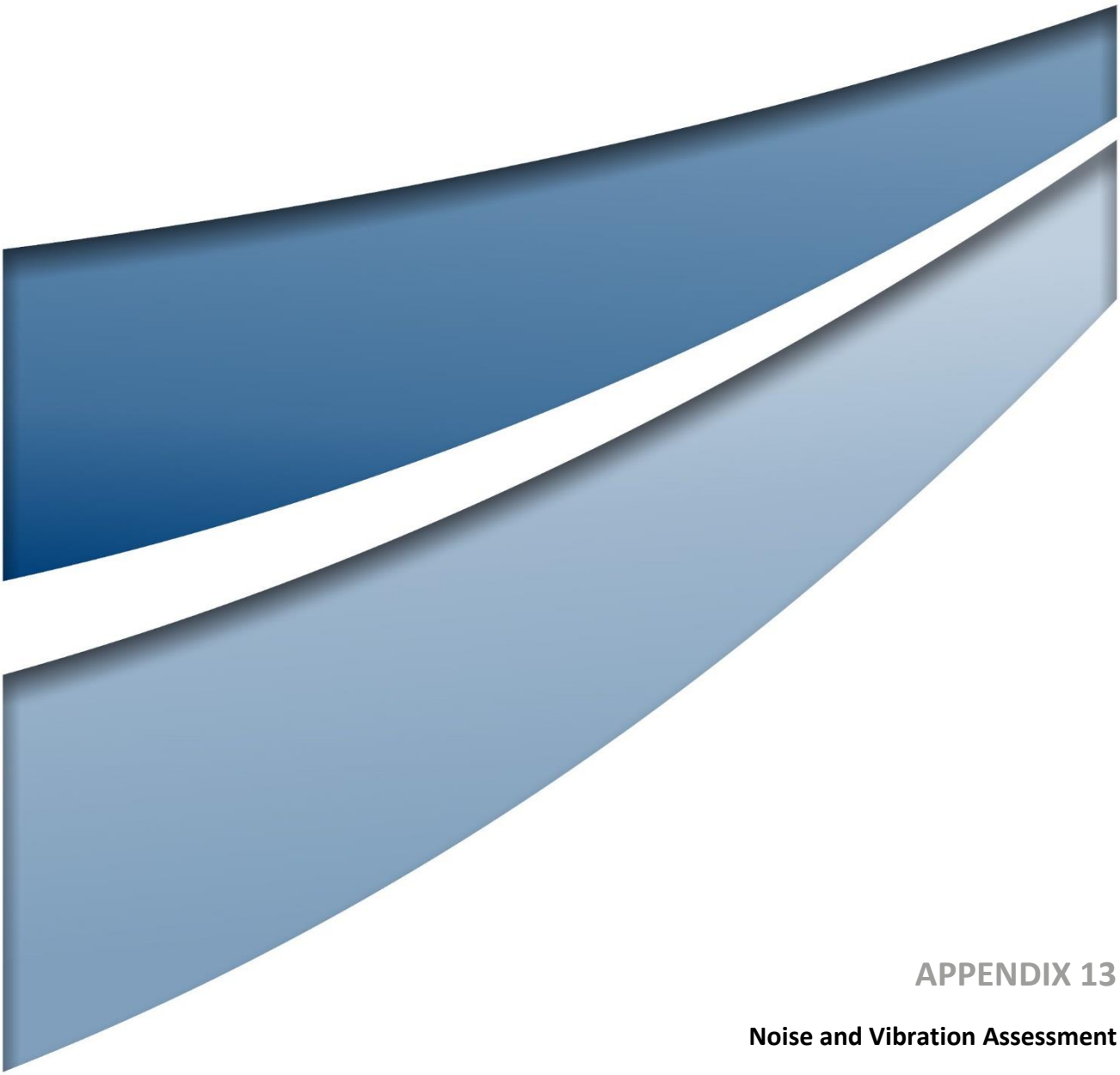

APPENDIX 13

Noise and Vibration Assessment

umwelt
Environmental & Social Consultants

lightsource bp

GUNDARY SOLAR FARM

Noise and Vibration Impact Assessment

FINAL

October 2024

GUNDARY SOLAR FARM

Noise and Vibration Impact Assessment

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Lightsource bp Renewable Energy Limited

Project Director: Malinda Facey
Project Manager: Marion O'Neil
Technical Director: Tim Procter
Technical Manager: Ben Carlyle
Report No. 22223/R11
Date: October 2024

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

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.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final	Tim Procter	14/10/2024	Malinda Facey	14/10/2024

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Appendices

1.0 Introduction

Lightsource Development Services Australia Pty Ltd (Lightsource bp) proposes to develop the Gundary Solar Farm (the Project) in the Southern Tablelands of New South Wales (NSW), approximately 10 kilometres (km) southeast of Goulburn within the Goulburn Mulwaree Local Government Area (LGA). The location of the Project and its regional context is presented in **Figure 1.1**.

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 Overview of the Project

The Project will involve the construction, operation, maintenance and decommissioning of a 400-Megawatt peak (MWp) solar farm with a Battery Energy Storage System (BESS) of up to 555 MWp and 1,570-Megawatt hour (MWh) capacity and associated infrastructure to connect the Project to the national electricity grid. The Project will be accessed via the existing driveway at 961 Windellama Road via the Hume Highway. Intersection works on Windellama Road are proposed as part of the Project, to upgrade the Project's primary access point to accommodate heavy vehicles. The Project's conceptual layout is included in **Figure 1.2**.

The Project will supply electricity to the National Electricity Market (NEM), via a new onsite connection to the existing 330 kV overhead transmission line traversing through the north-west corner of the Project Area. The Project will generate enough clean energy for about 133,000 homes and reduce carbon emissions by 670,000 tonnes. The BESS will have capacity to store up to 1,570 MWh of on-demand energy for supply to the grid.

The Project would be located on land zoned RU1 – Primary Production. The area surrounding the Project is characterised predominantly by agricultural lands associated with rural residential properties, small settlements, conservation areas and rural tourism. Land within and adjacent to the Project has been subject to extensive cultivation associated with historic and more recent agricultural land uses.

The Project Area is bounded by Windellama Road on the west, for approximately 500 m, with Kooringaroo Road bordering the northeast corner of the Project Area. Properties directly north, east and west of the Project Area are privately owned rural residential properties with agricultural land use. The Project will be developed across five freehold lots, covering an area of approximately 702 ha (the Project Area). These properties are primarily used for grazing activities. The Project infrastructure will cover approximately 512 ha (the development footprint).

The Project is expected to generate up to 400 Full Time Equivalent (FTE) jobs over the 18-to-24 month construction period with between two and four FTE jobs during operation.

The Project is a State Significant Development (SSD) under the *State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP)* as the capital 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* (EP&A Act).

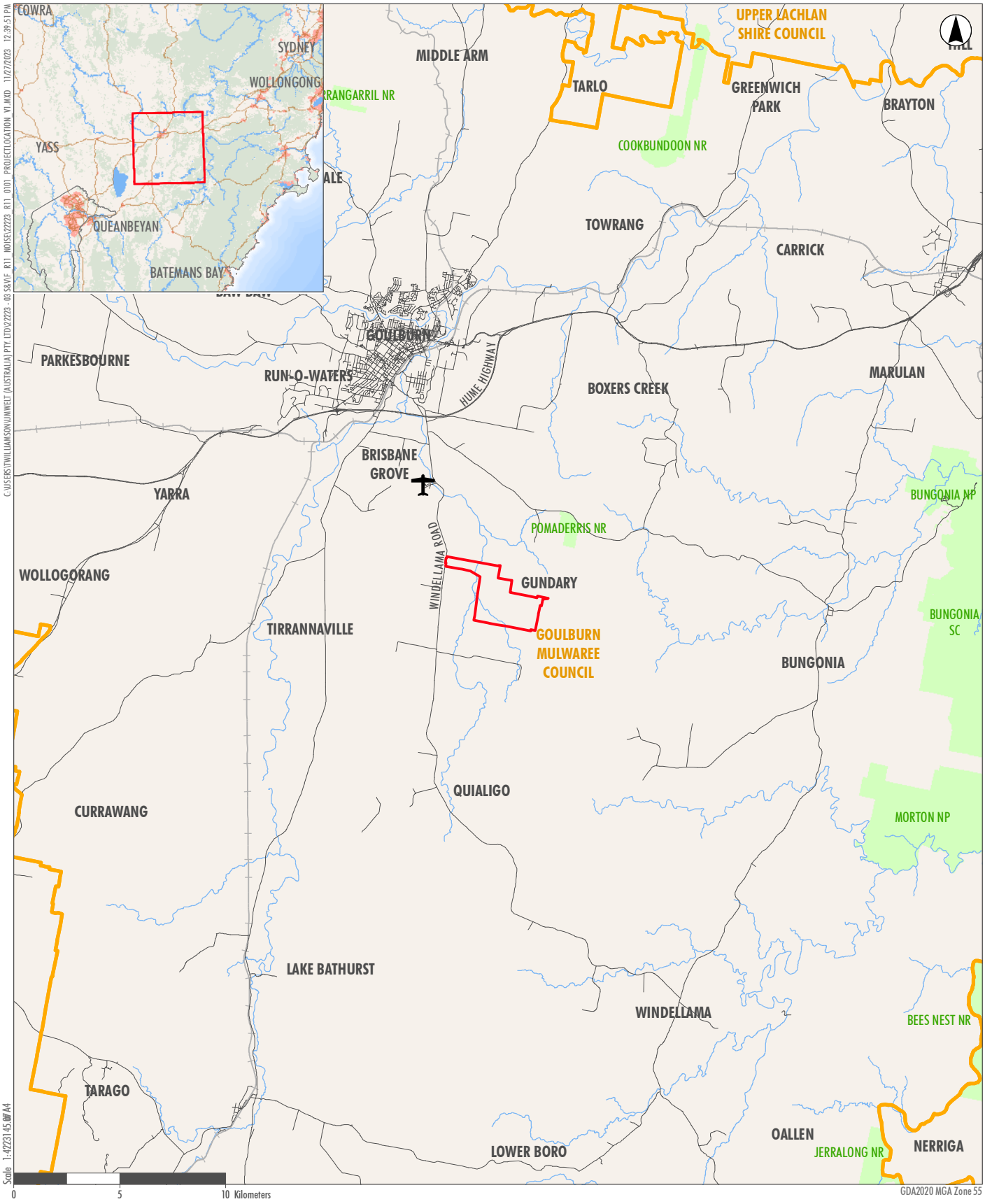


FIGURE 1.1

Project Location

Data source: NSW DSFI (2022); Lightsource BP (2022)

FIGURE 1.2

Gundary Solar Farm Indicative Layout

Legend

- Access Roads
- Security Fence
- Existing Transmission Line
- Roads
- Watercourses
- Watercourse / Bed Level Crossing
- Water Tank (40,000L)
- Water Tank (10,000L)
- Primary Access
- Emergency Access
- Emergency Gate
- Project Area
- Proposed Road Upgrade
- Solar Panels
- Landscaping Buffer (5m)
- Transgrid Line Works
- Centralised AC BESS
- Substation and O&M Facility Area
- Construction Compound Area
- Decentralised DC BESS

0 500 1,000

Metres

Scale: 1:0 at A4

GDA2020 MGA Zone 55

Image Source: ESRI Basemap (2023) | **Data Source:** NSW DFSI (2023)

2.0 Assessment Framework

2.1 Assessment Framework

The Planning Secretary's Environmental Assessment Requirements (SEARS) for the Project (SSD-48225958) identify matters that must be addressed in the Environmental Impact Statement (EIS). **Table 2.1** specifically lists the requirements relevant to the noise assessment:

Table 2.1 SEARs and where addressed

SSD-48225958 – Requirement	Section addressed
Noise – including: • an assessment of the construction noise impacts of the development in accordance with the Interim Construction Noise Guideline (ICNG) • operational noise impacts in accordance with the NSW Noise Policy for Industry (2017) • cumulative noise impacts (considering other developments in the area) • a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria.	**Section 6.0** **Section 5.0** **Section 7.0** **Appendix G**

In addition, the NVIA considers the submissions raised by the government agencies in relation to noise attached to the SEARs, as set out in **Table 2.2**.

Table 2.2 Agency Submissions Relating to Noise

Organisation Name	Submission	Section of this report
Goulburn Mulwaree Council	**Noise and Vibration** – This should be considered in relation to the potential impact on future rural residential areas identified south of the Hume Highway in the Urban and Fringe Housing Strategy	Given the future residential areas identified south of the Hume Highway are located approximately 4 km from the Project Area, noise and vibration impacts are anticipated to be minimal. For reference, receiver R55 is located 4 km north of the project area and predicted operational and construction noise levels, respectively shown in **Appendix E** and **Appendix F**, are at least 15 dB below the respective criterion.

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

- *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).
- *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.

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.

3.1 Sensitive Receivers and Noise Catchment Areas

Land surrounding the Project Area has predominantly been subject to agricultural land uses (including sheep and cattle grazing) associated with rural residential living. Several residential receivers are distributed throughout the surrounding area (i.e. sensitive receivers) with no other sensitive land uses (such as schools or places of worship) within or surrounding the Project Area. The sensitive receivers in the area surrounding the Project are illustrated on **Figure 3.1** and presented in **Appendix B**.

One of the residential receivers near the Project Area (approximately 520 m to the southwest) is an involved residence (owned by the host landholder) and is not considered a sensitive receiver. The closest non-involved residential receiver is located approximately 137 m north of the Project Area boundary.

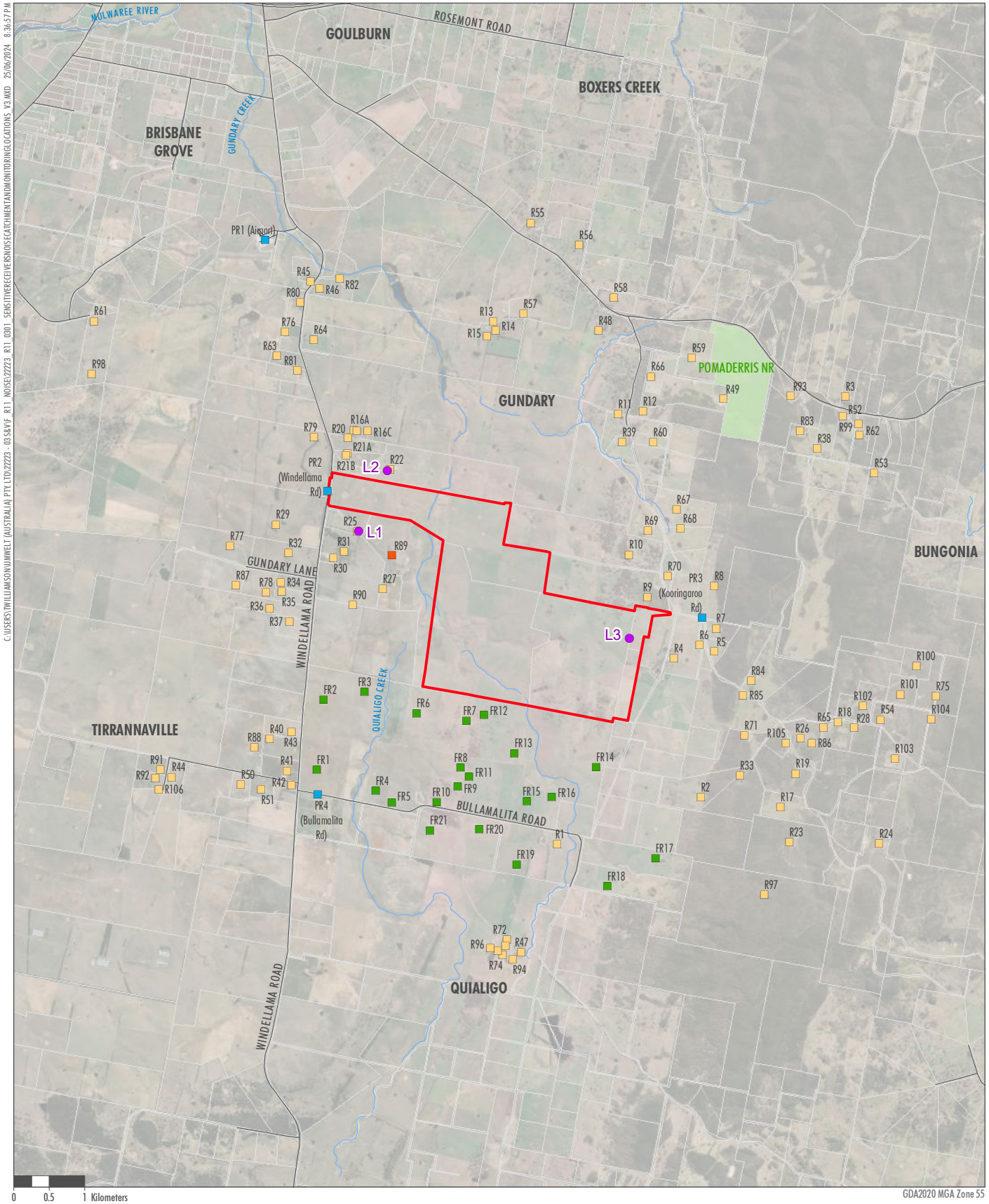
In addition, the property directly south of the Project Area has been approved for a 22 lot subdivision (hereafter referred to as the Rosedale subdivision). The original approval, dated September 2005, was for 24 lots, with a modified DA and revised layout for 22 lots approved in September 2010. It is understood from discussions with Goulburn Mulwaree Council that the approval has 'physically commenced'; however, to date the subdivision has not been registered nor enacted. Whilst it is uncertain whether these lots would be subdivided or developed in future, the noise assessment considered and assessed the potential location of the future residences as 'potential future receivers'. The location of these receivers used for the purposes of the assessment were based on the potential septic locations on the approved subdivision plan and is therefore only indicative at this stage. Should the subdivision be developed in future, the final location of the receivers will be subject to a separate local development application. Therefore, for the purposes of this assessment, 21 potential future receivers (i.e. FR1 to FR21) have been identified as part of the Rosedale subdivision as shown on **Figure 3.1**. There is an existing residence on one of the subdivision lots (Lot 19) and this residence has been identified as an existing receiver (R1).The assessment of existing acoustic environment is based on the grouping of residential receivers into the Noise Catchment Areas (NCAs) described in **Table 3.1** and shown on **Figure 3.1**.

Table 3.1 Noise Catchment Area descriptions

NCA	Description
NCA_1	An area in proximity to Windellama Road and representing the rural areas near the western extent of the Project, south of the Windellama Road Project Access point. Background data based on monitoring location L1.
NCA_2	An area in proximity to Windellama Road and representing the rural areas near the western extent of the Project, north of the Windellama Road Project Access point. Background data based on monitoring location L2.
NCA_3	An area representing the rural areas to the northern, east and south of the Project, that are located away from Windellama Road. Background data based on monitoring location L3.

3.2 Unattended Noise Monitoring

Unattended long-term noise monitoring was carried out at the three locations shown in **Table 3.2** and on **Figure 3.1**. These monitoring locations were selected to be representative of the potentially affected noise receivers within the respective NCAs in **Table 3.1**.



Legend

- Project Area
- Lot
- Local Government Area
- NPWS Estate
- Roads
- Railway
- Watercourses
- Noise Monitoring Locations
- Public Receiver
- Non-associated Dwelling
- Host Dwelling
- Potential Future Residences (Rosedale Subdivision)

FIGURE 3.1

Sensitive Receivers, Noise Catchment Areas and Background Noise Monitoring Locations

Data source: NSW DSFI (2022); Lightsource BP (2022)

Table 3.2 Noise Monitoring Locations

ID	Location / Receiver ID	Receiver Area	Monitoring Period	Location description [1]
L1	R25	NCA 1	18/4/2023–4/5/2023	The logger was located on the eastern side of the residence. The microphone was located 1.5 metres above ground level in the free-field.
L2	R22	NCA 2	18/4/2023–4/5/2023	The logger was located to the west of the residence on the southern boundary. The microphone was located 1.5 metres above ground level in the free-field.
L3	Project Area – Eastern Boundary	NCA 3	18/4/2023–4/5/2023	The logger was located in proximity to the eastern boundary of the Project Area. The microphone was located 1.5 metres 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. Th 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 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, which utilises the L_{A90} descriptor, has been determined for each period (Day, Evening and Night) during each day. 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, which was Goulburn Airport (Station 070330) approximately 3.3 km NW of the Project Area.

Post measurement analysis determined that insects were a dominant noise source, particularly during the daytime period. Given this noise source could be localised and a seasonal noise source, it may not be a feature at other receiver locations and/or be present throughout the year. In accordance with Fact Sheet A of the NPfI, the insect noise was excluded. The results of the noise monitoring with insects excluded are summarised in **Table 3.3** and the full noise monitoring results are shown graphically in **Appendix C**.

Table 3.3 Noise Monitoring Results, dB(A)

ID	Background Noise Level $L_{A90\ 15\ minute}$			Ambient Noise Level [2] $L_{Aeq,\ period}$		
	Day [1]	Evening [1]	Night [1]	Day [1]	Evening [1]	Night [1]
L1	24 [3]	20 [3]	17 [3]	43	38	35
L2	27 [3]	24 [3]	22 [3]	42	38	37
L3	22 [3]	18 [3]	17 [3]	43	40	39

Notes: [1] Day period is 7.00 am–6.00 pm Monday–Saturday and 8.00 am–6.00 pm Sunday and Public Holidays, evening period is 6.00 pm–10.00 pm and night period is 10.00 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**.*

3.3 Attended Noise Monitoring

Attended noise monitoring was undertaken at Locations L1, L2 and L3 to supplement the unattended noise monitoring and get a better understanding of the noise sources that make up the existing noise environment. The attended measurements are summarised in Table 3.4. As shown in Table 3.4 the measured noise levels were predominantly controlled by natural noise sources with some contribution from aircraft noise. Measured noise levels were comparable at L1 and L2. Higher noise levels were captured at L3 which was attributed to aircraft noise.

Further details (i.e., graphs and commentary) of the noise levels recorded during the monitoring period can be found in **Appendix D**.

The equipment used for the attended noise monitoring was a Type 1, Svantek 958 Noise and Vibration Analyser. Field calibration checks were undertaken for the instruments pre and post monitoring and were found to be within 1 dB of the reference signal.

Table 3.4 Attended Noise Level Measurements

ID	Location / Receiver ID	Period	Date/time	Measured Noise Level, dB(A)[1]			Comments
				L_{Amax}	L_{Aeq}	L_{A90}	
L1	R25	Day	18 April 2023 12:56 pm–1:11 pm	58	46	45	The background noise level L_{A90} and ambient noise level L_{Aeq} was dominated by natural noise sources (i.e. insects). The recorded maximum noise level L_{Amax} was from birds.
L2	R22	Day	18 April 2023 1:48 pm–2:03 pm	57	46	44	The background noise level L_{A90} and ambient noise level L_{Aeq} was dominated by natural noise sources (i.e. insects). The recorded maximum noise level L_{Amax} was from birds.
L3	Project Area – Eastern Boundary	Day	18 April 2023 2:49 pm–3:04 pm	55	53	52	The background noise level L_{A90} and ambient noise level L_{Aeq} was dominated by natural noise sources (i.e. insects). The recorded maximum noise level L_{Amax} was from aircraft.

Note: [1] See Table A1 of Appendix A for definition of descriptors.

