REZ) however it is not related to the REZ, nor is it dependent on the REZ infrastructure. This Project benefits from utilising the existing 330 kV Transgrid powerlines within the north-western extent of the Project Area, allowing connection to the national electricity grid. Approximately two km of new transmission line connecting to the Transgrid Lismore – Coffs Harbour 330 kV transmission line (line 89) from a 330 kV switching substation and a 330 kV / 33 kV substation. The conceptual project layout is shown in **Figure 1.3**.

The Project will have access via Main Camp Road and Summerland Way through three access points off Avenue Road (SA1, SA2, SA3)(refer to **Figure 1.3**). Road upgrades will be required to facilitate the transportation of vehicles during the construction and decommissioning phases of the Project. The Road Upgrade Area (refer to **Figure 1.3**) is located on local and state roads spanning 5.1 km from Summerland Way, west of the Project Area to SA3.

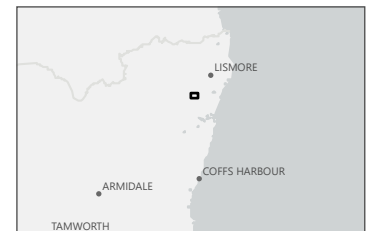
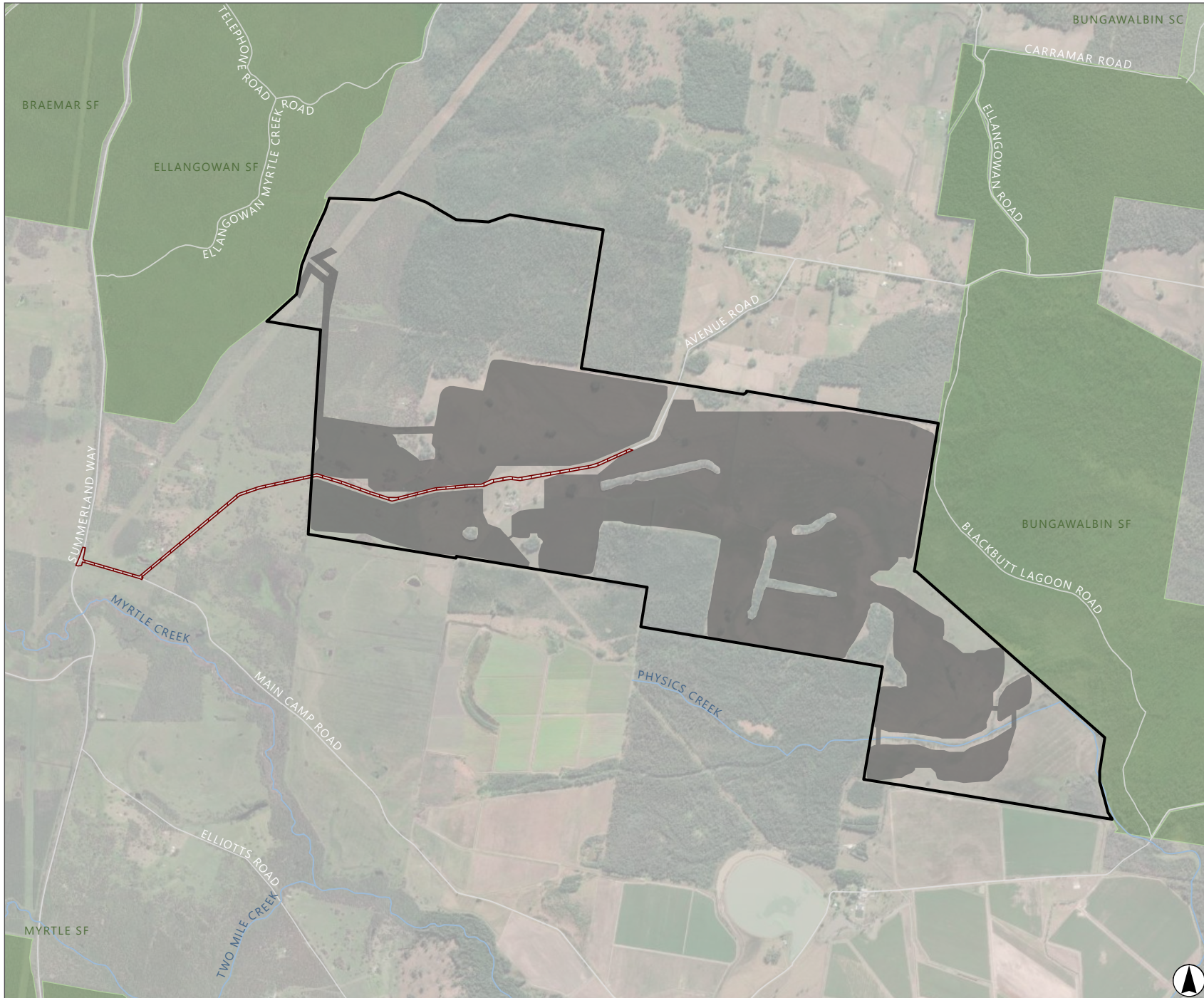
The Project is expected to operate for 30 years. After the initial 30-year operating period, the solar farm would either be decommissioned, removing all infrastructure except the transmission lines and substations and returning the Project Area to its existing land capability, or repurposed with new PV equipment subject to technical feasibility and planning consent.

The Project is a State Significant Development (SSD) under State Environmental Planning Policy (Planning Systems) 2021 (NSW) (Planning Systems SEPP) as the Project is in development for the purposes of electricity generating works and the capital investment value of the Project is over \$30 million. A Development Application (DA) for the Project is required to be submitted under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act).

FIGURE 1.2
Project Area

Legend

- Project Area
- Development Footprint
- Road Upgrade Area
- NPWS Reserve
- State Forest
- Roads
- Watercourse

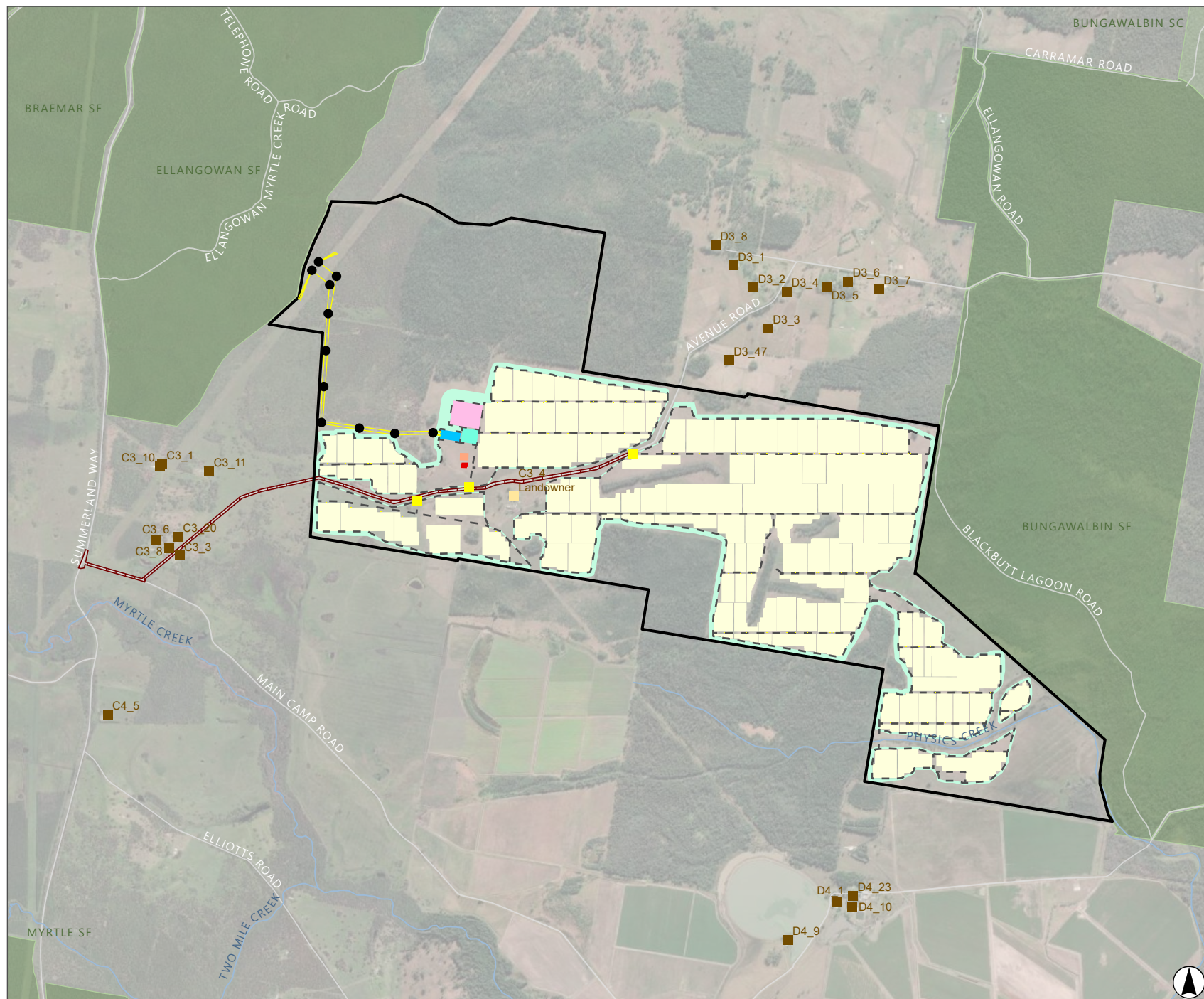


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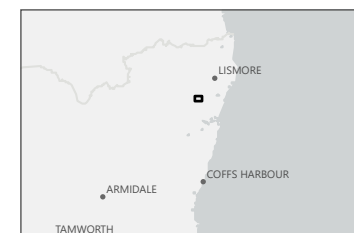
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FIGURE 1.3
Conceptual Project Layout



Legend

- Project Area
- Road Upgrade Area
- Associated Sensitive Receiver
- Non-Associated Sensitive Receiver
- Transmission Poles
- Access Points
- Transmission Lines
- Access Tracks
- Substation
- Switching Substation
- Staff Car Park
- O&M Facility
- BESS
- APZ
- Inverters
- Solar Array Blocks
- NPWS Reserve
- State Forest
- Roads
- Watercourse



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This NVIA has been prepared in accordance with the following guidelines and legislative requirements:

- *Noise Policy for Industry (NPfl)*, NSW Environment Protection Authority (EPA), 2017.
- *Interim Construction Noise Guideline (ICNG)*, NSW Department of Environment and Climate Change (DECC), 2009.
- *NSW Road Noise Policy (RNP)*, Department of Environment, Climate Change and Water (DECCW), 2011.
- *Assessing Vibration: A Technical Guideline (the Vibration Guideline)*, Department of Environment and Conservation (DEC), 2006.
- British Standard BS7385 (1993) Part 2 Evaluation and measurement of vibration in buildings (BS7385).
- German Institute for Standardisation DIN 4150-3:1999-02 Structural vibration – Effects of vibration on structures (DIN4150).
- Large-Scale Solar Energy Guideline, NSW Department of Planning and Environment (DPE), 2022.
- AS2436-2010 (2016) Guide to Noise Control on Construction, Demolition and Maintenance Sites.
- Construction Noise and Vibration Guideline (CNVG), Transport for NSW (TfNSW), 2023.

2.2 Modelling Methodology

Prediction of the operation and construction noise levels was undertaken with the proprietary computer noise modelling software CadnaA (Version 2023), using the CONCAWE noise prediction algorithms.

The CadnaA software is approved for use by the DPE and EPA. The software utilises terrain data, source and receptor locations and heights, source sound power levels (in octave or 1/3 octave frequency bands) and input meteorological conditions to predict noise levels. The CONCAWE prediction method accounts for the influence of noise propagation from atmospheric temperature, atmospheric relative humidity, wind speed, wind direction and Atmospheric Pasquill Stability Class (for defining the presence and strength of temperature inversions).

Operational noise impacts were predicted based on indicative sound power level data provided by Ark Energy for the proposed equipment. Construction noise impacts were predicted based on several construction activities and associated plant and equipment.

3.0 Existing Environment

The Project Area is located within a rural environment with typically low background noise levels. The area in the vicinity of the Project consists primarily of rural residential land, zoned RU1 – primary production under the Richmond Valley Local Environmental Plan 2012 (LEP).

3.1 Sensitive Receivers and Noise Catchment Areas

The Project Area is located within a rural setting with a number of residential receivers distributed sparingly within the surrounding area. In accordance with the NPfl, these are noise-sensitive land uses (i.e. receivers). The NPfl defines a receiver as, the noise-sensitive land use at which noise from a development can be heard. Sensitive receiver and receiver has been used interchangeably throughout this report. There are no other sensitive land uses (such as schools or places of worship) within or surrounding the Project Area.

To simplify the assessment of residential noise impacts and the presentation of results, sensitive receivers were grouped into Noise Catchment Areas (NCAs). A description of these NCAs is presented in **Table 3.1**, while the NCAs are also shown in **Figure 3.1**.

Table 3.1 Noise Catchment Area descriptions

NCA	Description
NCA_1	An area in proximity to Summerland Way and representing the rural areas near the western extent of the Project. Background data based on monitoring location L1.
NCA_2	An area representing the rural areas to the northern, east and south of the Project, that are located away from Summerland Way. Background data based on monitoring location L2.

Note: Monitoring locations described in Section 3.2.

One residential receiver located within the Project Area is an associated dwelling (owned by a host landholder for the Project) and is therefore not considered to be a sensitive receiver.

The sensitive receivers in the area surrounding the Project are presented in **Table 3.2** and **Figure 3.1**. Assessment of noise at these locations is determined to represent the worst case noise impacts for all sensitive receivers in the locality.

The closest non-associated sensitive receiver is located approximately 480 m north of the Development Footprint. Also provided in **Table 3.2** is the approximate separation distance between the sensitive receiver and the proposed road upgrades.

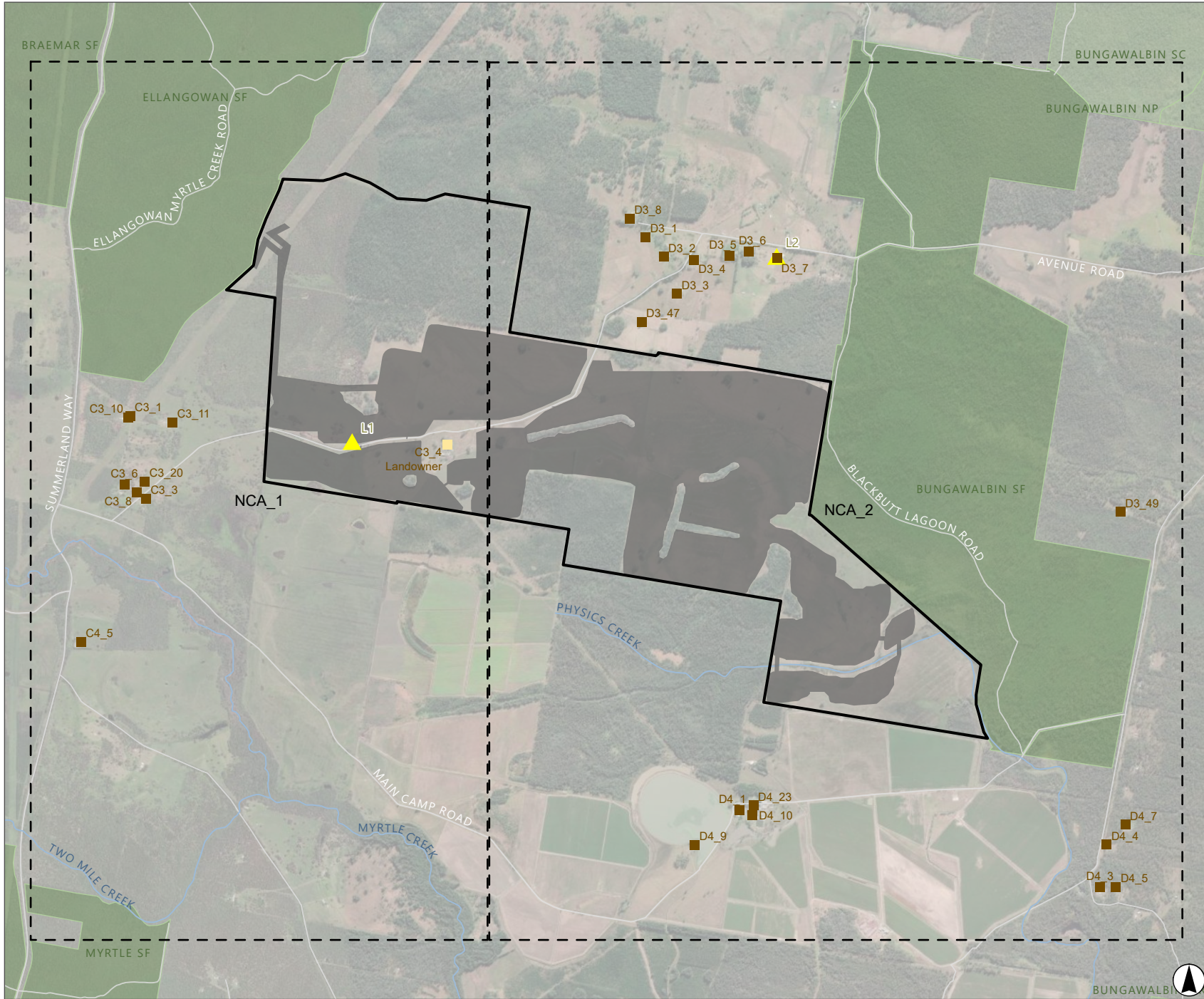
Table 3.2 Identified Receivers

Noise Catchment Area	Receiver ID	Receiver Type	Receiver Details	Approximate Distance to Development Footprint	Approximate Distance to Road Upgrades
NCA_1	C3_1	Residential	7460 Summerland Way Myrtle Creek	1.3 km	650 m
NCA_1	C3_3	Residential	82 Avenue Road Myrtle Creek	1.15 km	30 m
NCA_1	C3_4 ¹	Landowner	420 Avenue Road Myrtle Creek	Within Project Area	120 m
NCA_1	C3_6	Residential	75 Avenue Road Myrtle Creek	1.35 km	170 m
NCA_1	C3_8	Residential	95 Avenue Road Myrtle Creek	1.2 km	45 m
NCA_1	C3_10	Residential	7460 Summerland Way Myrtle Creek	1.3 km	650 m
NCA_1	C3_11	Residential	125 Avenue Road Myrtle Creek	900 m	350 m
NCA_1	C3_20	Residential	95 Avenue Road Myrtle Creek	1.15 km	75 m
NCA_1	C4_5	Residential	7270 Summerland Way Myrtle Creek	> 1.5 km	1.2 km
NCA_2	D3_1	Residential	55 Ermelo Road Ellangowan	1.2 km	> 1.5 km
NCA_2	D3_2	Residential	695 Avenue Road Ellangowan	1.1 km	> 1.5 km
NCA_2	D3_3	Residential	660 Avenue Road Ellangowan	900 m	> 1.5 km
NCA_2	D3_4	Residential	690 Avenue Road Ellangowan	1 km	> 1.5 km
NCA_2	D3_5	Residential	760 Avenue Road Ellangowan	1.1 km	> 1.5 km
NCA_2	D3_6	Residential	770 Avenue Road Ellangowan	1.2 km	> 1.5 km
NCA_2	D3_7	Residential	770 Avenue Road Ellangowan	1.1 km	> 1.5 km
NCA_2	D3_8	Residential	70 Ermelo Road Ellangowan	1.3 km	> 1.5 km
NCA_2	D3_47	Residential	610 Avenue Road Ellangowan	480 m	1.2 km
NCA_2	D3_49	Residential	2116 Myall Creek Road West Bungawalbin	> 1.5 km	> 1.5 km
NCA_2	D4_1	Residential	840 Main Camp Road Myrtle Creek	1.1 km	> 1.5 km
NCA_2	D4_3	Residential	2465 Myall Creek Road West Bungawalbin	> 1.5 km	> 1.5 km
NCA_2	D4_4	Residential	2395 Myall Creek Road West Bungawalbin	> 1.5 km	> 1.5 km
NCA_2	D4_5	Residential	2475 Myall Creek Road West Bungawalbin	> 1.5 km	> 1.5 km
NCA_2	D4_7	Residential	2371 Myall Creek Road West Bungawalbin	> 1.5 km	> 1.5 km

Noise Catchment Area	Receiver ID	Receiver Type	Receiver Details	Approximate Distance to Development Footprint	Approximate Distance to Road Upgrades
NCA_2	D4_9	Residential	840 Main Camp Road Myrtle Creek	> 1.5 km	> 1.5 km
NCA_2	D4_10	Residential	840 Main Camp Road Myrtle Creek	1.1 km	> 1.5 km
NCA_2	D4_23	Residential	840 Main Camp Road Myrtle Creek	970 m	> 1.5 km

Note: ¹ Receiver C3_4 is associated with the Project (host receiver) and therefore is not considered sensitive.

FIGURE 3.1
Sensitive Receivers, NCAs and Background Noise Monitoring Locations



- Legend**
- Project Area
 - Development Footprint
 - Associated Sensitive Receiver
 - Non-Associated Sensitive Receiver
 - Noise Monitoring Locations
 - NCAs
 - NPWS Reserve
 - State Forest
 - Roads
 - Watercourse



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3.2 Unattended Noise Monitoring

Unattended long-term noise monitoring (at least one week’s worth of valid data), was carried out in accordance with NPfI Fact Sheet A, at the two locations (L1 and L2) shown in **Table 3.3** and **Figure 3.1**. As outlined in **Table 3.1** these monitoring locations were selected to be representative of potentially impacted noise receivers within the respective NCAs.

Table 3.3 Noise monitoring locations

ID	Address / Description	Receiver Area	Monitoring Period	Location Description ¹
L1	255 Avenue Road, Myrtle Creek	NCA 1	31/8/2023–11/9/2023	The logger was located at the southern end of the property, on the eastern side of a cattle yard. The microphone was located 1.5 m above ground level in the free-field.
L2	820 Avenue Road, Ellangowan	NCA 2	31/8/2023–11/9/2023	The logger was located to the west of the dwelling on the western boundary. The microphone was located 1.5 m above ground level in the free-field.

Note: ¹ Free-field is greater than 3.5 metres from reflective surfaces.

Noise levels were measured in general accordance with AS1055:2018 and the requirements of the NPfI. The noise monitoring was conducted with Type 1, Svantek 977 Noise and Vibration Analysers. Field calibration checks were undertaken for the instruments pre and post logging and were found to be within 1 (decibel) dB of the reference signal.

The ambient noise level L_{Aeq} for each period (Day, Evening and Night) has been calculated in accordance with the NPfI. Similarly, the Assessment Background Level (ABL) using the lowest 10th percentile method has been determined for three periods (Day, Evening and Night) during each 24-hour period. The Rating Background Level (RBL) has been evaluated as the median value of the ABL in each period (Day, Evening and Night).

The noise data affected by extraneous noise, rain or wind exceeding 5 m/s were excluded from the noise data analysis, as per the procedures outlined in the NPfI Fact Sheet B. Meteorological data was obtained from the nearest Bureau of Meteorology (BOM) station at Casino Airport (Station 058208) approximately 22 km north of the Project Area.

The results of the noise monitoring are summarised in **Table 3.4**. The full noise monitoring results are shown graphically in **Appendix B**.

Table 3.4 Noise Monitoring Results, dB(A)

ID	RBL			Ambient Noise Level ² L_{Aeq} , period		
	Day ¹	Evening ¹	Night ¹	Day ¹	Evening ¹	Night ¹
L1	25 ³	23 ³	17 ³	46	55	44
L2	28 ³	24 ³	16 ³	47	41	40

Notes: ¹ Day period is 7 am–6 pm Monday-Saturday and 8 am–6 pm Sunday and Public Holidays, evening period is 6 pm–10 pm and night period is 10 pm to commencement of day period.

² In accordance with NPfI (Section 2.6), ambient noise levels are free-field noise levels (i.e. no correction from facade reflections)

³ These background noise levels are below the assumed policy minimum RBLs, see **Section 4.1.1**.

4.0 Noise and Vibration Criteria

4.1 Operational Noise Criteria

The potential operational noise impacts of the Project have been assessed against the NSW Environment Protection Authority (EPA) *Noise Policy for Industry* (NPfI, 2017).

The NPfI sets out two noise criteria to assess the potential noise impacts resulting from industrial activity. The first criterion is used to control short-term intrusive noise and its impacts on residences whilst the second criterion is used to protect against cumulative noise impacts and maintain noise level amenity for particular land uses including residential. Applying the more stringent of the two as the Project noise trigger level ensures that intrusive noise is limited and amenity is protected and that no single industry can unacceptably change the noise level of an area.

The Project Noise Trigger Levels (PNTLs) derived in accordance with the NPfI provide a benchmark or objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The PNTL is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.

The PNTL, feasible and reasonable mitigation, and consideration of residual noise impacts are used together to assess noise impact and manage the noise from a proposal or site.

The PNTL is the lower (that is, the more stringent) value of the Project Intrusiveness Noise Level (PINL) and Project Amenity Noise Level (PANL) determined in the NPfI Sections 2.3 and 2.4. Neither the intrusiveness noise levels nor the amenity noise levels are used directly as regulatory noise limits.

4.1.1 Project Intrusiveness Noise Level

The Project Intrusiveness Noise Level (PINL) ($L_{Aeq}(15 \text{ minute})$) is defined as the rating background noise level (RBL) + 5 dB. The RBL is determined by measurement of the long-term background noise level L_{A90} and calculated in accordance with **Section 3.2** and the NPfI Fact Sheets A and B.

If the RBLs derived from site measurements are lower than the minimum assumed RBLs in Table 2.1 of the NPfI, shown in **Table 4.1**, the minimum assumed RBLs are to be applied.

Table 4.1 Minimum Assumed RBLs (NPfI Table 2.1)

Time of Day ¹	Minimum Assumed RBL dB(A)
Day period	35
Evening period	30
Night period	30

Note: ¹ Day period is 7 am–6 pm Monday–Saturday and 8 am–6 pm Sunday and Public Holidays, evening period is 6 pm–10 pm and night period is 10 pm to commencement of day period.

The Project RBLs are derived as the greater of the measured RBLs shown in **Table 3.4** and the minimum assumed RBLs shown in **Table 4.1**.

The derived PINLs based on the RBLs are shown in **Table 4.2**.

Table 4.2 Derived Project Intrusiveness Noise Levels at Receivers LAeq(15 minute) dB(A)

NCA	RBL			PINL		
	Day ¹	Evening ¹	Night ¹	Day ¹	Evening ¹	Night ¹
NCA 1 ⁴	35 (25) ²	30 (23) ³	30 (17) ³	40	35	35
NCA 2	35 (28) ²	30 (24) ³	30 (16) ³	40	35	35

Notes: ¹ Day period is 7 am–6 pm Monday-Saturday and 8 am–6 pm Sunday and Public Holidays, evening period is 6 pm–10 pm and night period is 10 pm to commencement of day period.

² Where the day RBLs are less than 35 dB(A) then RBL is set at 35 dB(A), actual measured RBL is in brackets ().

³ Where the evening or night RBLs are less than 30 dB(A) then RBL is set at 30 dB(A), actual measured RBL is in brackets ().

⁴ Receiver C3_4 is associated with the Project (host receiver) and the PINLs are not applicable.

4.1.2 Project Amenity Noise Level

The Project Amenity Noise Level (PANL) (LAeq(period)) at receivers is defined as the recommended amenity noise levels in NPfI Table 2.2 minus 5 dB(A). For derivation of the PNTLs, the PANLs LAeq(period) are converted to LAeq(15 minute) by the addition of 3 dB(A). The PANL at a receiver depends on the type of receiver and the noise amenity area of each receiver.

The residential receivers surrounding the Project are zoned RU1 Primary Production which is typical of a rural environment. With reference to Table 2.3 of the NPfI, all sensitive receivers potentially affected by the Project have been assigned a Rural Residential amenity.

The PANL for all receivers surrounding the Project Area are shown in **Table 4.3**.

Table 4.3 NPfI Derived Project Amenity Noise Levels (PANL), dB(A)

Receiver / Land Use Category	Time of Day ¹	Recommended Amenity Noise Level LAeq(period)	Project Amenity Noise Level LAeq(period)	Project Amenity Noise Level LAeq(15 min)
All residential receivers / Rural Residential ²	Day	50	45	48
	Evening	45	40	43
	Night	40	35	38

Notes: ¹ Day period is 7 am–6 pm Monday-Saturday and 8 am–6 pm Sunday and Public Holidays, evening period is 6 pm–10 pm and night period is 10 pm to commencement of day period.

² Receiver C3_4 is associated with the Project (host receiver) and the PANLs are not applicable as per Section 4 of the NPfI.

4.1.3 Project Noise Trigger Level

The PNTLs are defined as the lower (that is, the more stringent) of the PINL and the PANL in terms of LAeq(15 minute) noise levels. The PNTLs for each NCA are shown in **Table 4.4**. For all NCAs the PNTL is based on the PINL which is more stringent than the PANL. The PNTL are the lowest criteria that the NPfI allows (i.e. the captured background levels in **Table 3.4** were lower than the minimum assumed RBLs in the NPfI).

Table 4.4 Project Noise Trigger Levels – Residential Receivers, LAeq(15 minute), dB(A)

Receiver	Time of day ¹	PINL	PANL	PNTL
NCA_1 All residential receivers ²	Day	40	48	40
	Evening	35	43	35
	Night	35	38	35
NCA_2 All residential receivers	Day	40	48	40
	Evening	35	43	35
	Night	35	38	35

Notes: ¹ Day period is 7 am–6 pm Monday-Saturday and 8 am–6 pm Sunday and Public Holidays, evening period is 6 pm–10 pm and night period is 10 pm to commencement of day period.

² Receiver C3_4 is associated with the Project (host receiver) and the PNTLs are not applicable.

4.1.4 Correction Factors

Where a noise source contains characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. Conversely, some noise sources may cause less annoyance where only a single event occurs for a limited duration.

Fact Sheet C of the NPfI outlines how correction factors should be applied to source noise levels at the receiver before comparison with the respective project noise trigger levels. These correction factors account for the additional annoyance caused by the factors that modify the noise.

The assessment of modifying factors and application of correction factors for annoying noise characteristics are discussed in **Section 5.2.1**.

4.1.5 Maximum Noise Event Assessment Levels (Sleep Disturbance)

The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. According to the NPfI, a detailed maximum noise level assessment should be undertaken where the development’s night-time noise levels at a residential location exceed:

- LAeq,15minute 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater; and/or
- LAfmax 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater.

The sleep disturbance assessment levels for each defined receiver area are provided in **Table 4.5**.

Table 4.5 Sleep Disturbance Assessment Levels – Residential Receivers, LAeq,15minute and LAfmax dB(A)

NCA	Night-time Period (10 pm–7 am)	
	Assessment Level LAeq,15minute	Assessment Level LAfmax
NCA 1 All residential receivers	40 ¹	52 ²
NCA 2 All residential receivers	40 ¹	52 ²

Notes: ¹ As per NPfI Section 2.5, minimum sleep disturbance assessment level is the greater of LAeq, 15minute 40 dB(A) or RBL + 5 dB. In this case RBL + 5 lower than 40 dB.

² As per NPfI Section 2.5, minimum sleep disturbance assessment level is the greater of LAfmax 52 dB(A) or RBL + 15 dB. In this case RBL + 15 lower than 52 dB.