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*, 2017 (NPfI).

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 residences. 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) ($L_{Aeq(15\ minute)}$) 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 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 and PINLs (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 7.00 am–6.00 pm Monday–Saturday and 8.00 am–6.00 pm Sunday and Public Holidays, evening period is 6.00 pm–10.00 pm and night period is 10.00 pm to commencement of day period.

The project RBLs are derived as the greater of the measured RBLs shown in **Table 3.3** 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 $L_{Aeq(15\ minute)}$ dB(A)

Receiver Area	RBL			PINL		
	Day [1]	Evening [1]	Night [1]	Day [1]	Evening [1]	Night [1]
NCA 1	35 (24) [2]	30 (20) [3]	30 (17) [3]	40	35	35
NCA 2	35 (27) [2]	30 (24) [3]	30 (22) [3]	40	35	35
NCA 3	35 (22) [2]	30 (18) [3]	30 (17) [3]	40	35	35

Notes: [1] Day period is 7.00 am–6.00 pm Monday–Saturday and 8.00 am–6.00 pm Sunday and Public Holidays, evening period is 6.00 pm–10.00 pm and night period is 10.00 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 ( ).

4.1.2 Project Amenity Noise Level

The Project Amenity Noise Level (PANL) ($L_{Aeq(period)}$) at receivers are defined as the recommended amenity noise levels in NPfI Table 2.2 minus 5 dB(A). For derivation of the PTNLs, the PANLs $L_{Aeq(period)}$ are converted to $L_{Aeq(15\ minute)}$ by the addition of 3 dB. 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 residential 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, dB(A)

Receiver Area	Time of day [1]	Recommended amenity noise level $L_{Aeq(period)}$	Project amenity noise level $L_{Aeq(period)}$	Project amenity noise level $L_{Aeq(15\ min)}$
NCA 1 All residential receivers	Day	50	45	48
	Evening	45	40	43
	Night	40	35	38
NCA 2 All residential receivers	Day	50	45	48
	Evening	45	40	43
	Night	40	35	38
NCA 3 All residential receivers	Day	50	45	48
	Evening	45	40	43
	Night	40	35	38

Notes: [1] Day period is 7.00 am–6.00 pm Monday–Saturday and 8.00 am–6.00 pm Sunday and Public Holidays, evening period is 6.00 pm–10.00 pm and night period is 10.00 pm to commencement of day period.

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 $L_{Aeq(15\ minute)}$ 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 4.2** were lower than the minimum assumed RBLs in the NPfI).

Table 4.4 Project Noise Trigger Levels – Residential Receivers, $L_{Aeq(15\ minute)}$, dB(A)

Receiver Area	Time of day [1]	PINL	PANL	PNTL
NCA 1 All residential receivers	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
NCA 3 All residential receivers	Day	40	48	40
	Evening	35	43	35
	Night	35	38	35

Notes: [1] Day period is 7.00 am–6.00 pm Monday–Saturday and 8.00 am–6.00 pm Sunday and Public Holidays, evening period is 6.00 pm–10.00 pm and night period is 10.00 pm to commencement of day period.

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, where the development's night-time noise levels at a residential location exceed:

- *$L_{Aeq,15minute}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater; and/or*
- *L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,*

a detailed maximum noise level event assessment should be undertaken.

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, $L_{Aeq,15minute}$ and L_{AFmax} dB(A)

Receiver Area	Night-time Period (10:00 pm–7:00 am)	
	Assessment Level $L_{Aeq,15minute}$	Assessment Level L_{AFmax}
NCA 1 All residential receivers	40 [1]	52 [2]
NCA 2 All residential receivers	40 [1]	52 [2]
NCA 3 All residential receivers	40 [1]	52 [2]

Notes: [1] As per NPfI Section 2.5, minimum sleep disturbance assessment level is the greater of $L_{Aeq, 15minute}$ 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 L_{AFMax} 52 dB(A) or RBL + 15 dB. In this case RBL + 15 lower than 52 dB.

4.1.6 Cumulative Noise Criteria

The other industries in the local area that have the potential to contribute to project noise levels, include Merino Solar Farm Stages 1 and 2, which are respectively located west and southwest of the Project.

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, a conservative approach has been adopted by utilising a PANL that is 5 dB below the recommended amenity noise level, which ensures that industrial noise levels from up to three or four industrial noise sources 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 – $L_{Aeq(15min)}$, dB(A)

Receiver Area	Period [1]	PANL for Project Contribution
NCA 1 All residential receivers	Day	48
	Evening	43
	Night	38
NCA 2 All residential receivers	Day	48
	Evening	43
	Night	38
NCA 3 All residential receivers	Day	48
	Evening	43
	Night	38

Notes: [1] Day period is 7.00 am–6.00 pm Monday–Saturday and 8.00 am–6.00 pm Sunday and Public Holidays, evening period is 6.00 pm–10.00 pm and night period is 10.00 pm to commencement of day period.

4.2 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 $L_{Aeq(15\ min)}$
Residential	**Recommended Standard Hours** Monday to Friday – 7.00 am to 6.00 pm Saturday – 8.00 am to 1.00 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 Area	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	45	75
NCA 2 All residential receivers	45	75
NCA 3 All residential receivers	45	75

Notes: [1] *Recommended standard hours: Monday to Friday 7.00 am–6.00 pm; Saturday 8.00 am–1.00 pm.*

4.3 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).

4.3.1 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.

4.3.1.1 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

Notes: [1] *Day time period is 7.00 am–10.00 pm. Night time period is 10.00 pm–7.00 am.*

4.3.1.2 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

Notes: [1] Day time period is 7.00 am–10.00 pm. Night time period is 10.00 pm–7.00 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.

4.3.2 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)

Notes: [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.

4.3.3 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.

4.4 Road Traffic Noise Criteria

An assessment of potential noise levels from Project-related traffic 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 the proposed Project-related transport route from the Hume Highway to the Project Area. Under the road category definitions provided in the RNP, the proposed Project-related transport route is classified as a sub-arterial 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 7.00 am to 10.00 pm	Night 10.00 pm to 7.00 am
Freeway/arterial/ sub-arterial road	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,(15\ hour)}$ 60 (external)	$L_{Aeq,(9\ hour)}$ 55 (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, 2011* 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 substation, BESS and DC BESS PCU station footprints and an absorption factor of 1.0 applied for all other areas, both within and outside of the Project Area.
- The noise source levels of individual plant and equipment (refer to **Section 5.2**).
- Three operational scenarios for the BESS configuration namely 1) centralised AC BESS, 2) decentralised DC BESS, and 3) a combined centralised AC and decentralised DC BESS.
- The incorporated noise control measures (refer to **Section 5.3**).
- 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

Lightsource bp 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
Decentralised BESS			
Tracker motor	8303	74	3% (30 seconds per 15 minutes)
PV Inverters	74	94 (89 dB(A) + 5 dB) [1]	100%
Battery Containers Sides	222	91 (86 dB(A) + 5 dB) [1]	100%
Battery Containers Ends		80 (75 dB(A) + 5 dB) [1]	100%
DC BESS Converters	592	92	100%
Substation (225 MVA transformer)	2	99 (94 dB(A) + 5 dB) [1]	100%
HVAC (O&M building & control room)	2	70 [2]	100%
Centralised BESS			
Tracker motor	8303	74	3% (30 seconds per 15 minutes)
PV Inverters	104	94 (89 dB(A) + 5 dB) [1]	100%
Battery Containers Sides	208	91 (86 dB(A) + 5 dB) [1]	100%
Battery Containers Ends		80 (75 dB(A) + 5 dB) [1]	100%
Substation (225 MVA transformer)	1	99 (94 dB(A) + 5 dB) [1]	100%
Aux. Transformer 33 kV/415 V 5 MVA	4	94 (89 dB(A) + 5 dB) [1]	100%
HVAC (O&M building & control room)	2	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 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.

For this assessment, the noise from the batteries, inverters and transformers are considered to be tonal in nature. In accordance with the NPfI a 5 dB penalty has been applied to the predicted noise contributions from the batteries, inverters and transformers. For these items, the sound power levels within **Table 5.1**, are inclusive of the 5 dB 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 Incorporated Noise Control Measures

Throughout the development of the conceptual Project layout, consultation with Lightsource bp's design team was undertaken to identify, design and optimise the operational noise controls that can be implemented. This process was undertaken to inform the operational constraints to the Project that may be required to meet noise criteria.

As part of the Project design, Lightsource bp has committed to a suite of operational noise controls to further avoid and minimise noise emissions. The following feasible noise mitigation measures have been incorporated into the modelling process and are shown on **Figure 5.1**:

- The placement of 5.5-metre high noise barriers around the substation HV transformers, with the inside of the barrier to be lined with acoustic absorption.
- For particular decentralised DC BESS PCU stations, the placement of 3 m high noise barriers.

It is noted that the above noise barriers have been incorporated into the design of the Project to act as mitigation measures for operational noise impacts.

5.4 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 the sensitive receivers are presented on **Figure 5.2** and are tabulated in **Table E.1** within **Appendix E**. For those receivers where the predicted operational noise level is greater than 30 dB(A) $L_{Aeq(15\ min)}$ the results have been summarised in **Table 5.2**.

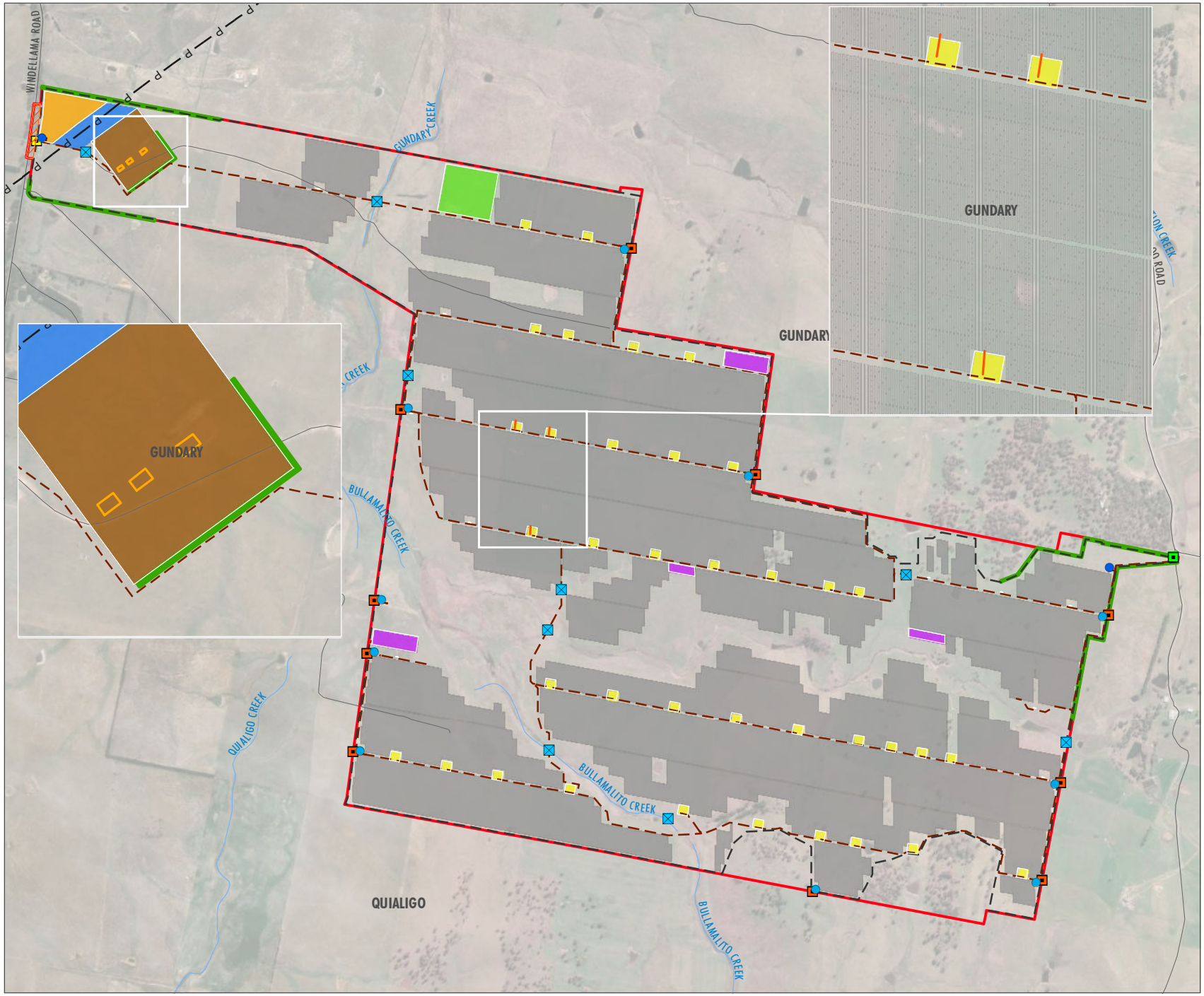


FIGURE 5.1

Location of Noise Barriers

Legend

- Access Roads
- Security Fence
- Existing Transmission Line
- Roads
- Watercourses
- Watercourse / Bed Level Crossing
- Water Tank (40,000L)
- Water Tank (10,000L)
- Primary Site Access
- Emergency Access and Egress
- Emergency Gate
- Project Area
- Proposed Road Upgrade
- Noise Barrier - 5.5 m high (HV Transformer)
- Noise Barrier - 3 m high (DC BESS PCU Station)
- Solar Panels
- Landscaping Buffer (5m)
- Transgrid Line Works
- Centralised AC BESS
- Substation and O&M Facility Area
- Construction Compound Area
- Decentralised DC BESS
- Temporary Laydown Area

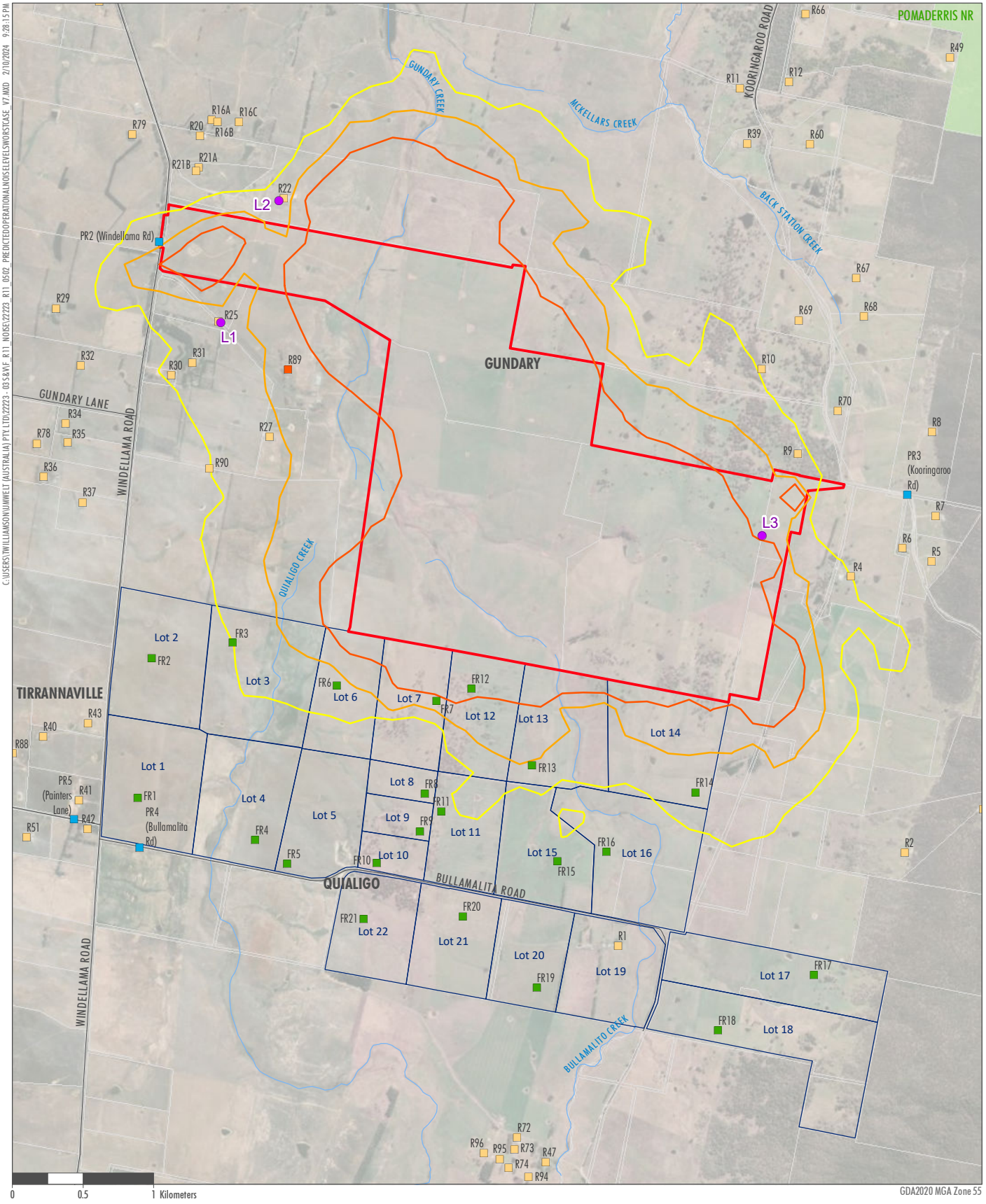
0 500 1,000

Metres

Scale: 1:0 at A4

GDA2020 MGA Zone 55

Image Source: ESRI Basemap (2023) | **Data Source:** NSW DFSI (2023)



Legend

- Project Area
- Lot
- Rosedale Subdivision
- NPWS Estate
- Roads
- Watercourses
- Noise Monitoring Locations
- Public Receiver
- Non-associated Dwelling
- Host Dwelling
- Potential Future Residences (Rosedale Subdivision)

Operational Noise Levels

- 30 dB(A)
- 35 dB(A)
- 40 dB(A)

FIGURE 5.2

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

Data source: NSW DSFI (2022); Lightsource BP (2022)

Table 5.2 Predicted Operational Levels (where greater than 30 dB(A)), $L_{Aeq,15minute}$ dB(A)

Rec ID [1]	Structure	PNTL [1], D/E/N [2]	Operational Noise for Solar Farm and BESS Options		
			Centralised	Decentralised	Centralised and Decentralised
R4	Residence	40/35/35	-	31	31
R9	Residence	40/35/35	-	34	34
R22	Residence	40/35/35	31	-	33
R25	Residence	40/35/35	31	31	34
R27	Residence	40/35/35	-	33	35
R31	Residence	40/35/35	-	-	31
FR3	Vacant Land [3]	na	-	32	32
FR6	Vacant Land [3]	na	-	34	34
FR7	Vacant Land [3]	na	-	40	40
FR11	Vacant Land [3]	na	-	31	31
FR12	Vacant Land [3]	na	-	42	42
FR13	Vacant Land [3]	na	-	35	35
FR14	Vacant Land [3]	na	-	33	33
FR22	Vacant Land [3]	na	-	33	34

Notes: *[1] PNTL - Project Noise Tigger Levels are the operational noise criteria for the Project.*

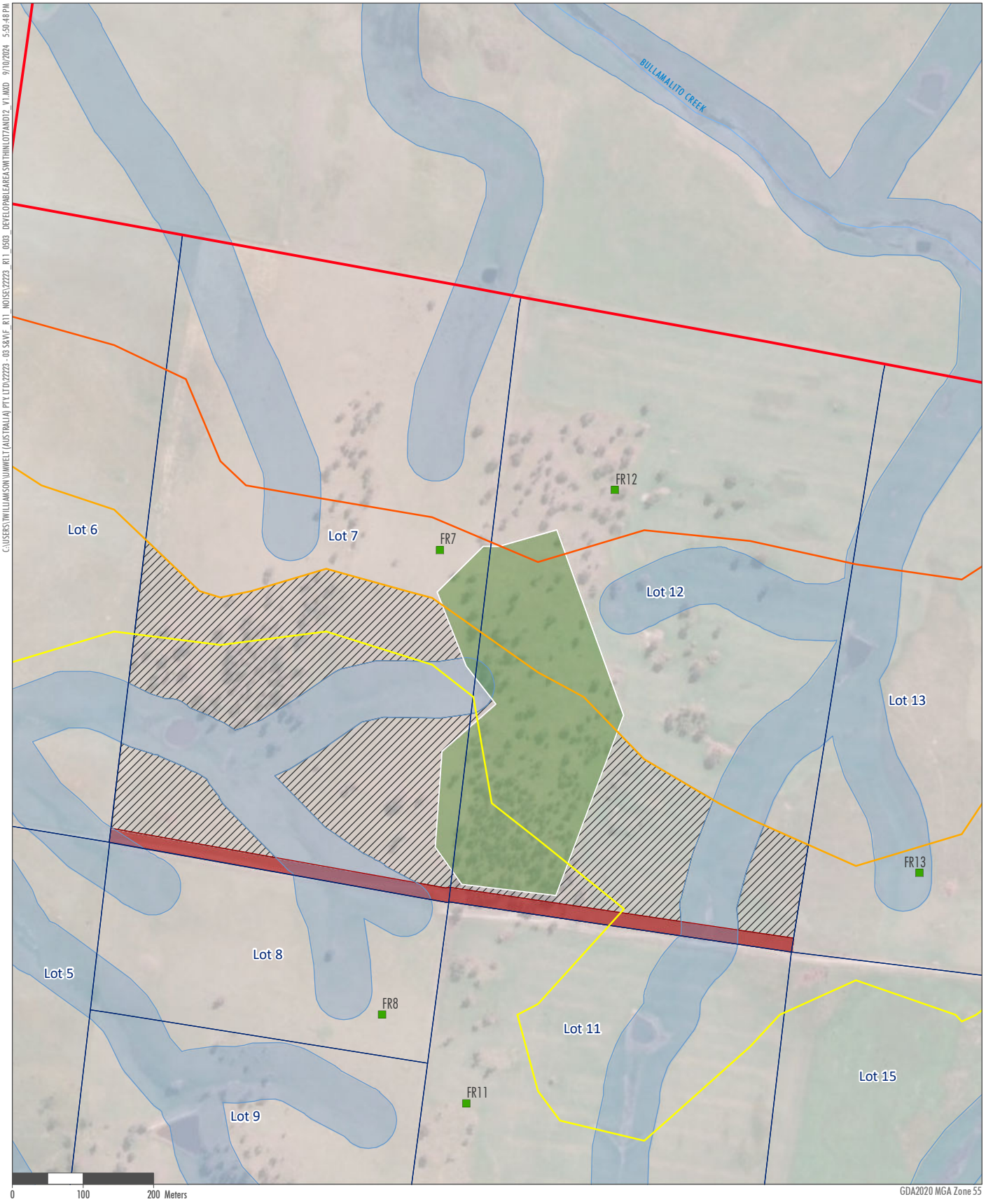
[2] Day period (D) is 7.00 am–6.00 pm Monday–Saturday and 8.00 am–6.00 pm Sunday and Public Holidays, evening period (E) is 6.00 pm–10.00 pm and night period (N) is 10.00 pm to commencement of day period.

[3] The final location of future receivers on vacant land are subject to a separate local development application once each residence is proposed to be developed. Locations used for this assessment are indicative and were determined by the locations of the potential septic locations on the subdivision approval. The residence could be located elsewhere on the lot to avoid / minimise noise impacts.

The operational noise levels in **Table 5.2** are predicted to comply with the day, evening and night-time noise limits at all existing external sensitive receivers not involved with the Project.

As discussed in **Section 5.3,** the Project design includes operational noise control measures proposed through strategically located noise barriers around the noisiest equipment. No further operational management and mitigation measures are required for the Project at existing receivers.

Exceedances are predicted however at two potential future receivers as part of the Rosedale subdivision, being FR7 and FR12, on existing vacant land (refer to **Figure 5.2**). These exceedances are predicted only for the decentralised BESS option and/or combined BESS option. As discussed in **Section 3.1**, the locations of the potential future receivers are only indicative at this stage and the final location will be subject to a separate local development application, should the subdivision be developed in future. Considering other environmental and planning related site constraints applicable to Lot 7 and Lot 12, illustrated on **Figure 5.3**, alternative siting options would be available should the landholder proceed with the subdivision development and wish to locate the residences outside the 35 dB(A) contour. The developable area outside the 35 dB(A) contour for Lot 7 and Lot 12 (taking other environmental and planning constraints into account as illustrated on **Figure 5.3**) are approximately 11 ha and approximately 7.5 ha respectively. In light of this, no mitigation is proposed for FR7 and FR12 at this stage. However, the landholder may be eligible in future for mitigation should the subdivision proceed, and residences be developed within the 35 dB(A) contour, subject to verification monitoring to confirm noise impacts. Furthermore, should only the centralised BESS option be developed, no operational noise exceedances are predicted to be experienced at any of the Rosedale future receivers based on the assumed locations as assessed in this NIA.



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Legend

- Project Area
- Lot
- Rosedale Subdivision
- Watercourses
- Potential Future Residences (Rosedale Subdivision)

Operational Noise Levels

- 30 dB(A)
- 35 dB(A)
- 40 dB(A)

- Developable Areas

Environmental / Planning Constraints

- Right of Carriageway
- Salinity Rehabilitation Area
- Creek Buffers (40m either side)

FIGURE 5.3

Developable Areas within Lot 7 and Lot 12

Data source: NSW DSFI (2022); Lightsource BP (2022)

5.5 Switchyard

During operation of the electricity transmission network, noise emission (hissing or cracking noise) associated with power lines and insulators within the switchyard 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-involved receivers to the switchyard (i.e. R21B and R25) are some distance (approximately 385 m) from the proposed switchyard (see **Figure 1.2**), potential noise impacts from corona discharge are not anticipated. Further, existing power lines are already a feature of the area and are located closer to R21B than the proposed switchyard.

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 approximately 18–24 months.

The construction stages 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. Primary access upgrade.

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: 7.00 am–6.00 pm.
- Saturday: 8.00 am–1.00 pm.
- Sunday and public holidays: No work.

No construction activities are proposed to occur on Sundays or public holidays. Exceptions to these hours may occur, however would be limited to activities with low noise generation where practicable.
These activities will be assessed on a case-by-case basis prior to the commencement of those activities. The Goulburn Mulwaree Council, other relevant government agencies and surrounding residences, would be notified of any foreseeable exceptions. This would include justifying why works are required outside the standard hours and outlining the timing, duration and potentially expected noise levels.

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,* 2022 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 $L_{Aeq(15\ min)}$ dB(A)/ unit	Combined Sound Power Level $L_{Aeq(15\ min)}$ dB(A)
Sc.1	Site Establishment and civil works	Excavator w/ rock hammer	120 (115 +5)	123
		Asphalt paver	114	
		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 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	

Construction Stages / Scenarios	Activity description	Equipment	Sound Power Levels $L_{Aeq(15\ min)}$ dB(A)/ unit	Combined Sound Power Level $L_{Aeq(15\ min)}$ 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	Primary access upgrade	Dump truck	110	118
		Asphalt paver	114	
		Grader	113	
		Roller	109	
		Water truck	107	

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

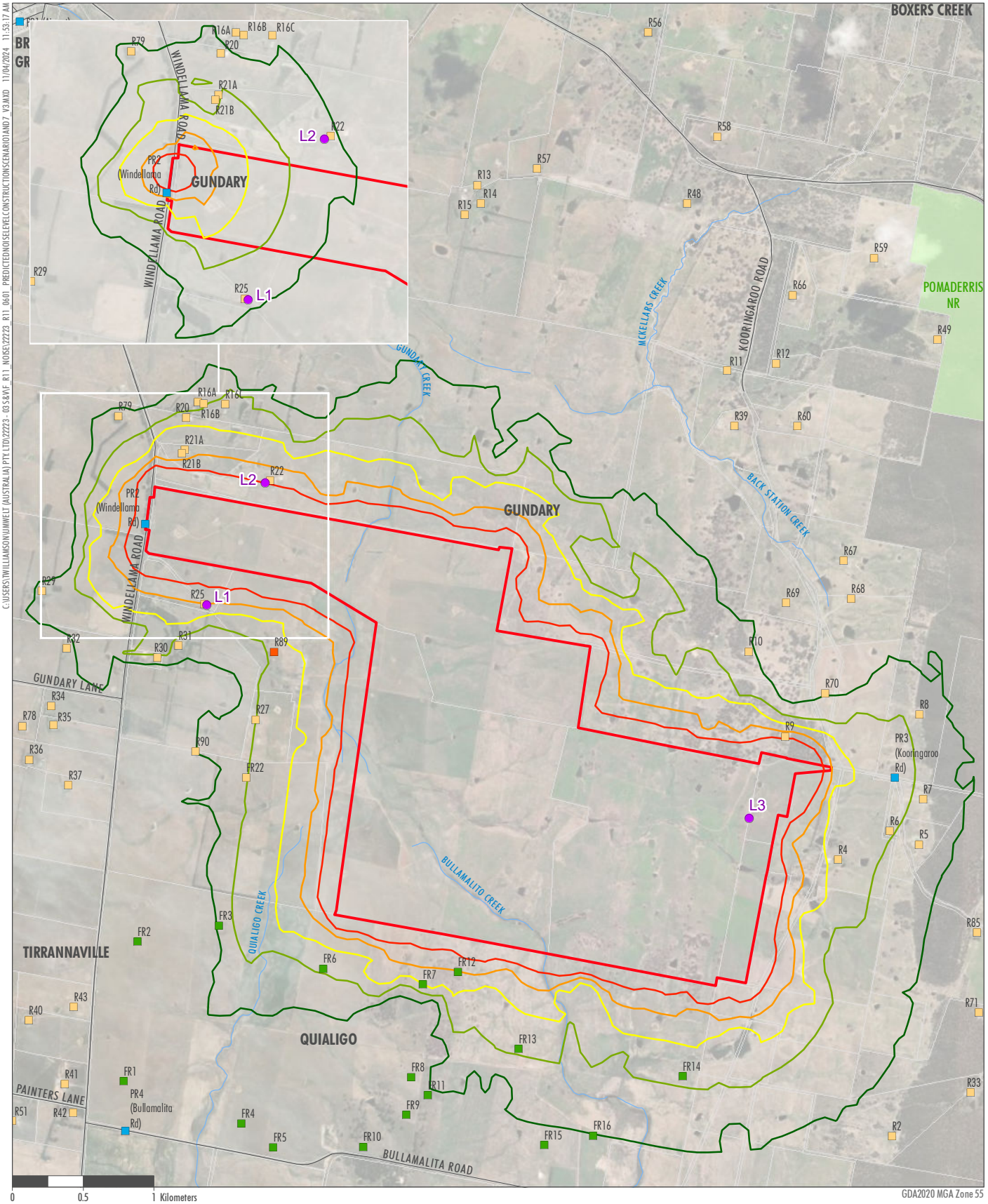
6.1.4 Construction Noise Levels

Prediction of the construction noise levels was undertaken with the proprietary computer noise modelling software CadnaA (Version 2021 MR 2), 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 seven 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 boundary 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 tabulated results for each construction scenario (Sc.1 to Sc.7) for all receivers are presented in **Table F.1** within **Appendix F.** The predicted noise level contours for the worst-case scenario (Scenario 1 combined with the Primary access upgrade Scenario 7) are presented on **Figure 6.1**. For those receivers where the predicted noise level is greater than the daytime noise management level (NML) of 45 dB(A) $L_{Aeq(15\ min)}$ the results have been summarised in **Table 6.2**. Whilst the NML 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 locations of the receivers are presented in **Figure 3.1** and **Figure B1.1**.

As the predicted construction noise levels are above the NML (i.e. 45 dB(A)) at 21 receivers, 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.



Legend

- Project Area
- Lot
- NPWS Estate
- Roads
- Watercourses
- Noise Monitoring Locations
- Public Receiver
- Non-associated Dwelling
- Host Dwelling
- Potential Future Residences (Rosedale Subdivision)

Construction Noise Levels

- 45 dB(A)
- 50 dB(A)
- 55 dB(A)
- 60 dB(A)
- 65 dB(A)

FIGURE 6.1

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

Data source: NSW DSFI (2022); Lightsource BP (2022)

Table 6.2 Predicted Daytime Construction Noise Levels (where greater than 45 dB(A)), $L_{Aeq(15\ min)}$, dB(A)

Rec ID [1]	Structure	Construction Scenario						
		Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7
R4	Residence	**53**	**48**	**46**	43	43	43	<20
R5	Residence	**48**	43	41	38	38	38	<20
R6	Residence	**51**	**46**	44	41	41	41	<20
R7	Residence	**49**	44	42	39	39	39	<20
R8	Residence	**49**	44	42	39	39	39	21
R9	Residence	**64**	**59**	**57**	**54**	**54**	**54**	20
R10	Residence	**47**	42	40	37	37	37	27
R16A	Residence	**49**	44	42	39	39	39	41
R16B	Residence	**49**	44	42	39	39	39	41
R16C	Residence	**51**	**46**	44	41	41	41	40
R20	Residence	**52**	**47**	45	42	42	42	**48**
R21A	Residence	**56**	**51**	**49**	**46**	**46**	**46**	**52**
R21B	Residence	**56**	**51**	**49**	**46**	**46**	**46**	**52**
R22	Residence	**64**	**59**	**57**	**54**	**54**	**54**	**46**
R25	Residence	**60**	**55**	**53**	**50**	**50**	**50**	**46**
R27	Residence	**50**	45	43	40	40	40	28
R29	Residence	**47**	42	40	37	37	37	38
R30	Residence	**48**	43	41	38	38	38	44
R31	Residence	**48**	43	41	38	38	38	40
R79	Residence	**46**	41	39	36	36	36	**48**
R90	Residence	**46**	41	39	36	36	36	28

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.

The Historical Heritage Impact Assessment (Umwelt 2023) identified that there are no listed historical heritage items within the Project Area. Further, the nearest local heritage item is 'Pelican' Homestead (Item I599 on the Goulburn Mulwaree LEP 2009), which is located approximately 3.4 km west of the Project Area.

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

- 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 *Construction Noise and Vibration Guideline* (CNVG) (TfNSW, 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 separation distances between the Project Area boundary and the nearest external sensitive receivers (i.e. approximately 137 m), vibration impacts from construction activities are anticipated to be negligible.

6.3 .Construction Noise and Vibration Mitigation Measures and Strategies

The construction noise levels are predicted to exceed the nominated noise management level (i.e. 45 dB(A)) at 21 receivers, as outlined in **Table 6.2**, therefore reasonable and feasible noise management and mitigation strategies should be considered during the construction phase of the Project.

6.3.1 General Noise Controls

The construction noise levels are predicted to exceed the nominated noise management levels, 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 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 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.
- If required a noise verification program should be carried out in accordance with the NVMP for the Project (note, verification is not applicable for projects less than 3 weeks). The draft CNVMP within Appendix G details what scenarios and receivers are triggered for verification monitoring.
- 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 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.

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 (7.00 am–6.00 pm)** **Saturday (8.00 am–1.00 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. 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)	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. 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. Attended measurements are to be undertaken within a period of 14 days from the commencement of construction activities (or as agreed with the DPHI). 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.
Specific Notification (SN)	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. 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. 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.

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

Table 6.7 Proposed Noise Mitigation Measures

Rec ID [1]	Structure	Construction Scenario						
		Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7
R4	Residence	-	-	-	-	-	-	-
R5	Residence	-	-	-	-	-	-	-
R6	Residence	-	-	-	-	-	-	-
R7	Residence	-	-	-	-	-	-	-
R8	Residence	-	-	-	-	-	-	-
R9	Residence	PN, V	PN, V	PN, V	-	-	-	-
R10	Residence	-	-	-	-	-	-	-
R16A	Residence	-	-	-	-	-	-	-
R16B	Residence	-	-	-	-	-	-	-
R16C	Residence	-	-	-	-	-	-	-
R20	Residence	-	-	-	-	-	-	-
R21A	Residence	PN, V	-	-	-	-	-	-
R21B	Residence	PN, V	-	-	-	-	-	-
R22	Residence	PN, V	PN, V	PN, V	-	-	-	-
R25	Residence	PN, V	-	-	-	-	-	-
R27	Residence	-	-	-	-	-	-	-
R29	Residence	-	-	-	-	-	-	-
R30	Residence	-	-	-	-	-	-	-
R31	Residence	-	-	-	-	-	-	-
R79	Residence	-	-	-	-	-	-	-
R90	Residence	-	-	-	-	-	-	-

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.
- 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 Port Botany in Sydney or Port Kembla south of Wollongong to the Project Area via the Hume Highway. Two transport routes via the Hume Highway to the Project have been considered:

- Option 1: Hume Highway – Hume Highway – Sydney Road – Reyolds Street – Grafton Street – Sloane Street – Braidwood Road – Bungonia Road – Windellama Road.
- Option 2: Hume Highway – Hume Street – Garroorigang Road – Sloane Street – Braidwood Road – Bungonia Road – Windellama Road.

The daily construction traffic movements are based on the peak construction traffic numbers as considered in the Traffic Impact Assessment (TIA) undertaken for the Project by The Transport Planning Partnership (TTPP, 2024), and are:

- 250 light vehicle movements (cars, vans, utes)
- 60 shuttle bus movements
- 137 heavy vehicle movements.

Up to ten (10) oversize/overmass (OSOM) two-way vehicle movements are expected for the full duration of the construction phase to deliver the substation components.

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

- Existing traffic along Windellama Road is based on the automatic tube count (ATC) data from Appendix A of the TIA. For a conservative assessment the ATC data has also been adopted for Bungonia Road and Braidwood Road.
- 50% of the daily Project-related light-vehicle movements will be on the roads travelling to the Project Area during the night period (i.e., prior to 7.00 am).
- 50% of the daily Project-related shuttle buses will be on the roads travelling to the Project Area during the night period (i.e., prior to 7.00 am). The shuttle buses for construction workers have been assessed as heavy vehicles.
- Daily Project-related heavy-vehicle movements will be spread evenly throughout the day (i.e., averaged on an hourly basis).
- All heavy vehicle transportation (including buses) will access the Project Area from the north via Windellama Road.
- It is assumed that 90% of light vehicle traffic would travel to the site from the north. Potential traffic noise impacts south of Project Area is anticipated to be negligible and has not been assessed further.

- A posted speed limit of 100 km/h for Windellama Road. (Note, the posted speed limited along Windellama Road at the Goulburn end is 80 km/km increasing to 100 km/hr south of the Hume Highway).
- In accordance with the RNP and **Table 4.13** Windellama Road is classified as a sub-arterial 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 Merino Solar Farm project is 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]	Merino Solar Farm [3]	Combined traffic volume (Existing + Project)	Cumulative traffic volume (Existing + Project + External Projects)
Windellama Rd / Bungonia Rd / Braidwood Rd North of Project Area	Day (7.00 am–10.00 pm)	Light Vehicles	941	113	127	1053	1180
		Heavy Vehicles	183	156	175	338	513
		Total	1123	268	302	1391	1693
	Night (10.00 pm–7.00 am)	Light Vehicles	79	113	127	192	318
		Heavy Vehicles	30	41	47	71	118
		Total	109	154	173	263	436

Notes: [1] Volumes based on automatic tube count (ATC) data undertaken on Windellama Road from Appendix A of the TIA. For a conservative assessment the ATC data has also been adopted for Bungonia Road and Braidwood Road.

[2] Volumes and compositions based on Section 4.2 of the TIA.

[3] Volumes based on Section 5.7 of the TIA, which indicates that the Merino Solar Farm will generate 12.5% more construction traffic than the Gundary Solar Farm Project.

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** are based on the nominated traffic volumes presented in **Table 7.1**.

Table 7.2 Windellama Rd / Bungonia Rd / Braidwood Rd Predicted Construction Traffic Noise levels, L_{Aeq}, 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
Windellama Rd / Bungonia Rd / Braidwood Rd North of Project Area	Day (7.00 am–10.00 pm) $L_{Aeq(15\ hour)}$	10 m	62	64	60	2.0	Complies – change not > 2 dB
		20 m	59	61	60	1.9	Complies – change not > 2 dB
		30 m	57	59	60	N/A [1]	Complies – limit not exceeded
		40 m	55	57	60	N/A [1]	Complies – limit not exceeded
	Night (10.00 pm–7.00am) $L_{Aeq(9\ hour)}$	10 m	56	60	55	3.8	**Exceeds – limit exceeded & change > 2 dB**
		20 m	52	56	55	3.8	**Exceeds – limit exceeded & change > 2 dB**
		30 m	50	54	55	N/A [1]	Complies – limit not exceeded
		40 m	48	52	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.*

The predicted road traffic noise levels for Windellama Road, Bungonia Road and Braidwood Road indicate that:

- The potential traffic noise level is predicted to comply with the daytime noise limit of 60 dB(A) $L_{Aeq(15hr)}$. The potential traffic noise level is predicted to comply with the night-time noise limit of 55 dB(A) $L_{Aeq(9hr)}$ at 30 m from the road edge. Within 30 m, exceedance of the limits is predicted, as additional Project traffic exceeds the 2 dB(A) allowance.
- Of the identified receivers in **Appendix B** (i.e. those within 4 km of the Project Area), one receiver (R45) is located within 30 m of the road edge and maybe impacted by road traffic noise. However, typically, the sensitive receivers located in the vicinity of the Project Area are located at a distance greater than 30 m from the road edge 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 is based on peak construction traffic movements.
- Additionally, the Project has committed to using buses to reduce the total number of light vehicles movements.

Regarding potential traffic noise impacts on the remaining sections of the two transport routes (i.e. from Sloane Street to the Hume Highway) the peak hour traffic surveys with Appendix A of the TIA were referred to. Given existing traffic volumes along these roads are substantially higher than Windellama Road (at least double), heavy vehicle movements may be split between the two transport routes, and light vehicles and shuttle buses will travel through Goulburn from multiple directions, traffic noise impacts whilst possible are not anticipated.

There is a section of Garroorigang Road (south of Finlay Road), where existing traffic volumes are approximately 30% lower than Windellama Road. However, the nearest residential receiver is located a substantial distance (230 m) from the carriageway, so noise impacts are not anticipated.

7.2 Operational Traffic

Operational traffic generation is expected to be in the order of up to 10 two-way light vehicle movements per day, therefore road traffic noise from operational traffic is anticipated to be negligible.

8.0 Cumulative Assessment

8.1 Nearby Projects for Consideration

There are a number of existing and proposed projects within the region, as shown in **Table 8.1**.

Apart from the proposed Merino Solar Farm project, these other projects are located at significant distances (i.e. greater than 3.5 km) from the Project Area and do not use the same local traffic route. Therefore, the assessment of cumulative impacts has been limited to the potential contribution from Merino Solar Farm.

Table 8.1 Developments and Proposed Developments within Vicinity of Project

Name (Development / Developer)	Project type	Approximate Location	Status
Existing Developments			
Goulburn Airport	Airport	3.5 km northwest of Project	Operating
One Raceway	Car Racing Track	5 km west of Project	Operating
Goulburn Base Hospital Redevelopment	Hospital	10 km north of Project	Under construction / Operating
Ardmore Park Quarry	Quarry	14 km southeast of Project	Operating
Gunlake Quarry	Quarry	26 km northeast of Project	Operating
Lynwood Quarry	Quarry	27 km northeast of Project	Operating
Marulan South Limestone Mine	Mine	23 km northeast of Project	Operating
Peppertree Quarry	Quarry	23 km northeast of Project	Operating
Woodlawn Bioreactor	Waste Facility	29 km southwest of Project	Operating
Woodlawn Mine	Mine	28 km southwest of Project	Operating
Developments Currently Under Assessment			
Merino Solar Farm	Solar Farm	1 km west of Project	Prepare EIS
Goulburn Poultry Processing Mixed Use Development	Mixed Use Development	11 km north of Project	Withdrawn
Marulan Quarry	Quarry	15 km northeast of Project	Prepare EIS
Woodlawn Advanced Recovery Centre	Waste Facility	29 km south of Project	Response to submissions
Marulan Gas Fired Power Station	Power station	35 km northeast of Project	Approved
Marulan Solar Farm	Solar Farm	35 km northeast of Project	Approved
Western Range Solar Farm	Solar Farm	60 km west of Project	Prepare EIS
Wattle Creek Solar Farm	solar farm	50 km northeast of Project	Prepare EIS
Wattle Creek BESS	BESS	50 km northeast of Project	Prepare EIS
Crookwell 3 Wind Farm	Wind Farm	50 km north of Project	Approved
Hume Link	500 kV transmission line	55 km north of Project	Under Assessment
Gunning Solar Farm	Solar Farm	56 km west of Project	response to submissions

Name (Development / Developer)	Project type	Approximate Location	Status
Springdale Solar Farm	Solar farm	58 km southwest of Project	Approved
Blind Creek Solar Farm	Solar Farm	43 km southwest of Project	Approved
Paling Yards Wind Farm	Wind farm	76 km north of Project	Response to submissions
Yass Solar Farm	Solar farm	77 km west of Project	Prepare EIS
Wallaroo Solar Farm	Solar Farm	78 km southwest of Project	under assessment
Coppabella Wind Farm	Wind farm	100 km west of Project	Approved

8.1.1 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 project intrusiveness noise level (PINL), described in **Section 4.1**, aims to protect against significant changes in noise levels, whilst the project amenity noise level (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 $L_{Aeq,15minute}$ 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 Project as the project noise trigger levels (PNTL). The most stringent PINL/PNTLs of 35 dB(A) $L_{Aeq,15minute}$ are for the night time period. The corresponding night time PANLs are 38 dB(A) $L_{Aeq,15minute}$. The maximum predicted $L_{Aeq,15minute}$ under default worst-case meteorological in Table 5.2 is 35 dB(A), 3 dB below the PANL.

Additionally, the NPfI notes that cumulative industrial noise does not need to be a consideration when there are no other industries present in the area and are unlikely to be introduced into the future. When this is the case, the relevant recommended amenity noise level can be assigned as the PANL for the Project. If this was adopted, the maximum predicted $L_{Aeq,15minute}$ under default worst-case meteorological would be 8 dB below the adopted PANL.

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

8.1.2 Construction Noise

It is assumed that the construction phase of the Gundary Solar Farm and Merino Solar Farm project would occur concurrently, should the projects proceed as proposed. Therefore, there is potential for cumulative construction noise at those receivers located between both project areas, near Windellama Road. These would include R16A, R16B, R16C, R20, R21A, R21B, R22, R25, R27, R29, R30, R31, R79 and R90.

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.