4.1.6 Cumulative Noise Criteria

As specified in the NPfI, the recommended amenity noise levels represent the objective for total industrial noise at a receiver location, whereas PANL represents the objective for noise from a single industrial development at a receiver location. For this Project, by adopting a PANL that is 5 dB below the recommended amenity noise level, it ensures that industrial noise levels from up to three or four industrial noise sources (as in the case for this Project) remain within the recommended amenity noise level for an area.

Further, Section 2.4 of the NPfI states:

“Where the project amenity noise level applies and it can be met, no additional consideration of cumulative industrial noise is required.”

In accordance with the NPfI, predicted compliance with the established PANL will consequently address cumulative noise. For clarity, the cumulative noise limits are specified below in **Table 4.6** and are consistent for all NCAs.

Table 4.6 Cumulative noise criteria – LAeq(15min), dB(A)

NCA	Period ¹	PANL or Cumulative Noise Criteria
NCA 1 All residential receivers ²	Day	48
	Evening	43
	Night	38
NCA 2 All residential receivers	Day	48
	Evening	43
	Night	38

Notes: ¹ Day period is 7 am–6 pm Monday-Saturday and 8 am–6 pm Sunday and Public Holidays, evening period is 6 pm–10 pm and night period is 10 pm to commencement of day period.

² Receiver C3_4 is associated with the Project (host receiver) and the cumulative noise criteria are not applicable.

4.2 Construction Noise and Vibration Criteria

4.2.1 Construction Noise Criteria

Assessment levels for noise from construction activities, excluding noise from construction-related traffic on public roads, are defined in the Department of Environment and Climate Change, Interim Construction Noise Guideline (ICNG, 2009).

Table 4.7 presents the ICNG Construction Noise Management Levels for representative receivers surrounding the Project Area. The assessment levels are intended to guide the need for and the selection of feasible and reasonable work practices to minimise construction noise impacts.

Table 4.7 ICNG Construction Noise Management Levels, dB(A)

Land use	Construction time	Noise Management Level LAeq(15 min)
Residential	Recommended Standard Hours Monday to Friday – 7 am to 6 pm Saturday – 8 am to 1 pm No work on Sundays or Public Holidays	Noise affected: RBL + 10 dB(A)
		Highly noise affected: 75 dB(A)
	Outside recommended standard hours	Noise affected: RBL + 5 dB(A)

The Construction Noise Management Levels for the receivers are summarised in **Table 4.8** based on the adopted RBLs presented in **Table 4.2**.

Table 4.8 Project Construction Noise Management Levels

Receiver	Noise Management levels (NML), dB(A)	
	Standard hours of Construction ¹	Highly Noise Affected
	LAeq(15 min)	LAeq(15 min)
NCA 1 All residential receivers ²	45	75
NCA 2 All residential receivers	45	75

Notes: ¹ Recommended standard hours: Monday to Friday 7 am–6 pm; Saturday 8 am–1 pm.

² Receiver C3_4 associated with the Project (host receiver) and the NMLs are not applicable in accordance with Section 7 of the ICNG.

4.2.2 Construction Vibration Criteria

This NVIA has considered the requirements of the following documents:

- *Assessing Vibration: A Technical Guideline* (the vibration guideline), Department of Environment and Conservation NSW (DEC), 2006.
- British Standard BS7385 (1993) Part 2 Evaluation and measurement of vibration in buildings (BS7385).
- German Institute for Standardisation DIN 4150-3:1999-02 Structural vibration – Effects of vibration on structures (DIN4150).

4.2.2.1 Human Perception of Vibration (The Vibration Guideline)

The vibration guideline presents non-mandatory preferred and maximum values for the use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. The preferred values correspond to vibration levels where there is a low probability of adverse comment or disturbance to building occupants. Where all possible and reasonable measures have been applied, values up to the ‘maximum’ value may be used if they can be justified. For values beyond the maximum value, direct negotiation with the affected receivers would need to be undertaken.

The guideline specifies that vibration and its associated effects are usually classified as continuous, impulsive, or intermittent. These vibration types and examples of their respective sources are shown in **Table 4.9**.

Table 4.9 Examples of Types of Vibration

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria.

Continuous and Impulsive Vibration

For continuous and impulsive vibration, the criteria are given in terms of root-mean-square (rms) vibration acceleration (m/s^2) in the frequency range 1–80 Hertz (Hz). They are also expressed at peak particle velocity (PPV) mm/s as presented in Appendix C of the vibration guideline. The criteria for continuous and impulsive vibration given in the Vibration Guideline for the relevant receivers in the area are shown in **Table 4.10**.

Table 4.10 The Vibration Guideline Values for Continuous and Impulsive Vibration for Human Comfort

Location	Assessment Period ¹	Weighted Vibration Acceleration (m/s^2 at 1-80 Hz)				Peak Particle Velocity (mm/s)	
		Preferred Values		Maximum Values		Preferred Values	Maximum Values
		z-axis	x- and y-axes	z-axis	x- and y-axes		
Continuous vibration							
Residences	Day	0.010	0.0071	0.020	0.014	0.28	0.56
	Night	0.007	0.005	0.014	0.010	0.20	0.4
Impulsive vibration							
Residences	Day	0.30	0.21	0.60	0.42	8.6	17.0
	Night	0.10	0.071	0.20	0.14	2.8	5.6

Note: ¹ Day time period is 7 am–10 pm. Night time period is 10 pm–7 am.

Intermittent Vibration

For intermittent vibration, the criteria are given in terms of vibration dose value (VDV), which is a parameter used for assessing the combined magnitude and the total duration of vibration impacts. The criteria for intermittent vibration given in the Vibration Guideline for the relevant receivers in the area are shown in **Table 4.11**. The VDV is calculated using the frequency-weighted rms acceleration as described in the Vibration Guideline.

Table 4.11 The Vibration Guideline Acceptable Vibration Dose Values for Intermittent Vibration for Human Comfort (VDV $m/s^{1.75}$)

Location	Daytime period ¹		Night-time period ¹	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residences	0.20	0.40	0.13	0.26

Note: ¹ Day time period is 7 am–10 pm. Night time period is 10 pm–7 am.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values.

4.2.2.2 Structural Vibration

Criteria for vibration effects on building structures recommended in the vibration guideline are given in British Standard *BS7385 (1993) Part 2 Evaluation and measurement of vibration in buildings* (BS7385). The criteria in BS7385 are given in terms of peak component (x-, y- or z-axes separately) vibration velocity values from transient (impulsive) vibration events. The criteria for continuous vibration are recommended to be 50% lower than for impulsive vibration.

The vibration criteria for the protection of structures and buildings from cosmetic damage (e.g. hairline cracks in drywalls, etc.) are given in **Table 4.12**.

Table 4.12 BS 7385 Vibration Criteria for Cosmetic Damage to Structures (peak vibration velocity, mm/s)

Type of Structure	Peak Component Particle Velocity (mm/s) ¹		
	4 Hz–15 Hz	15 Hz–40 Hz	40 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings.	50 (transient (impulsive) vibration) 25 (continuous vibration)		
Un-reinforced or light framed structures. Residential or light commercial type buildings.	15–20 (transient (impulsive) vibration) 7.5–10 (continuous vibration)	20–50 (transient (impulsive) vibration) 10–25 (continuous vibration)	50 (transient (impulsive) vibration) 25 (continuous vibration)

Note: ¹ Peak Component Particle Velocity is the maximum peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer.

4.2.2.3 Heritage Structures

Assessment guidelines for vibration damage to heritage-protected structures are commonly referenced from the German Institute for Standardisation *DIN 4150-3:1999-02 Structural vibration – Effects of vibration on structures* (DIN4150). This standard differentiates between short-term and long-term vibration, where short-term vibration is caused by sources such as drop-hammers, impact piling, etc. All other sources of vibration are considered to be long-term.

The guideline value for heritage-protected structures for short-term and long-term vibration is respectively 3 mm/s peak partial velocity (PPV) and 2.5 mm/s PPV in the horizontal plane at all frequencies. This guideline value is primarily intended for older, sensitive, above-ground structures (typically buildings).

In regard to heritage buildings, *BS7385 Part 2 (1993)* notes that a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

4.3 Road Traffic Noise Criteria

An assessment of potential noise levels from project-related traffic on Summerland Way, Main Camp Road and Avenue Road is required. The NSW *Road Noise Policy (RNP) (DECCW)* sets out criteria for road traffic noise through the provision of a framework that addresses traffic noise issues associated with new developments, new or upgraded road developments, or planned building developments.

Table 4.13 outlines the road traffic noise criteria for residential land uses along Summerland Way and Main Camp Road / Avenue Road. Under the road category definitions provided in the RNP, Summerland Way is classified as an arterial road and Main Camp Road and Avenue Road are classified as a local road.

Table 4.13 Road Traffic Noise Assessment Criteria For Residential Land Uses

Road Category	Type of Project/Land Use	Assessment Criteria dB(A)	
		Day 7 am to 10 pm	Night 10 pm to 7 am
Freeway/arterial/ sub-arterial road	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	LAeq,(15 hour) 60 (external)	LAeq,(9 hour) 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	LAeq,(1 hour) 55 (external)	LAeq,(1 hour) 50 (external)

Additionally, Section 3.4 of the RNP notes that where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria.

The EPA publication *Applying the NSW Road Noise Policy* states:

“...for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.”

In assessing noise impact, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

5.0 Operational Noise Assessment

5.1 Modelling Methodology

Prediction of the operational noise levels was undertaken with the proprietary computer noise modelling software CadnaA (Version 2023), using the CONCAWE noise prediction algorithms.

The software utilises terrain data, source and receptor locations and heights, source sound power levels (in octave or 1/3 octave frequency bands) and input meteorological conditions to predict noise levels. The CONCAWE prediction method accounts for the influence of noise propagation from atmospheric temperature, atmospheric relative humidity, wind speed, wind direction and Atmospheric Pasquill Stability Class (for defining the presence and strength of temperature inversions).

The noise prediction model considered:

- Location and separation distance between noise sources and sensitive receiver locations.
- Geometric spreading and air absorption.
- Heights of sources and receivers referenced to 3-dimensional digital ground contours with a 1 m contour interval.
- A receiver height of 1.5 m above ground level.
- Source heights were set according to the source item.
- Ground type and reflections between sources and receivers. A ground absorption factor of 0.2 for the BESS and substation footprints and an absorption factor of 1.0 applied for all other areas.
- The noise source levels of individual plant and equipment (refer to **Section 5.2**).
- Operational noise levels have been predicted under default worst-case meteorological conditions (D-class with 3 m/s windspeed or F-class with 2 m/s windspeed) in accordance with the NPfI. These meteorological conditions represent worst-case enhancing conditions for either day, evening or night periods.

5.2 Noise Source Data

Ark Energy has provided indicative reference noise data for the proposed equipment/plant to be installed on site for the Project. This has been supplemented with additional source data from Umwelt's noise source library. The proposed equipment, utilisation, quantities and sound power levels are summarised in **Table 5.1**.

Table 5.1 Indicative Equipment Quantities and Sound Power Levels

Plant Item	Quantity	Indicative Sound Power Level per unit, dB(A)	Assumed Utilisation per unit per 15-minute period
Tracker motor	10,003	60	3% (30 seconds per 15 minutes)
PV Inverters	118	96 (91 dB(A) + 5 dB) ¹	100%
PV MV Transformers	118	60 ²	100%
Battery	716	95	100%
Battery Inverters	106	98 (93 dB(A) + 5 dB) ¹	100%
Battery MV Transformers	106	60 ²	100%
Substation HV Transformers (330 kV/33 kV 230 MVA)	3	99 (94 dB(A) + 5 dB) ¹	100%
Aux. Transformers (33 kV/400 V 4.6 MVA)	4	94 (89 dB(A) + 5 dB) ¹	100%
HVAC Control Room	1	70 ²	100%

Notes: ¹ Includes an assumed +5 dB penalty for tonality.

² Assumed sound power level sourced from Umwelt noise source library.

5.2.1 Corrections for Annoying Noise Characteristics

Where a noise source contains characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. Conversely, some noise sources may cause less annoyance where only a single event occurs for a limited duration.

Fact Sheet C of the NPfl outlines how correction factors should be applied to source noise levels at the receiver before comparison with the respective project noise trigger levels. These correction factors account for the additional annoyance caused by the factors that modify the noise.

For this assessment, the noise from the inverters and the substation and auxiliary transformers are considered to be tonal in nature. Tonality is not expected to be associated with the tracker motors. In accordance with the NPfl a 5 dB(A) penalty has been applied to the predicted noise contributions from the inverters and transformers. For these items, the sound power levels within **Table 5.1**, are inclusive of the 5 dB(A) penalty.

The proposed individual plant items are not expected to have modulation characteristics. Further, given the numerous items of equipment and the alternating charge/discharge cycles that would occur across the batteries, a subsequent range of equipment modes and associated noise levels would be expected at any one time. As such, any modulation would not be expected to be audible at the receivers, as total site noise emission would be blended or 'masked' and any equipment exhibiting modulation characteristics would be cancelled out by other equipment operating on different cycles.

Low frequency and impulsive noise are not expected to be generated by the Project. Potential impulsive noise events may occur when circuit breakers are triggered but these would only be in emergency situations and anticipated to occur very rarely.

5.3 Operational Noise Levels

The noise levels have been predicted under default worst-case meteorological conditions (D-class with 3 m/s windspeed or F-class with 2 m/s windspeed) in accordance with the NPfI. The predicted operational noise levels at these sensitive receivers are presented in **Table 5.2** and shown graphically as noise contours in **Figure 5.1**.

The operational noise levels in **Table 5.2** are predicted to comply with the day, evening and night-time noise limits at all non-associated sensitive receivers. The associated receiver does not have PNTL criteria given it is hosting the Project.

Table 5.2 Predicted Operational Noise Levels, LAeq,15minute dB(A)

Rec ID	Structure	PNTL, D/E/N	Predicted Operational Noise ¹
C3_1	Residential	40/35/35	26
C3_3	Residential	40/35/35	25
C3_4 ²	Landowner	-	50
C3_6	Residential	40/35/35	24
C3_8	Residential	40/35/35	24
C3_10	Residential	40/35/35	26
C3_11	Residential	40/35/35	28
C3_20	Residential	40/35/35	25
C4_5	Residential	40/35/35	< 20
D3_2	Residential	40/35/35	30
D3_3	Residential	40/35/35	32
D3_4	Residential	40/35/35	28
D3_5	Residential	40/35/35	27
D3_6	Residential	40/35/35	24
D3_7	Residential	40/35/35	21
D3_8	Residential	40/35/35	29
D3_47	Residential	40/35/35	35
D3_49	Residential	40/35/35	< 20
D4_1	Residential	40/35/35	23
D4_3	Residential	40/35/35	< 20
D4_4	Residential	40/35/35	< 20
D4_5	Residential	40/35/35	< 20
D4_7	Residential	40/35/35	< 20
D4_9	Residential	40/35/35	< 20
D4_10	Residential	40/35/35	21
D4_23	Residential	40/35/35	22

Notes: ¹ Predictions below 20 dB(A) have been presented as < 20.

² Receiver C3_4 is associated with the Project (host receiver) and the PNTLs are not applicable.

5.4 Transmission Line

During operation of the electricity transmission network, noise emission (hissing or cracking noise) associated with the power lines can result from an effect called corona discharge (or corona effect). The intensity of the corona discharge and the resulting noise is dependent on meteorological conditions (such as humidity, rain, fog and wind), the concentration of airborne particles (dust, ash) and the state of the conductor surface.

Corona effects are relatively small in fair weather but can become evident during light rainfall and humid conditions as a consequence of water droplets mixing with dust on the conductor itself creating a migrating electricity leakage path. Corona effects can also become significant under electrically charged clouds.

Given the nearest non-associated sensitive receiver (C3_11) is located a significant distance (approximately 1.1 km) from the proposed transmission line (see **Figure 3.1**), potential noise impacts from corona discharge are not anticipated.

FIGURE 5.1

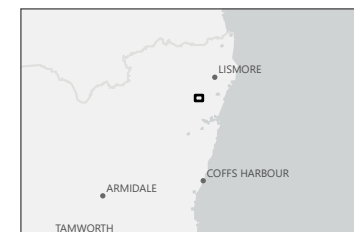
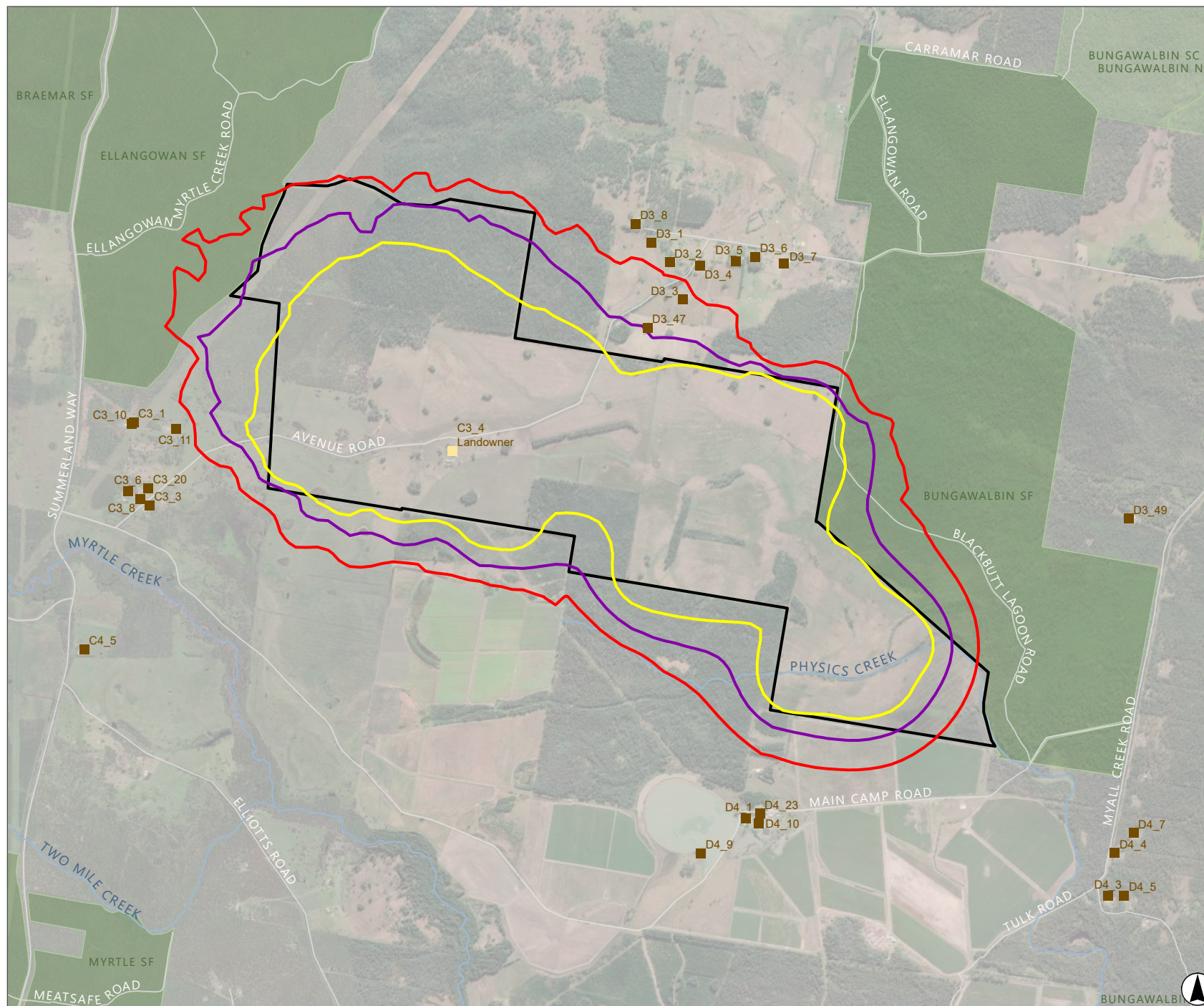
Predicted Operational Noise Levels under default Worst-case Meteorological Conditions, LAeq(15 min) dB(A)

Legend

- Project Area
- Associated Sensitive Receiver
- Non-Associated Sensitive Receiver
- NPWS Reserve
- State Forest
- Roads
- Watercourse

Predicted Noise Levels, LAeq(15 min) dB(A)

- 30
- 35
- 40



Kilometers

Scale 1:50,000 at A4
GDA 1994 MGA Zone 56

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6.0 Construction Noise and Vibration Assessment

6.1 Construction Noise

6.1.1 Construction Staging

The construction period for the Project will be undertaken across multiple stages. The total construction timeframe is anticipated to be up to 24 months.

The construction stages will broadly include the following:

1. Site Establishment.
2. Piling and foundations.
3. Assembly / installation of all equipment / onsite structures (trackers, inverters, modules, BESS, substation balance of system).
4. Underground cabling.
5. Commissioning.
6. Site rehabilitation, removal of temporary construction facilities.
7. Main Camp Road/Avenue Road upgrades.
8. Summerland Way/Main Camp Road upgrades.

It is likely that some of these stages may occur simultaneously through the progression of the construction program.

6.1.2 Construction Hours

Any construction activities to be undertaken during standard construction hours will be undertaken in accordance with the ICNG as follows:

- Monday to Friday: 7 am–6 pm
- Saturday: 8 am–1 pm
- Sunday and public holidays: No work.

Work would only be undertaken outside of these hours in an emergency and would be kept to a minimum. In general, no activities would occur on Sundays or public holidays, However, in cases of emergencies, major asset inspection or maintenance programs may be undertaken outside standard hours. Richmond Valley Council and surrounding landholders would be notified of any works expected to be performed outside standard daytime work hours that may be expected to cause noise exceedance to neighbouring dwellings.

6.1.3 Construction Equipment

The typical construction activities, equipment and associated sound power levels (SWLs) of equipment are outlined in **Table 6.1**. Typical sound power levels have been sourced from the *Roads and Maritime Construction Noise Estimator Tool* and Umwelts noise source library.

Table 6.1 Indicative Construction Scenarios, Equipment and Sound Power Levels

Construction Stages / Scenarios	Activity description	Equipment	Sound Power Levels LAeq(15 min) dB(A)/ unit	Combined Sound Power Level LAeq(15 min) dB(A)
Sc.1	Site Establishment and civil works	Asphalt paver	114	120
		Grader	113	
		Dozer	110	
		Dump truck	110	
		Roller	109	
		Delivery trucks	108	
		Water truck	107	
		Excavator	106	
		Compactor	106	
		Bobcat	104	
		Generator	103	
		Mobile crane / telehandler	98	
Light vehicle	90			
Sc.2	Piling and foundations	Pneumatic pile driving rig	117 (112 + 5)	118
		Concrete truck	109	
		Excavator	106	
		Bobcat	104	
		Mobile crane / telehandler	98	
		Light vehicle	90	
Sc.3	Assembly / installation of all equipment / onsite structures (trackers, inverters, modules, BESS, substation balance of system)	Pneumatic wrench	113	116
		Powered hand tools	110	
		Truck	108	
		Mobile crane 130T	105	
		Compressor	103	
		Generator	103	
		Mobile crane / telehandler	98	
		Light vehicle	90	
Sc.4	Underground cabling	Loader	112	113
		Bobcat/trencher	104	
		Cable trenching and laying equipment	100	
		Light vehicle	90	

Construction Stages / Scenarios	Activity description	Equipment	Sound Power Levels LAeq(15 min) dB(A)/ unit	Combined Sound Power Level LAeq(15 min) dB(A)
Sc.5	Commissioning	Power hand tools	110	113
		Electrical works/testing	110	
		Mobile crane	98	
		Light vehicle	90	
Sc.6	Site rehabilitation, removal of temporary construction facilities	Dump truck	110	113
		Truck	108	
		Forklift	100	
		Mobile crane / telehandler	98	
		Light vehicle	90	
Sc.7	Main Camp Road/Avenue Road upgrades	Dump truck	110	118
		Asphalt paver	114	
		Grader	113	
		Roller	109	
		Line marking truck	108	
		Water truck	107	
		Line marking truck	108	
		Mobile crane / telehandler	98	
Sc.8	Summerland Way/Main Camp Road upgrades	Dump truck	110	118
		Asphalt paver	114	
		Grader	113	
		Roller	109	
		Line marking truck	108	
		Water truck	107	
		Line marking truck	108	
		Mobile crane / telehandler	98	

Notes: ¹ Includes a +5 dB penalty for impulsiveness characteristics.

6.1.4 Construction Noise Levels

Prediction of the construction noise levels was undertaken with the proprietary computer noise modelling software CadnaA (Version 2023), using the CONCAWE noise prediction algorithms. Default worst-case noise-enhancing meteorological conditions (D-class with 3 m/s windspeed) in accordance with the NPfI, has been utilised for the assessment.

Construction noise levels have been predicted for the eight indicative construction scenarios described in **Section 6.1.1** and **Table 6.1**. The predicted noise levels are presented without any mitigation controls applied. The predictions are conservative and assume all equipment associated with each scenario is operating simultaneously at the closest point within the Development Footprint to the respective receiver location. In reality, a receiver would experience a range of construction noise levels, dependent upon the number of plant items operating at any one time and their precise location on site.

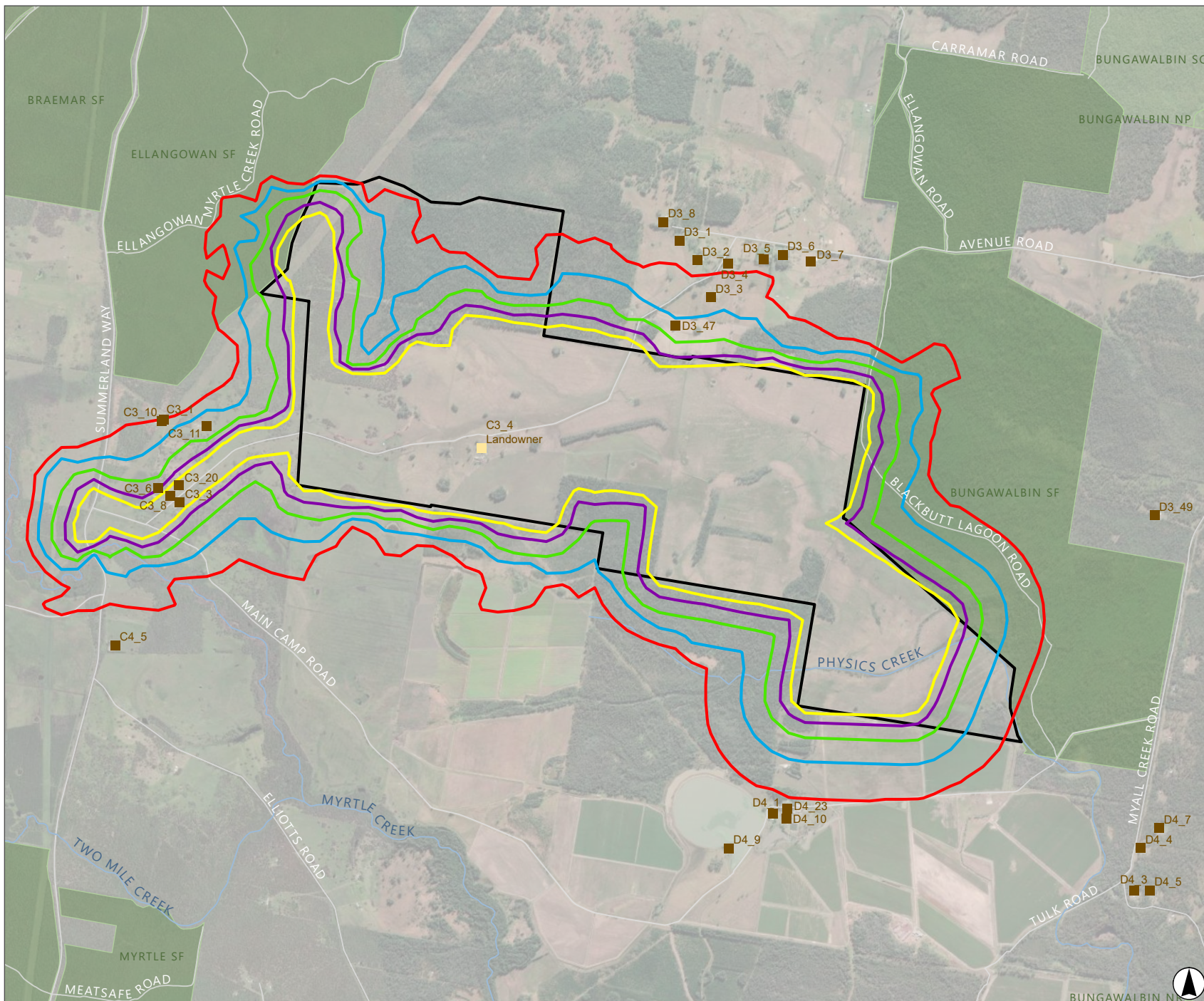
The results for each construction scenario (Sc.1 to Sc.8) for all receivers are presented in **Table 6.2**. Some exceedances are predicted at D3_3 and D3_47 for scenarios 1, 2 and 3 but these are considered relatively low (< 6 dB(A)). Larger exceedances are predicted at up to seven receivers, during Scenarios 7 and 8 but given these are associated with road upgrades, works will be transient in nature and impacts temporary. Whilst the noise management level at some receivers is predicted to be exceeded, no receiver is predicted to be 'highly noise affected' (i.e. in accordance with the ICNG, exposed to noise levels greater than 75 dB(A)).

The predicted noise levels for the worst-case scenario (Scenario 1 combined with Scenario 7 and 8) are shown graphically as noise contours in **Figure 6.1**. The locations of the receivers are presented in **Figure 3.1**.

As the predicted construction noise levels are above the noise management level, reasonable and feasible noise mitigation and management strategies are required (see **Section 6.3**), in order to reduce the potential impacts on the receivers surrounding the Project Area.

FIGURE 6.1

Construction Scenario 1, 7 and 8 Combined - Predicted Noise Levels, LAeq(15 min) dB(A)

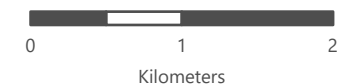
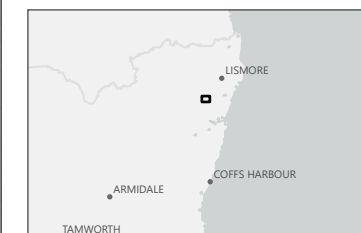


Legend

- Project Area
- Associated Sensitive Receiver
- Non-Associated Sensitive Receiver
- NPWS Reserve
- State Forest
- Roads
- Watercourse

Predicted Noise Levels, LAeq(15 min) dB(A)

- 45
- 50
- 55
- 60
- 65



Scale 1:50,000 at A4
GDA 1994 MGA Zone 56

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Table 6.2 Predicted Daytime Construction Noise Levels, LAeq(15 min), dB(A)

Rec ID	Structure	Standard Hours Noise Management Level, LAeq(15 min)	Construction Scenario Noise Prediction							
			Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc. 7	Sc. 8
C3_1	Residential	45	37	35	33	30	30	30	46	42
C3_3	Residential	45	43	41	39	36	36	36	74	44
C3_4 ¹	Landowner	-	65	63	61	58	58	58	64	< 20
C3_6	Residential	45	38	36	34	31	31	31	59	50
C3_8	Residential	45	42	40	38	35	35	35	72	47
C3_10	Residential	45	37	35	33	30	30	30	47	43
C3_11	Residential	45	40	38	36	33	33	33	53	40
C3_20	Residential	45	39	37	35	32	32	32	68	46
C4_5	Residential	45	34	32	30	27	27	27	40	37
D3_1	Residential	45	43	41	39	36	36	36	37	< 20
D3_2	Residential	45	44	42	40	37	37	37	37	< 20
D3_3	Residential	45	48	46	44	41	41	41	38	< 20
D3_4	Residential	45	42	40	38	35	35	35	32	< 20
D3_5	Residential	45	44	42	40	37	37	37	34	< 20
D3_6	Residential	45	42	40	38	35	35	35	27	< 20
D3_7	Residential	45	38	36	34	31	31	31	25	< 20
D3_8	Residential	45	42	40	38	35	35	35	36	< 20
D3_47	Residential	45	51	49	47	44	44	44	39	< 20
D3_49	Residential	45	25	23	21	< 20	< 20	< 20	< 20	< 20
D4_1	Residential	45	43	41	39	36	36	36	23	< 20
D4_3	Residential	45	31	29	27	24	24	24	< 20	< 20
D4_4	Residential	45	33	31	29	26	26	26	< 20	< 20
D4_5	Residential	45	26	24	22	< 20	< 20	< 20	< 20	< 20
D4_7	Residential	45	30	28	26	23	23	23	< 20	< 20
D4_9	Residential	45	34	32	30	27	27	27	< 20	< 20
D4_10	Residential	45	39	37	35	32	32	32	< 20	< 20
D4_23	Residential	45	39	37	35	32	32	32	< 20	< 20

Note: ¹ Receiver C3_4 is associated with the Project (host receiver) and the Noise Management Levels are not applicable.

6.2 Construction Vibration

Many items of construction equipment generate vibration that may be perceptible to receivers and cause annoyance or cause structural damage to buildings or other structures.

Section 6.0 of the EIS Historical Heritage Impact Assessment (Umwelt 2023) states that there are no listed historical heritage items within the Project Area.

The types of vibration-sensitive receivers in the Project area likely include:

- Residential (landowner)
- Commercial/agricultural buildings.

The commercial buildings in the area are structurally similar to residential buildings, therefore the assessment for residential buildings is considered to be relevant for the commercial receivers as well.

Recommended safe working distances for vibration generating equipment from sensitive receivers (i.e. the receiver building or its occupants) are given in Table 2 of the NSW *Construction Noise and Vibration Guideline* (CNVG) (RMS, 2023) reproduced in **Table 6.3**.

Table 6.3 Recommended Minimum Working Distances for Vibration Generating Plant from a Residential Sensitive Receiver (CNVG Table 2)

Plant Item	Rating/Description	Minimum Working Distance ¹	
		Cosmetic Damage (Residential Building)	Human Response
Vibratory Roller	< 50 kN (Typically 1–2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2–4 tonnes)	6 m	20 m
	< 200 kN (Typically 4–6 tonnes)	12 m	40 m
	< 300 kN (Typically 7–13 tonnes)	15 m	100 m
	> 300 kN (Typically 13–18 tonnes)	20 m	100 m
	> 300 kN (> 18 tonnes)	25 m	100 m
Small Hydraulic Hammer	300 kg – 5 to 12 t excavator	2 m	7 m
Medium Hydraulic Hammer	900 kg – 12 to 18 t excavator	7 m	23 m
Large Hydraulic Hammer	1600 kg – 18 to 34 t excavator	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Handheld	1 m (nominal)	2 m

Notes: ¹ For alternative equipment with higher vibration levels, larger minimum working distances are required.

² More stringent conditions may apply to heritage or other sensitive structures.

Due to the large separation distances between the Development Footprint and the external sensitive receivers (i.e. closest is approximately 480 m), vibration impacts from construction activities are anticipated to be negligible from the solar farm and BESS construction.

In regards to road upgrades, all receivers fall outside the minimum working distances for cosmetic damage. For the Avenue Road Upgrade works, receivers C3_3, C3_8 and C3_20 fall within the minimum working distance for human response for some plant items (i.e., vibratory roller >4 tonnes and large hydraulic hammer >18 tonnes). However, given the transient nature of the works, human disturbance impacts are anticipated to be low.

Construction vibration mitigation strategies are provided in **Section 6.3.4**.

6.3 Construction Noise and Vibration Mitigation Measures and Strategies

6.3.1 General Noise Controls

The construction noise levels are predicted to exceed the nominated noise management levels (**Table 6.2**), therefore reasonable and feasible noise management and mitigation strategies should be considered during the construction phase of the Project.

This may include a range and combination of mitigation measures, such as:

- Engineering noise controls including attenuators, temporary barriers, enclosures.
- Management strategies including scheduling of noise activities.
- Substitution of equipment and/or processes.
- Commercial agreements with affected landholders.

The overall effectiveness of these mitigation measures varies depending on a range of factors including equipment selections, landform/terrain, separation distance, machine utilisation, meteorological conditions and are generally evaluated on a case-by-case basis.

The typical effectiveness of noise mitigation measures are discussed in *AS2436-2010 (2016) Guide to Noise Control on Construction, Demolition and Maintenance Sites (AS2436)*. This standard provides a guide to the typical reduction that can be expected from different noise control methods (refer to **Table 6.4**).

Table 6.4 Typical Effectiveness of Mitigation Measures

Control Method	Likely Noise Reduction, dB(A)
Separation Distance	An increase of separation distance reduces noise levels at a rate of 6 dB(A) per doubling of distance
Screening	5 to 10 dB(A)
Enclosure	15 to 25 dB(A)
Silencing	5 to 10 dB(A)

6.3.2 Noise Mitigation Measures and Strategies

Noise and vibration mitigation measures to be implemented during construction of the Project include:

- A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the Construction Environmental Management Plan (CEMP). The NVMP will generally follow the approach in the ICNG and identify:
 - All potential significant noise and vibration generating activities associated with the Project.
 - Feasible and reasonable mitigation measures to be implemented.

- A monitoring program to assess performance against relevant noise and vibration criteria.
- Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures.
- Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.
- The CEMP and NVMP should be regularly updated to account for any changes in noise and vibration management of the Project.
- For best practice, the additional mitigation measures outlined in the Transport for NSW (TfNSW) *Construction Noise and Vibration Guideline (CNVG, 2023)* should be adopted (refer to **Section 6.3.3**).
- All sensitive receivers likely to be affected should be notified at least seven days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification should include:
 - Details of the Project.
 - The construction period and construction hours.
 - Contact information for project management staff.
 - Complaint and incident reporting.
 - How to obtain further information.
- All employees, contractors and subcontractors are to receive an environmental induction. The induction must include at a minimum, all applicable mitigation measures; hours of works; any limitations on high noise-generating activities; location of nearest sensitive receivers; designated parking areas; relevant approval conditions and incident procedures.
- Contractors are to keep noise to a minimum, including limiting the use of loud stereos/radios, shouting on site and car door slams.
- The noise levels of plant and equipment should have operating Sound Power or Sound Pressure Levels consistent with those nominated in **Table 6.1**.
- Noise emitting plant to be directed away from sensitive receivers and to be throttled down or shut down when not in use.
- Non-tonal reversing beepers should be fitted and used on all construction vehicles and mobile plant used regularly on site and for any out of hours work.
- Limit the use of engine compression brakes.
- Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise should be scheduled during less sensitive time periods.

6.3.3 Additional Mitigation Measures

In accordance with the CNVG, the triggers for the implementation of noise mitigation measures are described in **Table 6.5**.

Table 6.5 Triggers for the Implementation of Noise Mitigation Measures

Construction hours	Receiver Perception	dB(A) above NML	Additional Management Measures
Standard Hours Monday-Friday (7 am–6 pm) Saturday (8 am–1 pm)	Noticeable	0	-
	Clearly audible	< 10	-
	Moderately intrusive	> 10 to 20	PN, V
	Highly intrusive	> 20	PN, V
	75 dB(A) or greater	N/A	PN, V, SN

In accordance with the CNVG, the descriptions of the additional measures are provided in **Table 6.6**.

Table 6.6 Description of Noise Mitigation Measures

Additional Management Measure	Description
Period Notification (PN)	Advanced warning of upcoming works and potential disruptions can assist in reducing the impact on the community. Typically distributed on a monthly basis, notifications may consist of a letterbox drop, and/or email mailing lists, and published on the website. Updates detail work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of seven days prior to the start of works. The approval conditions for projects may specify requirements for notification to the community about works that may impact on them.
Verification Monitoring (V)	<p>Verification monitoring of noise and/or vibration levels during construction is in the form of routine checks of noise levels or following reasonable complaints, conducted at the affected receiver(s) or a nominated representative location.</p> <p>Where monitoring finds that the actual levels exceed those predicted in the assessment then immediate refinement of mitigation measures may be required and the management plan amended.</p> <p>Attended measurements are to be undertaken within a period of 14 days from the commencement of construction activities (or as agreed with the DPHI/EPA).</p> <p>For project durations greater than three months, attended measurements are to be repeated on a three-monthly basis, where reasonable and feasible, as part of the audit cycle. Where outside of standard work hour (OOWH) are required, attended measurements must be undertaken at the time intervals described in the management, OOWH assessment, approval and/or licence conditions.</p>
Specific Notification (SN)	<p>Specific notifications are to be letterbox dropped, hand distributed, or via phone calls, to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives.</p> <p>Alternatively (or in addition to), communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities and provide an individual briefing.</p> <p>The specific notification provides additional information when relevant and information to more highly affected receivers than covered in general letterbox drops. This form of communication is used to support periodic notifications, or to advertise unscheduled works.</p>

Based on the predicted construction noise level in **Table 6.2**, the CNVG additional noise mitigation measures shown in **Table 6.7** are triggered.

Table 6.7 Proposed Noise Mitigation Measures

Rec ID	Structure	Construction Scenario							
		Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7	Sc.8
C3_1	Residential	-	-	-	-	-	-	-	-
C3_3	Residential	-	-	-	-	-	-	PN, V	-
C3_4 ¹	Landowner	-	-	-	-	-	-	-	-
C3_6	Residential	-	-	-	-	-	-	PN, V	-
C3_8	Residential	-	-	-	-	-	-	PN, V	-
C3_10	Residential	-	-	-	-	-	-	-	-
C3_11	Residential	-	-	-	-	-	-	-	-
C3_20	Residential	-	-	-	-	-	-	PN, V	-
C4_5	Residential	-	-	-	-	-	-	-	-
D3_1	Residential	-	-	-	-	-	-	-	-
D3_2	Residential	-	-	-	-	-	-	-	-
D3_3	Residential	-	-	-	-	-	-	-	-
D3_4	Residential	-	-	-	-	-	-	-	-
D3_5	Residential	-	-	-	-	-	-	-	-
D3_6	Residential	-	-	-	-	-	-	-	-
D3_7	Residential	-	-	-	-	-	-	-	-
D3_16	Residential	-	-	-	-	-	-	-	-
D3_20	Residential	-	-	-	-	-	-	-	-
D3_23	Residential	-	-	-	-	-	-	-	-
D3_47	Residential	-	-	-	-	-	-	-	-
D3_49	Residential	-	-	-	-	-	-	-	-
D4_1	Residential	-	-	-	-	-	-	-	-
D4_2	Residential	-	-	-	-	-	-	-	-
D4_3	Residential	-	-	-	-	-	-	-	-
D4_4	Residential	-	-	-	-	-	-	-	-
D4_5	Residential	-	-	-	-	-	-	-	-
D4_7	Residential	-	-	-	-	-	-	-	-
D4_9	Residential	-	-	-	-	-	-	-	-
D4_10	Residential	-	-	-	-	-	-	-	-
D4_13	Residential	-	-	-	-	-	-	-	-

Note: ¹ Receiver C3_4 is associated with the Project (host receiver) and the Noise Management Levels are not applicable.

6.3.4 Construction Vibration Mitigation

The actual construction equipment to be used on site would be confirmed by the construction contractor during the detailed design phase. For any vibration generating plant not listed in **Table 6.3**, minimum working distances will need to be established.

In the event that any vibration-generating equipment would be used within the recommended safe working distances nominated in **Table 6.3**, the following is recommended:

- An independent specific structural assessment is undertaken on the structure to ascertain the structural integrity and its ability to withstand vibration, and establishment of an appropriate vibration criterion.
- A dilapidation survey is undertaken on the structure prior to works commencing, and regular inspection of the structure throughout the construction activities.
- A pre-construction vibration monitoring to establish baseline vibration impacts induced on the structure from existing sources.
- Establish site specific vibration minimum working distances for the nominated equipment on site.
- Where appropriate, continuous vibration monitoring is conducted on the structure for the duration of the period of construction while vibration generating equipment is used. The vibration logger should be equipped with the facility to remotely alert the site to reduce or cease construction activities if vibration levels are approaching the criterion threshold.

7.0 Road Traffic

7.1 Construction Traffic

Construction material and equipment would typically be transported via road from the Port of Brisbane Motorway (M4), Gateway Motorway (M1), Pacific Motorway (M1), Myocum Road, Hinterland Way (B62), Lismore-Bangalow Road (B62), Bruxer Highway (B60), Summerland Way (B91), Main Camp Road, Avenue Road to the three access points (refer to **Figure 1.3**).

Construction traffic volumes, have been taken from the Access Traffic Consulting assessment *Richmond Valley Solar Farm EIS Traffic and Transport Assessment* (EIS TTIA), dated 18 March 2024:

- Peak daily Project traffic volume is estimated to be 87 movements per day during May 2026, including 53 heavy vehicles (including buses) and 33 light vehicle movements. This equates to an additional 194 vehicles per day (i.e. 87vpd inbound & outbound), including 106 heavy vehicles (53vpd inbound & outbound) and 66 light vehicles (33vpd inbound & outbound).
- Peak AM (6 am–7 am) hourly Project traffic volume is estimated to be 28 movements, comprising 12 heavy vehicle movements and 16 light vehicle movements.
- Peak PM (5 pm–6 pm) hourly Project traffic volume is estimated to be 20 movements, comprising four heavy vehicle movements and 16 light vehicle movements.

The following inputs and assumptions have been applied in evaluating the potential traffic noise impacts:

- In accordance with the EIS TTIA, 2026 projected baseline traffic volumes (i.e. existing non-Project traffic) have been utilised for the assessment. This year corresponds with expected peak Project construction movements.
- For the existing traffic, it has been assumed that there is a nominal split of 90% of traffic during the day period (7 am–10 pm) to 10% traffic volume between the night period (10 pm–7 am).
- Project day period (7 am–10 pm) and night period (10 pm–7 am) volumes and composition, have been based on the hourly volumes shown in Figure 30 of the EIS TTIA. The same splits have been assumed for other surrounding projects including Summerville Solar Farm and Myrtle Creek Solar Farm.
- For this assessment, the buses used to transport workers, have been modelled as heavy vehicles.
- A posted speed limit of 100 km/h for Summerland Way and an assumed construction traffic speed limit of 60 km/h for Main Camp Road and Avenue Road was adopted.
- In accordance with the RNP and **Table 4.13** Summerland Way is classified as an arterial road and Main Camp Road and Avenue Road are classified as a local road.

Based on the above assumptions, the indicative construction-related traffic volumes adopted for the noise assessment are presented in **Table 7.1**. Additionally, indicative construction-related traffic volumes for the Summerville Solar Farm and Myrtle Creek Solar Farm projects are also presented in **Table 7.1** for the consideration of potential cumulative road traffic noise impacts.

Table 7.1 Indicative Construction Related Traffic Volumes

Location	Period	Parameter	Existing traffic volume (without Project) ¹	Project Related traffic volume ²	Summerville Solar Farm ³	Myrtle Creek Solar Farm ³	Combined traffic volume (Existing + Project)	Cumulative traffic volume (Existing + Project + External Projects)
Summerland Way North of Main Camp Road	Day (7 am–10 pm)	Light Vehicles	1610	31	18	18	1640	1677
		Heavy Vehicles	351	57	192	192	409	792
		Total	1961	88	210	210	2049	2468
	Night (10 pm–7 am)	Light Vehicles	179	10	6	6	189	200
		Heavy Vehicles	39	7	24	24	46	95
		Total	218	17	30	30	235	296
Summerland Way South of Main Camp Road	Day (7 am–10 pm)	Light Vehicles	1610	20	12	12	1630	1654
		Heavy Vehicles	351	37	128	128	389	644
		Total	1961	57	140	140	2018	2298
	Night (10 pm–7 am)	Light Vehicles	179	6	4	4	185	193
		Heavy Vehicles	39	5	16	16	44	76
		Total	218	11	20	20	229	269
Main Camp Road (Summerland Way to Avenue Road)	AM Peak Hourly/ PM Peak Hourly ⁴	Light Vehicles	4 / 6	16 / 16	-	-	20 / 22	30 / 32
		Heavy Vehicles	12 / 4	12 / 4	-	-	24 / 8	54 / 38
		Total	16 / 10	28 / 20	-	-	44 / 30	84 / 70
Avenue Road (Main Camp Road to SA3)	AM Peak Hourly/ PM Peak Hourly ⁴	Light Vehicles	2 / 3	16 / 16	-	-	18 / 19	18 / 19
		Heavy Vehicles	6 / 2	12 / 4	-	-	18 / 6	18 / 6
		Total	8 / 5	28 / 20	-	-	36 / 25	36 / 25

Notes: ¹ Volumes based on Table 14 of EIS TTA, and light and heavy vehicle compositions based on Table 6 of EIS TTA.

² Volumes based on Table 14 of EIS TTA, light and heavy vehicle compositions based on Section 4.1 of EIS TTA, and daytime (15hr) and night-time (9hr) splits based on Figure 30 of EIS TTA.

³ Volumes based on Table 13 of EIS TTA, light and heavy vehicle compositions based on Table 7 of Traffic Engineering Pty Ltd assessment Summerville Solar Farm Rappville NSW Traffic Impact Assessment, dated 15 September 2023 (Summerville EIS), and daytime (15hr) and night-time (9hr) splits based on Figure 21 of EIS TTA.

⁴ Volumes and composition based on Figure 30 (Project), Figure 40 (Combined), Figure 41 (Cumulative) and Table 14 (Avenue Road Existing Volumes) of EIS TTA. AM Peak is 6 am–7 am; PM Peak is 5 pm–6 pm.

Road traffic noise calculations were performed with CadnaA (Version 2023), using the Calculation of Road Traffic Noise (CoRTN) algorithms. The predicted road traffic noise levels presented in **Table 7.2** and **Table 7.3** are based on the nominated traffic volumes presented in **Table 7.1**.

Table 7.2 Summerland Way Predicted Construction Traffic Noise levels, LAeq, dB(A)

Road	Time Period	Receiver / Distance from Road Edge	Existing Traffic Noise Levels, dB(A)	Existing + Project Combined Traffic Noise Levels, dB(A)	Noise Limit, dB(A)	Noise Level Change due to Project, dB(A)	Comply/Exceed
Summerland Way North of Main Camp Road	Day (7 am–10 pm) LAeq(15 hour)	10 m	65	65	60	0.5	Complies – change not > 2 dB
		20 m	61	61	60	0.4	Complies – change not > 2 dB
		30 m	58	59	60	N/A ¹	Complies – limit not exceeded
		40 m	57	57	60	N/A ¹	Complies – limit not exceeded
	Night (10 pm– 7 am) LAeq(9 hour)	10 m	57	58	55	0.6	Complies – change not > 2 dB
		20 m	53	54	55	N/A ¹	Complies – limit not exceeded
		30 m	51	52	55	N/A ¹	Complies – limit not exceeded
		40 m	49	50	55	N/A ¹	Complies – limit not exceeded
Summerland Way South of Main Camp Road	Day (7 am–10 pm) LAeq(15 hour)	10 m	65	65	60	0.3	Complies – change not > 2 dB
		20 m	61	61	60	0.3	Complies – change not > 2 dB
		30 m	58	59	60	N/A ¹	Complies – limit not exceeded
		40 m	57	57	60	N/A ¹	Complies – limit not exceeded
	Night (10 pm–7 am) LAeq(9 hour)	10 m	57	58	55	0.5	Complies – change not > 2 dB
		20 m	53	54	55	N/A ¹	Complies – limit not exceeded
		30 m	51	51	55	N/A ¹	Complies – limit not exceeded
		40 m	49	50	55	N/A ¹	Complies – limit not exceeded

Notes: ¹ Change in noise level assessment is not applicable if the predicted noise level is below the noise limit.

Table 7.3 Avenue Road Predicted Construction Traffic Noise levels, LAeq, dB(A)

Road	Time Period	Receiver / Distance from road edge	Existing traffic noise levels, dB(A)	Existing + Project Combined traffic noise levels, dB(A)	Noise Limit, dB(A)	Noise Level Change due to Project, dB(A)	Comply/Exceed
Avenue Road	Day (7 am–10 pm) LAeq(1 hour)	C3_1	< 30	30	55	N/A ¹	Complies – limit not exceeded
		C3_3	45	51	55	N/A ¹	Complies – limit not exceeded
		C3_6	32	39	55	N/A ¹	Complies – limit not exceeded
		C3_8	42	48	55	N/A ¹	Complies – limit not exceeded
		C3_10	< 30	31	55	N/A ¹	Complies – limit not exceeded
		C3_11	< 30	34	55	N/A ¹	Complies – limit not exceeded
		C3_20	39	44	55	N/A ¹	Complies – limit not exceeded
	Night (10 pm–7 am) LAeq(1 hour)	C3_1	30	35	50	N/A ¹	Complies – limit not exceeded
		C3_3	50	55	50	4.9	Exceeds – limit exceeded & change > 2 dB
		C3_6	38	43	50	N/A ¹	Complies – limit not exceeded
		C3_8	47	52	50	5.0	Exceeds – limit exceeded & change > 2 dB
		C3_10	30	35	50	N/A ¹	Complies – limit not exceeded
		C3_11	33	38	50	N/A ¹	Complies – limit not exceeded
		C3_20	44	48	50	N/A ¹	Complies – limit not exceeded

Notes: ¹ Change in noise level assessment is not applicable if the predicted noise level is below the noise limit.

The predicted road traffic noise levels indicate that for the northern and southern approach of Summerland Way to the Project Area:

- As shown in **Table 7.2**, the construction traffic noise levels on Summerland Way are predicted to comply with the criteria.

The predicted road traffic noise levels indicate that for Avenue Road:

- As shown in **Table 7.3**, the construction traffic noise levels are predicted to comply with the criteria at the majority of the receivers. Exceedances are predicted during the night-time period (with movements anticipated to be between 6 am–7 am during this period) at Receiver C3_3 and C3_8.

Potential noise mitigation measures to reduce construction-related traffic noise may include the following:

- Restricting Project related traffic to 60 km/h along Avenue Road.
- Car-pooling and the use of buses/mini-vans to reduce the total number of light vehicle movements is already being adopted by the Project.

7.2 Operational Traffic

The workforce will consist of a small number of local workers (i.e. approximately 10–15 full time staff) who are expected to reside locally to the Project Area (e.g. Casino or Grafton) or if residing elsewhere, travel to site irregularly. Given the small number of staff, noise from operational traffic movements is anticipated to be negligible.

8.0 Cumulative Assessment

8.1 Nearby Projects for Consideration

As detailed within the EIS, there are a number of existing and proposed projects within the region. Apart from the proposed Summerville Solar Farm and Myrtle Creek Solar Farm projects (see **Figure 8.1**), the other projects are located at significant distances (i.e. greater than 19 km) from the Project Area. Therefore, the assessment of cumulative impacts has been limited to the potential contribution from Summerville Solar Farm and Myrtle Creek Solar.










Table 8.1 Developments and Proposed Developments within Vicinity of Project

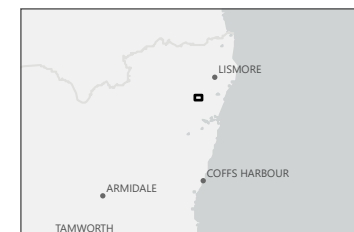
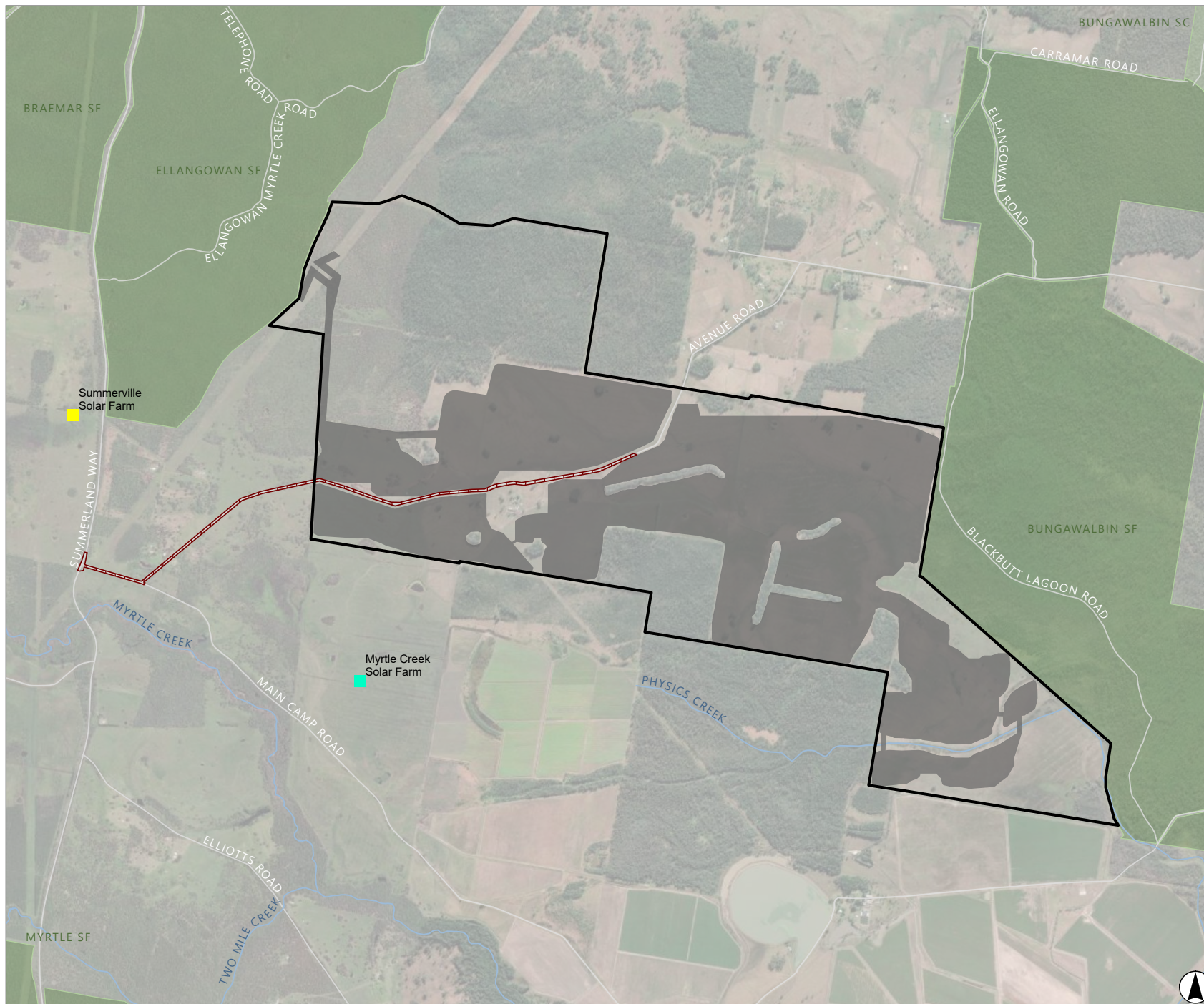
Project	Status	Generation Capacity (MW) / Industry	Construction Start Date	Approximate Distance from Project Area (km)	LGA
Major Energy Projects within 50 km of the Project Area					
Myrtle Creek Solar Farm (SSD-12360774)	In Planning - Prepare EIS	120 MW	Unknown	Directly south of the Project Area	Richmond Valley
Summerville Solar Farm (SSD-46982232)	In Planning – Response to Submissions	90 MW	Late 2024	1.4 km east	Richmond Valley

FIGURE 8.1

Summerville Solar Farm and Myrtle Creek Solar Farm Locality

Legend

-  Project Area
-  Development Footprint
-  Road Upgrade Area
-  Myrtle Creek Solar Farm
-  Summerville Solar Farm
-  NPWS Reserve
-  State Forest
-  Roads
-  Watercourse



Kilometers

Scale 1:45,000 at A4
GDA 1994 MGA Zone 56

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8.2 Construction Noise

The construction phase of the Project, Summerville Solar Farm and Myrtle Solar Farm projects could occur concurrently, should the projects proceed as proposed. Therefore, there is potential for cumulative construction noise at those sensitive receivers located near the project areas, to the west of the Project. The reasonable and feasible management and mitigation strategies discussed in **Section 6.3** are applicable to the cumulative construction noise impacts, a collaborative approach to managing potential construction noise impacts may be necessary at times to minimise potential noise impacts at the sensitive receivers nearest to both projects.

8.3 Operational Noise

When assessing cumulative noise levels, there are two aspects that need to be considered. The first is the existing ambient noise levels within an area from all industrial noise sources. The recommended amenity noise levels for all receivers surrounding the Project Area are shown in **Table 4.3**. The second is the project-specific contribution to the ambient noise levels.

Section 2.1 of the NPfI notes that the PINL, described in **Section 4.1**, aims to protect against significant changes in noise levels, whilst the PANL seeks to protect against cumulative noise impacts from all industrial noise sources within an area. The PANL for a project is the recommended amenity noise levels in NPfI Table 2.2 minus 5 dB(A). The period based PANL is converted to a LAeq,15minute by the addition of 3 dB.

The NPfI noted that in circumstances where the PANL cannot be feasibly and reasonably met, an assessment of existing industrial noise, combined with the project-specific contribution, is required. However, where the PANL applies and it can be met, no additional consideration of cumulative industrial noise is required.

The PINLs and not the PANLs apply to the PNTL. The most stringent PINL/PNTLs of 35 dB(A) LAeq,15minute are for the night-time period. The corresponding night-time PANLs are 38 dB(A) LAeq,15minute. The maximum predicted LAeq,15minute under default worst-case meteorological in **Table 5.2** is 35 dB(A), 3 dB below the PANL.

As the PANL for the Project can be met it is proposed no additional consideration of cumulative industrial noise is required.

8.4 Road Traffic Noise

The construction-related traffic noise levels have been evaluated with consideration of the concurrent Summerville Solar Farm and Myrtle Creek Solar Farm traffic volumes. The indicative traffic volumes for Summerville Solar Farm and Myrtle Creek Solar Farm are presented in **Table 7.1**.

The cumulative traffic noise levels considering the simultaneous construction traffic from Summerville Solar Farm and Myrtle Creek Solar Farm on Summerland Way are presented in **Table 8.2**.