8.1.3 Road Traffic Noise

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

The cumulative traffic noise levels considering the simultaneous construction traffic from Merino Solar Farm on Windellama Rd / Bungonia Rd / Braidwood Rd are presented in **Table 8.2**.

Table 8.2 Windellama Rd / Bungonia Rd / Braidwood Rd Predicted Cumulative Construction Traffic Noise levels, L_{Aeq}, 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
Windellama Rd / Bungonia Rd / Braidwood Rd North of Project Area	Day (7.00 am–10.00 pm) $L_{Aeq(15\ hour)}$	10 m	62	66	60	3.4	**Exceeds – limit exceeded & change > 2 dB**
		20 m	59	62	60	3.4	**Exceeds – limit exceeded & change > 2 dB**
		30 m	57	60	60	N/A [1]	Complies – limit not exceeded
		40 m	55	58	60	N/A [1]	Complies – limit not exceeded
	Night (10.00 pm–7.00 am) $L_{Aeq(9\ hour)}$	10 m	56	62	55	6.0	**Exceeds – limit exceeded & change > 2 dB**
		20 m	52	58	55	6.0	**Exceeds – limit exceeded & change > 2 dB**
		30 m	50	56	55	6.0	**Exceeds – limit exceeded & change > 2 dB**
		40 m	48	54	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.*

The predicted road traffic noise levels for Windellama Road, Bungonia Road and Braidwood Road indicate that:

- The potential traffic noise level is predicted to comply with the daytime noise limit of 60 dB(A) $L_{Aeq(15hr)}$ at 30 m from the road edge and comply with the night-time noise limit of 55 dB(A) $L_{Aeq(9hr)}$ at 40 m from the road edge. Within these distances, exceedance of the limits is predicted, as additional Project traffic exceeds the 2 dB(A) allowance.

- Of the identified receivers in **Appendix B** (i.e. those within 4 km of the Project Area), two receivers are located within 40 m of the road edge and maybe impacted by road traffic noise. However, typically, the sensitive receivers located in the vicinity of the Project Area are located at a distance greater than 40 m from the road edge 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 both 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 possible that a similar approach may be adopted by the Merino Solar Farm project.

Regarding potential traffic noise impacts on the remaining sections of the two transport routes (i.e. from Sloane Street to the Hume Highway) the peak hour traffic surveys with Appendix A of the TIA were referred to. Given existing traffic volumes along these roads are substantially higher than Windellama Road (at least double), heavy vehicle movements for the two Projects may be split between the two transport routes, and light vehicles and shuttle buses will travel through Goulburn from multiple directions, traffic noise impacts whilst possible are not anticipated.

There is a section of Garroorigang Road (south of Finlay Road), where existing traffic volumes are approximately 30% lower than Windellama Road. However, the nearest residential receiver is located a substantial distance (230 m) from the carriageway, so noise impacts are not anticipated.

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 the construction as 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 proposed Gundary Solar Farm to be located near Goulburn, 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, noise impacts are predicted to occur at the nearest surrounding receivers (21 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.

Some of the construction noise mitigation measures include, the preparation of a NVMP; the use of non-tonal reversing beepers; the placement of plant away from sensitive receivers and to be turned off when not in use; employee, contractor and subcontractor inductions, addressing how to minimise potential noise impacts; consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures; and contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.

Project construction-related road traffic noise has been assessed and it was found that exceedance of the noise limits was predicted during the night period, within 30 m of Windellama Road, Bungonia Road and Braidwood Road. However, with the exception of one receiver which may be impacted by road traffic noise, given the sensitive receivers located in the vicinity of the Project Area are typically located at a distance greater than 30 m from the road, additional road traffic noise is likely to be negligible for the majority of sensitive receivers in the area.

Potential operational noise levels have been assessed in accordance with the *Noise Policy for Industry* (NPfI, 2017). This assessment found that with the incorporation of some noise control measures (**Section 5.3**) the Project is expected to comply with the applicable day, evening and night-time noise limits at nearby existing sensitive receivers not involved with the Project.

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 Merino 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 Windellama Road, Bungonia Road and Braidwood Road. However, with the exception of two receivers which may be impacted by road traffic noise, 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, Roads and Maritime, v 1.0, 2016.

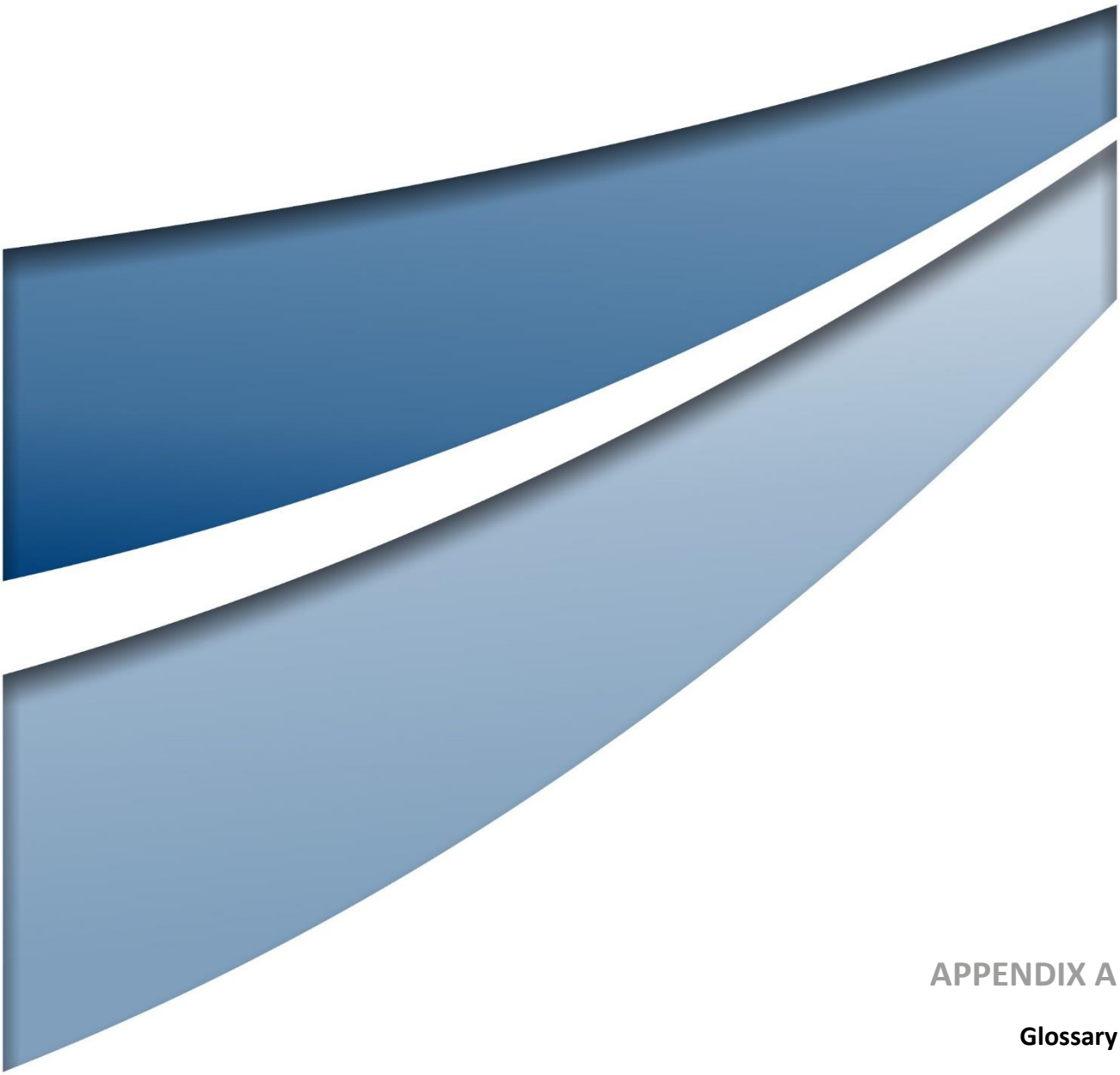
German Standard (Deutsche Norm) DIN 4150-3:1999-02 Structural Vibration Part 3: Effects of vibration on structures.

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.

Transit Noise and Vibration Impact Assessment, Federal Transit Administration, 2018.

Large-Scale Solar Energy Guideline for State Significant Development, 2018 (DPE).



APPENDIX A

Glossary

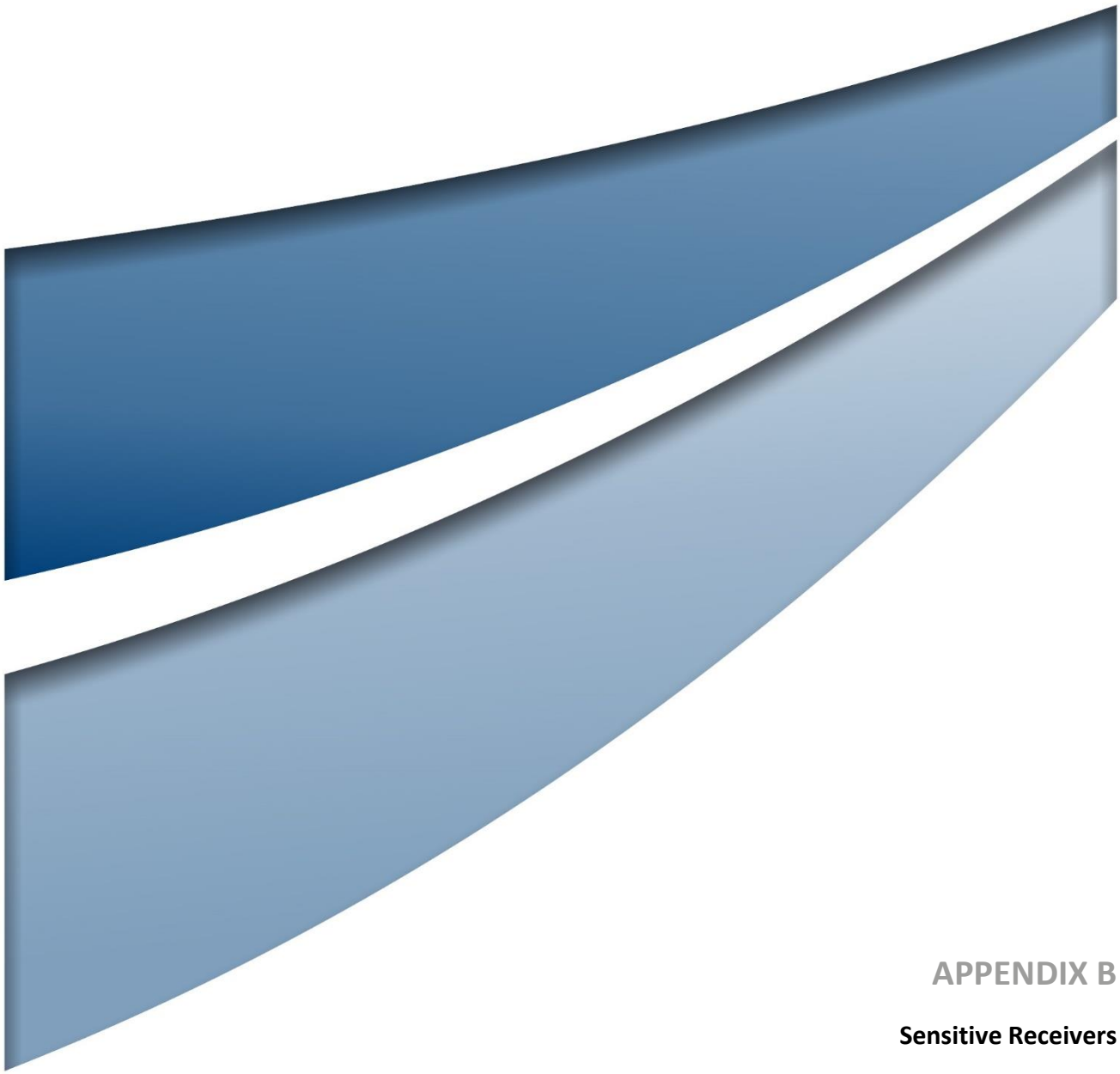
A.1 Glossary

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 7.00 am to 6.00 pm Monday to Saturday or 8.00 am to 6.00 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 6.00 pm to 10.00 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
$L_{A1,1minute}$	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 6.00 am to 7.00 am.
Night	The period between 10.00F am and 7.00 pm.
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.
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: $SPL = 10.\log10\ (p/po)^2$ where p is the rms sound pressure in pascals and po 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: $SWL = 10.\log10\ (W/Wo)$ where W is the sound power in watts and Wo 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

Sensitive Receivers

Table B.1 Sensitive Receivers

Receiver ID	Easting	Northing	Approx. distance to Project Area (m)	Approx. distance to nearest Project Feature (m)	Project Feature
Existing receiver					
R001	754289.9	6136361	1,803	1,860	Solar panels
R002	756316	6136997	1,481	1,547	Solar panels
R003	758386.1	6142643	3,938	4,163	Solar panels
R004	755926	6138953	448	494	Solar panels
R005	756500.6	6139048	799	970	Solar panels
R006	756301.5	6139145	587	749	Solar panels
R007	756534.4	6139372	671	946	Solar panels
R008	756518.7	6139962	724	1,011	Solar panels
R009	755566.5	6139800	137	272	Solar panels
R010	755312.5	6140406	718	793	Solar panels
R011	755160.6	6142391	1,970	2,025	Solar panels
R012	755507.8	6142439	2,276	2,330	Solar panels
R013	753394.9	6143702	2,507	2,521	Centralised BESS
R014	753422.4	6143574	2,386	2,400	Centralised BESS
R015	753306.6	6143493	2,286	2,299	Centralised BESS
R016A	751423.4	6142163	639	696	Substation
R016B	751459.1	6142147	629	679	Substation
R016C	751616.9	6142154	665	682	Substation
R017	757449.5	6136841	2,482	2,517	Solar panels
R018	758260.3	6138038	2,818	2,939	Solar panels
R019	757663.7	6137313	2,490	2,514	Solar panels
R020	751364.9	6142043	510	606	Substation
R021A	751327.8	6141824	288	401	Substation
R021B	751309.8	6141797	259	388	Substation
R022	751933.2	6141603	179	393	Solar panels
R023	757574.3	6136345	2,860	2,901	Solar panels
R024	758849.1	6136325	3,961	3,994	Solar panels
R025	751470.6	6140742	281	385	Substation
R026	757732.9	6137815	2,446	2,464	Solar panels
R027	751845.6	6139913	731	886	Solar panels
R028	758493.5	6137963	3,055	3,181	Solar panels
R029	750333.2	6140827	778	1,120	Substation
R030	751143.9	6140362	714	835	Substation
R031	751309.4	6140444	604	706	Substation
R032	750511.5	6140422	881	1,202	Substation
R033	756880.2	6137292	1,768	1,800	Solar panels
R034	750388.3	6140021	1,278	1,551	Substation

Receiver ID	Easting	Northing	Approx. distance to Project Area (m)	Approx. distance to nearest Project Feature (m)	Project Feature
R035	750417.1	6139885	1,382	1,640	Substation
R036	750244.6	6139639	1,681	1,937	Substation
R037	750512.8	6139470	1,724	1,926	Substation
R038	757967.3	6141908	3,107	3,352	Solar panels
R039	755217.5	6141976	1,785	1,846	Solar panels
R040	750229.8	6137803	2,283	2,318	Solar panels
R041	750495.9	6137368	2,230	2,286	Solar panels
R042	750541.2	6137149	2,317	2,351	Solar panels
R043	750544.7	6137899	1,954	1,990	Solar panels
R044	748872.7	6137285	3,735	3,799	Solar panels
R045	750814.8	6144262	2,708	2,873	Substation
R046	750939.5	6144174	2,610	2,753	Substation
R047	753786.4	6134791	3,440	3,454	Solar panels
R048	754879	6143574	2,734	2,786	Solar panels
R049	756644.9	6142612	3,112	3,251	Solar panels
R050	749822.3	6137158	2,918	2,953	Solar panels
R051	750111.5	6137091	2,703	2,738	Solar panels
R052	758333	6142371	3,696	3,939	Solar panels
R053	758776.3	6141562	3,489	3,767	Solar panels
R054	758864.8	6138076	3,325	3,503	Solar panels
R055	753913	6145088	3,960	3,990	Solar panels
R056	754600.2	6144774	3,762	3,817	Solar panels
R057	753808.9	6143813	2,680	2,714	Solar panels
R058	755091.6	6144044	3,249	3,301	Solar panels
R059	756197.5	6143187	3,277	3,332	Solar panels
R060	755656.2	6141997	2,136	2,234	Solar panels
R061	747748.5	6143712	3,991	4,290	Substation
R062	758569.8	6142100	3,666	3,924	Solar panels
R063	750339.7	6143221	1,824	2,106	Substation
R064	750856.3	6143439	1,887	2,068	Substation
R065	758045.8	6137972	2,679	2,753	Solar panels
R066	755623.5	6142924	2,669	2,724	Solar panels
R067	755969.8	6141045	1,441	1,565	Solar panels
R068	756026.3	6140772	1,184	1,320	Solar panels
R069	755567.5	6140750	1,070	1,167	Solar panels
R070	755840.7	6140109	497	630	Solar panels
R071	756939.5	6137856	1,659	1,677	Solar panels
R072	753584.5	6134966	3,306	3,323	Solar panels
R073	753563.5	6134882	3,392	3,410	Solar panels

Receiver ID	Easting	Northing	Approx. distance to Project Area (m)	Approx. distance to nearest Project Feature (m)	Project Feature
R074	753524.5	6134751	3,528	3,546	Solar panels
R075	759649.2	6138408	3931	4,167	Solar panels
R076	750449.5	6143557	2,095	2,335	Substation
R077	749672.5	6140533	1,501	1,836	Substation
R078	750197.2	6139871	1,510	1,798	Substation
R079	750861.5	6142060	552	862	Substation
R080	750670.1	6143969	2,440	2,639	Substation
R081	750633	6143006	1,515	1,772	Substation
R082	751219	6144312	2,744	2,848	Substation
R083	757731.1	6142154	3,151	3,377	Solar panels
R084	757036.1	6138631	1,477	1,598	Solar panels
R085	756925.5	6138421	1,538	1,558	Solar panels
R086	757873	6137759	2,594	2,635	Solar panels
R087	749747.5	6139990	1,726	2,071	Substation
R088	750021.1	6137709	2,511	2,562	Solar panels
R089 (host landholder)	751969.6	6140406	522	567	Solar panels
R090	751406.7	6139701	1,137	1,216	Solar panels
R091	748689.5	6137373	3,881	3,916	Solar panels
R092	748617.2	6137250	3,988	4,023	Solar panels
R093	757592.6	6142645	3,493	3,695	Solar panels
R094	753664.2	6134686	3,566	3,580	Solar panels
R095	753458.6	6134814	3,478	3,494	Solar panels
R096	753349.2	6134854	3,460	3,473	Solar panels
R097	757218.3	6135608	3,124	3,175	Solar panels
R098	747715.5	6142957	3,668	3,954	Substation
R099	758556.8	6142254	3,764	4,017	Solar panels
R100	759372.7	6138830	3,557	3,820	Solar panels
R101	759146.1	6138436	3,444	3,670	Solar panels
R102	758619.7	6138276	3,017	3,206	Solar panels
R103	759069.3	6137527	3,775	3,831	Solar panels
R104	759583.5	6138086	3,977	4,183	Solar panels
R105	757528.3	6137739	2,259	2,277	Solar panels
R106	748665.7	6137095	3,996	4,037	Solar panels
Potential / Future Receiver[1]					
FR01	750898	6137371	1,900	1,930	Solar panels
FR02	750995	6138357	1,406	1,432	Solar panels

[1] Locations of the receivers on the vacant land, forming part of the Rosedale subdivision, were determined by the locations of the potential septic locations on the subdivision approval. The residence could be located elsewhere on the lot to avoid / minimise noise impacts.

Receiver ID	Easting	Northing	Approx. distance to Project Area (m)	Approx. distance to nearest Project Feature (m)	Project Feature
FR03	751570.3	6138469	821	848	Solar panels
FR04	751729.9	6137072	1,617	1,642	Solar panels
FR05	751956.1	6136905	1,700	1,721	Solar panels
FR06	752308.8	6138166	392	412	Solar panels
FR07	753010.5	6138057	373	389	Solar panels
FR08	752928.9	6137398	1,035	1,051	Solar panels
FR09	752893.7	6137132	1,303	1,319	Solar panels
FR10	752590.9	6136908	1,578	1,595	Solar panels
FR11	753048.3	6137273	1,137	1,152	Solar panels
FR12	753258.7	6138142	245	259	Solar panels
FR13	753689.3	6137599	698	717	Solar panels
FR14	754846.8	6137405	673	816	Solar panels
FR15	753868.4	6136920	1,332	1,354	Solar panels
FR16	754216.2	6136988	1,201	1,215	Solar panels
FR17	755685	6136114	1,992	2,051	Solar panels
FR18	755005.3	6135724	2,324	2,418	Solar panels
FR19	753722.5	6136026	2,238	2,258	Solar panels
FR20	753199.5	6136529	1,841	1,855	Solar panels
FR21	752497.9	6136512	1,984	2,001	Solar panels
FR22	751764.4	6139516	757	814	Solar panels

APPENDIX C

Unattended Noise Monitoring Graphs

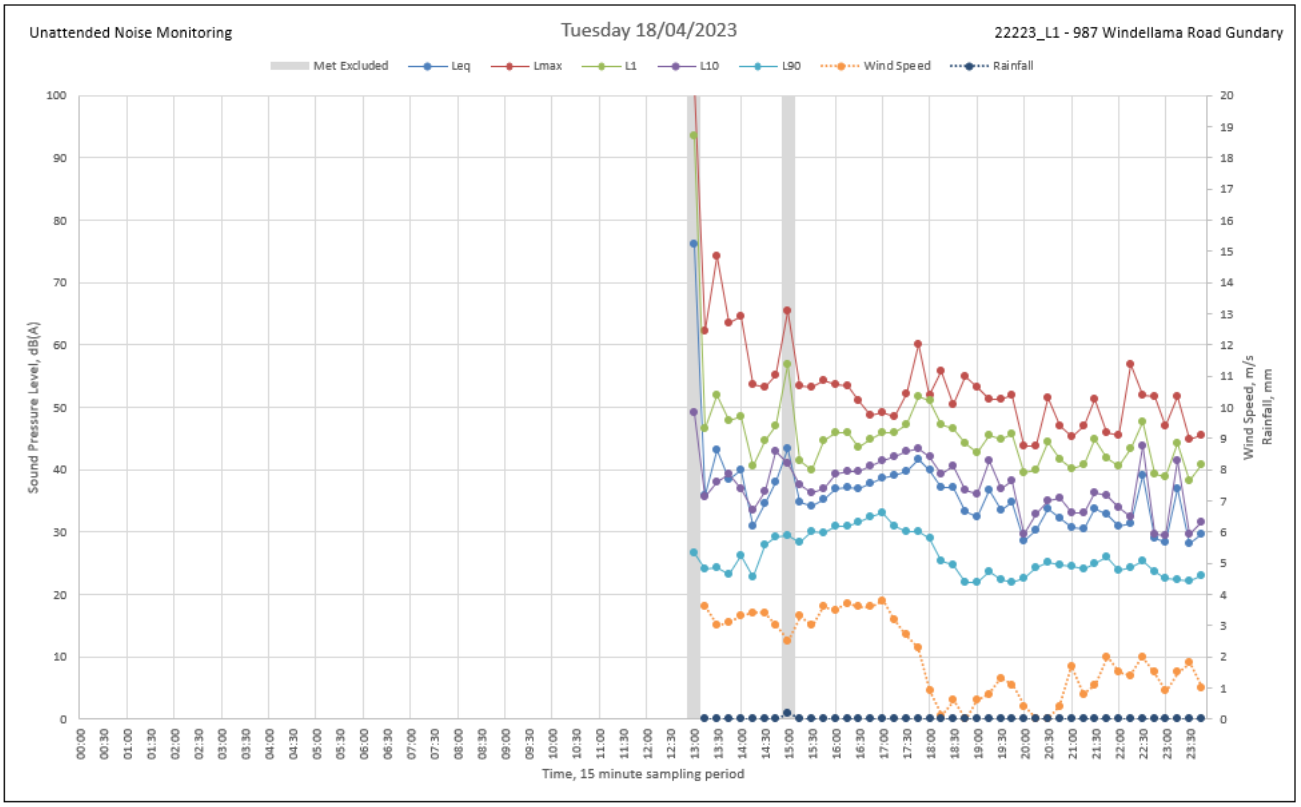


Figure C1.1 Unattended noise measurement at L1 – 18/4/2023

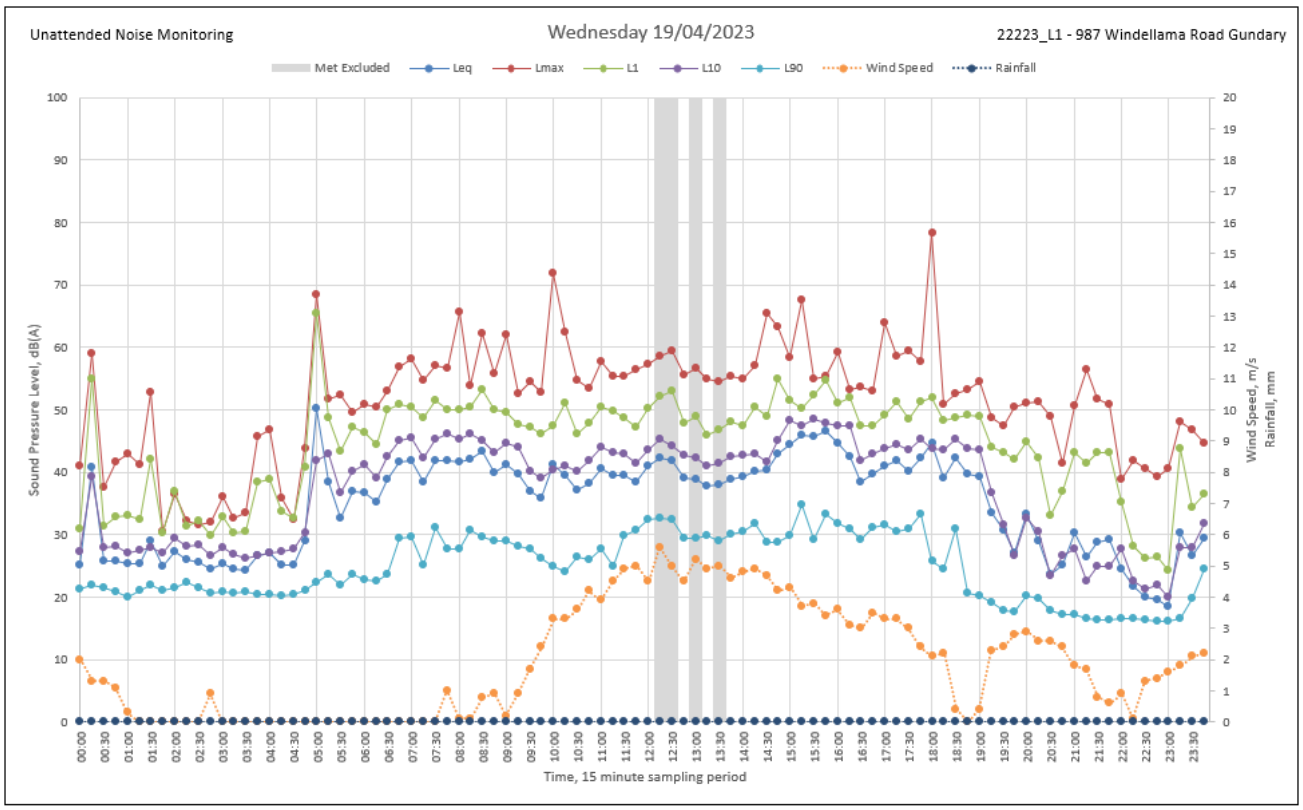


Figure C1.2 Unattended noise measurement at L1 – 19/4/2023

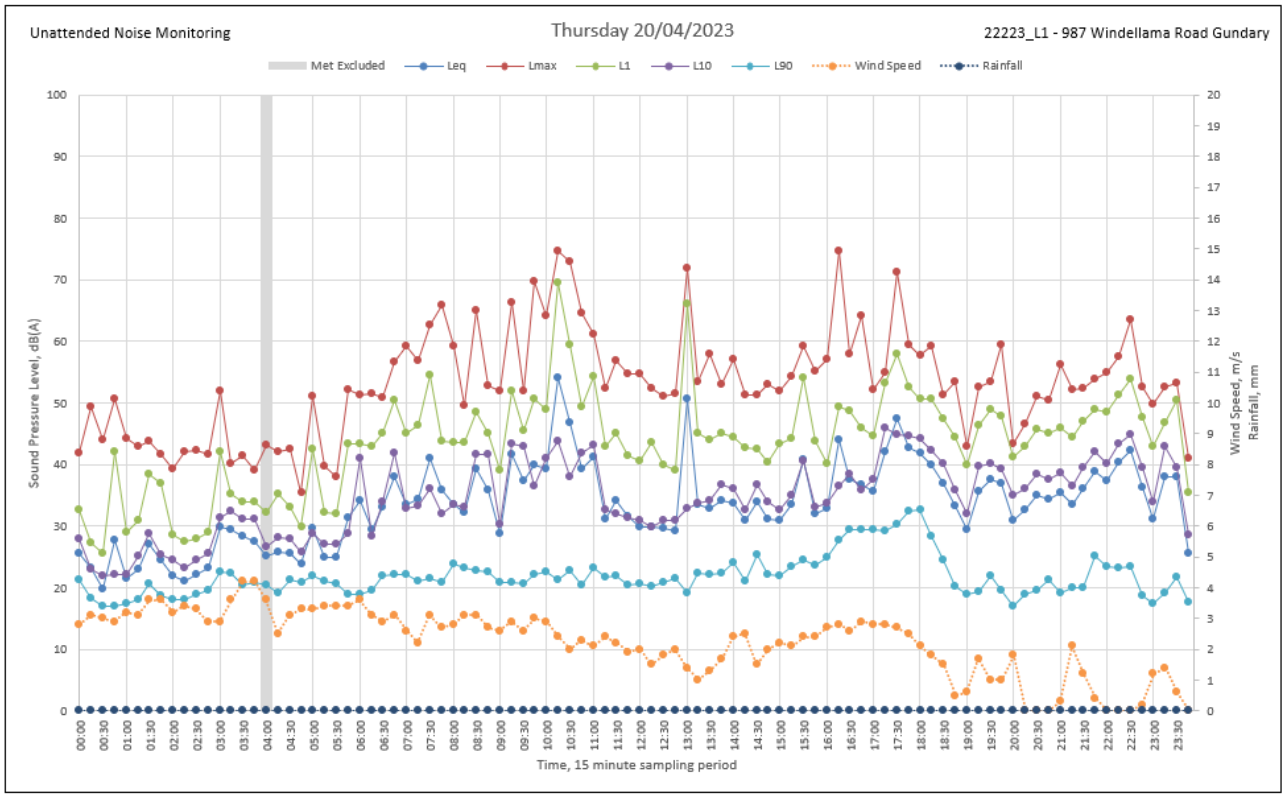


Figure C1.3 Unattended noise measurement at L1 – 20/4/2023

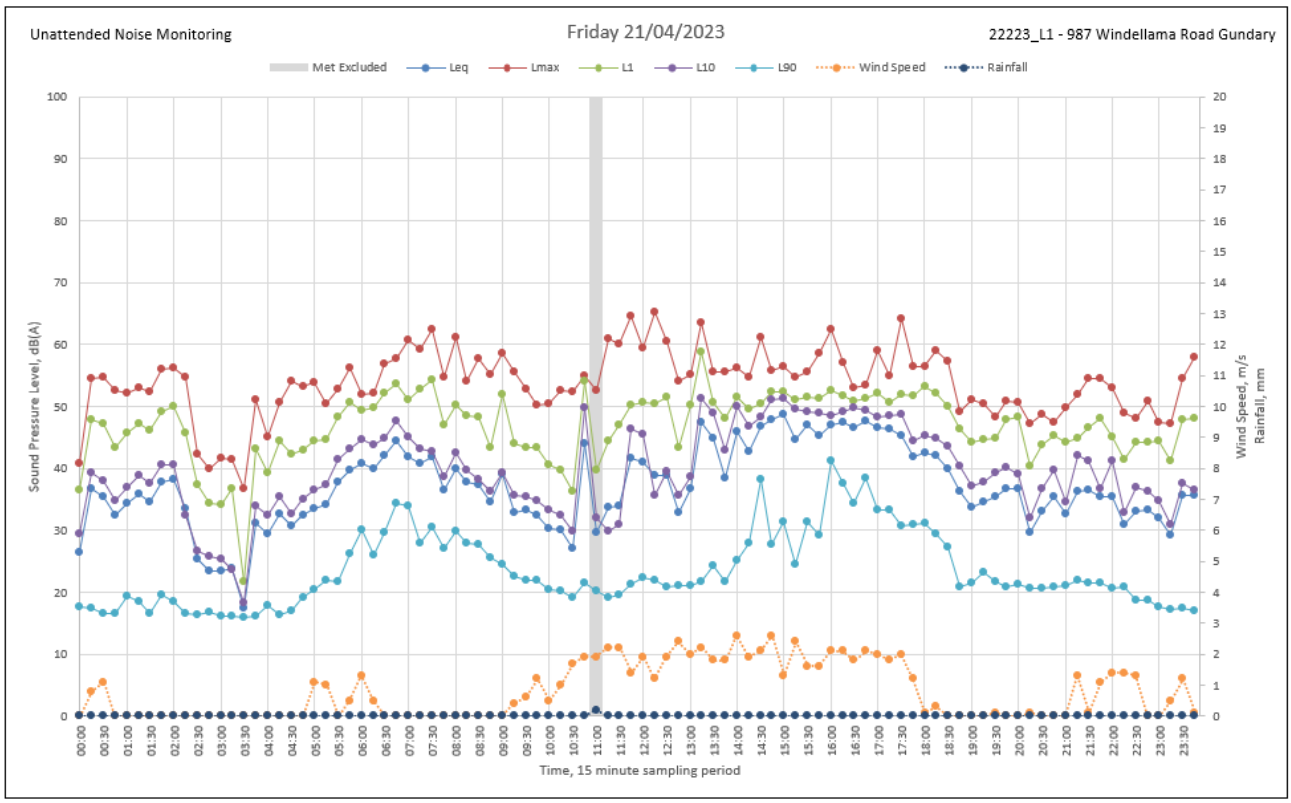


Figure C1.4 Unattended noise measurement at L1 – 21/4/2023

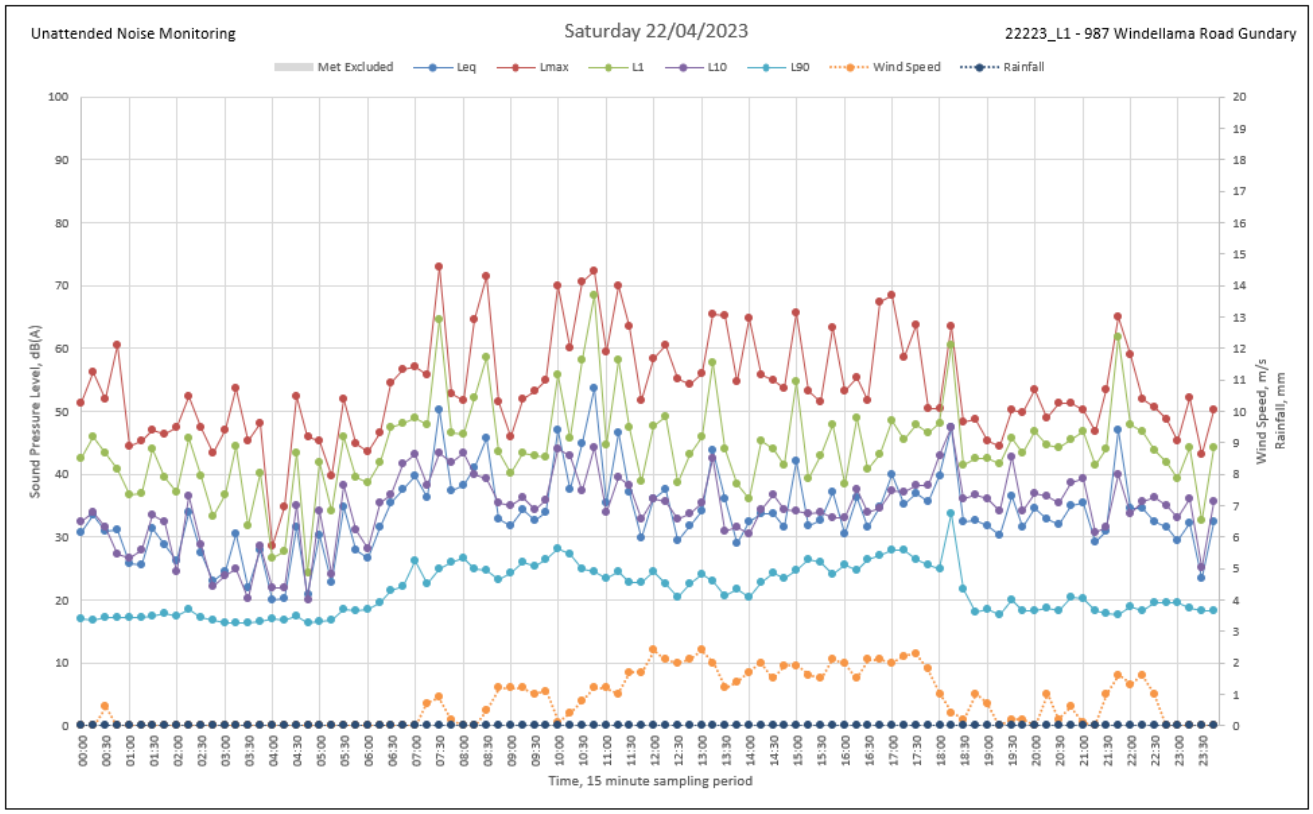


Figure C1.5 Unattended noise measurement at L1 – 22/4/2023

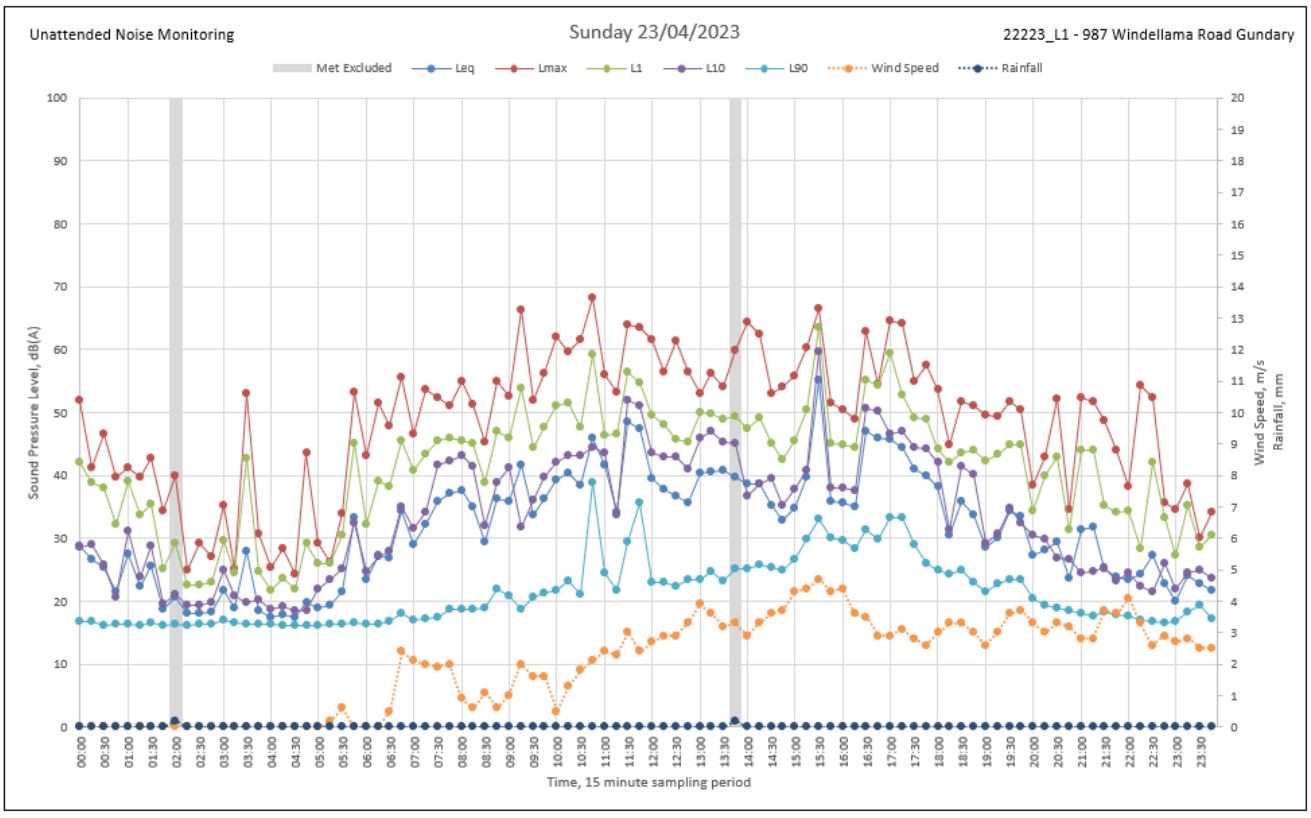


Figure C1.6 Unattended noise measurement at L1 – 23/4/2023

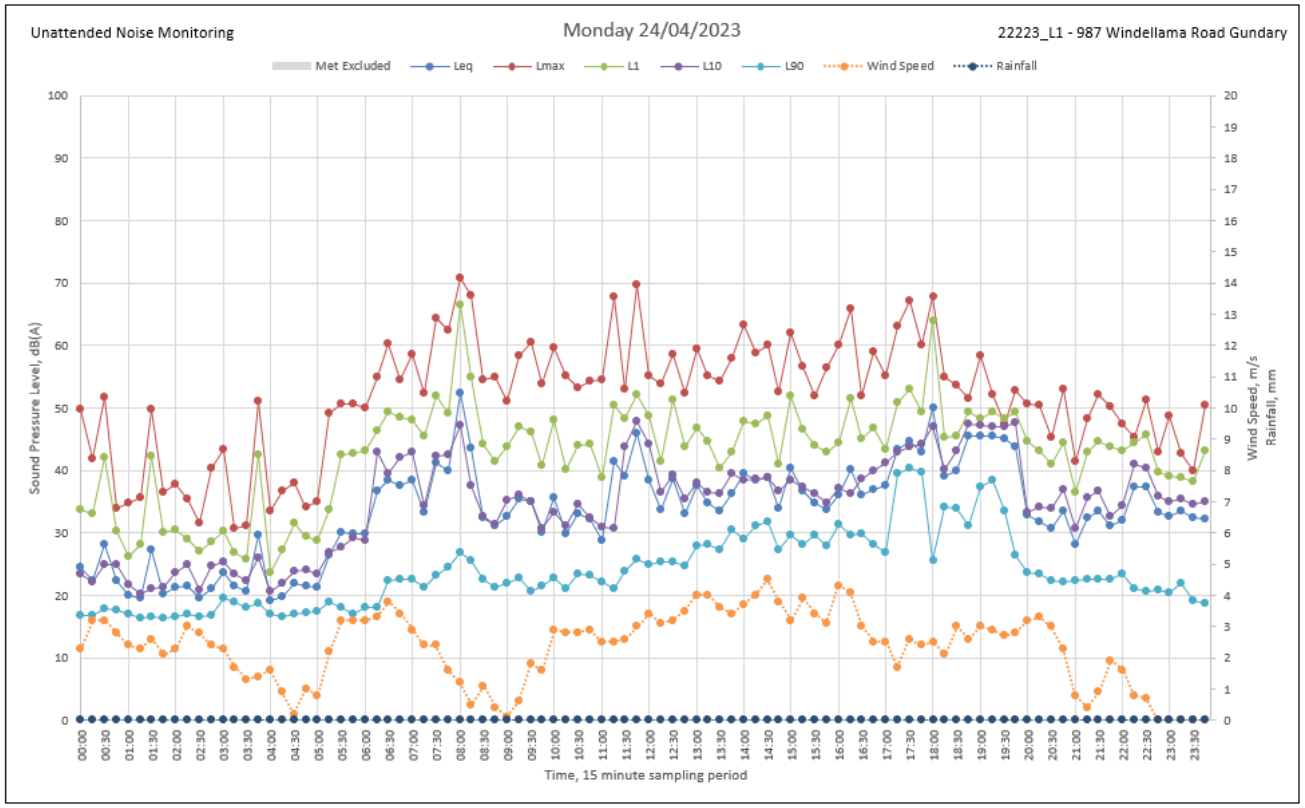