Table 8.2 Summerland Way Predicted Cumulative Construction Traffic Noise levels, LAeq, dB(A)

Road	Time Period	Receiver / Distance from Road Edge	Existing Traffic Noise Levels, dB(A)	Cumulative (Existing + Project + External projects) Traffic Noise Levels, dB(A)	Noise Limit, dB(A)	Noise Level Change Due to Project + External Projects, dB(A)	Comply/Exceed
Summerland Way North of Main Camp Road	Day (7 am–10 pm) LAeq(15 hour)	10 m	65	67	60	2.6	Exceeds – limit exceeded & change > 2 dB
		20 m	61	63	60	2.5	Exceeds – limit exceeded & change > 2 dB
		30 m	58	61	60	2.6	Exceeds – limit exceeded & change > 2 dB
		40 m	57	59	60	2.6	Complies – change not > 2 dB
	Night (10 pm–7 am) LAeq(9 hour)	10 m	57	60	55	3.0	Exceeds – limit exceeded & change > 2 dB
		20 m	53	56	55	3.1	Exceeds – limit exceeded & change > 2 dB
		30 m	51	54	55	3.1	Complies – limit not exceeded
		40 m	49	52	55	3.2	Complies – limit not exceeded
Summerland Way South of Main Camp Road	Day (7 am–10 pm) LAeq(15 hour)	10 m	65	67	60	1.9	Complies – change not > 2 dB
		20 m	61	63	60	1.9	Complies – change not > 2 dB
		30 m	58	60	60	2.0	Complies – limit not exceeded
		40 m	57	59	60	2.0	Complies – limit not exceeded
	Night (10 pm–7 am) LAeq(9 hour)	10 m	57	59	55	2.3	Exceeds – limit exceeded & change > 2 dB
		20 m	53	56	55	2.5	Exceeds – limit exceeded & change > 2 dB
		30 m	51	53	55	2.6	Complies – limit not exceeded
		40 m	49	52	55	2.7	Complies – limit not exceeded

The predicted cumulative road traffic noise levels indicate that:

- The potential traffic noise level is predicted to comply with the daytime noise limit of 60 dB(A) LAeq(9hr) and the night-time noise limit of 55 dB(A) LAeq(9hr) at 40 m from the road edge. Within 40 m, exceedance of the limits is predicted, as additional Project and external project traffic, exceeds the 2 dB(A) allowance.
- Typically, the sensitive receivers located in the vicinity of the Project Area are located at a distance greater than 40 m from the edge of the Summerland Way and therefore the additional road traffic noise is likely to be negligible for the majority of sensitive receivers in the area. Further, the predicted noise levels are conservative and assume that peak construction traffic movements for all projects, are occurring simultaneously, which is unlikely to occur.

Additionally, the Project has committed to using buses to reduce the total number of light vehicles movements. It is our understanding that a similar approach may be adopted by the Summerville Solar Farm and Myrtle Creek Solar Farm projects.

9.0 Decommissioning

The decommissioning of the Project would involve undertaking the construction activities in reverse. From a noise and vibration generating perspective, the decommissioning activities are not as intensive as with construction as intensive activities such as piling are not required. Noise emissions during decommissioning activities are therefore expected to be less than the construction activities. The reasonable and feasible management and mitigation strategies discussed in **Section 6.3** would be applicable to minimise potential decommissioning-related noise impacts at the sensitive receivers.

10.0 Conclusion

An assessment of the potential noise and vibration impacts has been prepared for the Project in the Northern Rivers region of NSW.

Potential construction noise and vibration impacts have been assessed in accordance with the *Interim Construction Noise Guideline* (ICNG, 2009). The assessment found that during some stages of construction, exceedance of the noise management level was predicted to occur at some receivers but no receiver was predicted to be 'highly noise affected' (i.e. exposed to noise levels greater than 75 dB(A)). Reasonable and feasible noise mitigation measures have been recommended and will be required during the construction phase of the Project.

Construction related road traffic noise has been assessed and it was found that two receivers along Avenue Road (C3_3 and C3_8) may experience elevated road traffic noise levels during the early morning (6 am–7 am) of the construction period. Potential noise mitigation measures include, restricting the speed of the Project vehicles along Avenue Road to 60 km/h; and car-pooling and the use of buses/mini-vans to reduce the total number of light vehicle movements.

Potential operational noise levels have been assessed in accordance with the *Noise Policy for Industry* (NPfI, 2017). This assessment found that the Project is expected to comply with the applicable day, evening and night-time noise limits at nearby non-associated sensitive receivers. Therefore, no additional noise mitigation is anticipated to be needed for the operation of the Project. The road traffic related to the operation of the Project is expected to be minimal and associated noise is anticipated to be negligible.

Cumulative operational noise impact from existing and approved projects in the area was determined to be within the noise limits. For cumulative construction noise impacts, reasonable and feasible mitigation and management measures, along with collaboration with Summerville Solar Farm and Myrtle Solar Farm, may be necessary at times, to minimise potential noise impacts at the sensitive receivers in proximity to the projects.

Cumulative construction-related road traffic noise has been assessed and it was found that exceedance of the noise limits was predicted within 40 m of the Summerland Way road edge. However, given the sensitive receivers located in the vicinity of the Project Area are typically located at a distance greater than 40 m from the road, additional road traffic noise is likely to be negligible for the majority of sensitive receivers in the area.

Noise emission during decommissioning activities is expected to be less than construction activities and therefore would comply with the noise management levels for construction.

11.0 References

Noise Policy for Industry, Environment Protection Authority, 2017 (NPfi, EPA).

Interim Construction Noise Guideline NSW Department of Environment and Climate Change, 2009 (ICNG, DECC).

NSW Road Noise Policy, Department of Environment, Climate Change and Water, 2011 (RNP, DECCW).

Construction Noise Estimator Tool, Roads and Maritime, version 4/08/2016.

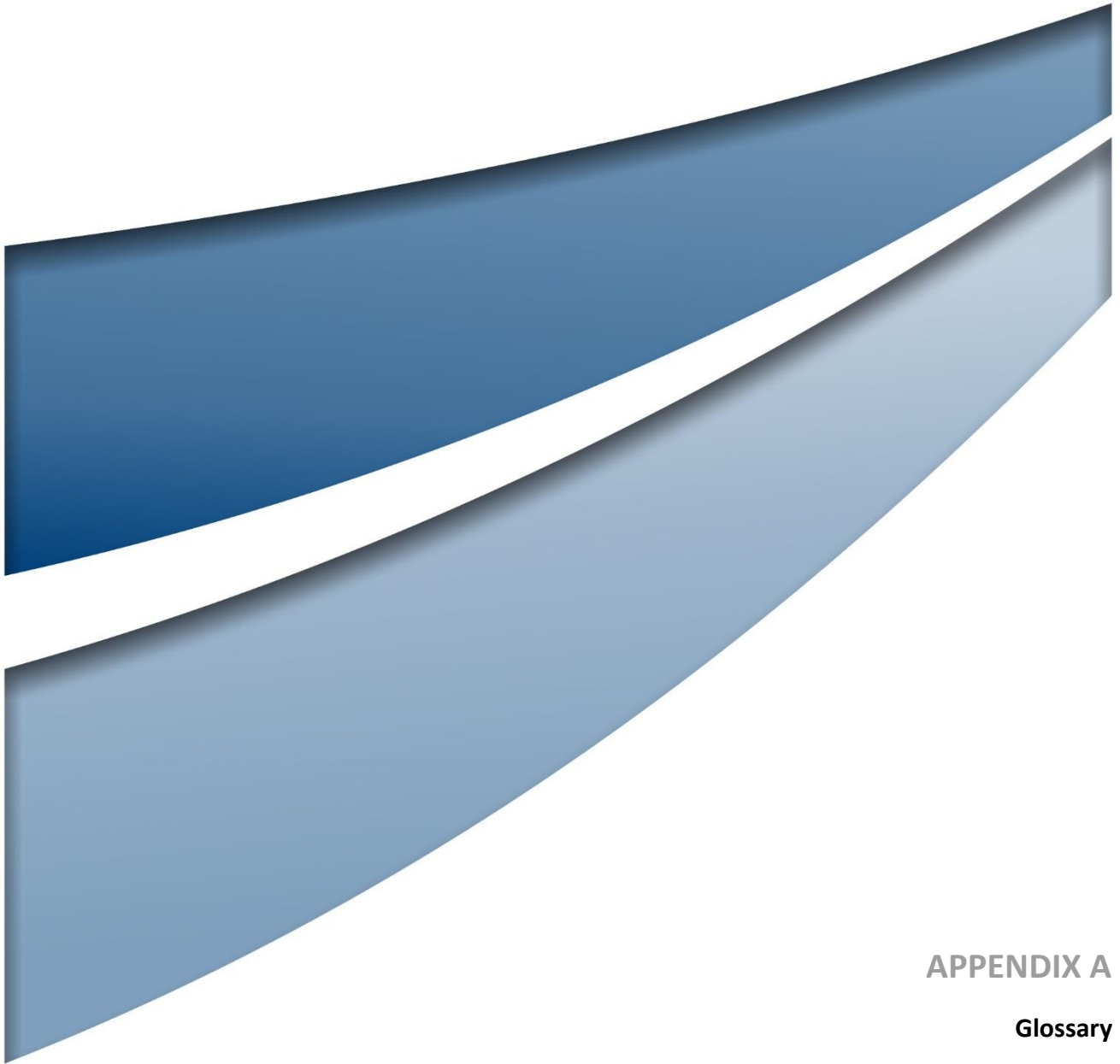
Construction Noise and Vibration Guideline, Transport for NSW (TfNSW), 2023.

German Standard (Deutsche Norm) DIN 4150-3:1999-02 Structural Vibration Part 3: Effects of vibration on structures.

British Standard BS7385-2:1993 Evaluation and measurement for vibration in buildings Part 2. Guide to damage levels from groundborne vibration.

Australian Standard AS2436-2010 (R2016) Guide to Noise Control on Construction, Demolition and Maintenance Sites.

Large-Scale Solar Energy Guideline, 2022 (DPE).



APPENDIX A

Glossary

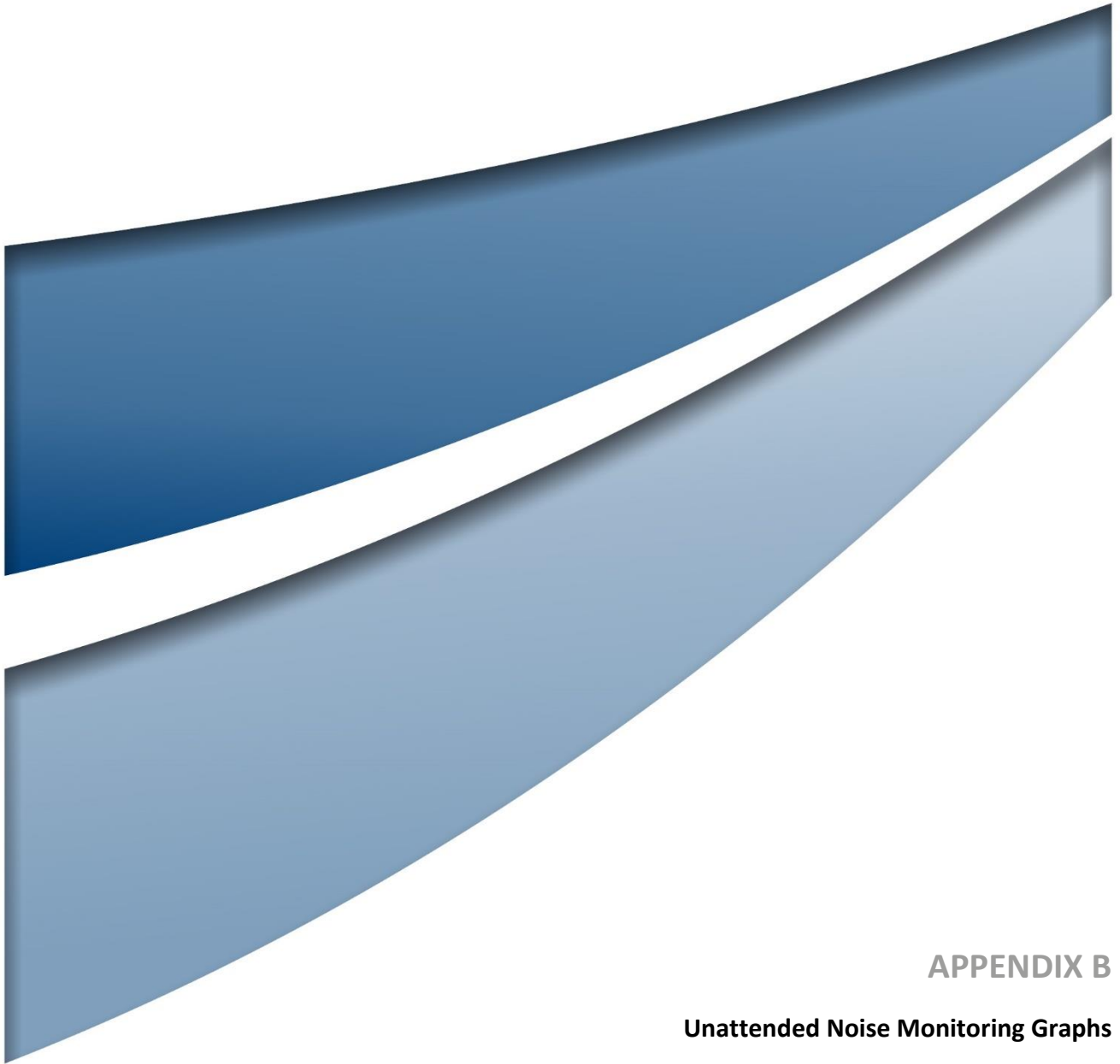
Glossary

Table A.1 provides descriptions of terms and abbreviations which may be used in this report.

Table A.1 Glossary of Terms and Abbreviations

Term	Description
1/3 Octave	Single octave bands divided into three parts.
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment background level – A single-figure background noise level representing each assessment period – day, evening and night (that is, three assessment background levels are determined for each 24 hour period of the monitoring period). It is determined by taking the lowest 10th percentile of the L ₉₀ level for each assessment period.
Ambient Noise	The noise associated with a given environment. Typically, a composite of sounds from many sources located both near and far where no particular sound is dominant.
Recommended Amenity Noise Level	Recommended noise levels scaled to reflect the perceived differential expectations and ambient noise environments of rural, suburban and urban communities for sensitive receivers.
Assessment Background Level (ABL)	The single-figure background level representing each assessment period: day, evening and night (that is, three assessment background levels are determined for each 24-hour period of the monitoring period). Its determination is by the methods described in Fact Sheet B.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dB(A), dBA	Decibels A-weighted.
dB(C), dBC	Decibels C-weighted.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Day	The period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays
Decibel (dB)	The units of sound level and noise exposure measurement where a step of 10 dB is a ten-fold increase in intensity or sound energy and actually sounds a little more than twice as loud.
Evening	Refers to the period from 6 pm to 10 pm.
Hertz (Hz)	The measure of the frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
L _{A10}	The percentile sound pressure level exceeded for 10% of the measurement period with 'A' frequency weighting calculated by statistical analysis. Typically used to assess the impact of an existing operation on a receiver area and is referred to as the cumulative noise levels at the receiver attributable to the noise source.
L _{A90}	Background Noise Level. The percentile sound pressure level exceeded for 90% of the measurement period with 'A' frequency weighting calculated by statistical analysis.
L _{Amax}	The maximum of the sound pressure levels recorded over an interval of 1 second.

Term	Description
$L_{A1,1\text{minute}}$	The measure of the short duration high-level noises that cause sleep arousal. The noise level is measured as the percentile sound pressure level that is exceeded 1% of measurement period with 'A' frequency weighting calculated by statistical analysis during a measurement time interval of 1 minute.
$L_{Aeq,t}$	Equivalent continuous sound pressure level - The value of the sound pressure level of a continuous steady noise that, a measurement interval of time (t), has the same mean square sound pressure as the sound under consideration whose level varies with time. Usually measured in dB with 'A' weighting.
L_{An}	Percentile level - A measure of the fluctuation of the sound pressure level which is exceeded 'n' percent of the observation time.
Morning Shoulder Period	Refers to the period from 6 am to 7 am.
Night	The period between 10 am and 7 pm.
Noise-sensitive land uses	Land uses that are sensitive to noise, such as residential areas, churches, schools and recreation areas.
Project Noise Trigger Levels (PNTL)	Target noise levels for a particular noise-generating facility. They are based on the most stringent of the project intrusiveness noise level or the project amenity noise level.
Project Amenity Noise Levels	The project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Calculated as the recommended amenity noise level less 5 decibels and refers to the day, evening and night periods.
Project Intrusive Noise Levels	The project intrusiveness noise level aims to protect against significant changes in noise levels. Calculated as rated background level plus 5 decibels and refers to a 15-minute period.
Receiver	The noise-sensitive land use at which noise from a development can be heard.
Residence	A lawful and permanent structure erected in a land-use zone that permits residential use (or for which existing use rights under the EP&A Act apply) where a person/s permanently reside and is not, nor associated with, a commercial undertaking such as caretakers' quarters, hotel, motel, transient holiday accommodation or caravan park.
Rating Background Noise level (RBL)	The overall single figure background level representing each assessment period over the whole monitoring period determined by taking the median of the ABLs found for each assessment period.
Sleep Disturbance	Awakenings and disturbance to sleep stages.
Sound Pressure Level (dBA)	The basic measure of noise loudness. The level of the root-mean-square sound pressure in decibels given by: $SPL = 10 \cdot \log_{10} (p/p_0)^2$ where p is the rms sound pressure in pascals and p_0 is the sound reference pressure at 20 uPa db.
Sound Power Level	A measure of the energy emitted from a source as sound and is given by: $SWL = 10 \cdot \log_{10} (W/W_0)$ where W is the sound power in watts and W_0 is the sound reference power at 10^{-12} watts.
Temperature Inversion	An atmospheric condition in which temperature increases with height above the ground.