Figure C1.7 Unattended noise measurement at L1 – 24/4/2023

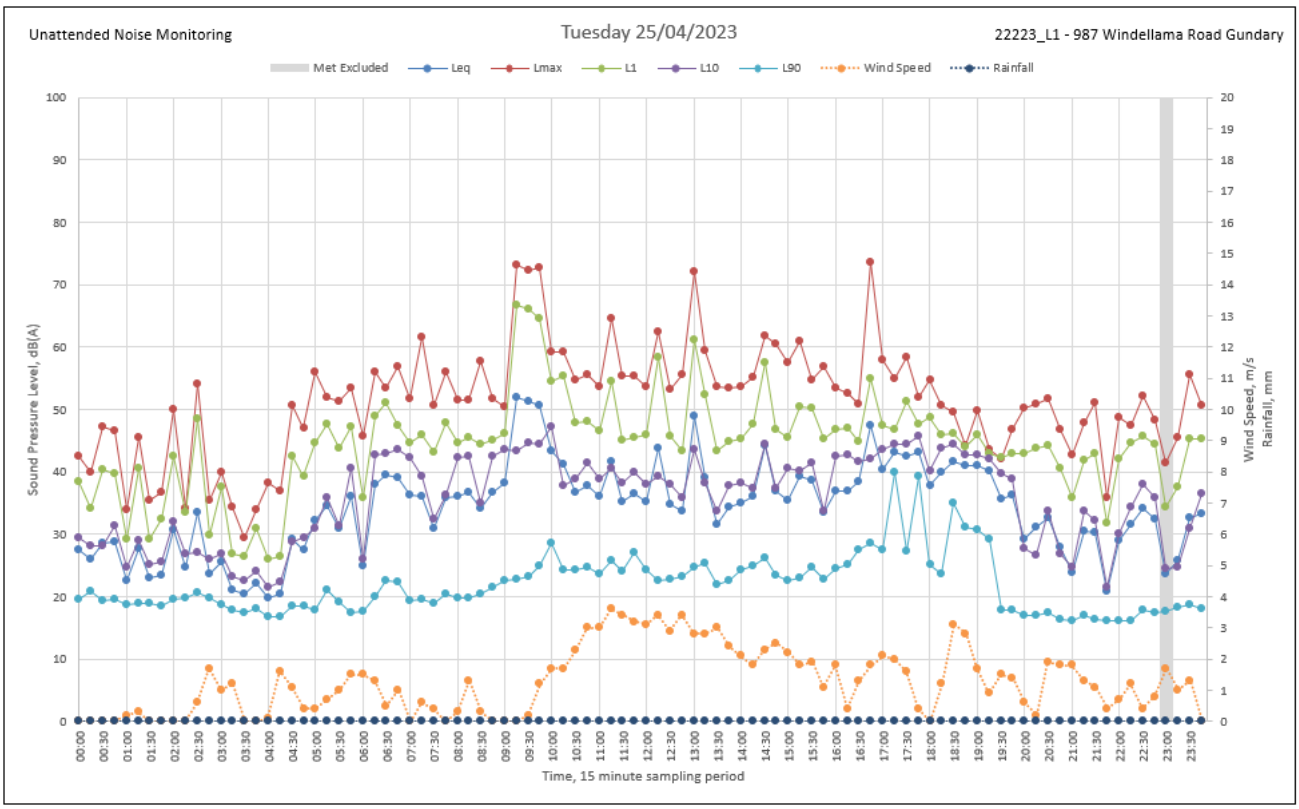


Figure C1.8 Unattended noise measurement at L1 – 25/4/2023

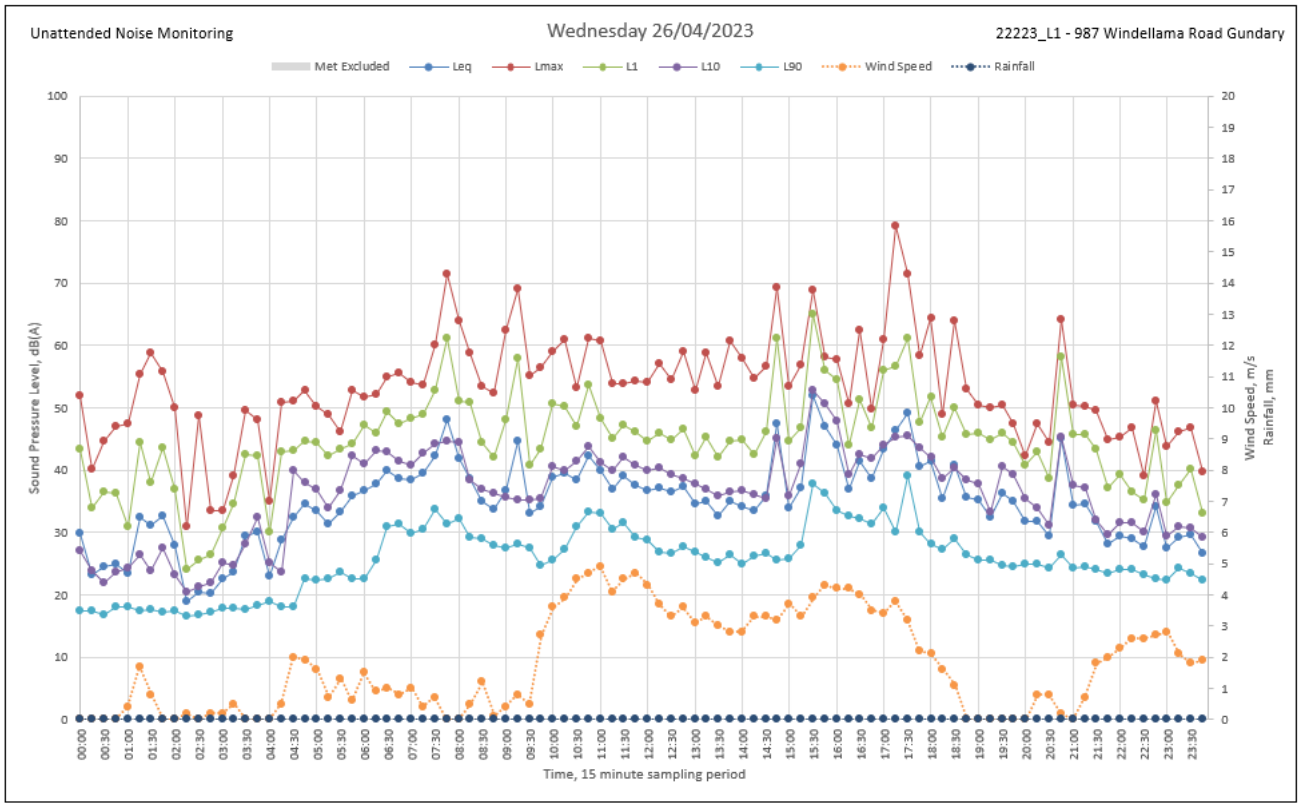


Figure C1.9 Unattended noise measurement at L1 – 26/4/2023

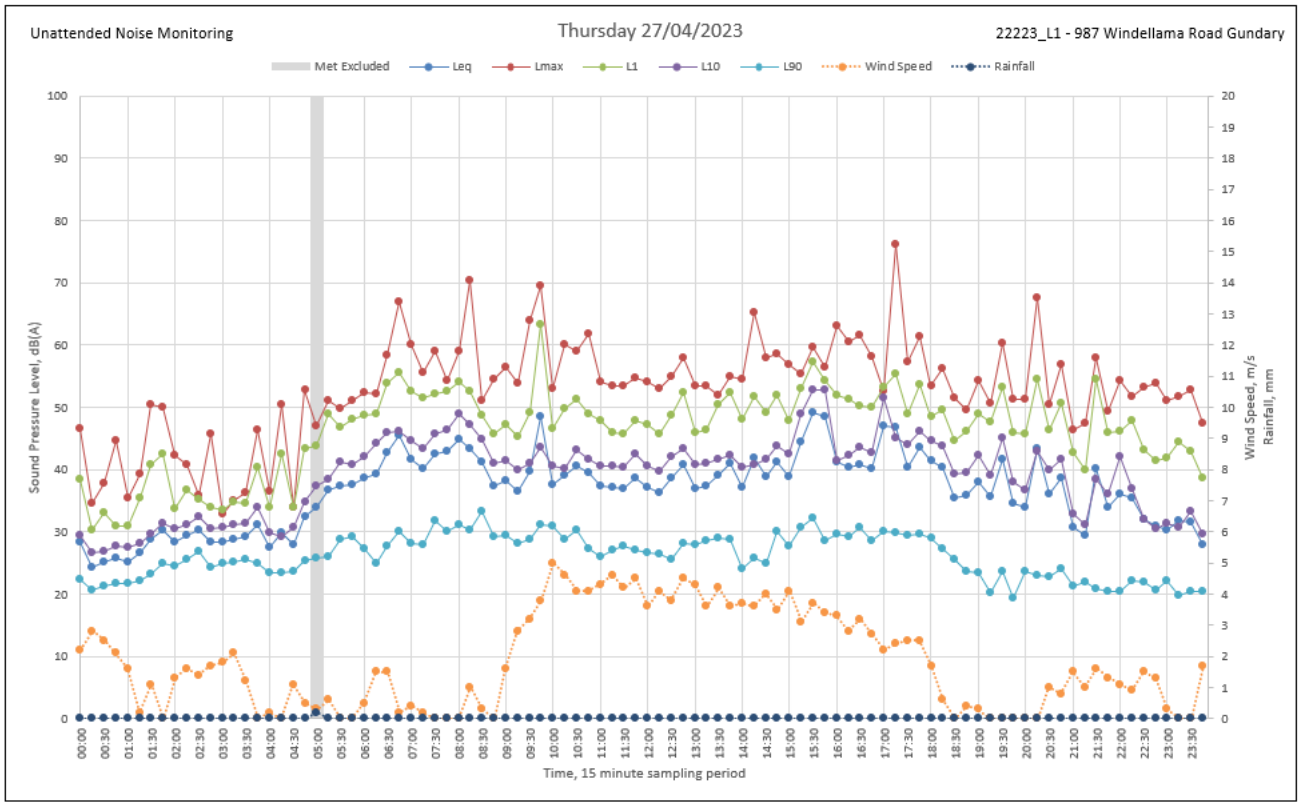


Figure C1.10 Unattended noise measurement at L1 – 27/4/2023

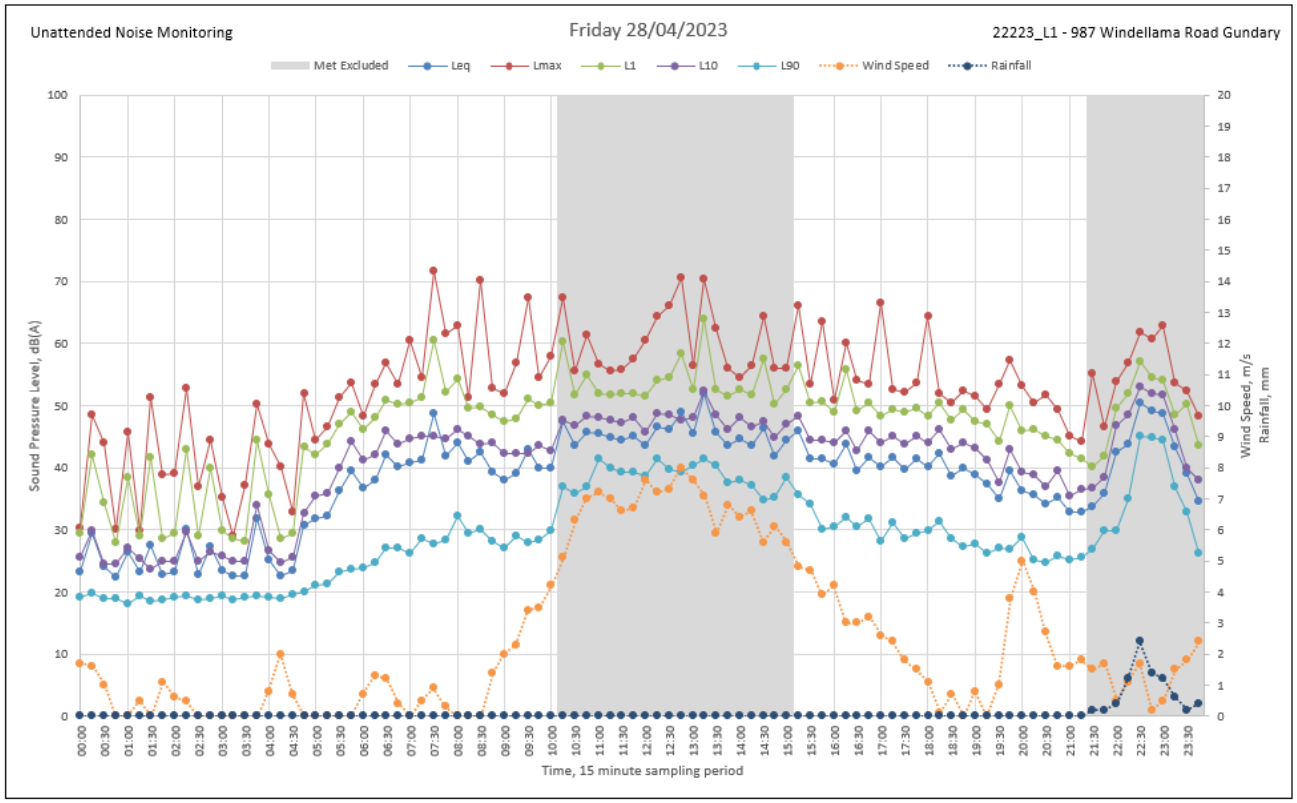


Figure C1.11 Unattended noise measurement at L1 – 28/4/2023

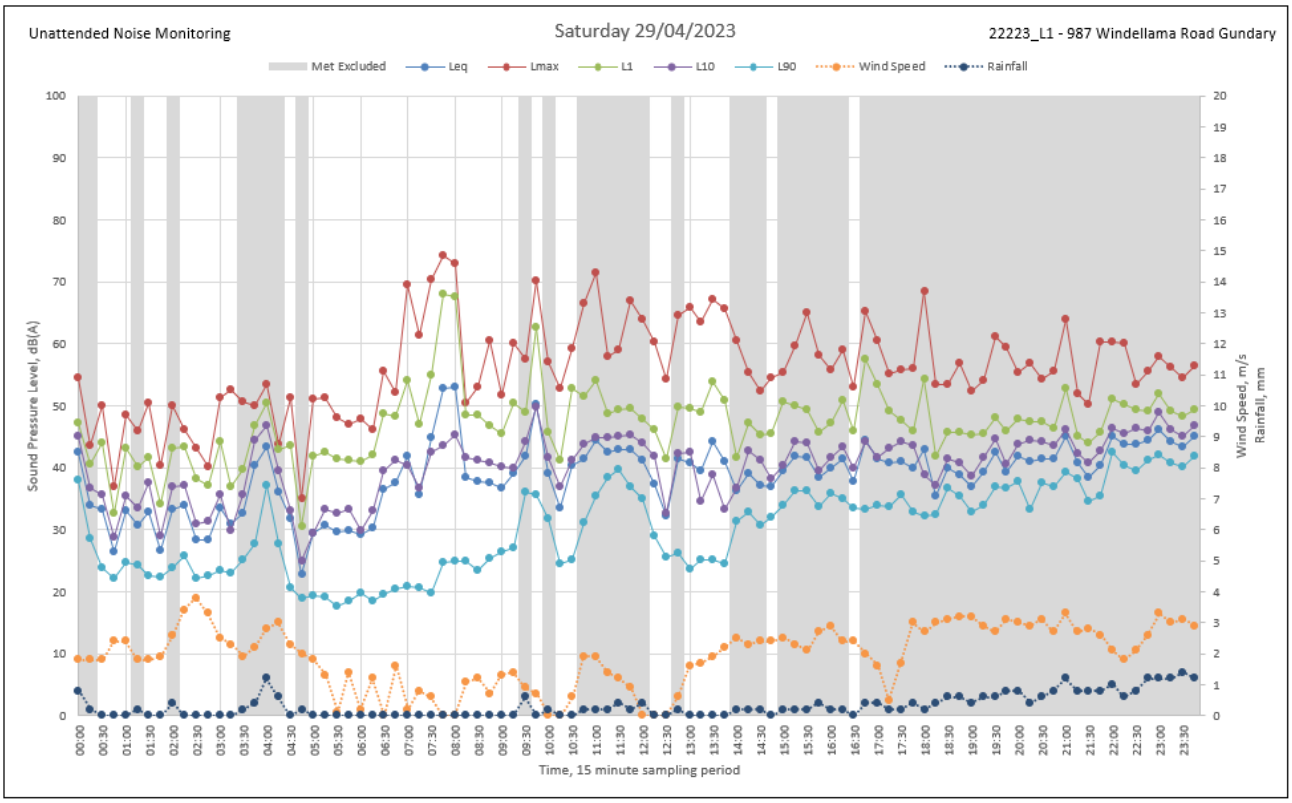


Figure C1.12 Unattended noise measurement at L1 – 29/4/2023

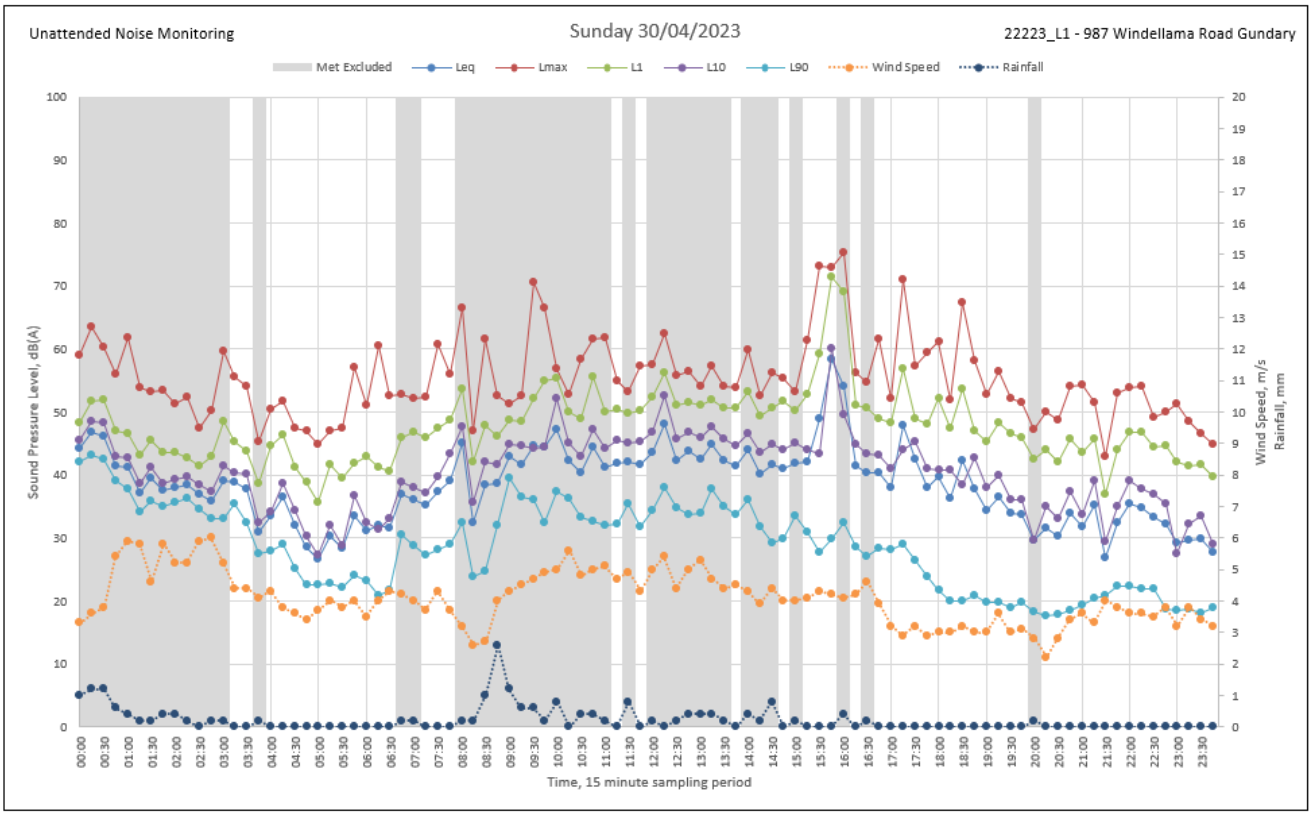


Figure C1.13 Unattended noise measurement at L1 – 30/4/2023

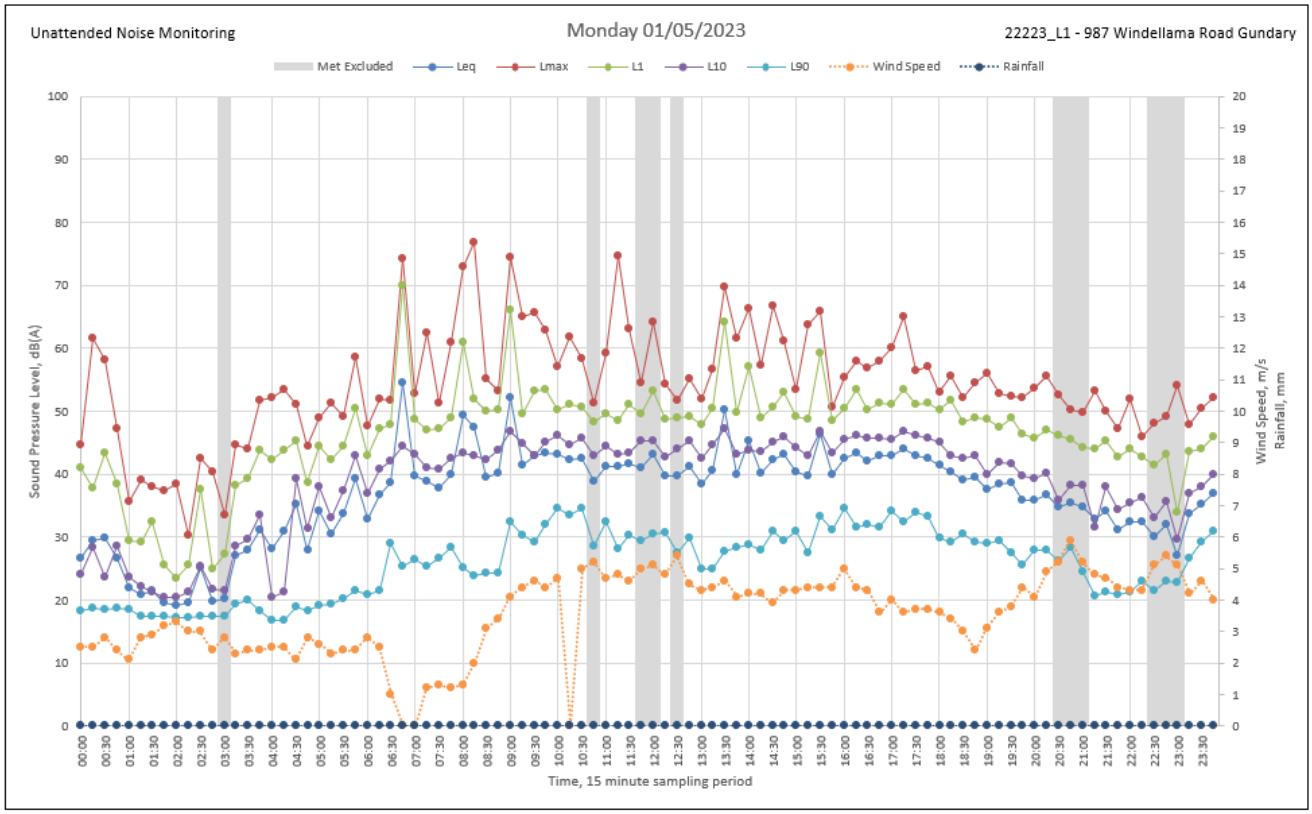


Figure C1.14 Unattended noise measurement at L1 – 1/5/2023

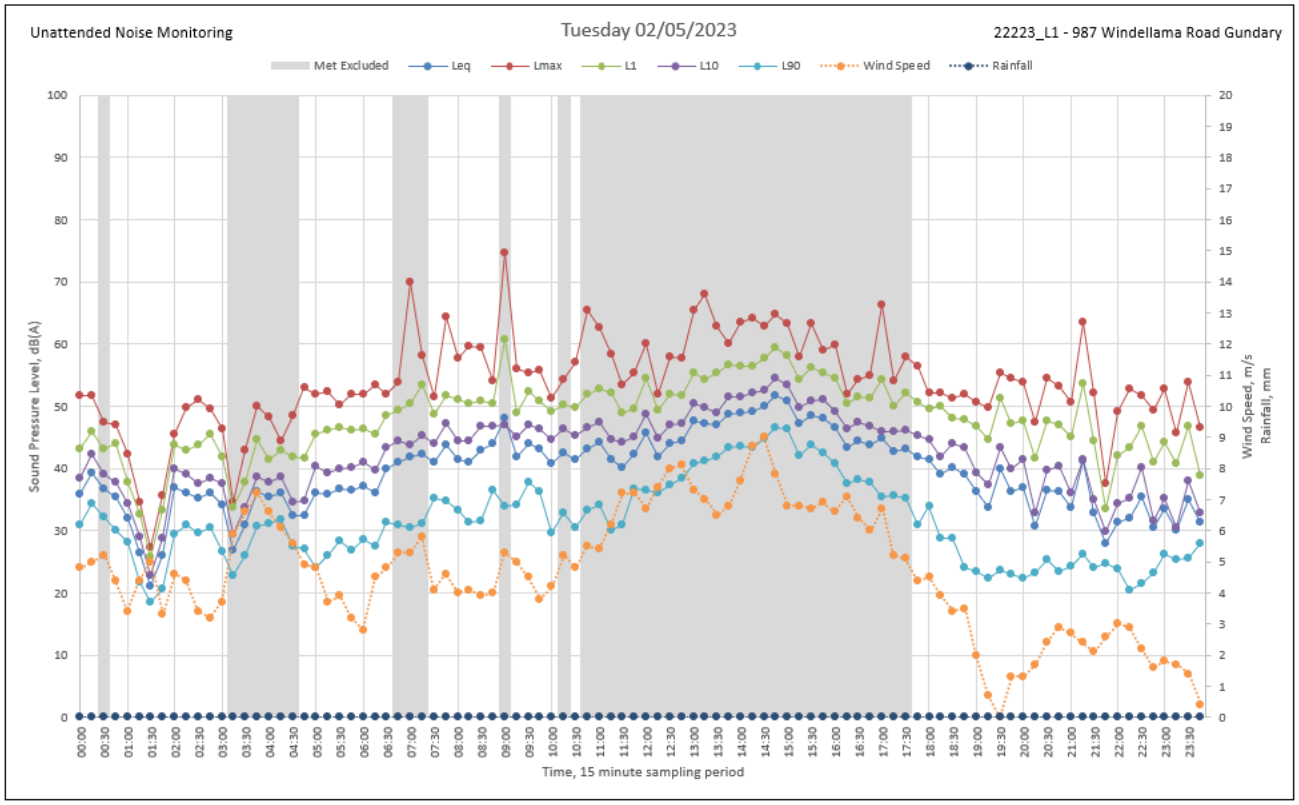


Figure C1.15 Unattended noise measurement at L1 – 2/5/2023

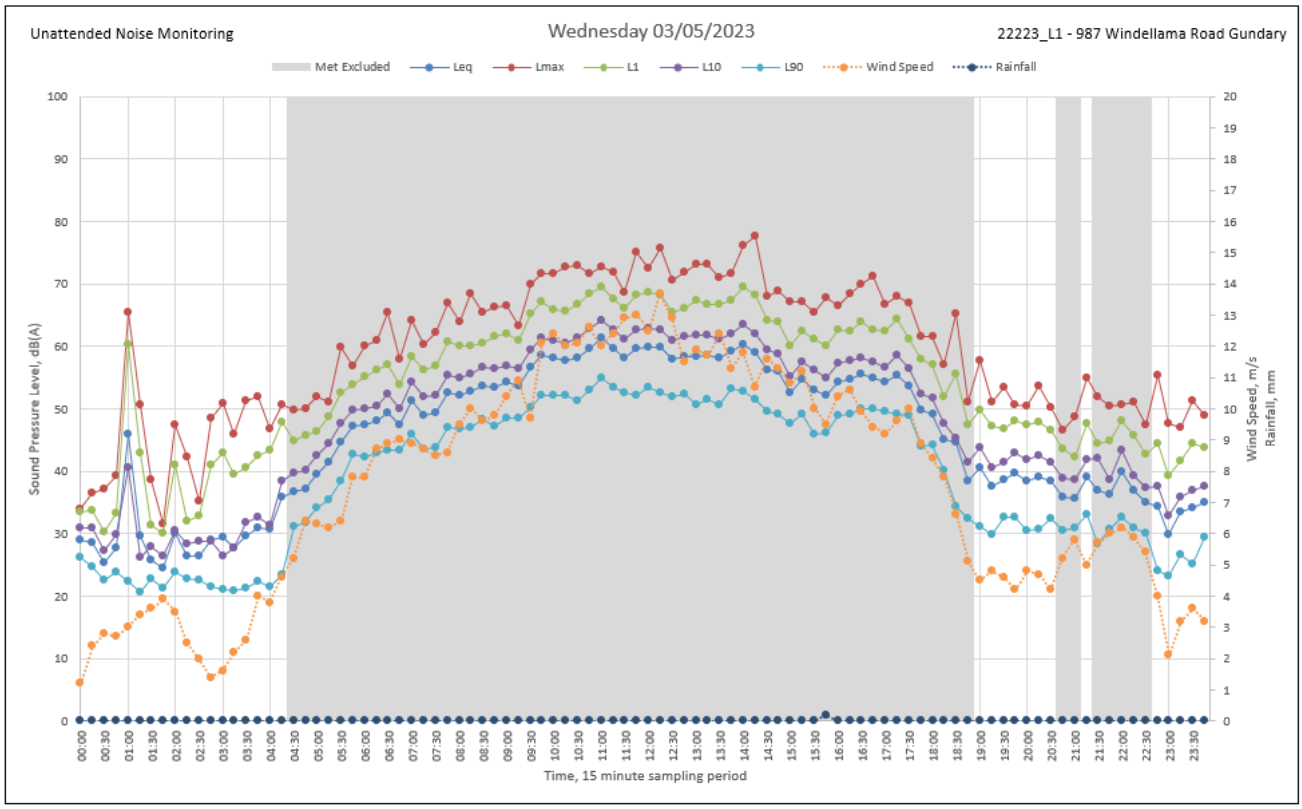


Figure C1.16 Unattended noise measurement at L1 – 3/5/2023

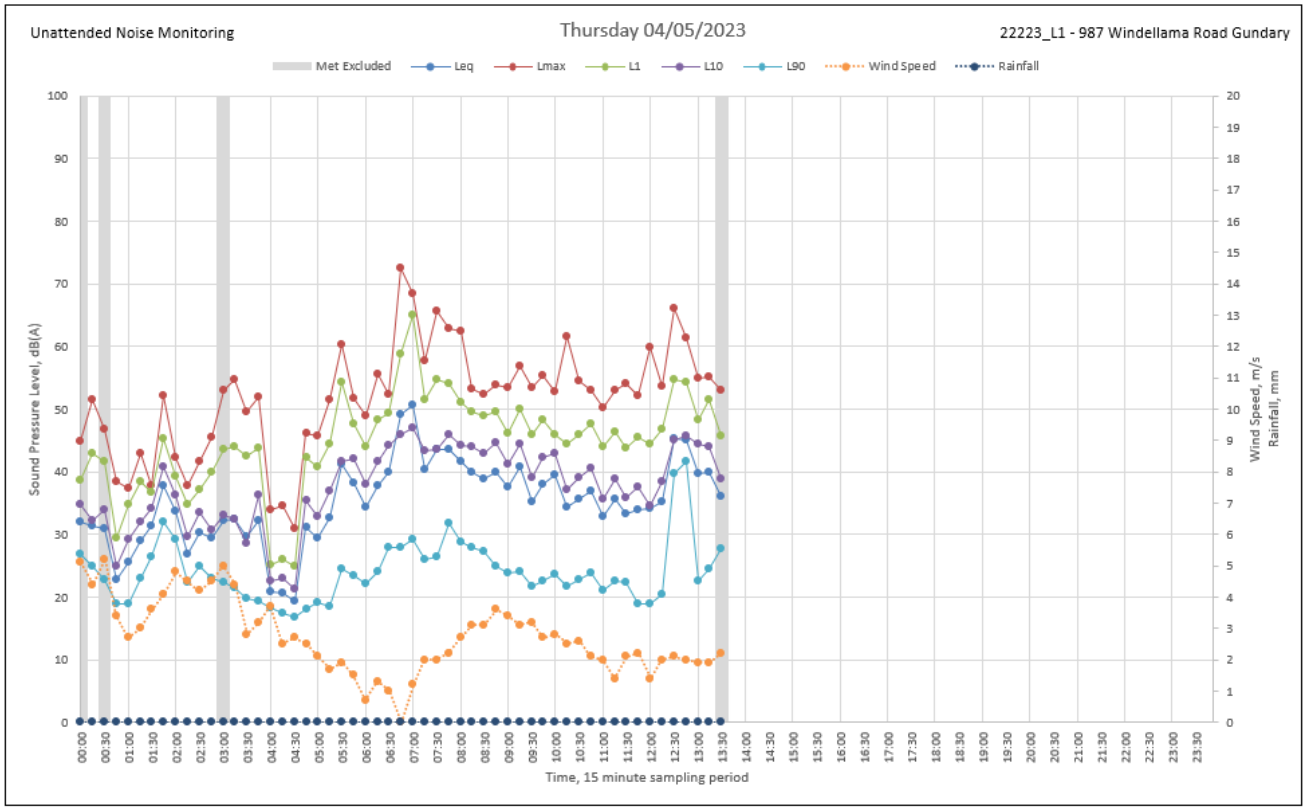


Figure C1.17 Unattended noise measurement at L1 – 4/5/2023

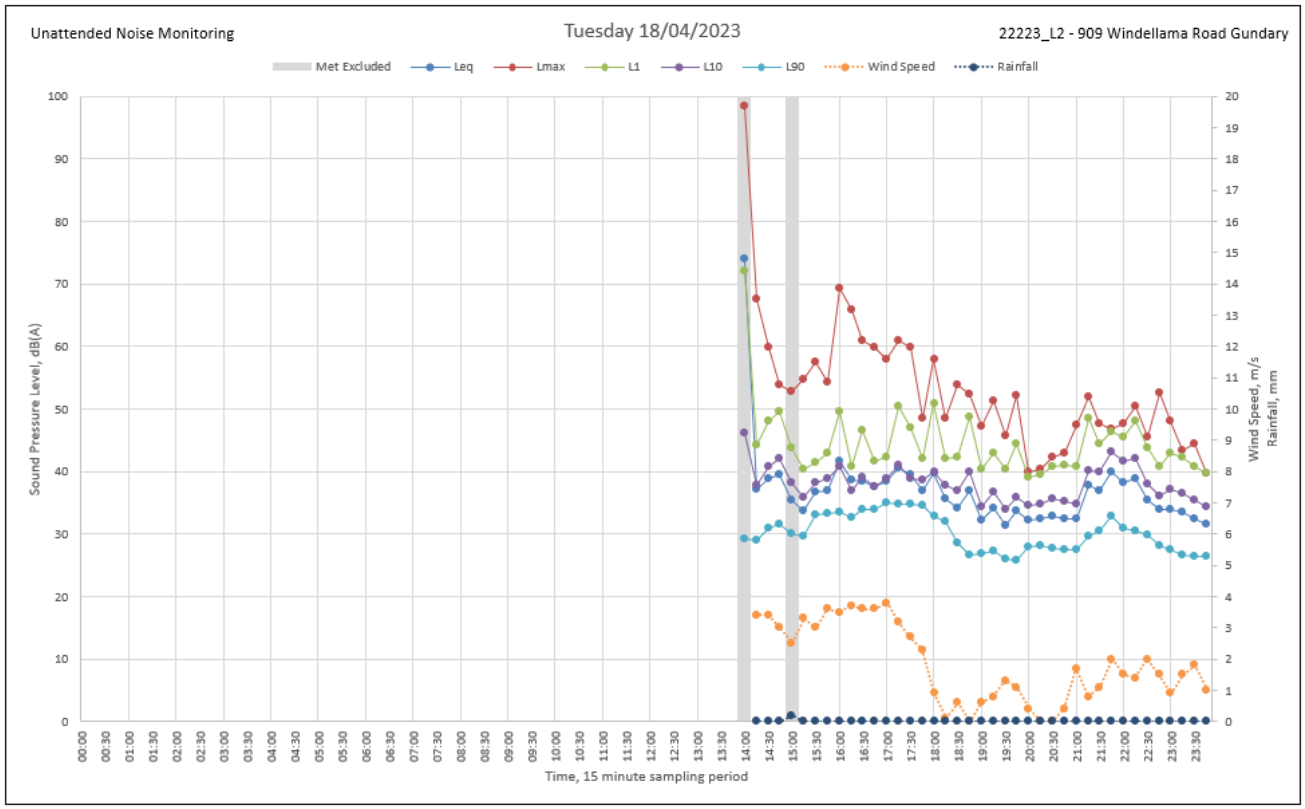


Figure C2.1 Unattended noise measurement at L2 – 18/4/2023

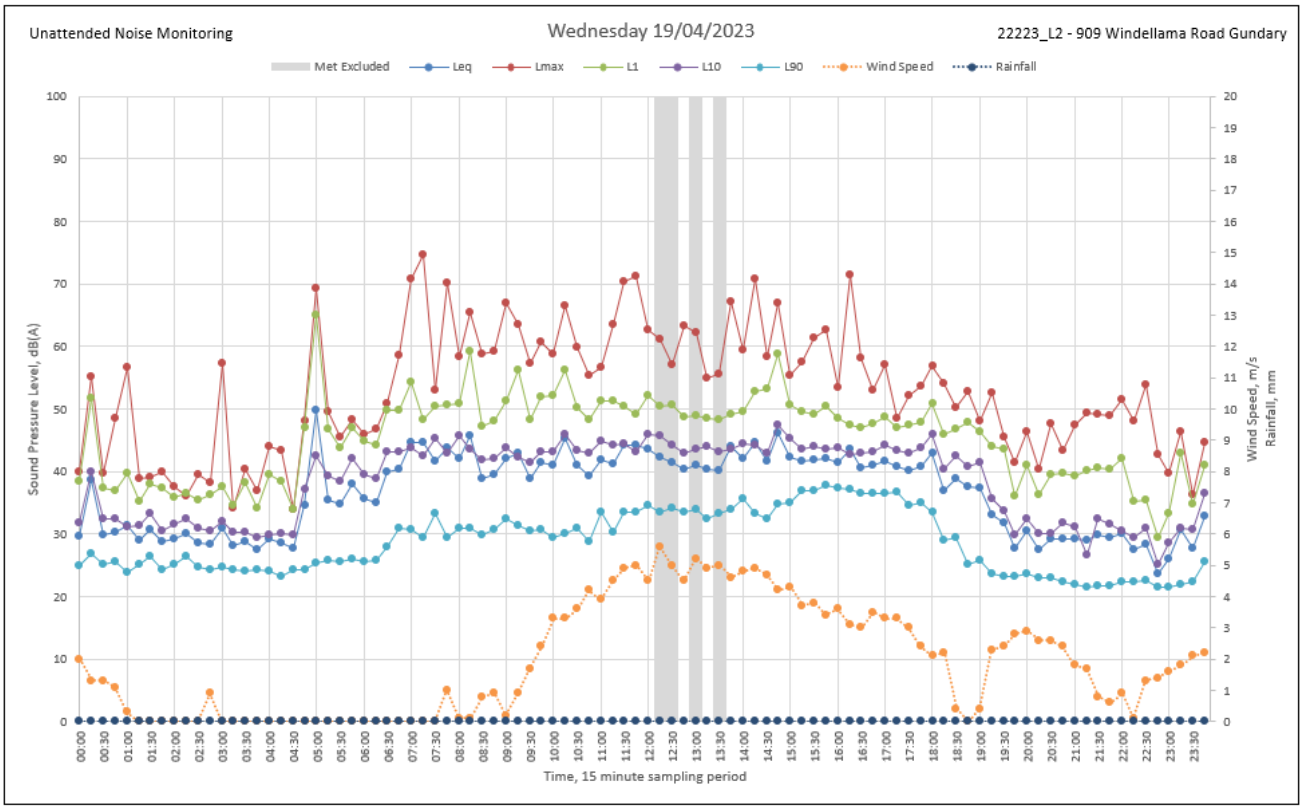


Figure C2.2 Unattended noise measurement at L2 – 19/4/2023

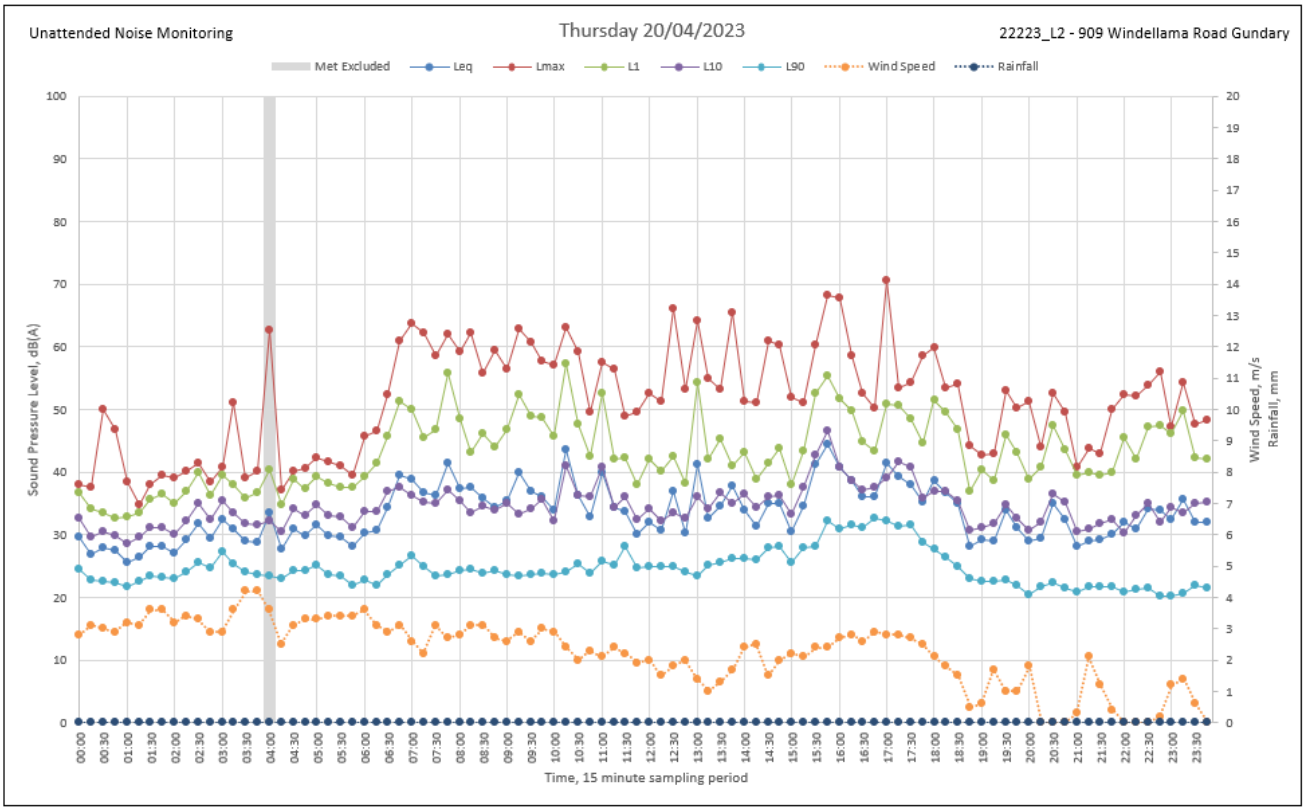


Figure C2.3 Unattended noise measurement at L2 – 20/4/2023

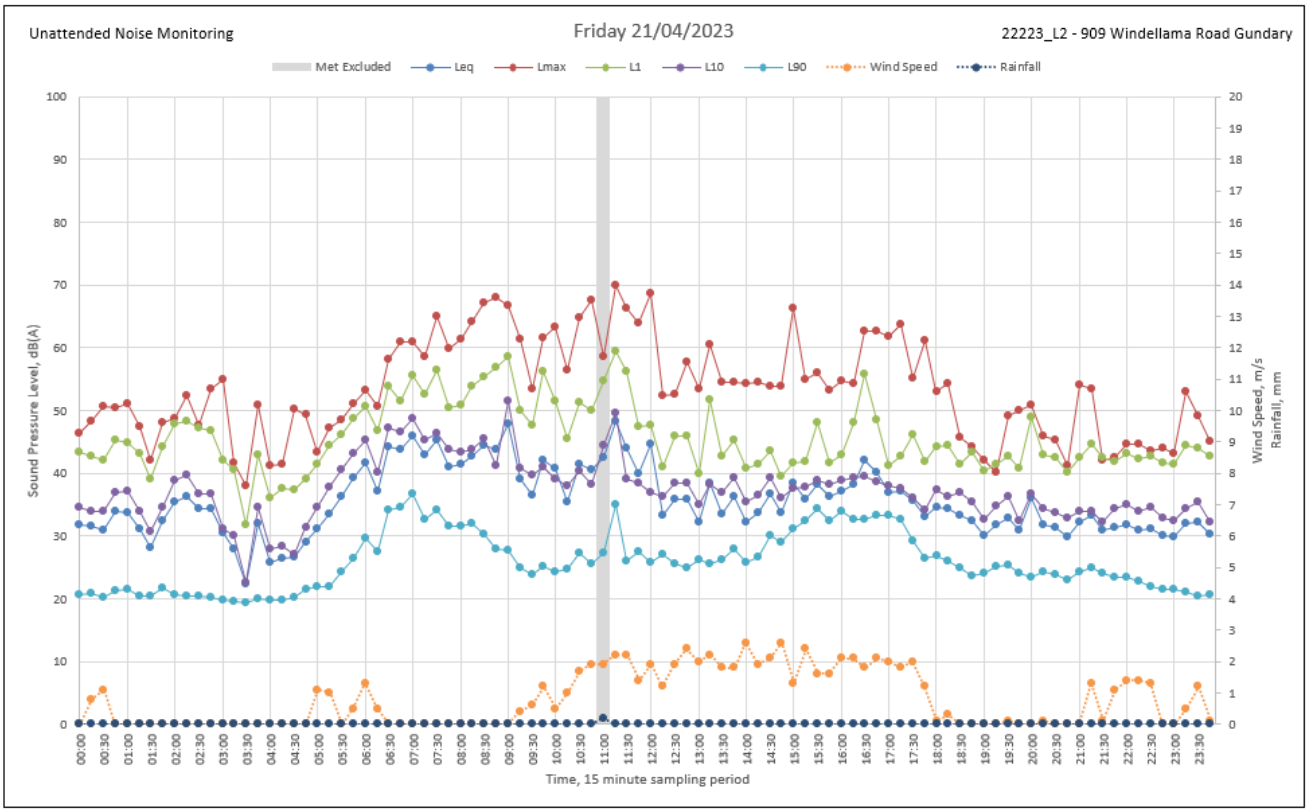


Figure C2.4 Unattended noise measurement at L2 – 21/4/2023