APPENDIX B

Unattended Noise Monitoring Graphs

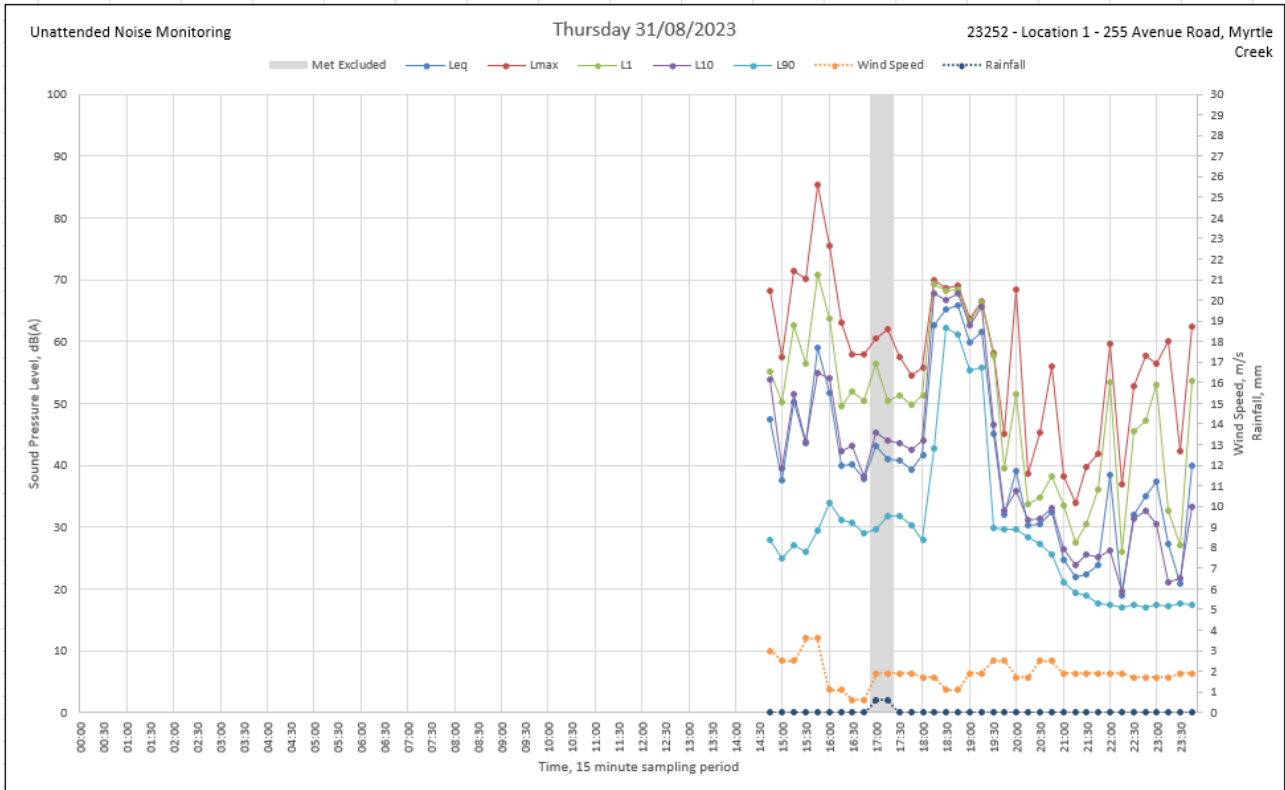


Figure B1.1 Unattended noise measurement at L1 - 31/8/2023

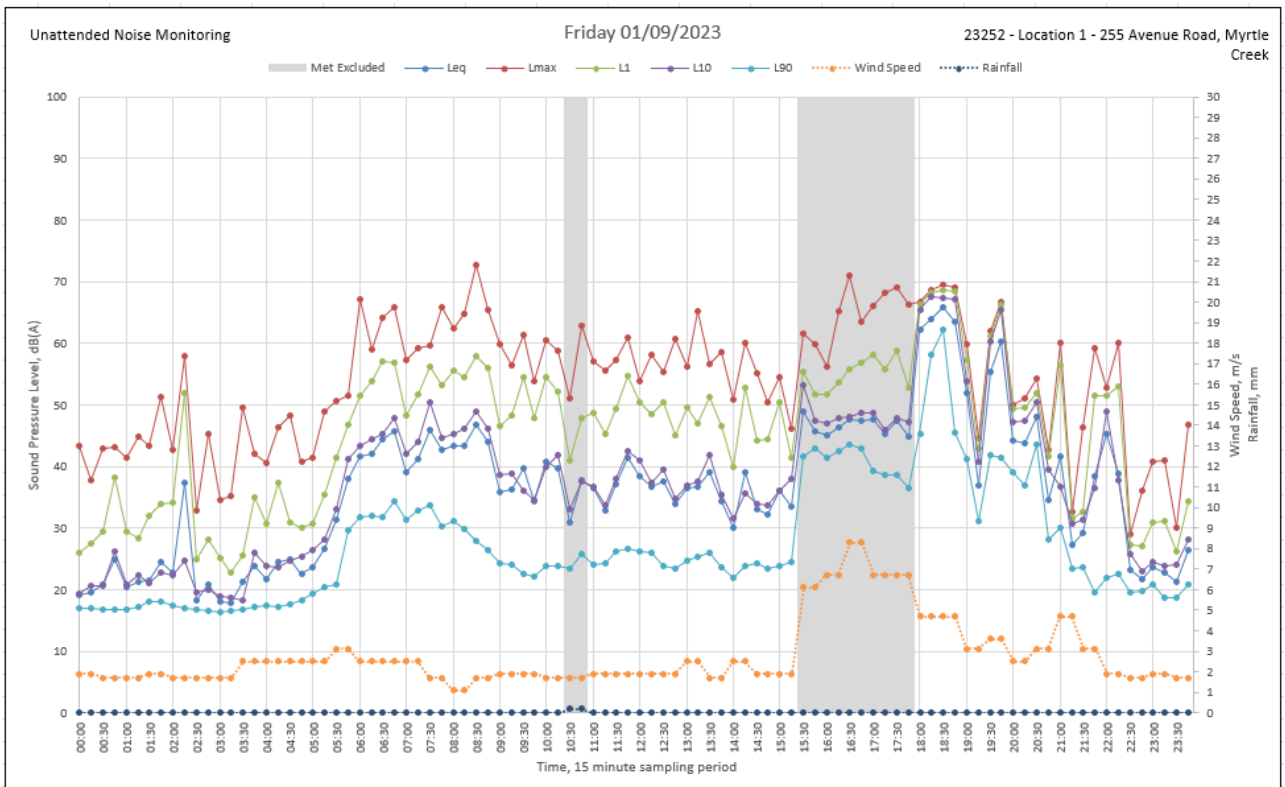


Figure B1.2 Unattended noise measurement at L1 - 1/9/2023

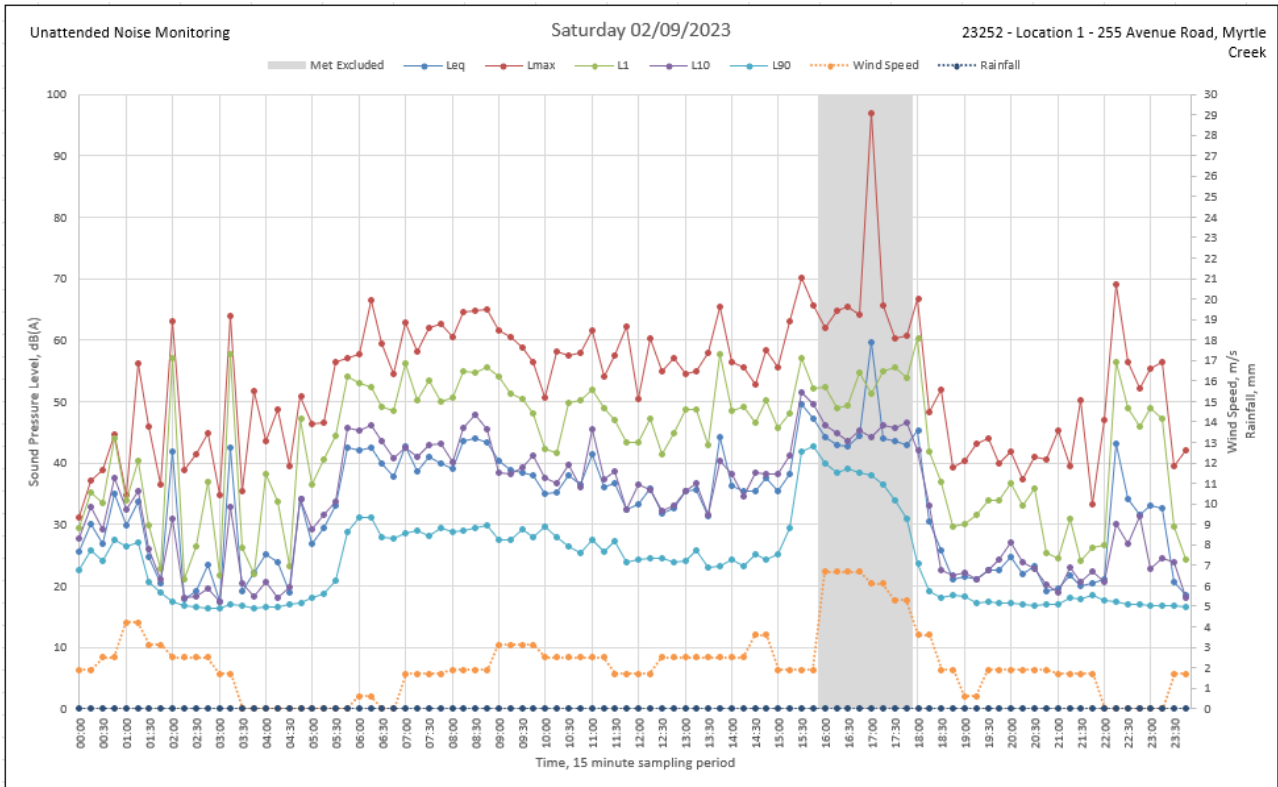


Figure B1.3 Unattended noise measurement at L1 - 2/9/2023

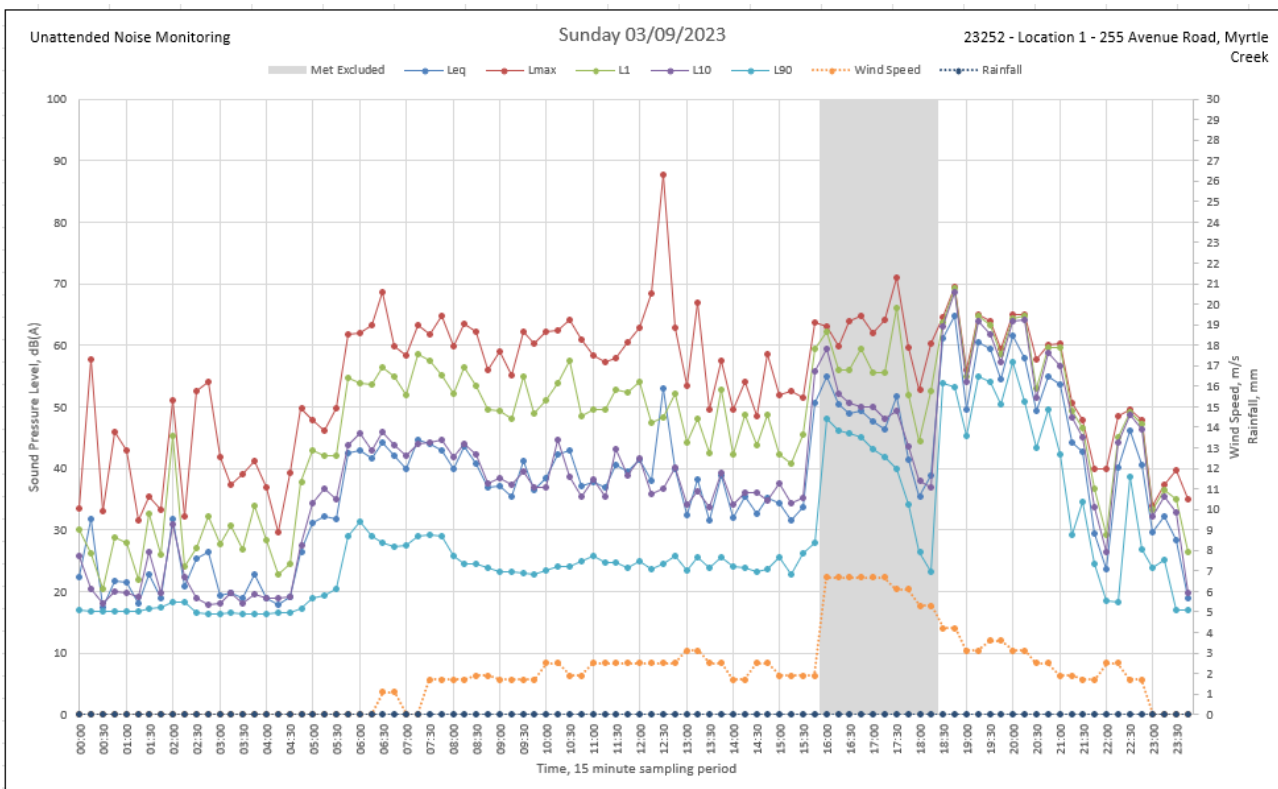


Figure B1.4 Unattended noise measurement at L1 - 3/9/2023

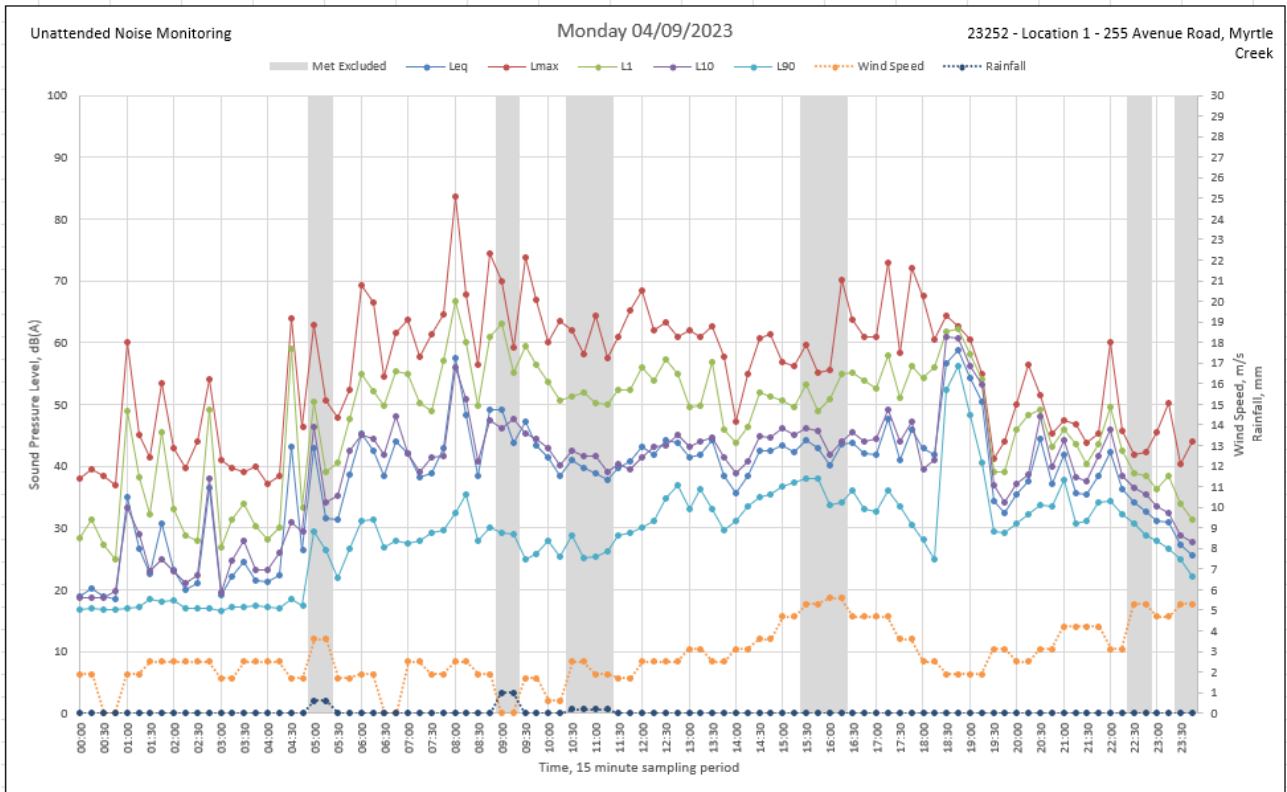


Figure B1.5 Unattended noise measurement at L1 - 4/9/2023

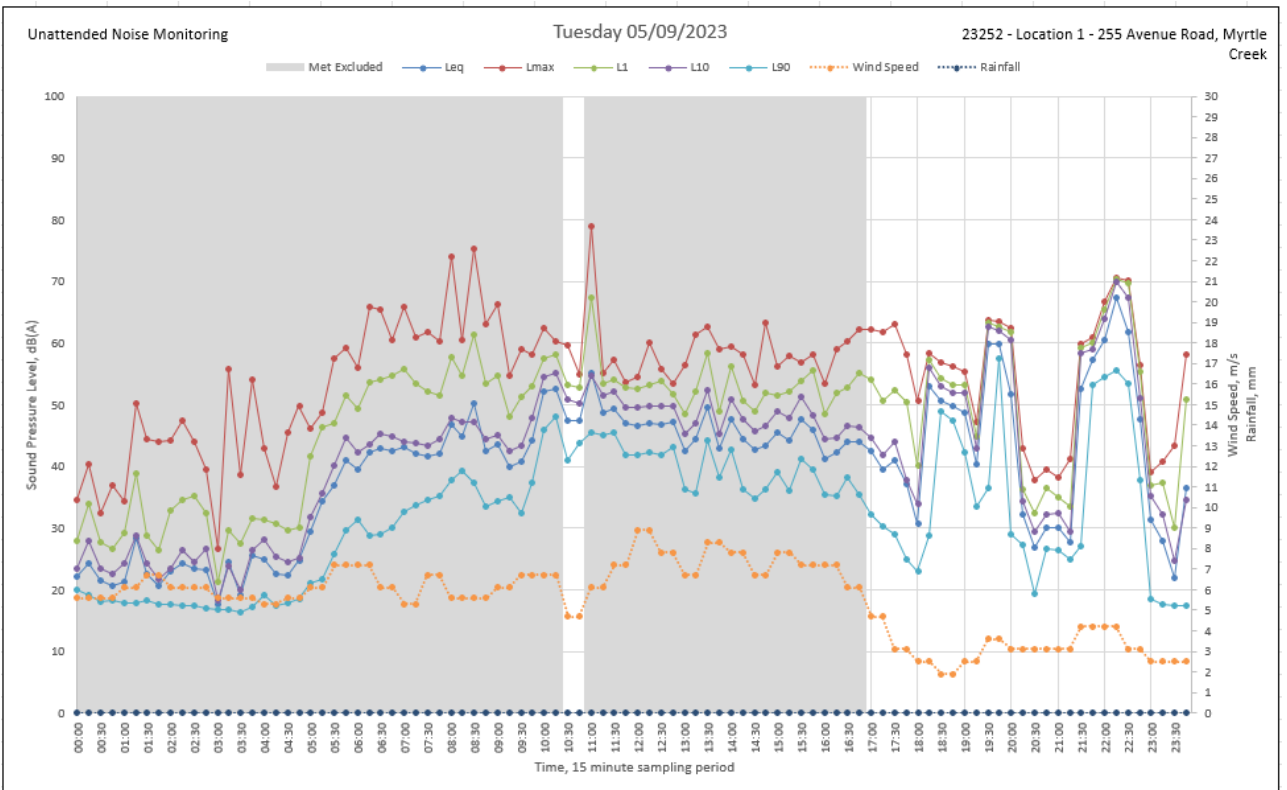


Figure B1.6 Unattended noise measurement at L1 - 5/9/2023

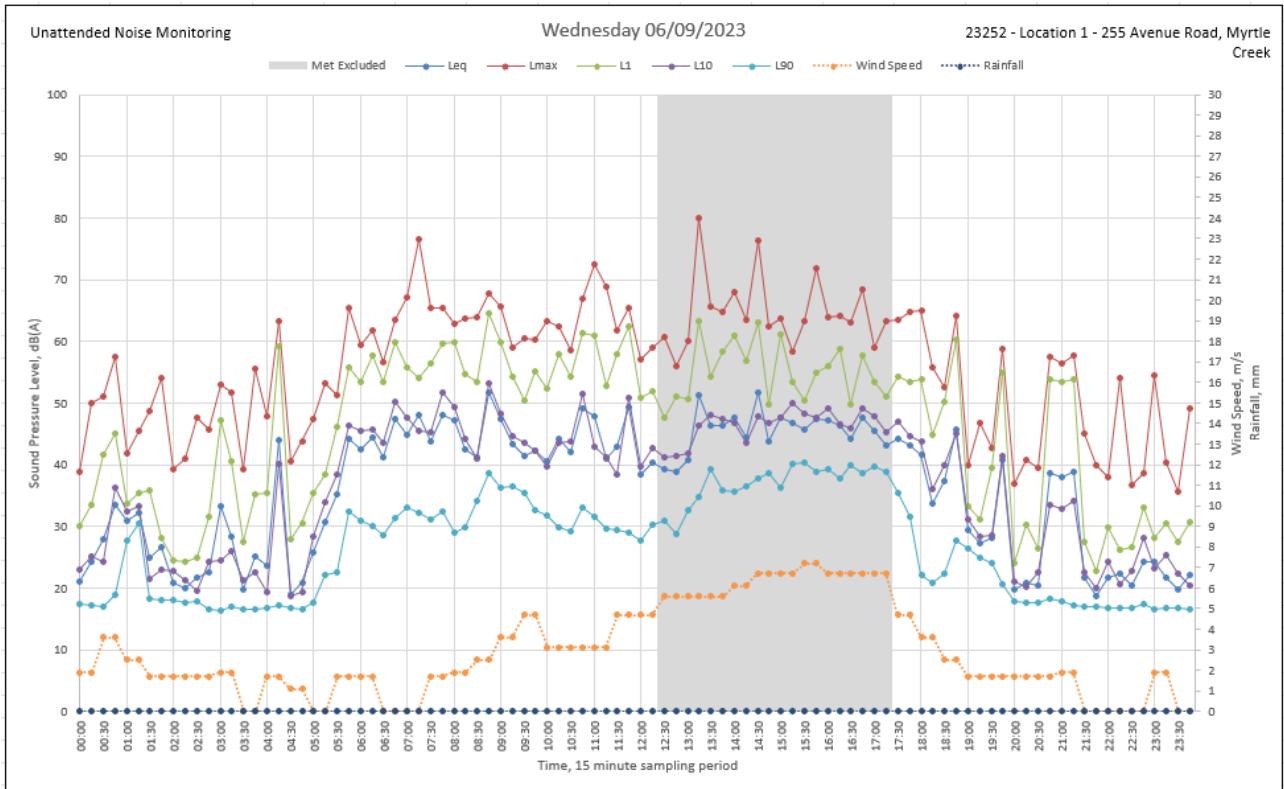


Figure B1.7 Unattended noise measurement at L1 - 6/9/2023

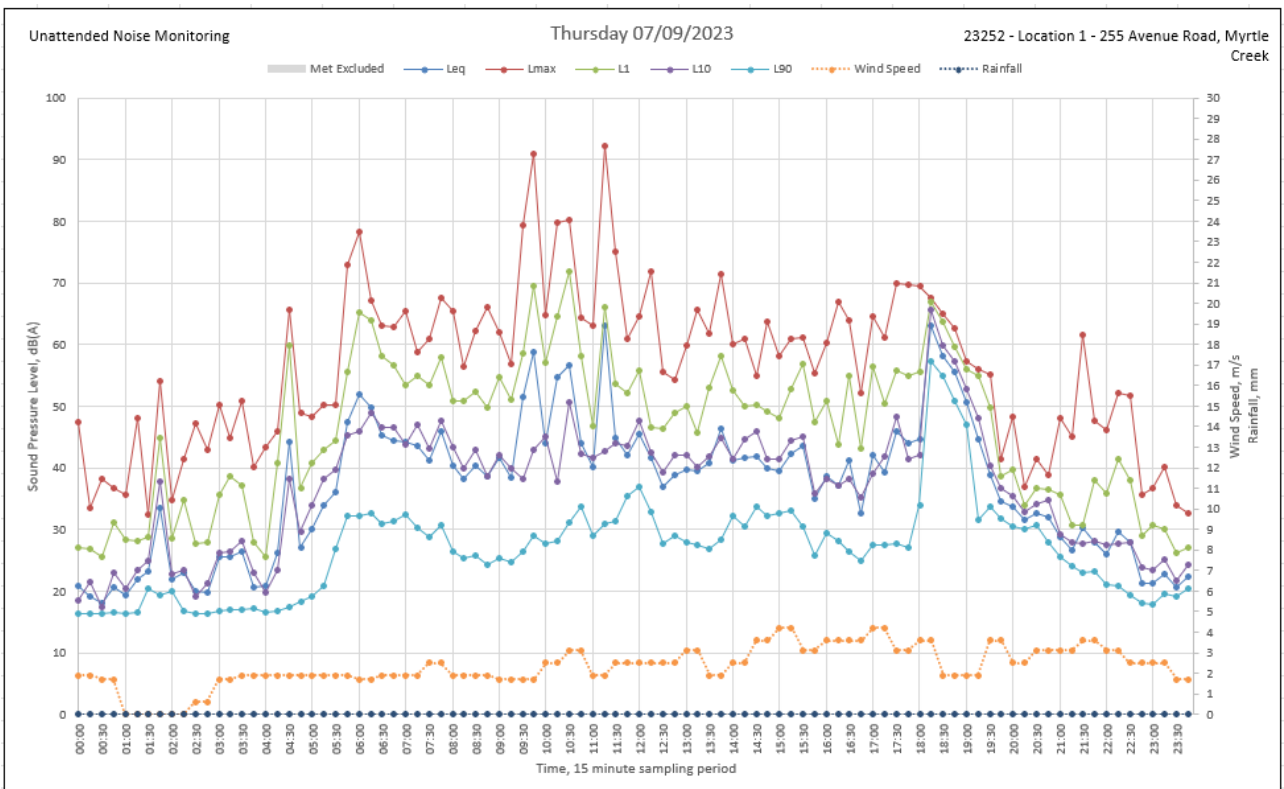


Figure B1.8 Unattended noise measurement at L1 - 7/9/2023

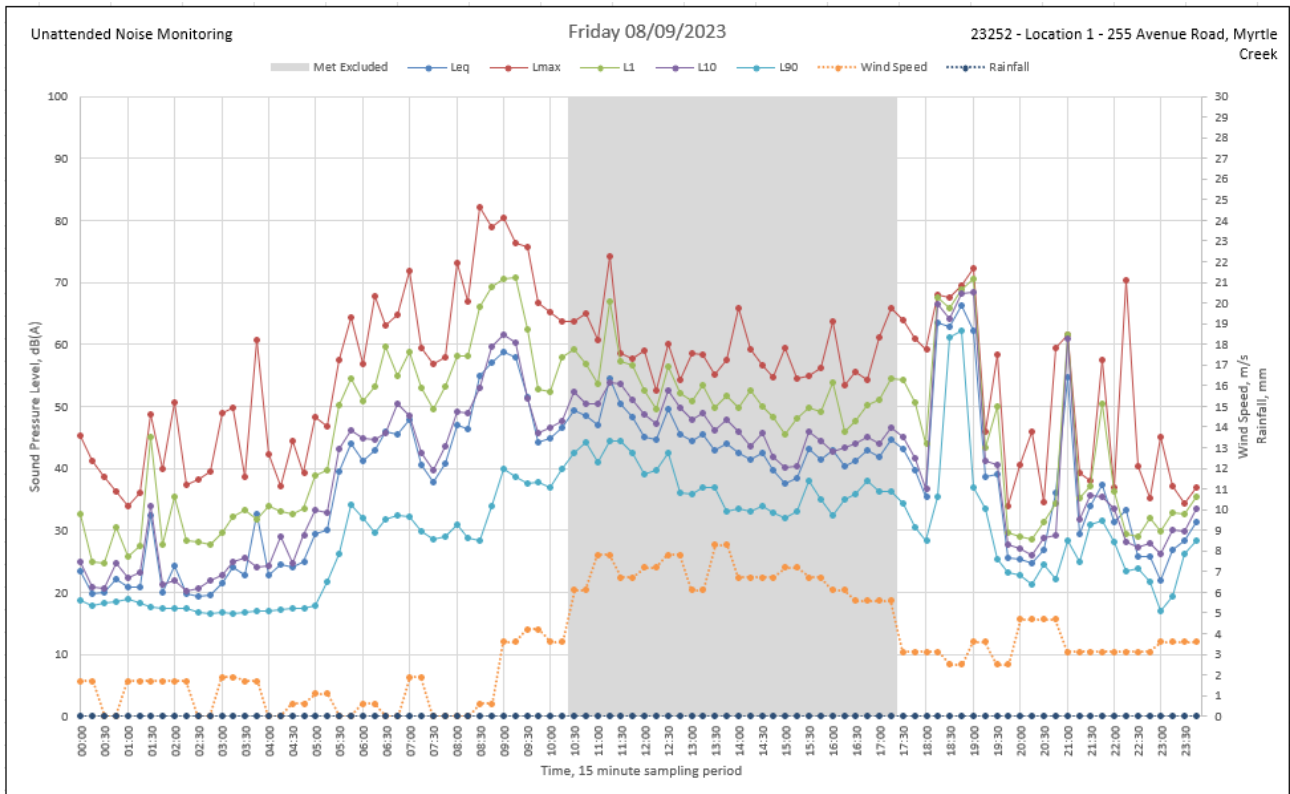


Figure B1.9 Unattended noise measurement at L1 - 8/9/2023

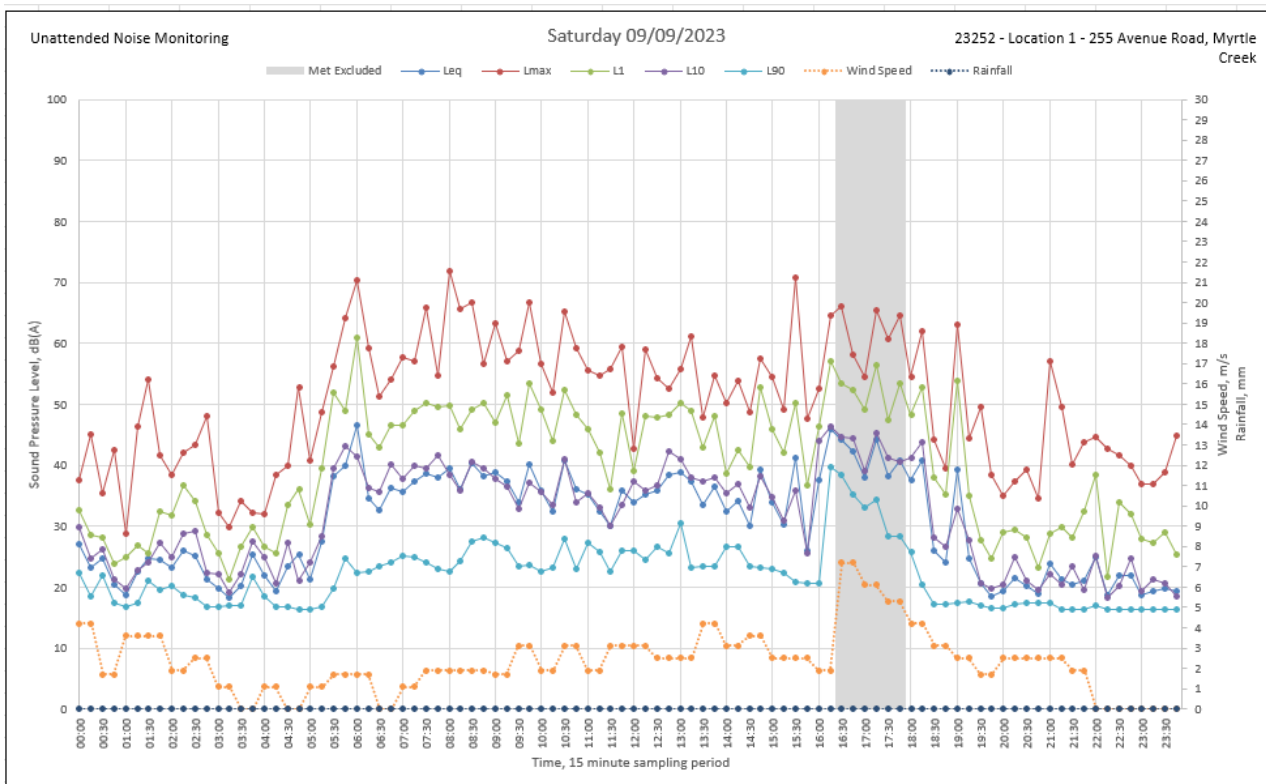


Figure B1.10 Unattended noise measurement at L1 - 9/9/2023

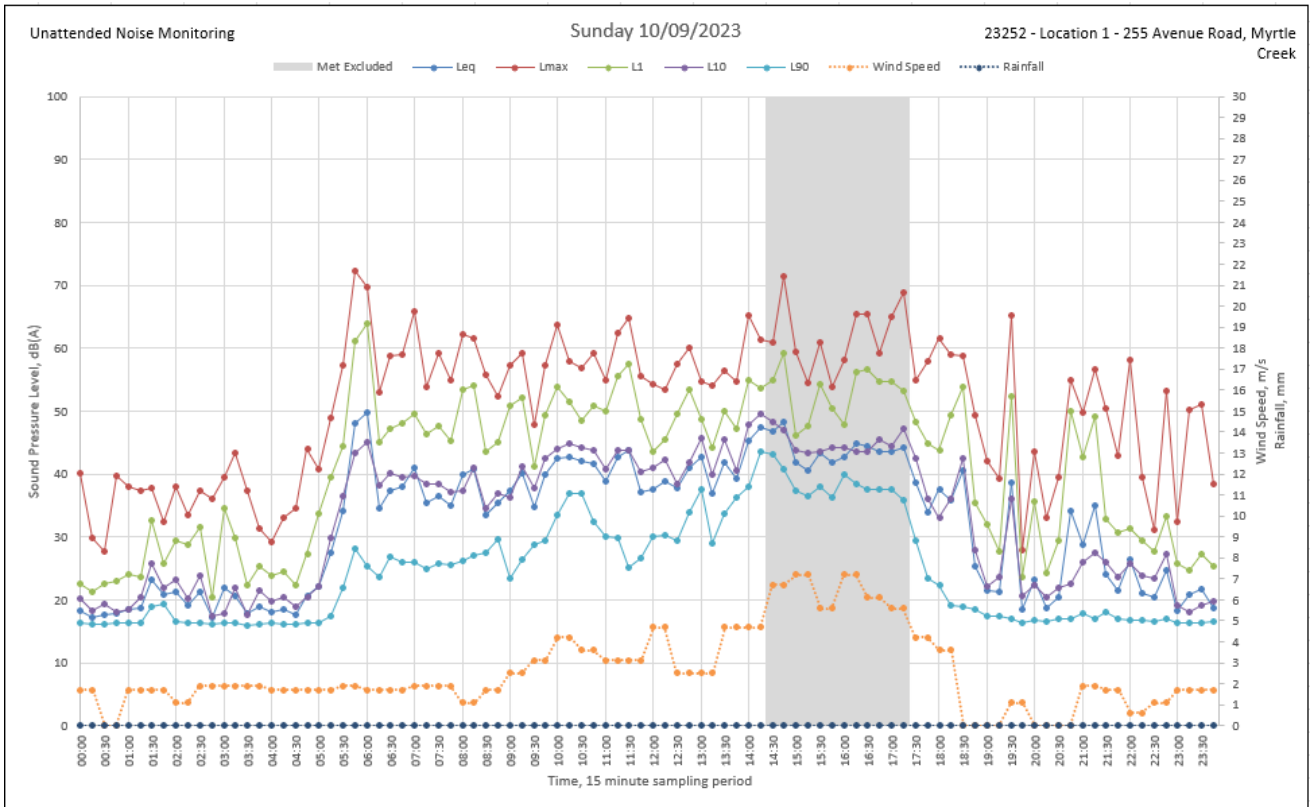


Figure B1.11 Unattended noise measurement at L1 - 10/9/2023

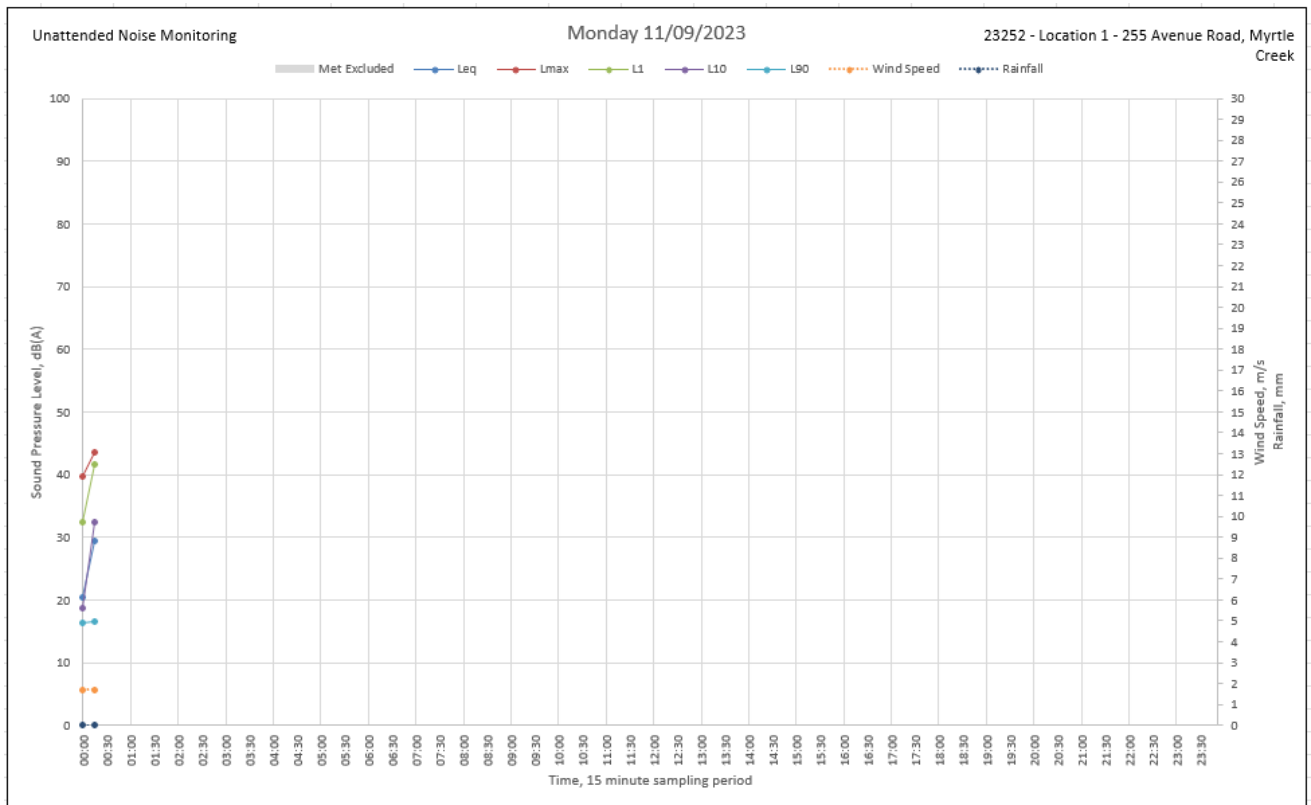


Figure B1.12 Unattended noise measurement at L1 - 11/9/2023

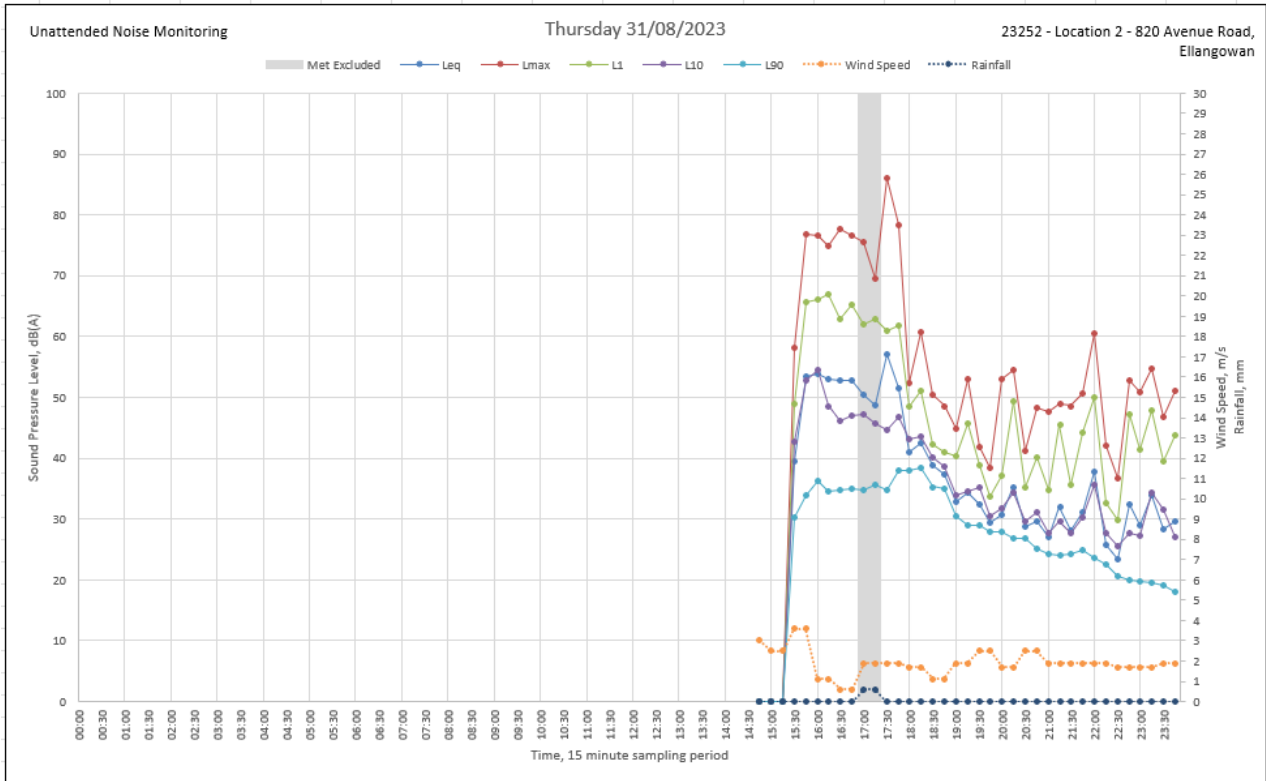


Figure B2.1 Unattended noise measurement at L2 - 31/8/2023

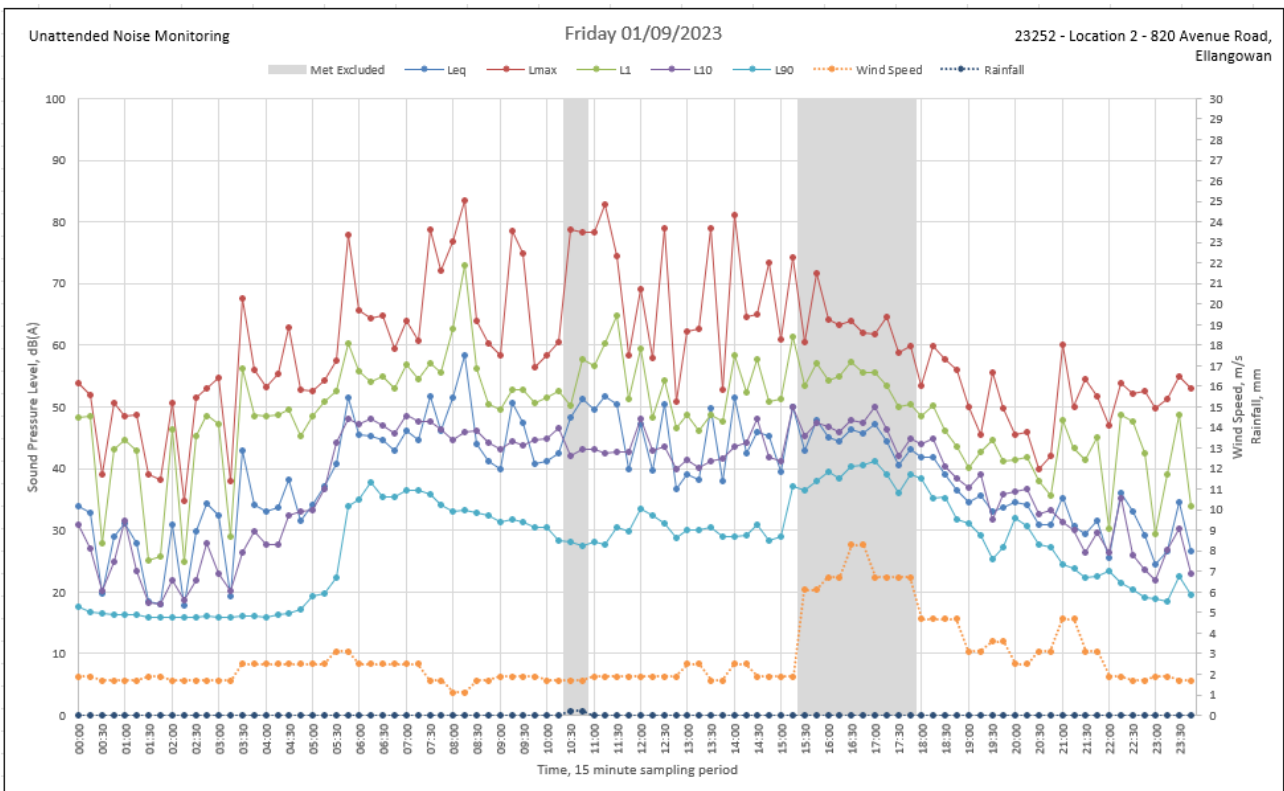


Figure B2.2 Unattended noise measurement at L2 - 1/9/2023

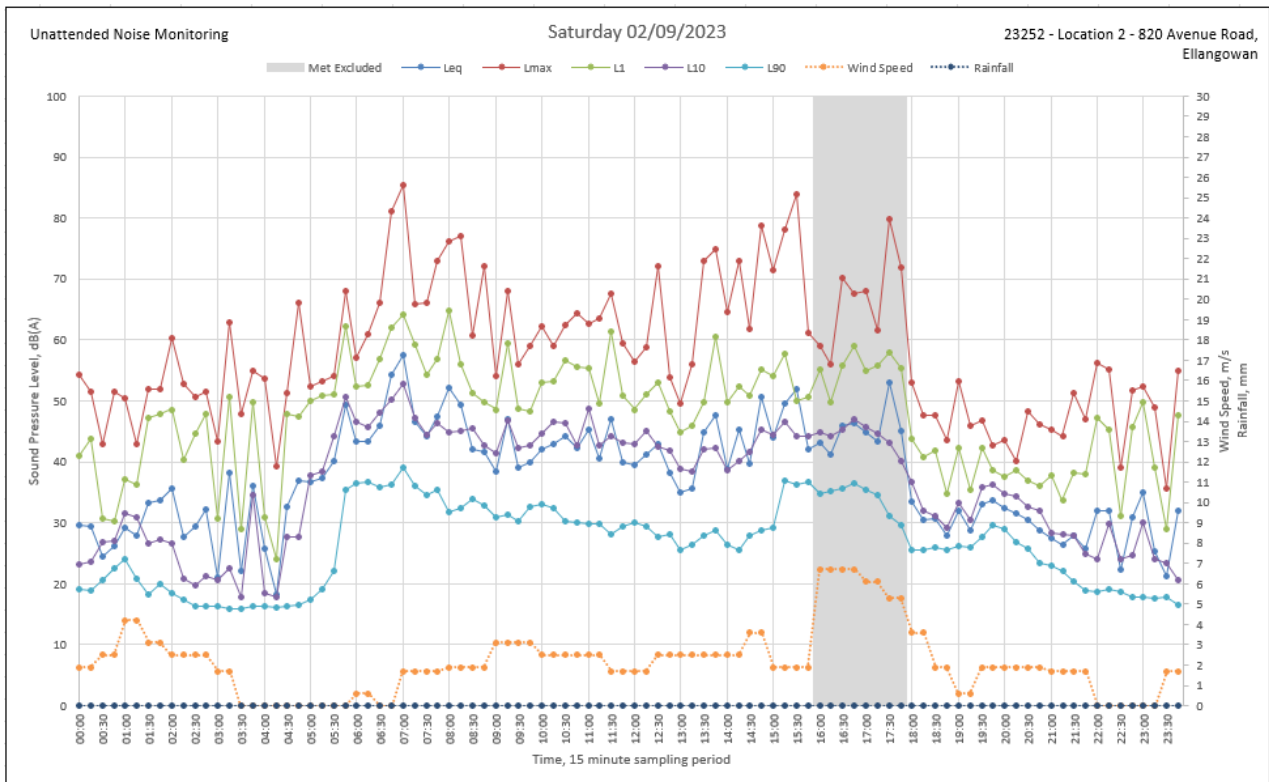


Figure B2.3 Unattended noise measurement at L2 - 2/9/2023

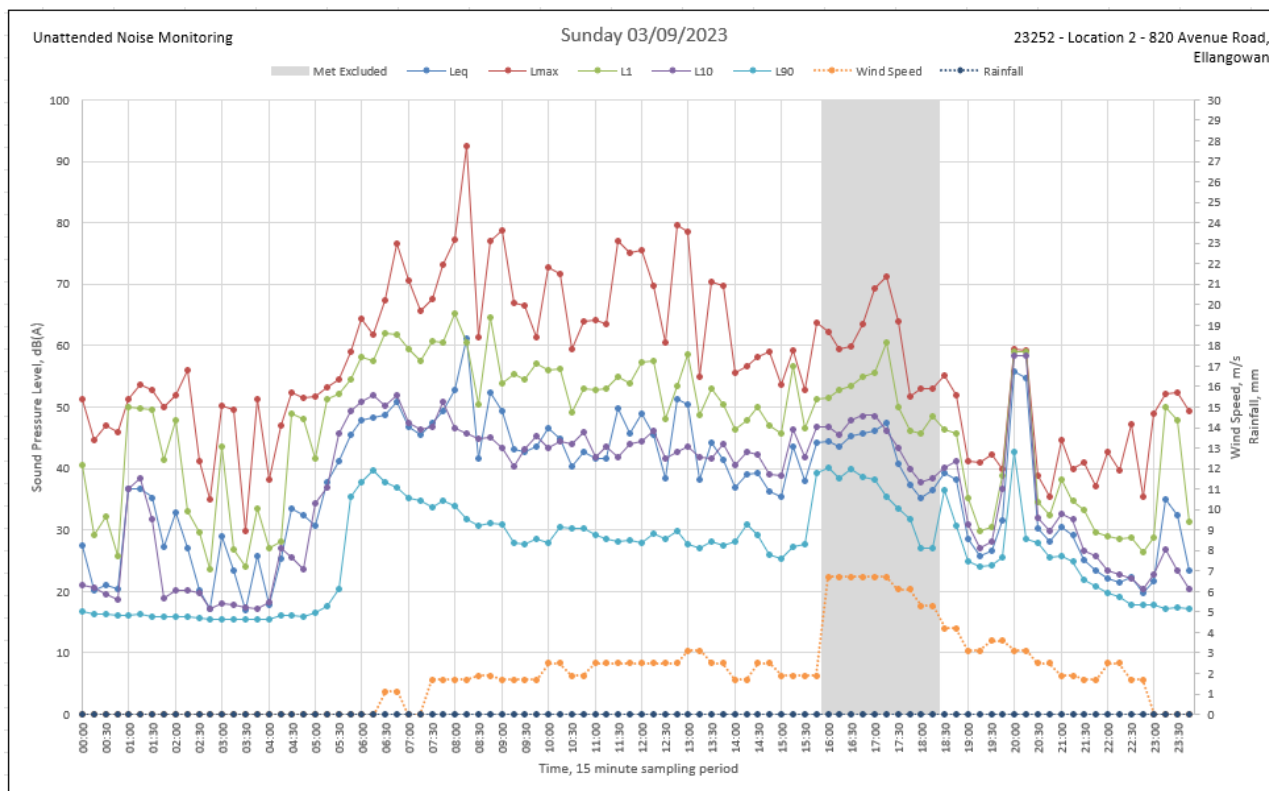


Figure B2.4 Unattended noise measurement at L2 - 3/9/2023

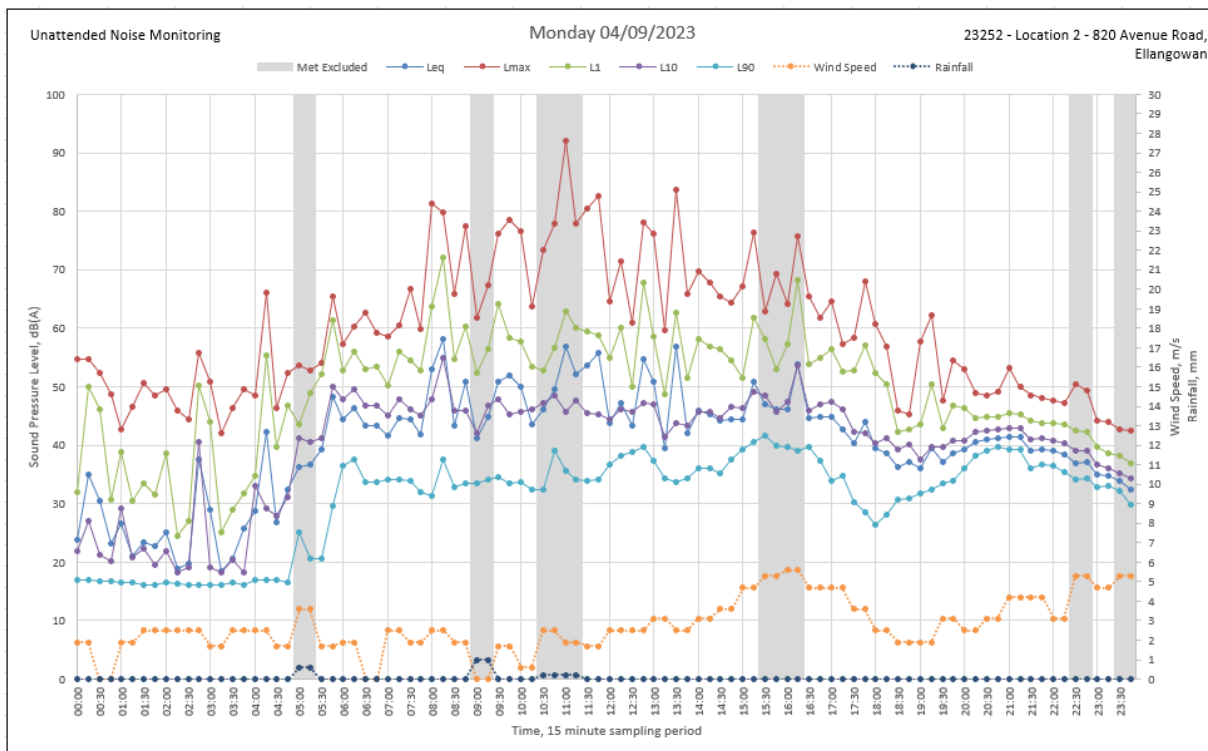


Figure B2.5 Unattended noise measurement at L2 - 4/9/2023

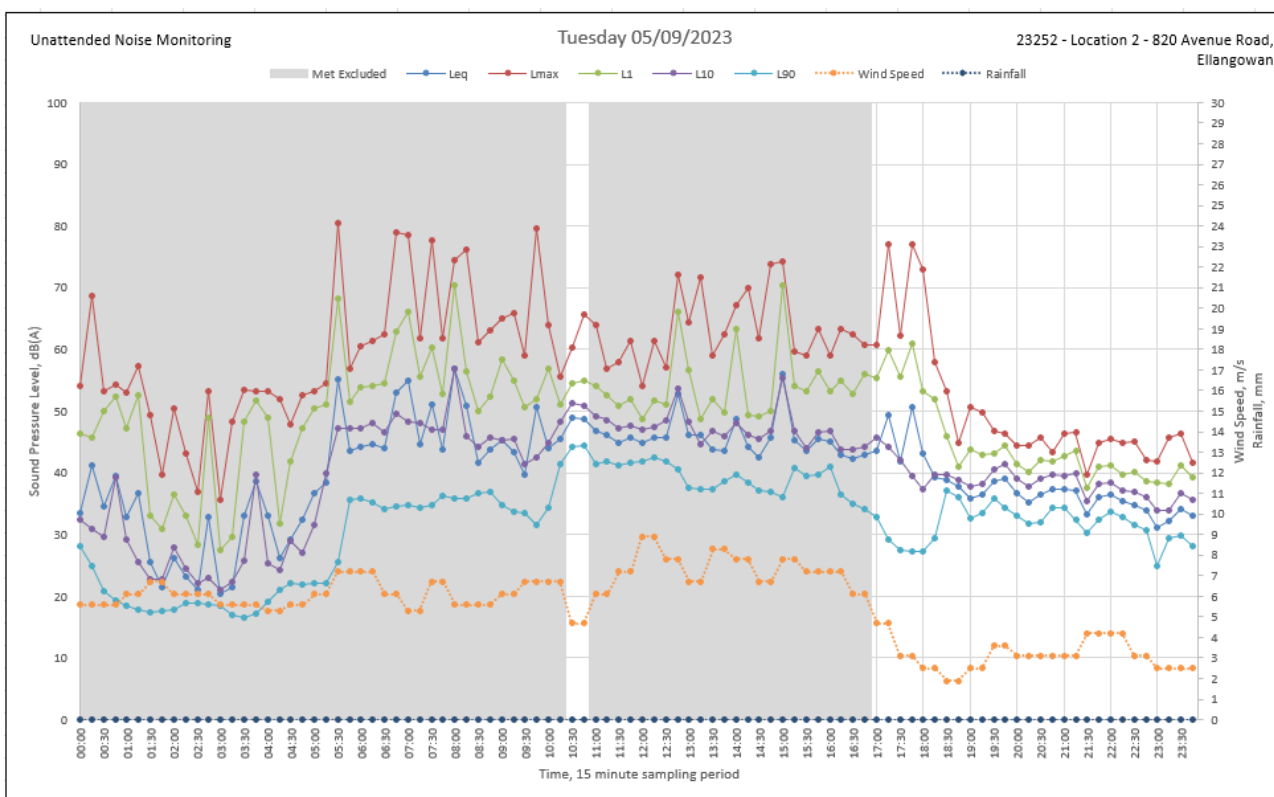


Figure B2.6 Unattended noise measurement at L2 - 5/9/2023

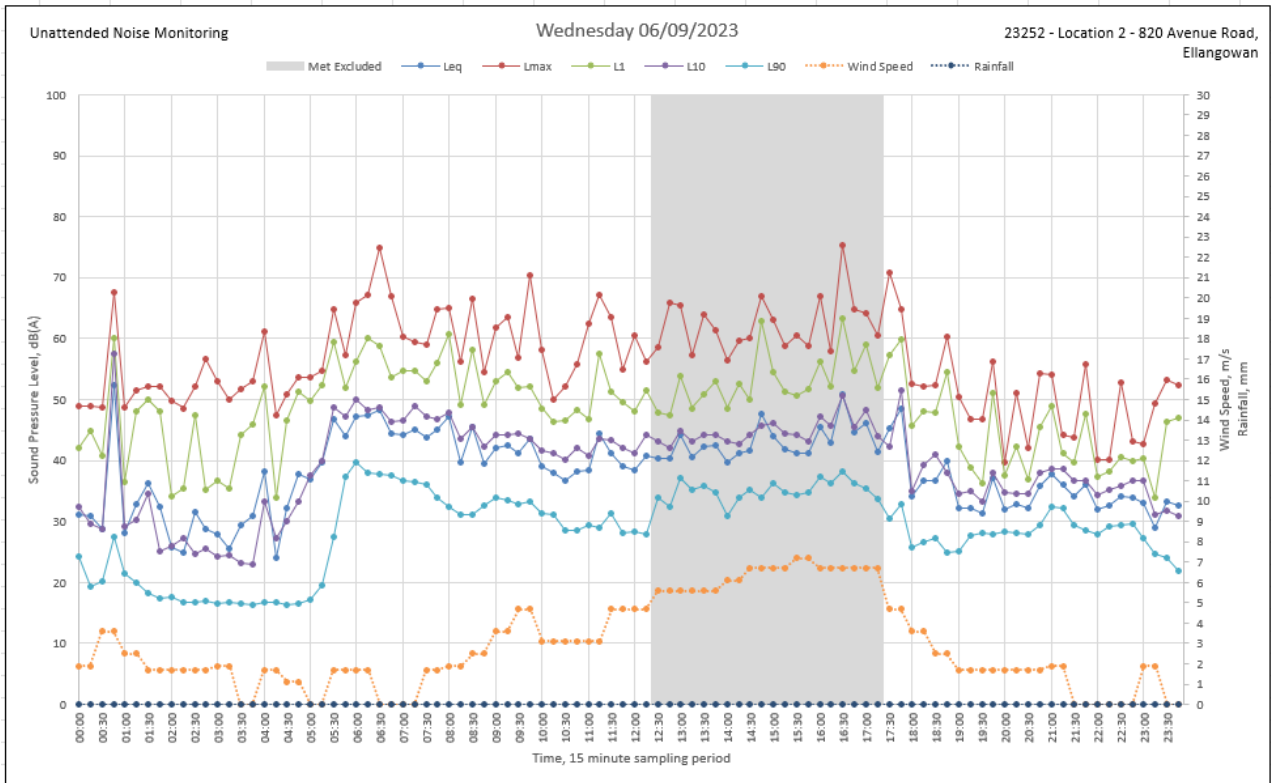


Figure B2.7 Unattended noise measurement at L2 - 6/9/2023

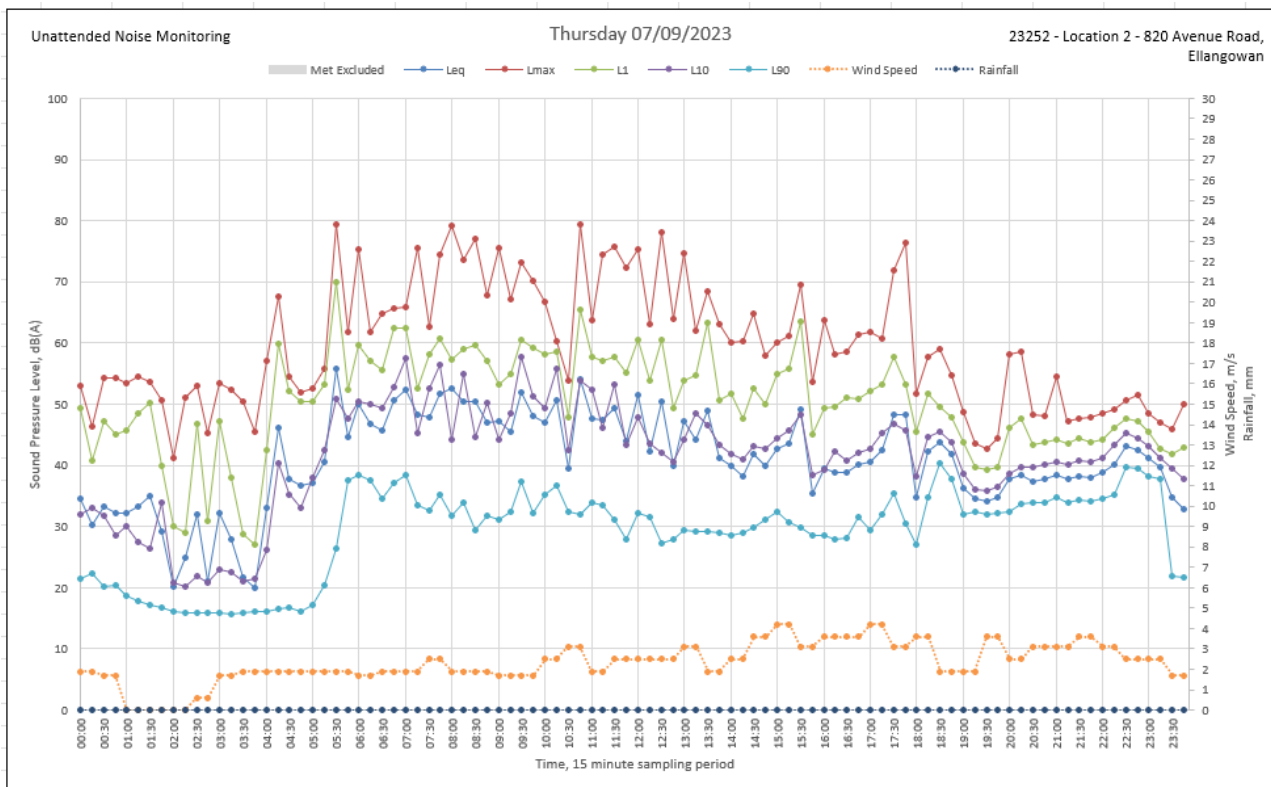


Figure B2.8 Unattended noise measurement at L2 - 7/9/2023

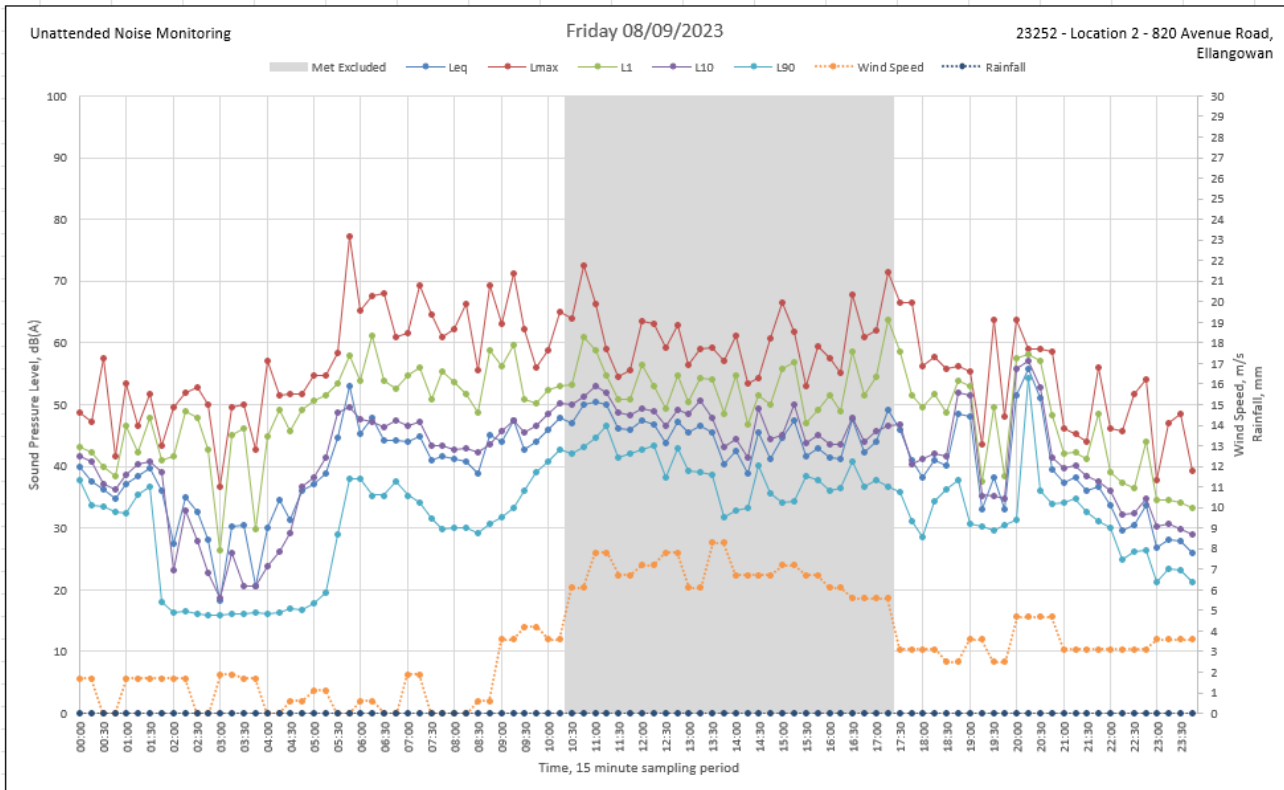


Figure B2.9 Unattended noise measurement at L2 - 8/9/2023

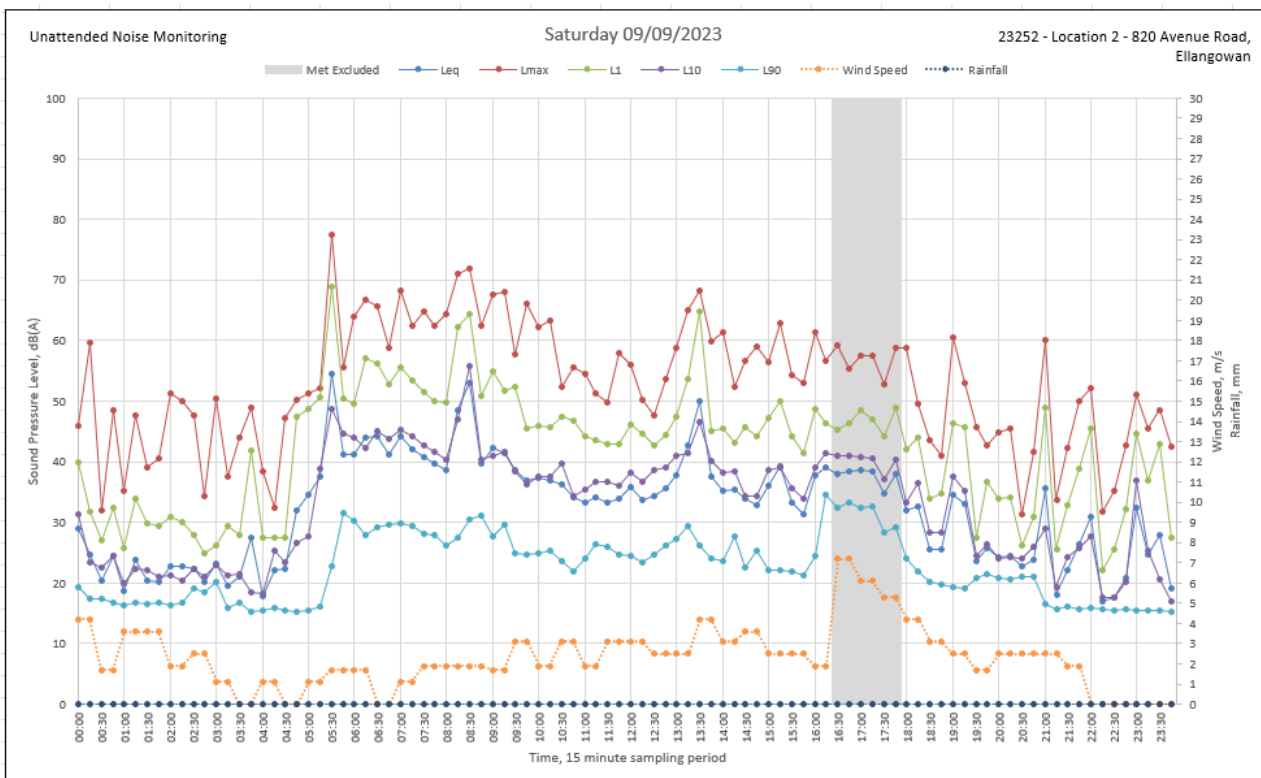


Figure B2.10 Unattended noise measurement at L2 - 9/9/2023

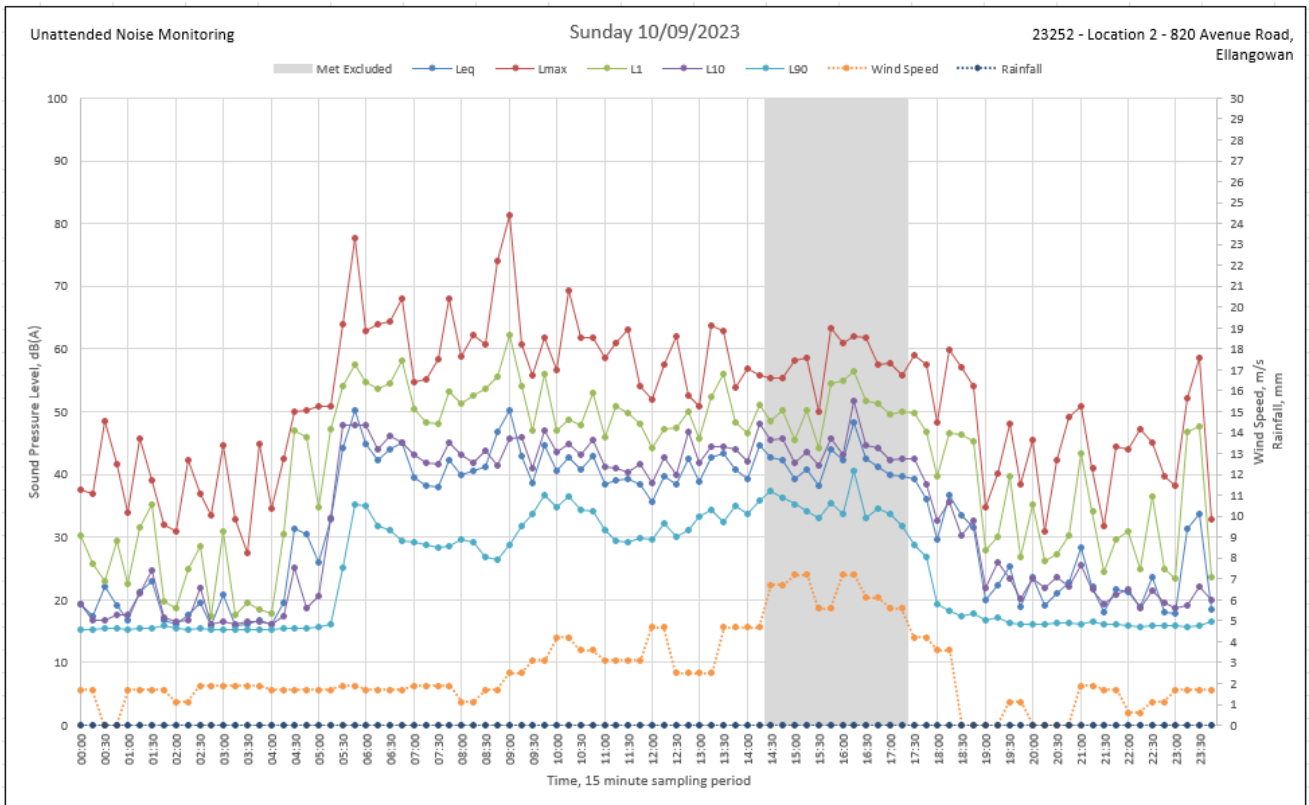


Figure B2.11 Unattended noise measurement at L2 - 10/9/2023

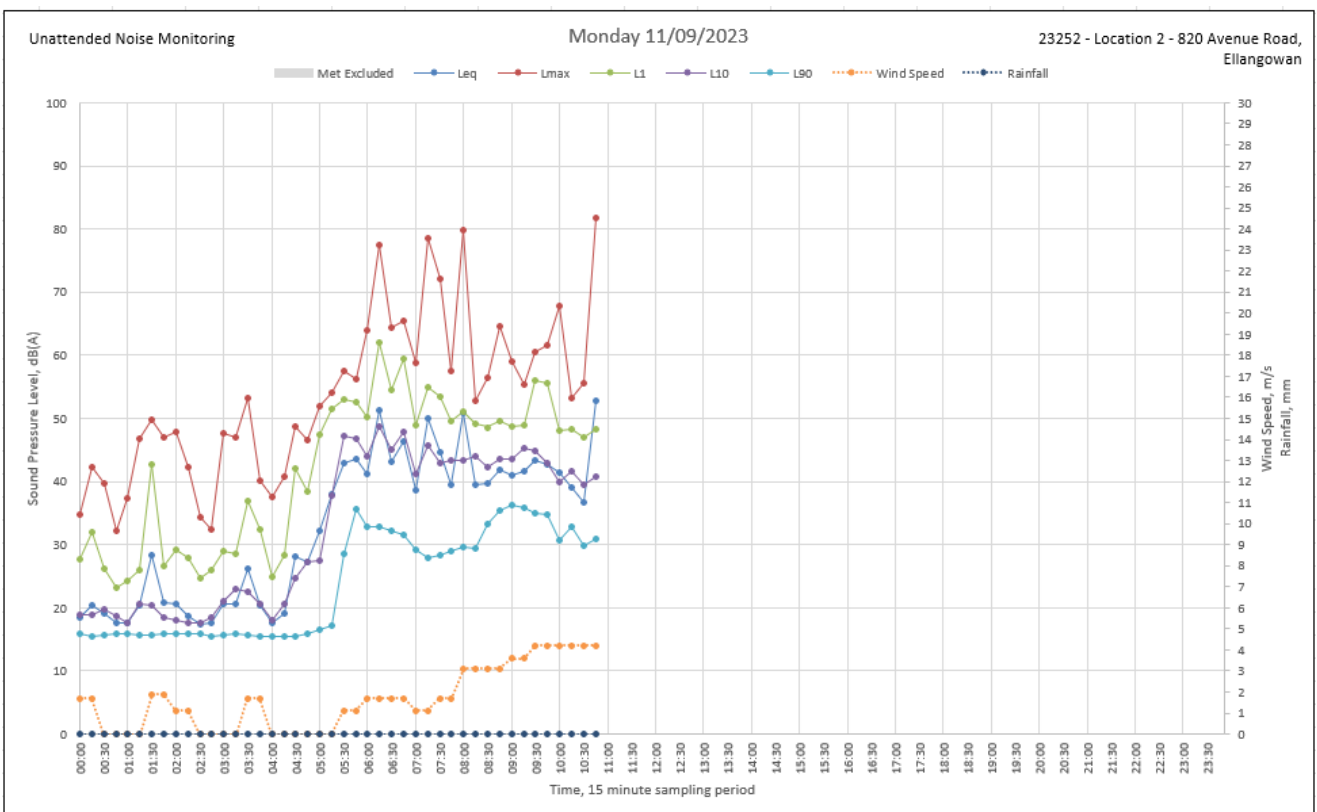
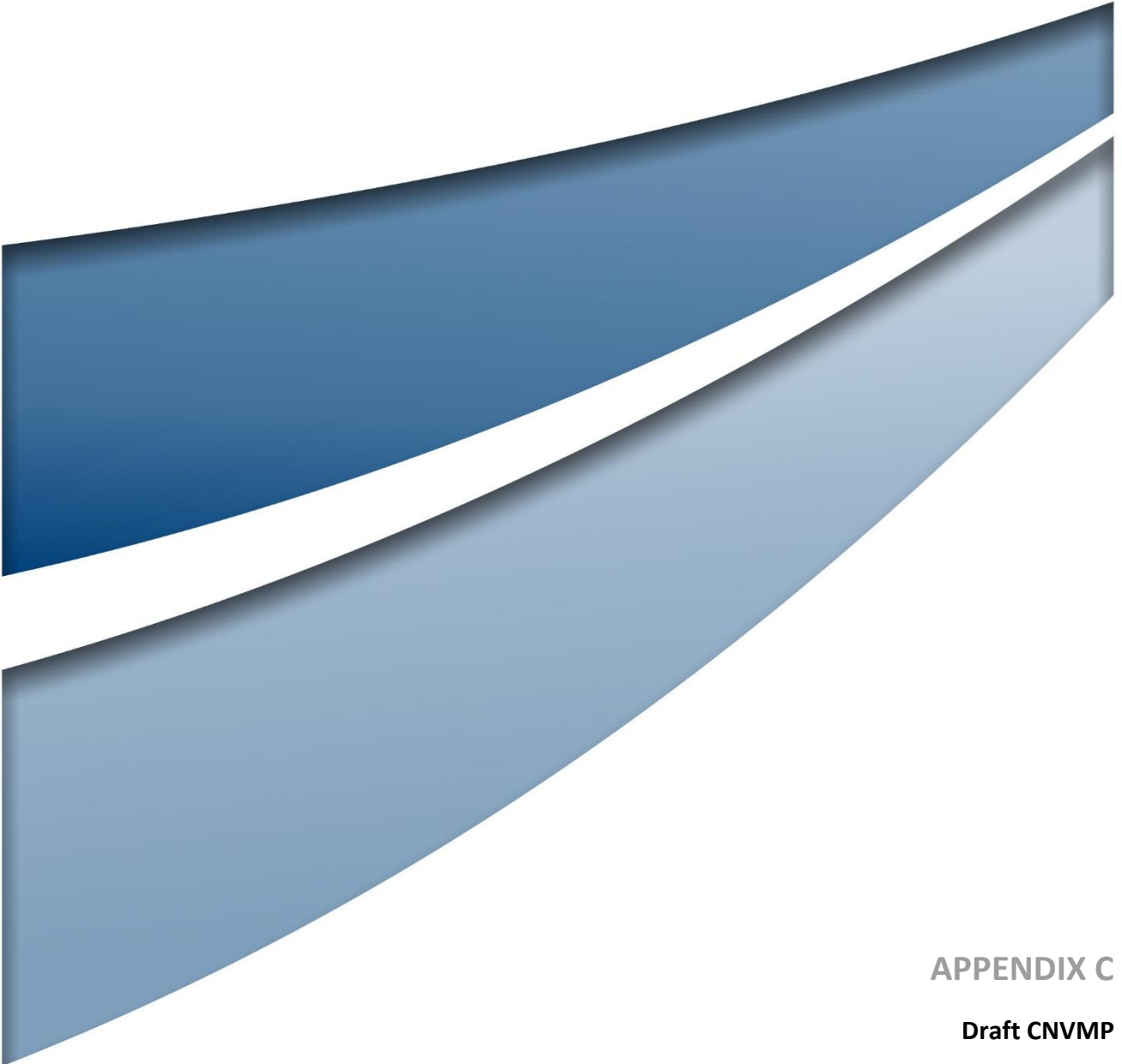
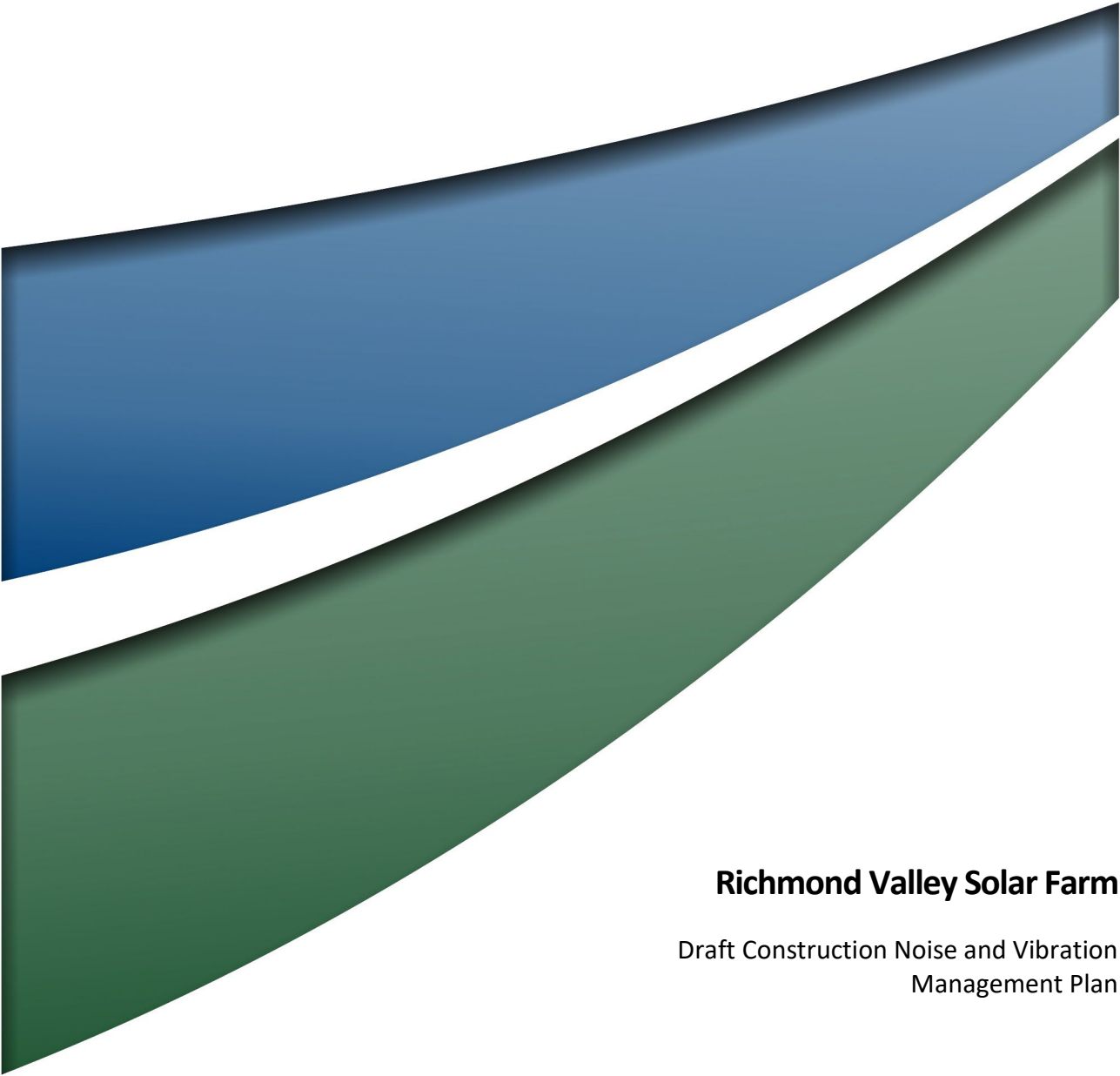


Figure B2.12 Unattended noise measurement at L2 - 11/9/2023



APPENDIX C

Draft CNVMP



Richmond Valley Solar Farm

Draft Construction Noise and Vibration
Management Plan

Draft

April 2024

Richmond Valley Solar Farm

Draft Construction Noise and Vibration Management Plan

Draft

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Ark Energy

Project Director: Malinda Facey
Project Manager: Jessica Henderson Wilson
Technical Director: Tim Procter
Technical Manager: Ben Carlyle
Report No. 23252/R08/Appendix C
Date: April 2024



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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Draft V1	Ben Carlyle	26/04/2024	Jessica Henderson-Wilson	26/04/2024

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1.0 Introduction

Ark Energy Projects Pty Ltd Limited (Ark Energy) proposes to develop the Richmond Valley Solar Farm (the Project) in the Northern Rivers region of New South Wales (NSW), approximately seven kilometres (km) to the west of the town of Rappville in the Richmond Valley Local Government Area (LGA). The location of the Project is presented in **Figure 1.1**.

The Project includes up to 500 megawatts (MW) of DC solar electricity generation with a Battery Energy Storage System (BESS) of approximately 2,200 MW hours (MWh) capacity. The Project will also include supporting infrastructure, inverters to convert DC to AC electricity, a substation, switching substation and transmission lines to the nearby Transgrid transmission network. The Project involves the construction, operation and decommissioning phases.

This Draft Construction Noise and Vibration Management Plan (DCNVMP) has been prepared by Umwelt to guide the management of potential noise and vibration impacts associated with Project construction, upgrading or decommissioning activities and detail mitigation measures / controls where required.

1.1 Project Overview

The Project Area comprises two freehold properties that span across ten cadastral lots, covering an area of approximately 1,475 hectares (ha) with the Development Footprint occupying approximately 803 ha, refer to **Figure 1.2**. The Project Area is approximately 95 km north-east of the New England Renewable Energy Zone (REZ) however it is not related to the REZ, nor is it dependent on the REZ infrastructure. This Project benefits from utilising the existing 330 kV Transgrid powerlines within the north-western extent of the Project Area, allowing connection to the national electricity grid. A new 2 km overhead 330 kilovolt (kV) transmission line is proposed to connect the Project to the 330 kV transmission line located north-west of the proposed switching substation. The conceptual project layout is shown in **Figure 1.3**.

The Project will have access from Avenue Road via Main Camp Road and Summerland Way, located south-west of the Project Area (refer to **Figure 1.1**). Road upgrades will be required to facilitate the transportation of vehicles during the construction and decommissioning phases of the Project.

The Project is expected to operate for 30 years. After the initial operating period, the solar farm would either be decommissioned, removing all above-ground infrastructure and returning the site to its existing land capability, or repurposed with new PV equipment subject to technical feasibility and planning consents.

The Project is a State Significant Development (SSD) under State Environmental Planning Policy (Planning Systems) 2021 (NSW) (Planning Systems SEPP) as the Project is development for the purposes of electricity generating works and the capital investment value of the Project is over \$30 million. A development Application (DA) for the Project is required to be submitted under Part 4 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act).

1.1.1 Construction Hours

Any construction activities to be undertaken during standard construction hours will be undertaken in accordance with the ICNG as follows:

- Monday to Friday: 7 am–6 pm
- Saturday: 8 am–1 pm
- Sunday and public holidays: No work.

Work would only be undertaken outside of these hours in an emergency and would be kept to a minimum. In general, no activities would occur on Sundays or public holidays, However, in cases of emergencies, major asset inspection or maintenance programs may be undertaken outside standard hours. Richmond Valley Council and surrounding landholders would be notified of any works expected to be performed outside standard daytime work hours that may be expected to cause noise exceedance to neighbouring dwellings.

1.1.2 Sensitive Receivers and Noise Catchment Areas

The Project Area is located within a rural setting with a number of residential receivers distributed sparingly within the surrounding area. These are sensitive receivers and there are no other sensitive land uses (such as schools or places of worship) within or surrounding the Project Area.

To simplify the assessment of residential receiver noise impacts and the presentation of results, residential receivers were grouped into Noise Catchment Areas (NCAs). The description of the NCAs is presented in **Table 1.1**, while the NCAs are also shown in **Figure 1.4**.

Table 1.1 Noise Catchment Area descriptions

NCA	Description
NCA_1	An area in proximity to Summerland Way and representing the rural areas near the western extent of the Project. Background data based on monitoring location L1.
NCA_2	An area representing the rural areas to the northern, east and south of the Project, that are located away from Summerland Way. Background data based on monitoring location L2.

One residential receiver located within the Project Area is an involved dwelling (owned by landholder involved in the Project) and is not considered a sensitive receiver.

The receivers in the area surrounding the Project are presented in **Table 1.2** and **Figure 1.4**. The closest non-involved sensitive residential receiver is located approximately 480 m north of the Development Footprint. Also provided in **Table 1.2**, is the approximate separation distance between the receiver and the Avenue Road upgrade and/or Bus Stop construction works.

Table 1.2 Identified Receivers

Noise Catchment Area	Receiver ID	Receiver Type	Receiver Details	Approximate Distance to Development Footprint	Approximate Distance to Avenue Rd and/or Bus Stop Construction Works
NCA_1	C3_1	Residential	7460 Summerland Way Myrtle Creek	1.3 km	650 m
NCA_1	C3_3	Residential	82 Avenue Road Myrtle Creek	1.15 km	30 m
NCA_1	C3_4 ¹	Landowner	420 Avenue Road Myrtle Creek	Within Project Area	120 m
NCA_1	C3_6	Residential	75 Avenue Road Myrtle Creek	1.35 km	170 m
NCA_1	C3_8	Residential	95 Avenue Road Myrtle Creek	1.2 km	45 m
NCA_1	C3_10	Residential	7460 Summerland Way Myrtle Creek	1.3 km	650 m
NCA_1	C3_11	Residential	125 Avenue Road Myrtle Creek	900 m	350 m
NCA_1	C3_20	Residential	95 Avenue Road Myrtle Creek	1.15 km	75 m
NCA_1	C4_5	Residential	7270 Summerland Way Myrtle Creek	> 1.5 km	1.2 km
NCA_2	D3_1	Residential	55 Ermelo Road Ellangowan	1.2 km	> 1.5 km
NCA_2	D3_2	Residential	695 Avenue Road Ellangowan	1.1 km	> 1.5 km
NCA_2	D3_3	Residential	660 Avenue Road Ellangowan	900 m	> 1.5 km
NCA_2	D3_4	Residential	690 Avenue Road Ellangowan	1 km	> 1.5 km
NCA_2	D3_5	Residential	760 Avenue Road Ellangowan	1.1 km	> 1.5 km
NCA_2	D3_6	Residential	770 Avenue Road Ellangowan	1.2 km	> 1.5 km
NCA_2	D3_7	Residential	770 Avenue Road Ellangowan	1.1 km	> 1.5 km
NCA_2	D3_8	Residential	70 Ermelo Road Ellangowan	1.3 km	> 1.5 km
NCA_2	D3_47	Residential	610 Avenue Road Ellangowan	480 m	1.2 km
NCA_2	D3_49	Residential	2116 Myall Creek Road West Bungawalbin	> 1.5 km	> 1.5 km
NCA_2	D4_1	Residential	840 Main Camp Road Myrtle Creek	1.1 km	> 1.5 km
NCA_2	D4_3	Residential	2465 Myall Creek Road West Bungawalbin	> 1.5 km	> 1.5 km
NCA_2	D4_4	Residential	2395 Myall Creek Road West Bungawalbin	> 1.5 km	> 1.5 km
NCA_2	D4_5	Residential	2475 Myall Creek Road West Bungawalbin	> 1.5 km	> 1.5 km


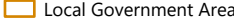

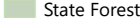


Noise Catchment Area	Receiver ID	Receiver Type	Receiver Details	Approximate Distance to Development Footprint	Approximate Distance to Avenue Rd and/or Bus Stop Construction Works
NCA_2	D4_7	Residential	2371 Myall Creek Road West Bungawalbin	> 1.5 km	> 1.5 km
NCA_2	D4_9	Residential	840 Main Camp Road Myrtle Creek	> 1.5 km	> 1.5 km
NCA_2	D4_10	Residential	840 Main Camp Road Myrtle Creek	1.1 km	> 1.5 km
NCA_2	D4_23	Residential	840 Main Camp Road Myrtle Creek	970 m	> 1.5 km

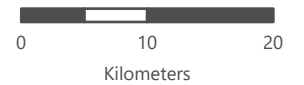
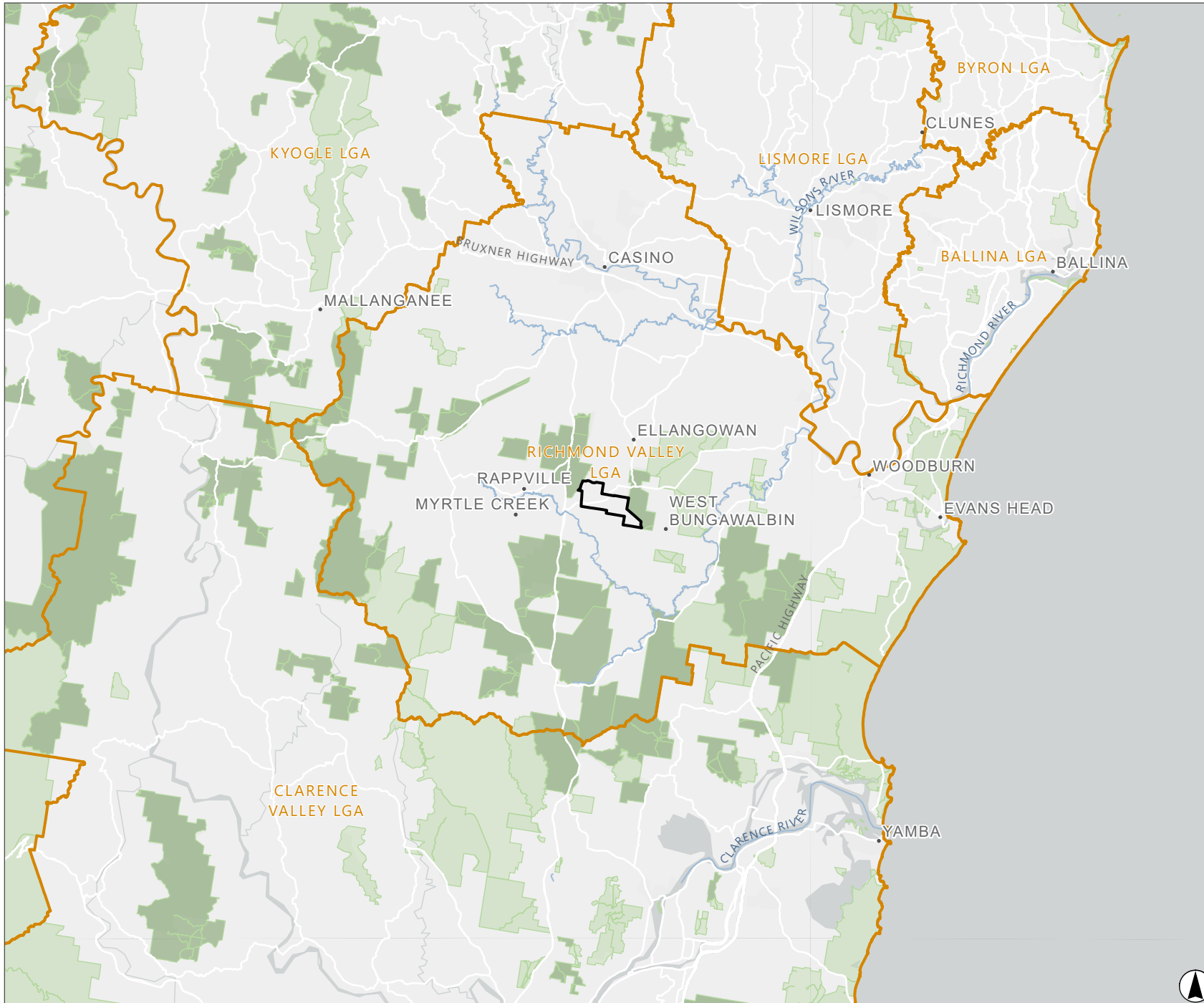
Note: ¹ Receiver C3_4 is involved in the Project (host receiver) and therefore are not considered sensitive.

FIGURE 1.1

Project Locality

Legend

-  Project Area
-  Local Government Area
-  NPWS Reserve
-  State Forest
-  Roads
-  Watercourse



Scale 1:600,000 at A4
GDA 1994 MGA Zone 56

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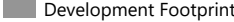


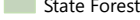


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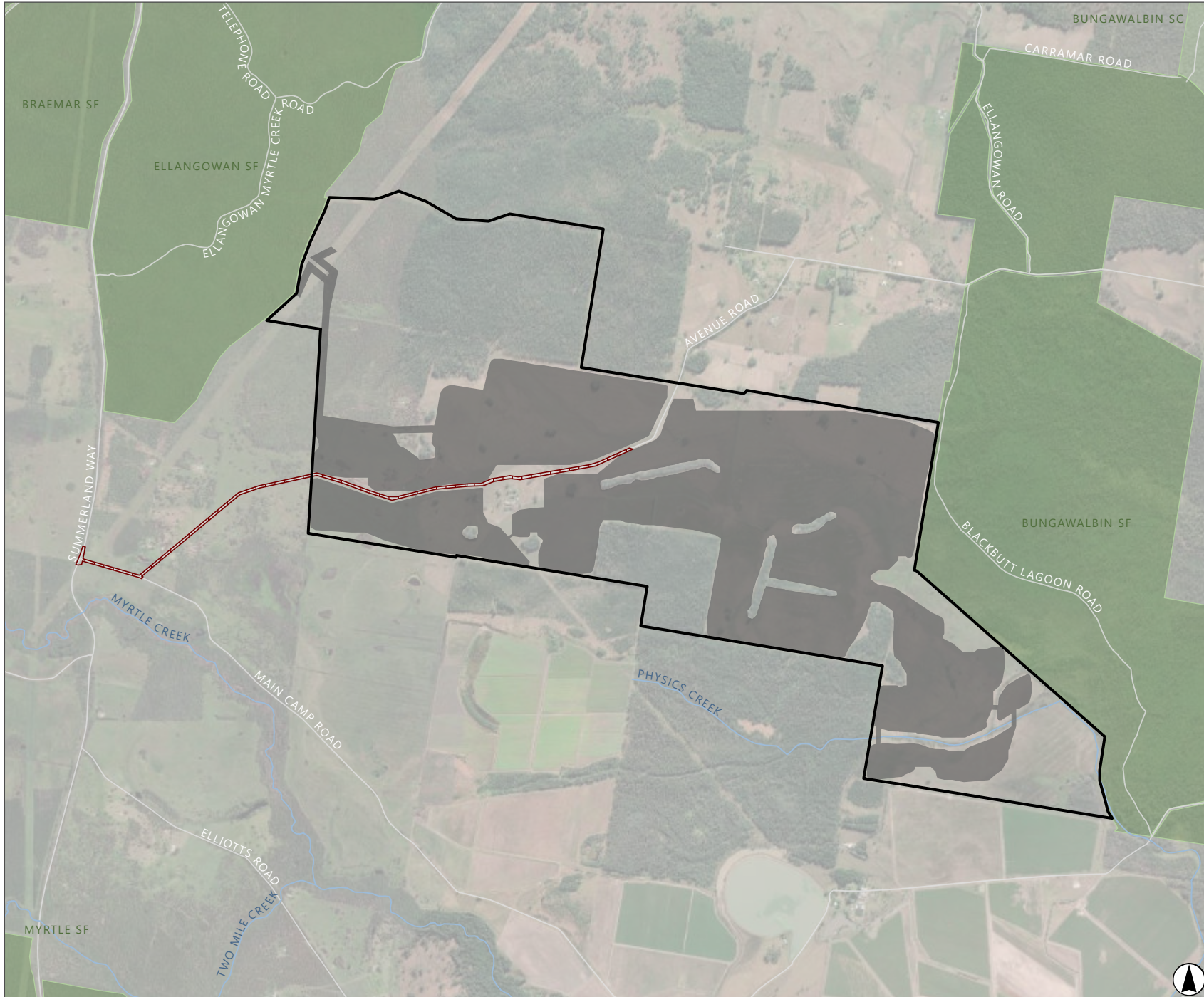


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FIGURE 1.2
Project Area

Legend

-  Project Area
-  Development Footprint
-  Road Upgrade Area
-  NPWS Reserve
-  State Forest
-  Roads
-  Watercourse

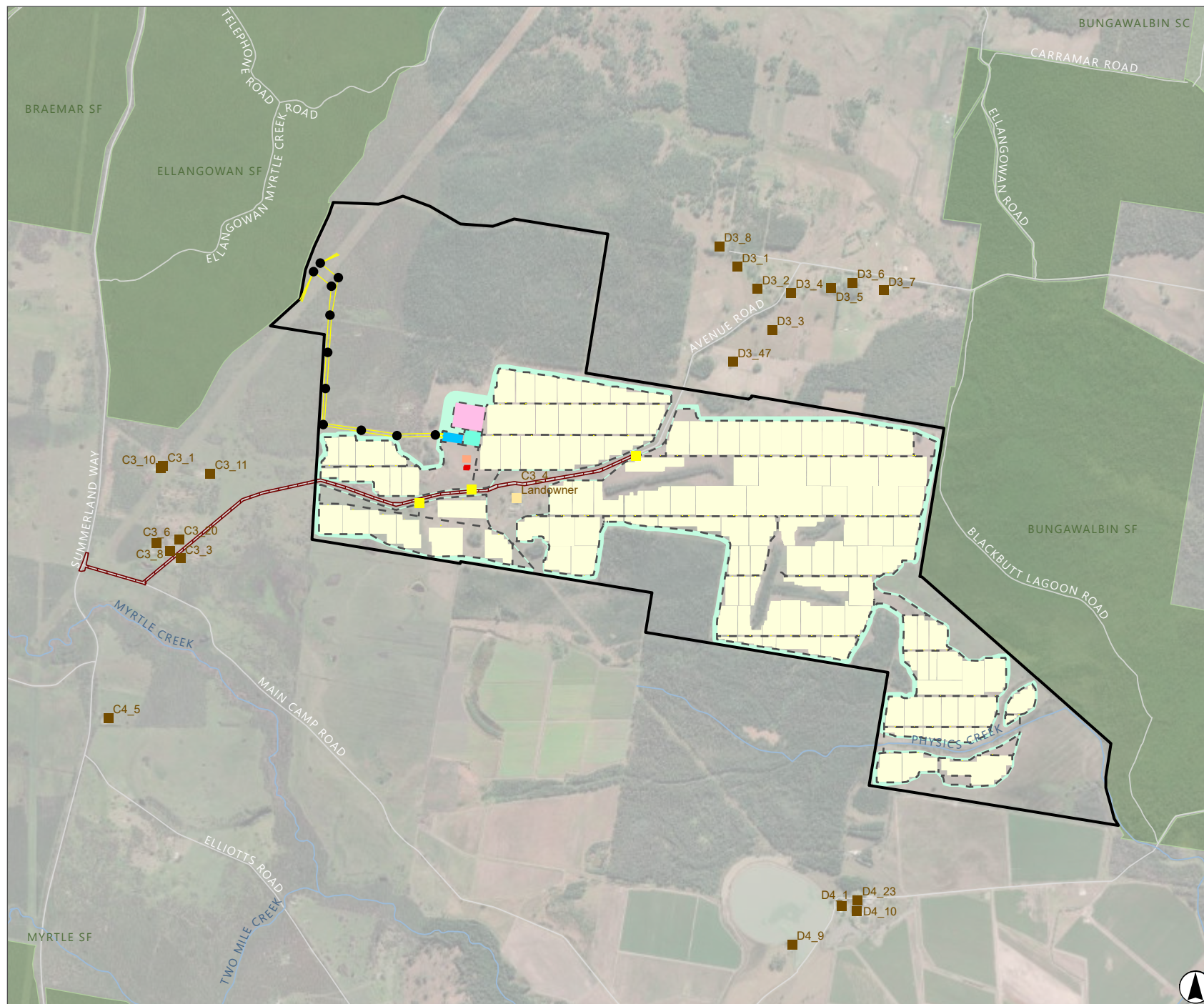


Kilometers
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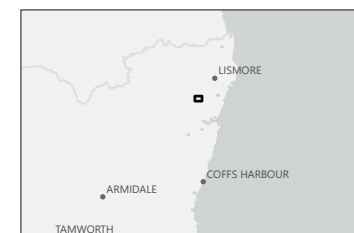
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FIGURE 1.3
Conceptual Project Layout



Legend

- Project Area
- Road Upgrade Area
- Associated Sensitive Receiver
- Non-Associated Sensitive Receiver
- Transmission Poles
- Access Points
- Transmission Lines
- Access Tracks
- Substation
- Switching Substation
- Staff Car Park
- O&M Facility
- BESS
- APZ
- Inverters
- Solar Array Blocks
- NPWS Reserve
- State Forest
- Roads
- Watercourse

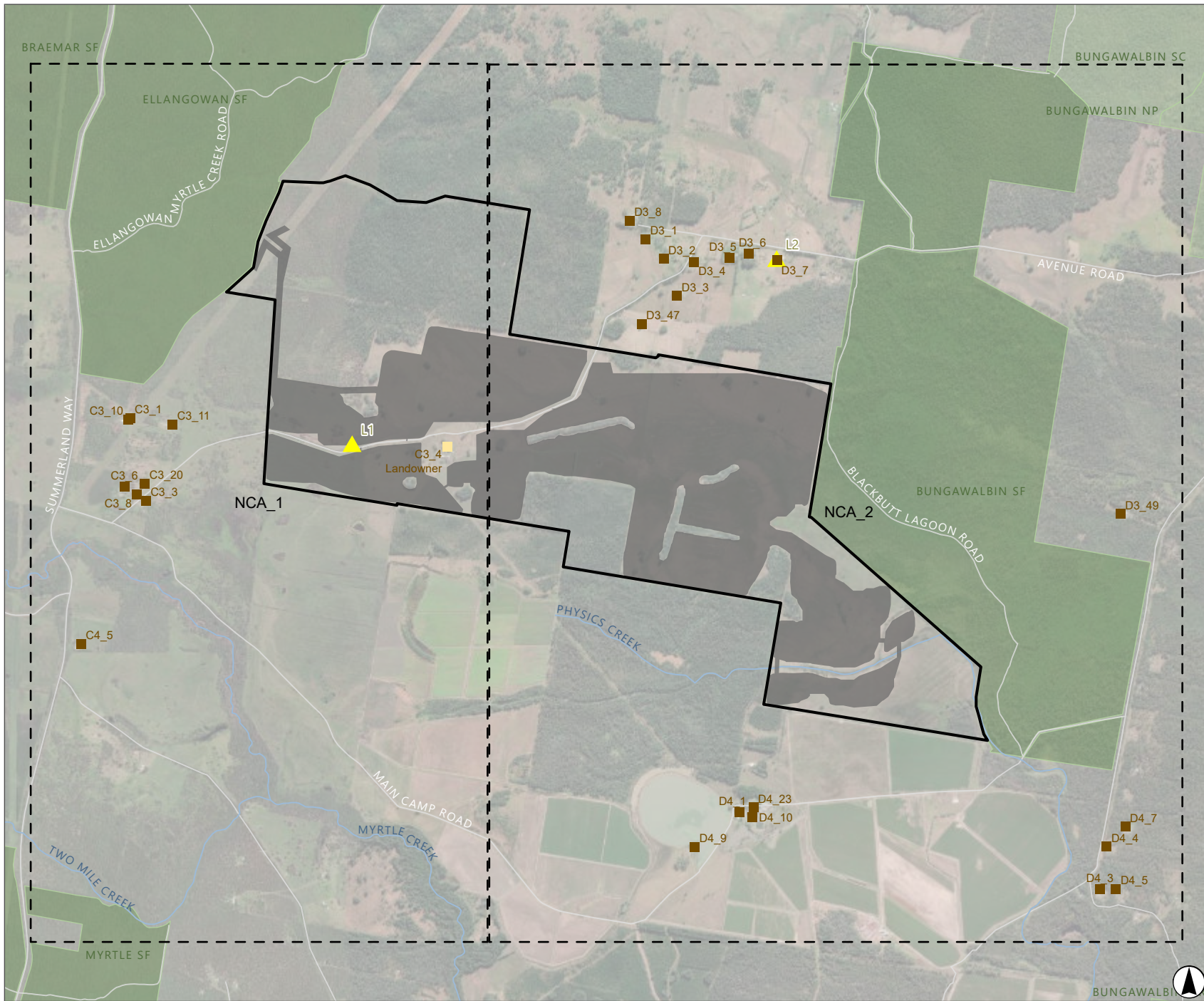


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FIGURE 1.4
Sensitive Receivers, NCAs and Background Noise Monitoring Locations



- Legend**
- Project Area
 - Development Footprint
 - Associated Sensitive Receiver
 - Non-Associated Sensitive Receiver
 - Noise Monitoring Locations
 - NCAs
 - NPWS Reserve
 - State Forest
 - Roads
 - Watercourse



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2.0 Legislative Requirements

2.1 Relevant Noise Guidelines and Policies

This DCNVMP has been prepared in accordance with the following guidelines and legislative requirements:

- *Noise Policy for Industry (NPf)*, NSW Environment Protection Authority (EPA), 2017.
- *Interim Construction Noise Guideline (ICNG)*, NSW Department of Environment and Climate Change (DECC), 2009.
- *NSW Road Noise Policy (RNP)*, Department of Environment, Climate Change and Water (DECCW), 2011.
- *Assessing Vibration: A Technical Guideline (the Vibration Guideline)*, Department of Environment and Conservation (DEC), 2006.
- British Standard BS7385 (1993) Part 2 Evaluation and measurement of vibration in buildings (BS7385).
- German Institute for Standardisation DIN 4150-3:1999-02 Structural vibration – Effects of vibration on structures (DIN4150).
- AS2436-2010 (2016) Guide to Noise Control on Construction, Demolition and Maintenance Sites.
- Construction Noise and Vibration Guideline (CNVG), Transport for NSW (TfNSW), 2023.

3.0 Construction Noise and Vibration Criteria

3.1 Existing Noise Environment

The site is located within a rural environment with typically low background noise levels. The area in the vicinity of the Project consists primarily of rural residential land, zoned RU1 – primary production.

The unattended long-term noise monitoring undertaken for the Umwelt EIS Noise and Vibration Impact Assessment (NVIA 2023) has been utilised for this DCNVMP.

3.2 Noise Criteria

Assessment levels for noise from construction activities, excluding noise from construction-related traffic on public roads, are defined in the Department of Environment and Climate Change, Interim Construction Noise Guideline (ICNG, 2009).

Table 3.1 presents the ICNG Construction Noise Management Levels for representative receivers surrounding the Project Area. The assessment levels are intended to guide the need for and the selection of feasible and reasonable work practices to minimise construction noise impacts.

Table 3.1 ICNG Construction Noise Management Levels, dB(A)

Land use	Construction time	Noise Management Level LAeq(15 min)
Residential	Recommended Standard Hours Monday to Friday – 7 am to 6 pm Saturday – 8 am to 1 pm No work on Sundays or Public Holidays	Noise affected: RBL + 10 dB(A)
		Highly noise affected: 75dB(A)
	Outside recommended standard hours	Noise affected: RBL + 5 dB(A)

The Construction Noise Management Levels for the surrounding receivers were established in the NVIA 2023 and are reiterated in **Table 3.2**.

Table 3.2 Project Construction Noise Management Levels

Receiver	Noise Management levels (NML), dB(A)	
	Standard hours of Construction ¹	Highly Noise Affected
	LAeq(15 min)	LAeq(15 min)
NCA 1 All residential receivers ²	45	75
NCA 2 All residential receivers	45	75

Notes: ¹ Recommended standard hours: Monday to Friday 7 am–6 pm; Saturday 8 am–1 pm.

² Receiver C3_4 is involved in the Project (host receiver) and the NMLs are not applicable.

3.3 Vibration Criteria

This DCEMP has considered the requirements of the following documents:

- *Assessing Vibration: A Technical Guideline* (the vibration guideline), Department of Environment and Conservation NSW (DEC), 2006.
- British Standard BS7385 (1993) Part 2 Evaluation and measurement of vibration in buildings (BS7385).
- German Institute for Standardisation DIN 4150-3:1999-02 Structural vibration – Effects of vibration on structures (DIN4150).

3.3.1.1 Human Perception of Vibration (the Vibration Guideline)

The vibration guideline presents non-mandatory preferred and maximum values for the use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. The preferred values correspond to vibration levels where there is a low probability of adverse comment or disturbance to building occupants. Where all possible and reasonable measures have been applied, values up to the ‘maximum’ value may be used if they can be justified. For values beyond the maximum value, direct negotiation with the affected receivers would need to be undertaken.

The guideline specifies that vibration and its associated effects are usually classified as continuous, impulsive, or intermittent. These vibration types and examples of their respective sources are shown in **Table 3.3**.

Table 3.3 Examples of Types of Vibration

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria.

Continuous and Impulsive Vibration

For continuous and impulsive vibration, the criteria are given in terms of root-mean-square (rms) vibration acceleration (m/s^2) in the frequency range 1–80 Hertz (Hz). They are also expressed at peak particle velocity (PPV) mm/s as presented in Appendix C of the vibration guideline. The criteria for continuous and impulsive vibration given in the Vibration Guideline for the relevant receivers in the area are shown in **Table 3.4**.

Table 3.4 The Vibration Guideline Values for Continuous and Impulsive Vibration for Human Comfort

Location	Assessment Period ¹	Weighted vibration acceleration (m/s ² at 1-80 Hz)				Peak Particle Velocity (mm/s)	
		Preferred values		Maximum values		Preferred values	Maximum values
		z-axis	x- and y-axes	z-axis	x- and y-axes		
Continuous vibration							
Residences	Day	0.010	0.0071	0.020	0.014	0.28	0.56
	Night	0.007	0.005	0.014	0.010	0.20	0.4
Impulsive vibration							
Residences	Day	0.30	0.21	0.60	0.42	8.6	17.0
	Night	0.10	0.071	0.20	0.14	2.8	5.6

Note: ¹ Day time period is 7 am–10 pm. Night time period is 10 pm–7 am.

Intermittent Vibration

For intermittent vibration, the criteria are given in terms of vibration dose value (VDV), which is a parameter used for assessing the combined magnitude and the total duration of vibration impacts. The criteria for intermittent vibration given in the Vibration Guideline for the relevant receivers in the area are shown in **Table 3.5**. The VDV is calculated using the frequency-weighted rms acceleration as described in the Vibration Guideline.

Table 3.5 The Vibration Guideline Acceptable Vibration Dose Values for Intermittent Vibration for Human Comfort (VDV m/s^{1.75})

Location	Daytime period ¹		Night-time period ¹	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26

Note: ¹ Day time period is 7 am–10 pm. Night time period is 10 pm–7 am.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values.

3.3.1.2 Structural Vibration

Criteria for vibration effects on building structures recommended in the vibration guideline are given in British Standard *BS7385 (1993) Part 2 Evaluation and measurement of vibration in buildings* (BS7385). The criteria in BS7385 are given in terms of peak component (x-, y- or z-axes separately) vibration velocity values from transient (impulsive) vibration events. The criteria for continuous vibration are recommended to be 50% lower than for impulsive vibration.

The vibration criteria for the protection of structures and buildings from cosmetic damage (e.g. hairline cracks in drywalls, etc.) are given in **Table 3.6**.

Table 3.6 BS 7385 Vibration Criteria for Cosmetic Damage to Structures (peak vibration velocity, mm/s)

Type of Structure	Peak Component Particle Velocity (mm/s) ¹		
	4 Hz–15 Hz	15 Hz–40 Hz	40 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings.	50 (transient (impulsive) vibration) 25 (continuous vibration)		
Un-reinforced or light framed structures. Residential or light commercial type buildings.	15–20 (transient (impulsive) vibration) 7.5–10 (continuous vibration)	20–50 (transient (impulsive) vibration) 10–25 (continuous vibration)	50 (transient (impulsive) vibration) 25 (continuous vibration)

Note: ¹ Peak Component Particle Velocity is the maximum peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer.

3.3.1.3 Heritage Structures

Assessment guidelines for vibration damage to heritage-protected structures are commonly referenced from the German Institute for Standardisation *DIN 4150-3:1999-02 Structural vibration – Effects of vibration on structures* (DIN4150). This standard differentiates between short-term and long-term vibration, where short-term vibration is caused by sources such as drop-hammers, impact piling, etc. All other sources of vibration are considered to be long-term.

The guideline value for heritage-protected structures for short-term and long-term vibration is respectively 3 mm/s peak partial velocity (PPV) and 2.5 mm/s PPV in the horizontal plane at all frequencies. This guideline value is primarily intended for older, sensitive, above-ground structures (typically buildings).

In regard to heritage buildings, *BS7385 Part 2 (1993)* notes that a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

3.4 Road Traffic Noise Criteria

An assessment of potential noise levels from project-related traffic on Summerland Way, Main Camp Road and Avenue Road is required. The NSW *Road Noise Policy (RNP) (DECCW)* sets out criteria for road traffic noise through the provision of a framework that addresses traffic noise issues associated with new developments, new or upgraded road developments, or planned building developments.

Table 3.7 outlines the road traffic noise criteria for residential land uses along Summerland Way and Main Camp Road / Avenue Road. Under the road category definitions provided in the RNP, Summerland Way is classified as a sub-arterial road and Main Camp Road and Avenue Road are classified as a local road.

Table 3.7 Road Traffic Noise Assessment Criteria For Residential Land Uses

Road Category	Type of Project/Land Use	Assessment Criteria dB(A)	
		Day 7 am to 10 pm	Night 10 pm to 7 am
Freeway/arterial/ sub-arterial road	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	LAeq,(15 hour) 60 (external)	LAeq,(9 hour) 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	LAeq,(1 hour) 55 (external)	LAeq,(1 hour) 50 (external)

Additionally, Section 3.4 of the RNP notes that where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria.

The EPA publication Applying the NSW Road Noise Policy states:

“...for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.”

In assessing noise impact, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

4.0 Construction Noise and Vibration Assessment

4.1 Construction Activities

The construction period for the Project will be undertaken across multiple stages. The total construction timeframe is anticipated to be up to 24 months.

The construction activities will broadly include the following:

1. Site Establishment.
2. Piling and foundations.
3. Assembly of all equipment (trackers, inverters, modules, balance of system).
4. Underground cabling.
5. Commissioning.
6. Site rehabilitation, removal of temporary construction facilities.
7. Avenue Road upgrade.
8. Bus stop formation at Summerland Way/Main Camp Road.

It is likely that some of these activities may occur simultaneously through the progression of the construction program.

4.2 Construction Equipment

The typical construction activities, equipment and associated sound power levels (SWLs) of equipment are outlined in **Table 4.1**. Typical sound power levels have been sourced from the *Roads and Maritime Construction Noise Estimator Tool* and Umwelts noise source library.

Table 4.1 Indicative Construction Scenarios, Equipment and Sound Power Levels

Construction Activities / Scenarios	Activity description	Equipment	Sound Power Levels LAeq(15 min) dB(A)/ unit	Combined Sound Power Level LAeq(15 min) dB(A)
Sc.1	Site Establishment and civil works	Asphalt paver	114	120
		Grader	113	
		Dozer	110	
		Dump truck	110	
		Roller	109	
		Delivery trucks	108	
		Water truck	107	
		Excavator	106	

Construction Activities / Scenarios	Activity description	Equipment	Sound Power Levels LAeq(15 min) dB(A)/ unit	Combined Sound Power Level LAeq(15 min) dB(A)
		Compactor	106	
		Bobcat	104	
		Generator	103	
		Mobile crane / telehandler	98	
		Light vehicle	90	
Sc.2	Piling and foundations	Pneumatic pile driving rig	117 (112 + 5)	118
		Concrete truck	109	
		Excavator	106	
		Bobcat	104	
		Mobile crane / telehandler	98	
		Light vehicle	90	
Sc.3	Assembly of all equipment (trackers, inverters, modules, balance of system)	Pneumatic wrench	113	116
		Powered hand tools	110	
		Truck	108	
		Mobile crane 130T	105	
		Compressor	103	
		Generator	103	
		Mobile crane / telehandler	98	
		Light vehicle	90	
Sc.4	Underground cabling	Loader	112	113
		Bobcat/trencher	104	
		Cable trenching and laying equipment	100	
		Light vehicle	90	
Sc.5	Commissioning	Power hand tools	110	113
		Electrical works/testing	110	
		Mobile crane	98	
		Light vehicle	90	
Sc.6	Site rehabilitation, removal of temporary construction facilities	Dump truck	110	113
		Truck	108	
		Forklift	100	
		Mobile crane / telehandler	98	
		Light vehicle	90	
Sc.7	Site Access Point Upgrade	Dump truck	110	118
		Asphalt paver	114	
		Grader	113	
		Roller	109	
		Water truck	107	

Construction Activities / Scenarios	Activity description	Equipment	Sound Power Levels LAeq(15 min) dB(A)/ unit	Combined Sound Power Level LAeq(15 min) dB(A)
Sc.8	Bus stop formation at Summerland Way/Main Camp Road	Chainsaw	115	118
		Dozer	110	
		Truck	108	
		Excavator	106	
		Power hand tools	110	
		Line marking truck	108	
		Mobile crane / telehandler	98	
		Scissor Lift	98	

Note: ¹ Includes a +5dB penalty for impulsiveness characteristics.

4.3 Construction Noise Assessment

Noise levels were predicted using the CadnaA (Version 2023) proprietary environmental noise modelling software package.

The noise prediction model considers:

- Location of noise sources and sensitive receiver locations.
- Heights of sources and receivers.
- Separation distances between sources and receivers.
- Ground type and reflections between sources and receivers.
- Geometric spreading and air absorption.

For the purposes of the noise impact assessment, worst-case scenario (Scenario 1 combined with Scenario 7 and 8), has been modelled.

4.4 Spatial Risk Map

A spatial risk map has been prepared for a worst-case scenario (Scenario 1 combined with Scenario 7 and 8), described in **Section 4.0**. The spatial risk map (refer to **Figure 4.1**) presents a 45 dB(A) noise risk contour and buffer zone which has been based on the daytime construction noise management level described in **Section 3.0**.

Effectively, **Figure 4.1** defines the buffer zones around each sensitive receiver to generate a 45 dB(A) noise contour. If construction work occurs inside the buffer zone, then the noise levels at the receivers could exceed 45 dB(A) and reasonable and feasible mitigation measures are to be applied.

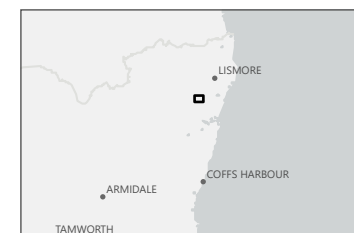
Conversely, the onsite area outside of the buffer zones indicates that the construction activity can be undertaken and comply with the applicable noise management level at the receiver locations. **Figure 4.1** indicates that whilst most construction activity can be undertaken and comply with the applicable noise management levels, there will be activities that may potentially exceed the criteria. Therefore, reasonable and feasible noise management and mitigation strategies (see **Section 7.0**) should be considered during the construction phase of the Project.

FIGURE 4.1

Spatial Risk Map – Construction Scenario 1, 7 and 8 Combined (worst case scenario) – Noise Risk Contour 45 dB(A)

Legend

- Project Area
- Development Footprint
- Road Upgrade Area
- Associated Sensitive Receiver
- Non-Associated Sensitive Receiver
- NPWS Reserve
- State Forest
- Roads
- Watercourse
- Noise Risk Contours**
- 45dB(A) Buffer Zone
- 50dB(A) Buffer Zone
- 55dB(A) Buffer Zone



Scale 1:55,000 at A4
GDA 1994 MGA Zone 56

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C:\Users\mshah\Documents\Umwelt\PROJECTS\123456789\123456789_03_S&W2023\Figures\FIGURE_4.1_NOISE_RISK_CONTOUR_45dB(A).png

5.0 Vibration Risk Profile

Many items of construction equipment generate vibration that may be perceptible to receivers and cause annoyance or cause structural damage to buildings or other structures.

Section 6.0 of the EIS Historical Heritage Impact Assessment (Umwelt 2023) states that there are no listed historical heritage items within the Project Area.

The types of vibration-sensitive receivers in the Project area likely include:

- Residential (landowner).
- Commercial/agricultural buildings.

The commercial buildings in the area are structurally similar to residential buildings, therefore the assessment for residential buildings is considered to be relevant for the commercial receivers as well.

Recommended safe working distances for vibration generating equipment from sensitive receivers (i.e. the receiver building or its occupants) are given in Table 2 of the NSW *Construction Noise and Vibration Guideline* (CNVG) (RMS, 2023) reproduced in **Table 5.1**.

Table 5.1 Recommended Minimum Working Distances for Vibration Generating Plant from a Residential Sensitive Receiver (CNVG Table 2)

Plant Item	Rating/Description	Minimum Working Distance ¹	
		Cosmetic Damage (Residential Building)	Human Response
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	100 m
	> 300 kN (> 18 tonnes)	25 m	100 m
Small Hydraulic Hammer	300 kg – 5 to 12t excavator	2 m	7 m
Medium Hydraulic Hammer	900 kg – 12 to 18t excavator	7 m	23 m
Large Hydraulic Hammer	1600 kg – 18 to 34t excavator	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Handheld	1 m (nominal)	2 m

Notes: ¹ For alternative equipment with higher vibration levels, larger minimum working distances are required.

² More stringent conditions may apply to heritage or other sensitive structures.

Due to the large separation distances between the Project boundary and the external sensitive receivers (i.e. approximately 310 m), vibration impacts from construction activities are anticipated to be negligible from the solar farm and BESS construction.

In regard to Avenue Road Upgrade and the Bus Stop construction works, all receivers fall outside the minimum working distances for cosmetic damage. For Avenue Road Upgrade works, receivers C3_3, C3_8 and C3_20 fall within the minimum working distance for human response for some plant items (i.e., vibratory roller 4> tonnes and large hydraulic hammer >18 tonnes). However, given the transient nature of the works, human disturbance impacts are anticipated to be low.

Construction vibration mitigation strategies are provided in **Section 7.3**.

6.0 Road Traffic Noise

Construction traffic noise was assessed in Section 7 of the EIS NIA. The assessment determined that compliance was predicted for Summerland Way, however, exceedances for predicted for Avenue Road. The Avenue Road predictions are reproduced below in **Table 6.1**.

As shown in **Table 6.1**, the construction traffic noise levels are predicted to comply with the criteria at the majority of the receivers, however, exceedances were predicted during the night-time (6 am–7 am) at Receiver C3_3 and C3_8.

Potential noise mitigation measures to reduce construction-related traffic noise may include the following:

- Restricting Project related traffic to 60 km/h along Avenue Road.
- Car-pooling and the use of buses/mini-vans to reduce the total number of light vehicle movements is already being adopted by the Project.

Table 6.1 Avenue Road Predicted Construction Traffic Noise levels, LAeq, dB(A)

Road	Time Period	Receiver / Distance from road edge	Existing traffic noise levels, dB(A)	Existing + Project Combined traffic noise levels, dB(A)	Noise Limit, dB(A)	Noise Level Change due to Project, dB(A)	Comply/Exceed
Avenue Road	Day (7 am–10 pm) LAeq(1 hour)	C3_1	< 30	30	55	N/A ¹	Complies – limit not exceeded
		C3_3	45	51	55	N/A ¹	Complies – limit not exceeded
		C3_6	32	39	55	N/A ¹	Complies – limit not exceeded
		C3_8	42	48	55	N/A ¹	Complies – limit not exceeded
		C3_10	< 30	31	55	N/A ¹	Complies – limit not exceeded
		C3_11	< 30	34	55	N/A ¹	Complies – limit not exceeded
		C3_20	39	44	55	N/A ¹	Complies – limit not exceeded
	Night (10 pm–7 am) LAeq(1 hour)	C3_1	30	35	50	N/A ¹	Complies – limit not exceeded
		C3_3	50	55	50	4.9	Exceeds – limit exceeded & change > 2dB
		C3_6	38	43	50	N/A ¹	Complies – limit not exceeded
		C3_8	47	52	50	5.0	Exceeds – limit exceeded & change > 2dB
		C3_10	30	35	50	N/A ¹	Complies – limit not exceeded
		C3_11	33	38	50	N/A ¹	Complies – limit not exceeded
		C3_20	44	48	50	N/A ¹	Complies – limit not exceeded

Note: ¹ Change in noise level assessment is not applicable if the predicted noise level is below the noise limit.

7.0 Mitigation Measures and Strategies

7.1 Construction Environmental Management Plan

This DCNVMP will be updated and implemented as a part of the Construction Environmental Management Plan (CEMP).

This would comprise at a minimum the following elements:

- Management responsibilities:
 - Identification of key environmental risks.
 - Work Method Statement for Key activities.
 - Performance criteria.
- Training:
 - Relevant workforce education and training.
- Compliance:
 - Ark Energy will be responsible for the development and implementation of the CEMP including compliance by contractors and staff.
- Corrective Actions.
- Reporting:
 - Establish performance criteria.
 - Conditions of consent.

Based on the worst-case construction noise levels presented in the spatial map in **Figure 4.1**, construction noise management levels are predicted to exceed the nominated noise management levels at some receivers, therefore reasonable and feasible noise management and mitigation strategies should be considered during the construction phase of the Project.

7.2 Noise Mitigation Measures and Strategies

The management and mitigation strategies will vary on a case-by-case basis, however these may include a range and combination of measures, such as

- Engineering noise controls including attenuators, temporary barriers, enclosures.
- Management strategies including scheduling of noise activities.
- Substitution of equipment and/or processes.
- Commercial agreements with affected landholders.

The overall effectiveness of these mitigation measures vary depending on a range of factors including equipment selections, landform/terrain, separation distance, machine utilisation, meteorological conditions and are generally evaluated on a case-by-case basis.

The typical effectiveness of noise mitigation measures are discussed in *AS2436-2010 (2016) Guide to Noise Control on Construction, Demolition and Maintenance Sites (AS2436)*. This standard provides a guide to the typical reduction that can be expected from different noise control methods (refer to **Table 7.1**).

Table 7.1 Typical Effectiveness of Mitigation Measures

Control Method	Likely noise reduction, dB(A)
Separation Distance	An increase of separation distance reduces noise levels at a rate of 6 dB(A) per doubling of distance
Screening	5 to 10 dB(A)
Enclosure	15 to 25 dB(A)
Silencing	5 to 10 dB(A)

Noise and vibration mitigation measures to be implemented during construction of the Project include:

- All sensitive receivers likely to be affected should be notified at least 7 days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification should include:
 - Details of the Project.
 - The construction period and construction hours.
 - Contact information for Project management staff.
 - Complaint and incident reporting.
 - How to obtain further information.
- All employees, contractors and subcontractors are to receive an environmental induction. The induction must include at a minimum, all applicable mitigation measures; hours of works; any limitations on high noise-generating activities; location of nearest sensitive receivers; designated parking areas; relevant approval conditions and incident procedures.
- Contractors are to keep noise to a minimum, including limiting the use of loud stereos/radios, shouting on site and car door slams.
- The noise levels of plant and equipment should have operating Sound Power or Sound Pressure Levels consistent with those nominated in **Table 4.1**.
- Noise emitting plant to be directed away from sensitive receivers and to be throttled down or shut down when not in use.

- Non-tonal reversing beepers should be fitted and used on all construction vehicles and mobile plant used regularly on site and for any out of hours work.
- Limit the use of engine compression brakes.
- Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise should be scheduled during less sensitive time periods.

7.2.1 Additional Mitigation Measures

In accordance with the CNVG, the triggers for the implementation of noise mitigation measures are described in **Table 7.2**.

Table 7.2 Triggers for the Implementation of Noise Mitigation Measures

Construction hours	Receiver perception	dB(A) above NML	Additional management measures
Standard Hours Monday-Friday (7 am–6 pm) Saturday (8 am–1 pm)	Noticeable	0	-
	Clearly audible	< 10	-
	Moderately intrusive	> 10 to 20	PN, V
	Highly intrusive	> 20	PN, V
	75 dB(A) or greater	N/A	PN, V, SN

In accordance with the CNVG, the descriptions of the additional measures are provided in **Table 7.3**.

Table 7.3 Description of Noise Mitigation Measures

Additional Management Measure	Description
Period Notification (PN)	Advanced warning of upcoming works and potential disruptions can assist in reducing the impact on the community. Typically distributed on a monthly basis, notifications may consist of a letterbox drop, and/or email mailing lists, and published on the website. Updates detail work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of seven days prior to the start of works. The approval conditions for projects may specify requirements for notification to the community about works that may impact on them.
Verification Monitoring (V)	<p>Verification monitoring of noise and/or vibration levels during construction is in the form of routine checks of noise levels or following reasonable complaints, conducted at the affected receiver(s) or a nominated representative location.</p> <p>Where monitoring finds that the actual levels exceed those predicted in the assessment then immediate refinement of mitigation measures may be required and the management plan amended.</p> <p>Attended measurements are to be undertaken within a period of 14 days from the commencement of construction activities (or as agreed with the DPE/EPA).</p> <p>For project durations greater than three months, attended measurements are to be repeated on a three-monthly basis, where reasonable and feasible, as part of the audit cycle. Where outside of standard work hour (OOWH) are required, attended measurements must be undertaken at the time intervals described in the management, OOWH assessment, approval and/or licence conditions.</p>

Additional Management Measure	Description
Specific Notification (SN)	<p>Specific notifications are letterbox dropped, hand distributed, or phone calls, to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives.</p> <p>Alternatively (or in addition to), communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities and provide an individual briefing.</p> <p>The specific notification provides additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops. This form of communication is used to support periodic notifications, or to advertise unscheduled works.</p>

Based on the predicted construction noise level in the NVIA 2023, the CNVG additional noise mitigation measures shown in **Table 7.4** are triggered.

Table 7.4 Proposed Noise Mitigation Measures

Rec ID	Structure	Construction Scenario							
		Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7	Sc.8
C3_1	Residential	-	-	-	-	-	-	-	-
C3_3	Residential	-	-	-	-	-	-	PN, V	-
C3_4 ¹	Landowner	-	-	-	-	-	-	-	-
C3_6	Residential	-	-	-	-	-	-	PN, V	-
C3_8	Residential	-	-	-	-	-	-	PN, V	-
C3_10	Residential	-	-	-	-	-	-	-	-
C3_11	Residential	-	-	-	-	-	-	-	-
C3_20	Residential	-	-	-	-	-	-	PN, V	-
C4_5	Residential	-	-	-	-	-	-	-	-
D3_1	Residential	-	-	-	-	-	-	-	-
D3_2	Residential	-	-	-	-	-	-	-	-
D3_3	Residential	-	-	-	-	-	-	-	-
D3_4	Residential	-	-	-	-	-	-	-	-
D3_5	Residential	-	-	-	-	-	-	-	-
D3_6	Residential	-	-	-	-	-	-	-	-
D3_7	Residential	-	-	-	-	-	-	-	-
D3_16	Residential	-	-	-	-	-	-	-	-
D3_20	Residential	-	-	-	-	-	-	-	-
D3_23	Residential	-	-	-	-	-	-	-	-
D3_47	Residential	-	-	-	-	-	-	-	-
D3_49	Residential	-	-	-	-	-	-	-	-
D4_1	Residential	-	-	-	-	-	-	-	-
D4_2	Residential	-	-	-	-	-	-	-	-
D4_3	Residential	-	-	-	-	-	-	-	-

Rec ID	Structure	Construction Scenario							
		Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7	Sc.8
D4_4	Residential	-	-	-	-	-	-	-	-
D4_5	Residential	-	-	-	-	-	-	-	-
D4_7	Residential	-	-	-	-	-	-	-	-
D4_9	Residential	-	-	-	-	-	-	-	-
D4_10	Residential	-	-	-	-	-	-	-	-
D4_13	Residential	-	-	-	-	-	-	-	-

Note: ¹ Receiver C3_4 is involved in the Project (host receiver) and the Noise Management Levels are not applicable.

7.3 Construction Vibration Mitigation

Section 5.0 has identified that only C3_3, C3_8 and C3_20 fall within the minimum working for human response for some plant items (i.e., vibratory roller >4 tonnes and large hydraulic hammer >18 tonnes). The actual construction equipment to be used on site would be confirmed by the construction contractor during the detailed design phase. For any vibration-generating plant not listed in **Table 5.1**, minimum working distances would need to be established.

In the event that any vibration-generating equipment would be used within the recommended safe working distances nominated in **Table 5.1**, the following is recommended:

- An independent specific structural assessment is undertaken on the structure to ascertain the structural integrity and its ability to withstand vibration, and establishment of an appropriate vibration criterion.
- A dilapidation survey is undertaken on the structure prior to works commencing, and regular inspection of the structure throughout the construction activities.
- Pre-construction vibration monitoring to establish baseline vibration impacts induced on the structure from existing sources.
- Establish site specific vibration minimum working distances for the nominated equipment on site.
- Where appropriate, continuous vibration monitoring is conducted on the structure for the duration of the period of construction while vibration generating equipment is used. The vibration logger should be equipped with the facility to remotely alert the site to reduce or cease construction activities if vibration levels are approaching the criterion threshold.

7.4 Construction Traffic Mitigation

Potential noise mitigation measures to reduce construction-related traffic noise may include the following:

- Restricting Project related traffic to 60 km/h along Avenue Road.
- Car-pooling and the use of buses/mini-vans to reduce the total number of light vehicle movements is already being adopted by the Project.

7.5 Complaint Management

In the event of a reasonable noise complaint, noise monitoring should be carried out to confirm predicted noise levels. Reasonable and feasible noise reduction measures must be investigated, where necessary.

Complaints will be managed in accordance with the Construction Environmental Management Plan (CEMP). The CEMP should define the standard processes and obligations that must be adhered to ensure the Project is controlled in an efficient manner. A complaint register with public access is to be provided.

8.0 References

- Noise Policy for Industry (NPfI), NSW Environment Protection Authority (EPA), 2017.
- Interim Construction Noise Guideline (ICNG), NSW Department of Environment and Climate Change (DECC), 2009.
- NSW Road Noise Policy (RNP), Department of Environment, Climate Change and Water (DECCW), 2011.
- Assessing Vibration: A Technical Guideline (the Vibration Guideline), Department of Environment and Conservation (DEC), 2006.
- British Standard BS7385 (1993) Part 2 Evaluation and measurement of vibration in buildings (BS7385).
- German Institute for Standardisation DIN 4150-3:1999-02 Structural vibration – Effects of vibration on structures (DIN4150).
- Australian Standard AS2436-2010 (2016) Guide to Noise Control on Construction, Demolition and Maintenance Sites.
- Construction Noise and Vibration Guideline (CNVG), Transport for NSW (TfNSW), 2023.
- Construction Noise Estimator Tool, Roads and Maritime.