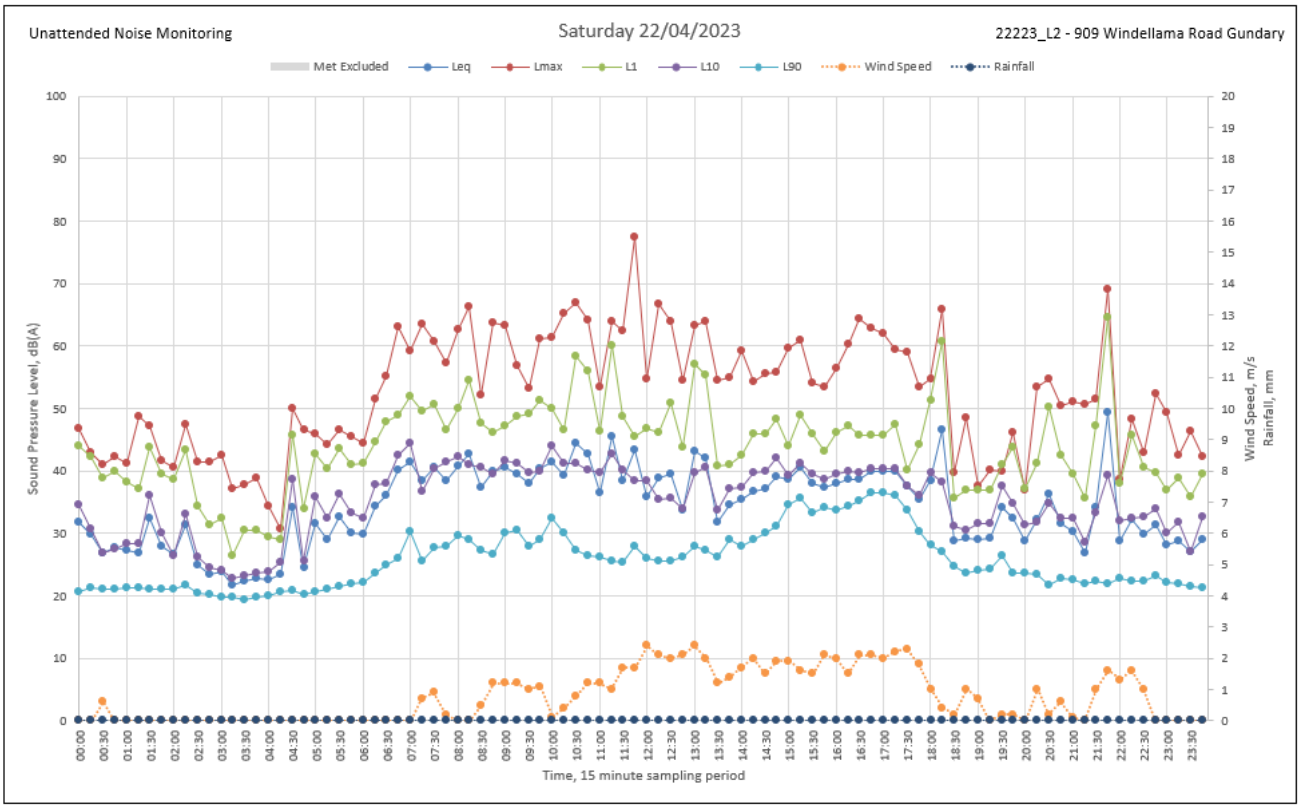


Figure C2.5 Unattended noise measurement at L2 – 22/4/2023

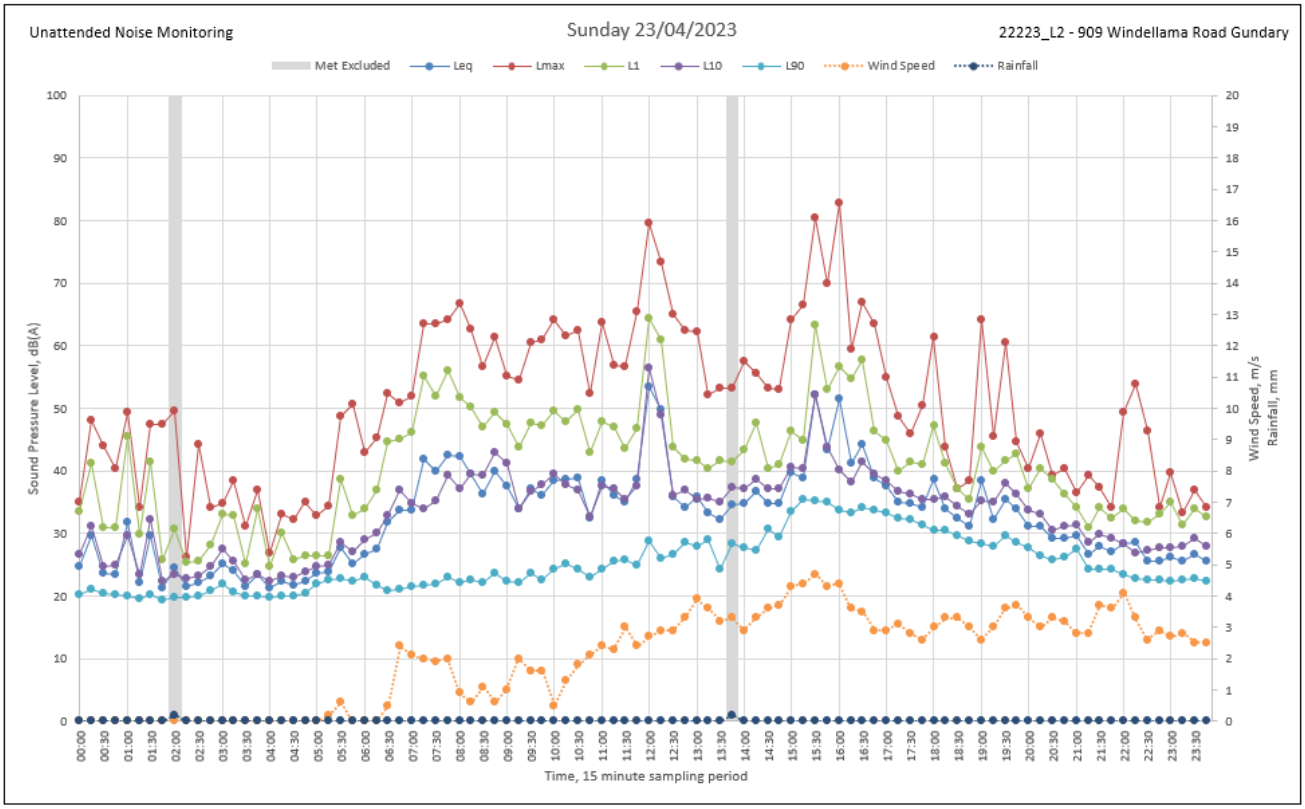


Figure C2.6 Unattended noise measurement at L2 – 23/4/2023

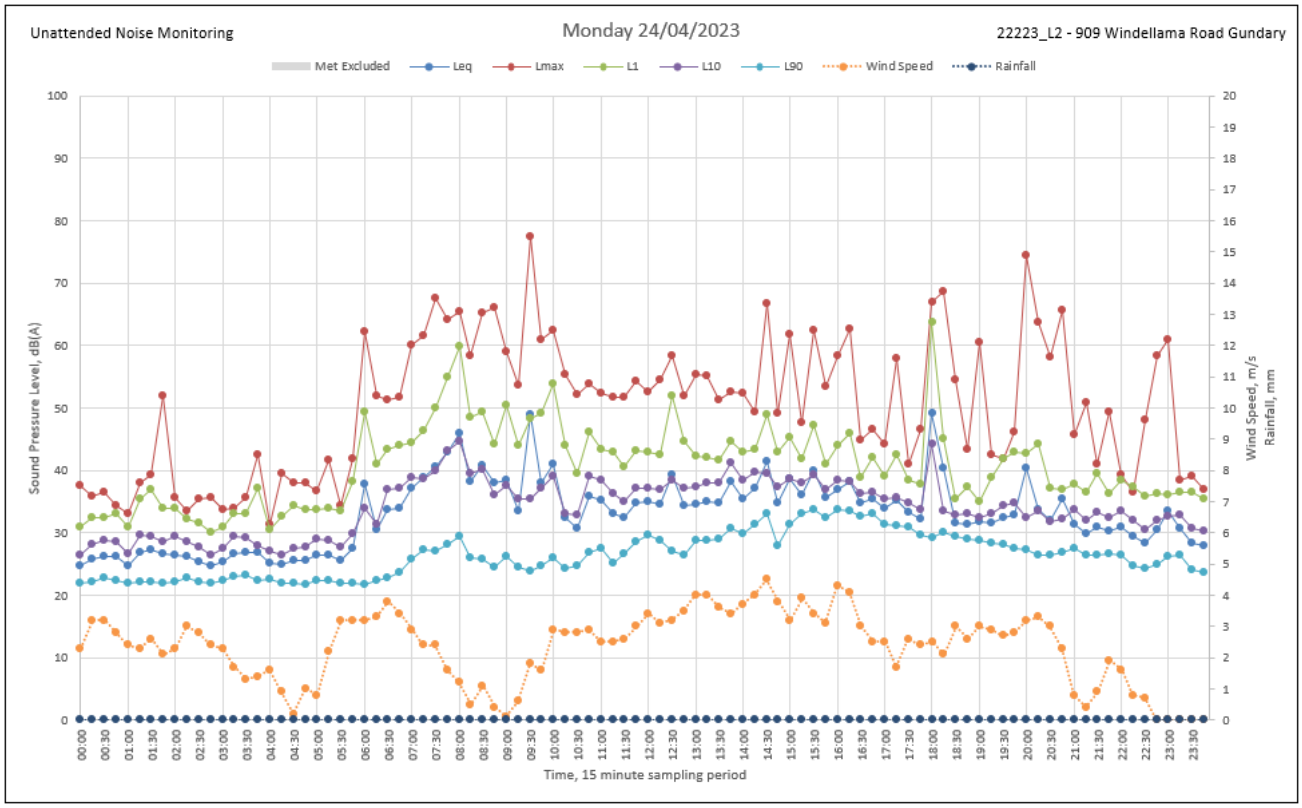


Figure C2.7 Unattended noise measurement at L2 – 24/4/2023

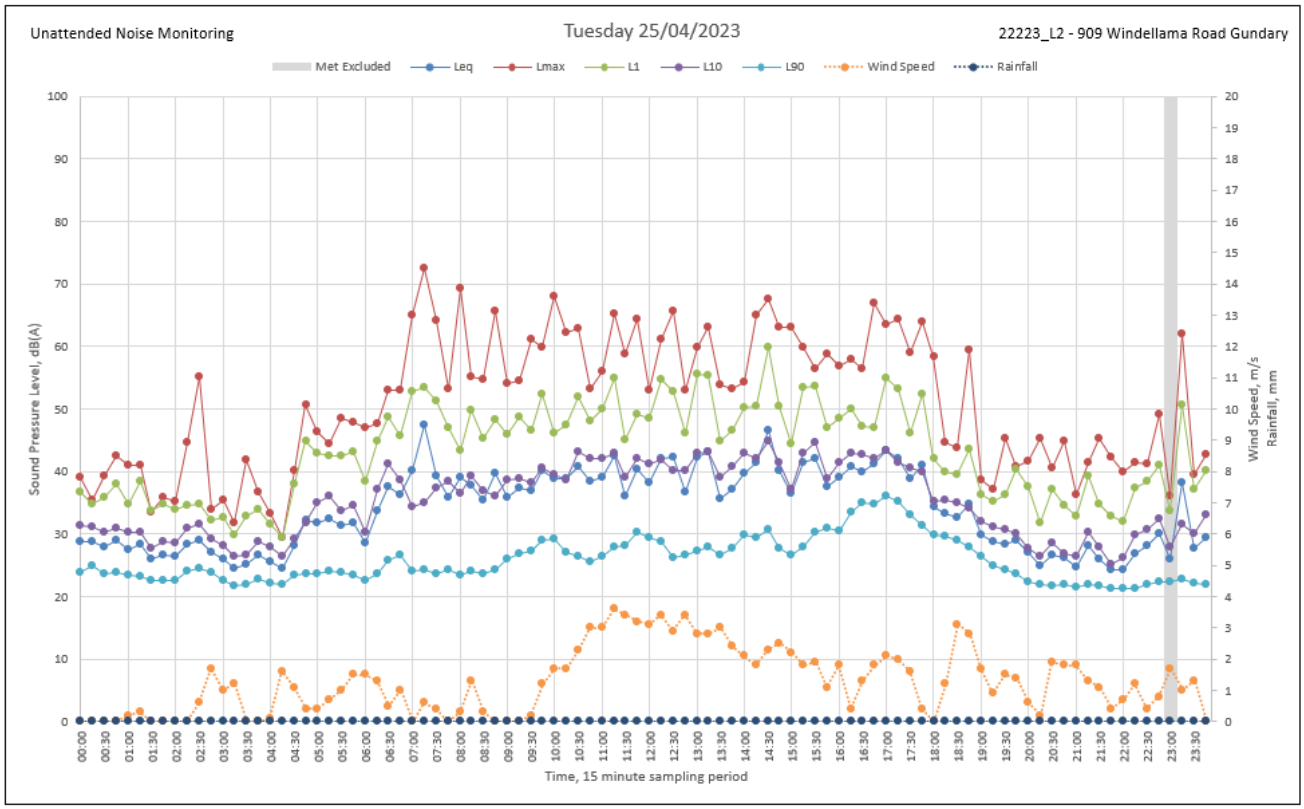


Figure C2.8 Unattended noise measurement at L2 – 25/4/2023

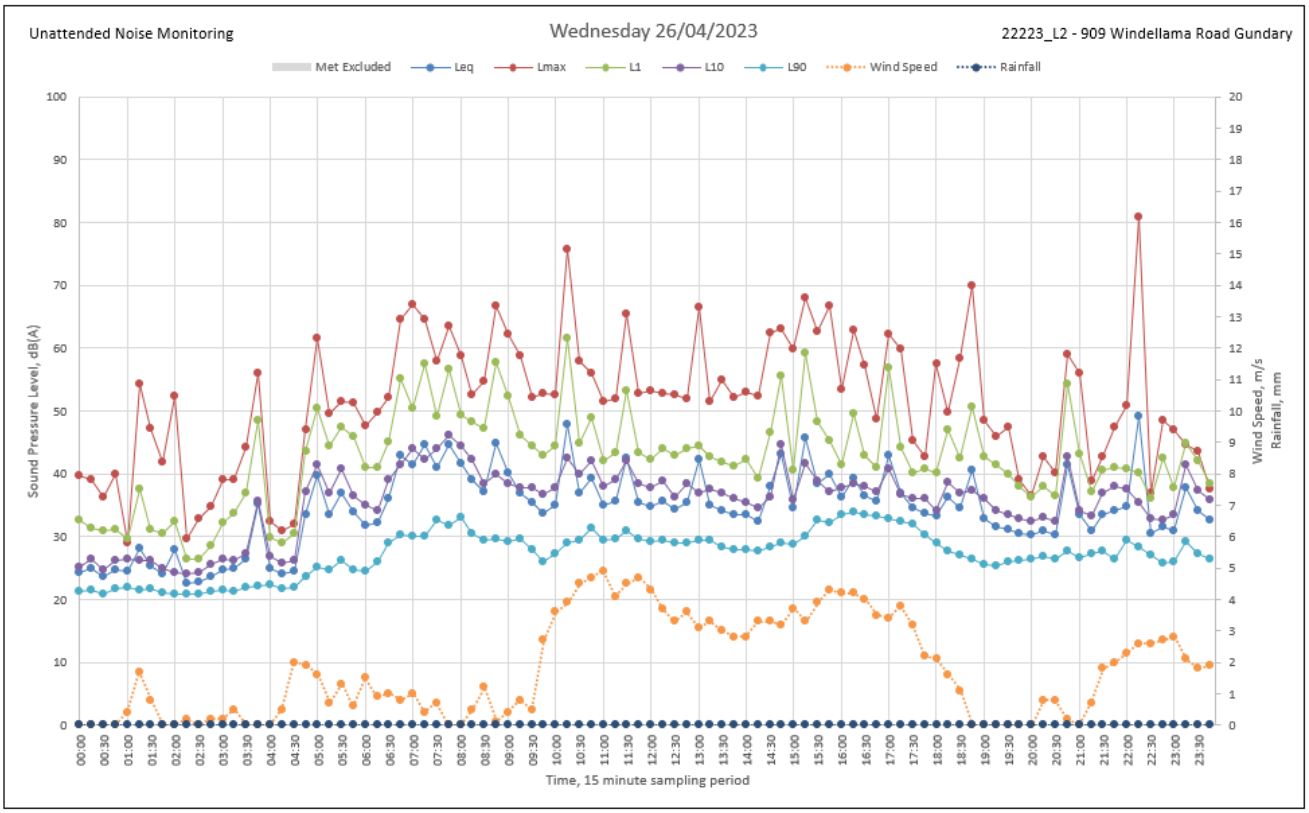


Figure C2.9 Unattended noise measurement at L2 – 26/4/2023

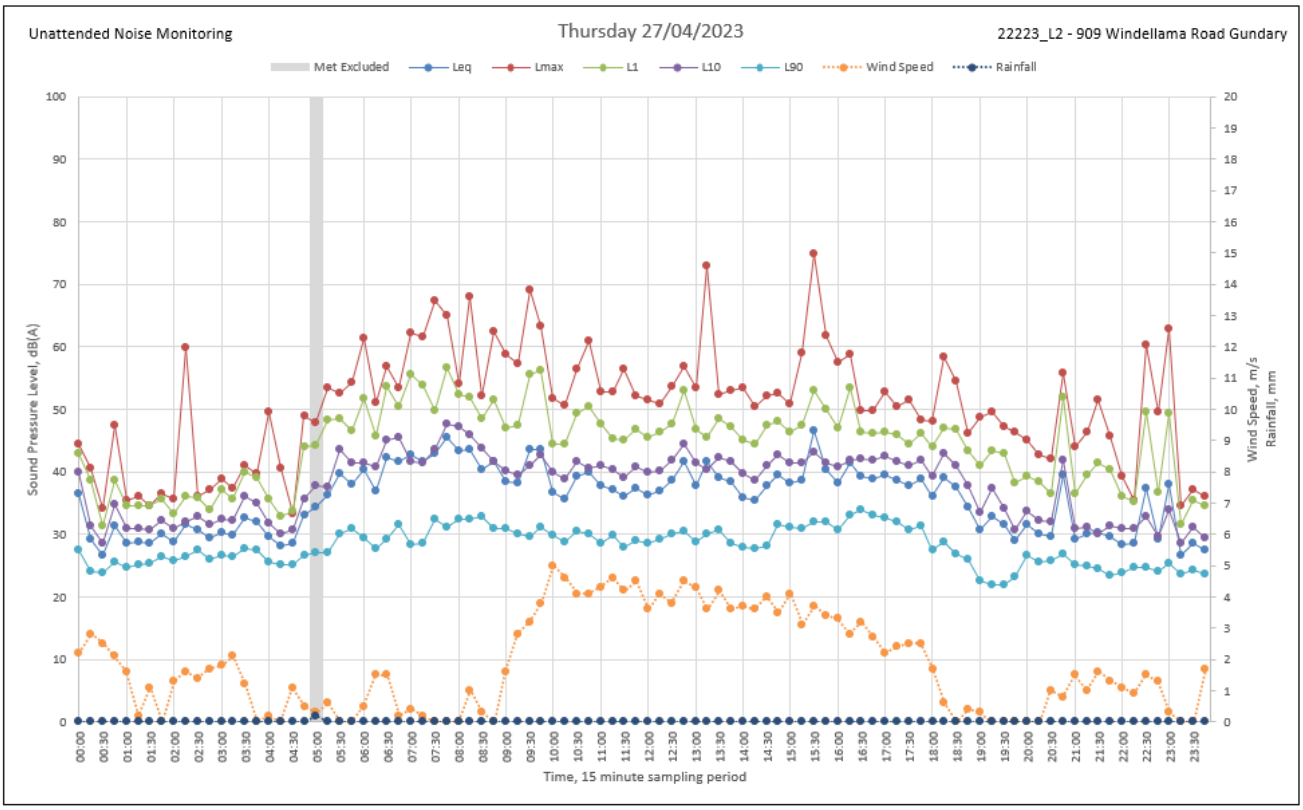


Figure C2.10 Unattended noise measurement at L2 – 27/4/2023

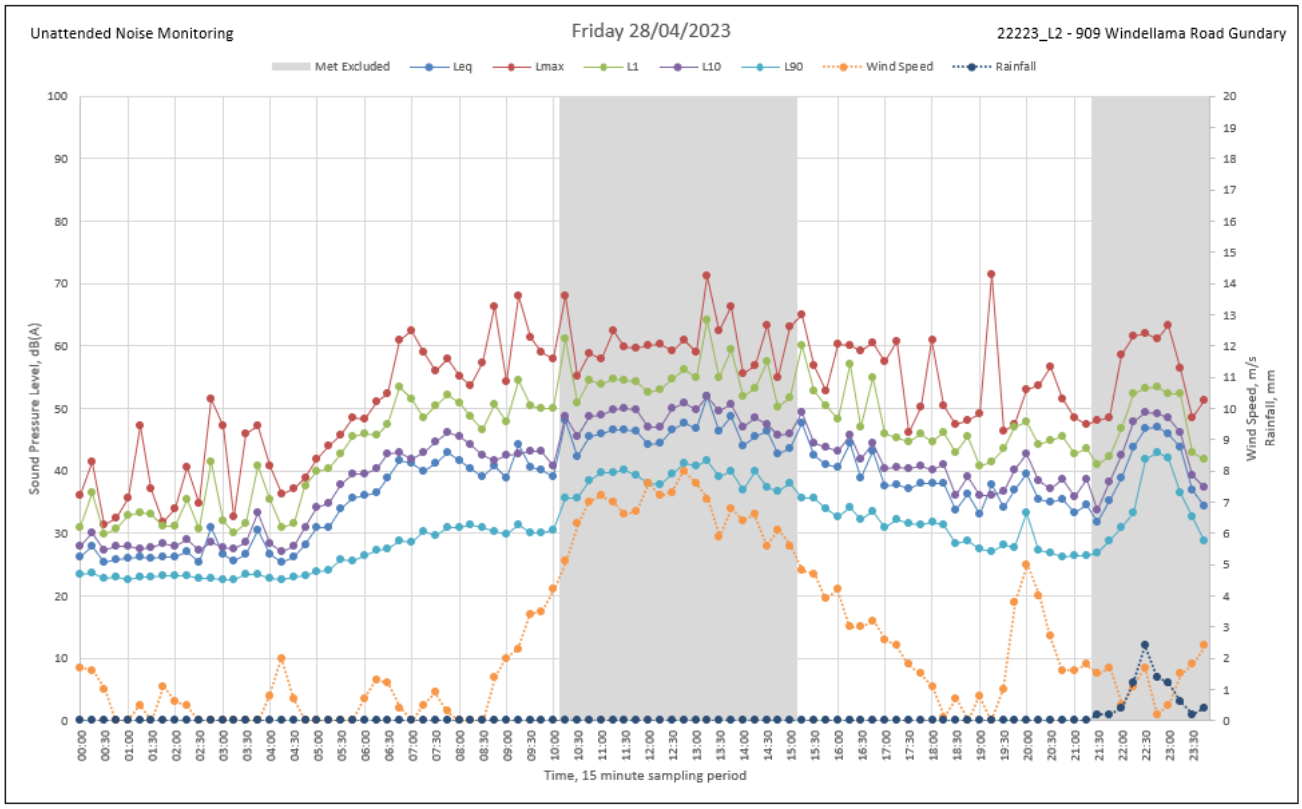


Figure C2.11 Unattended noise measurement at L2 – 28/4/2023

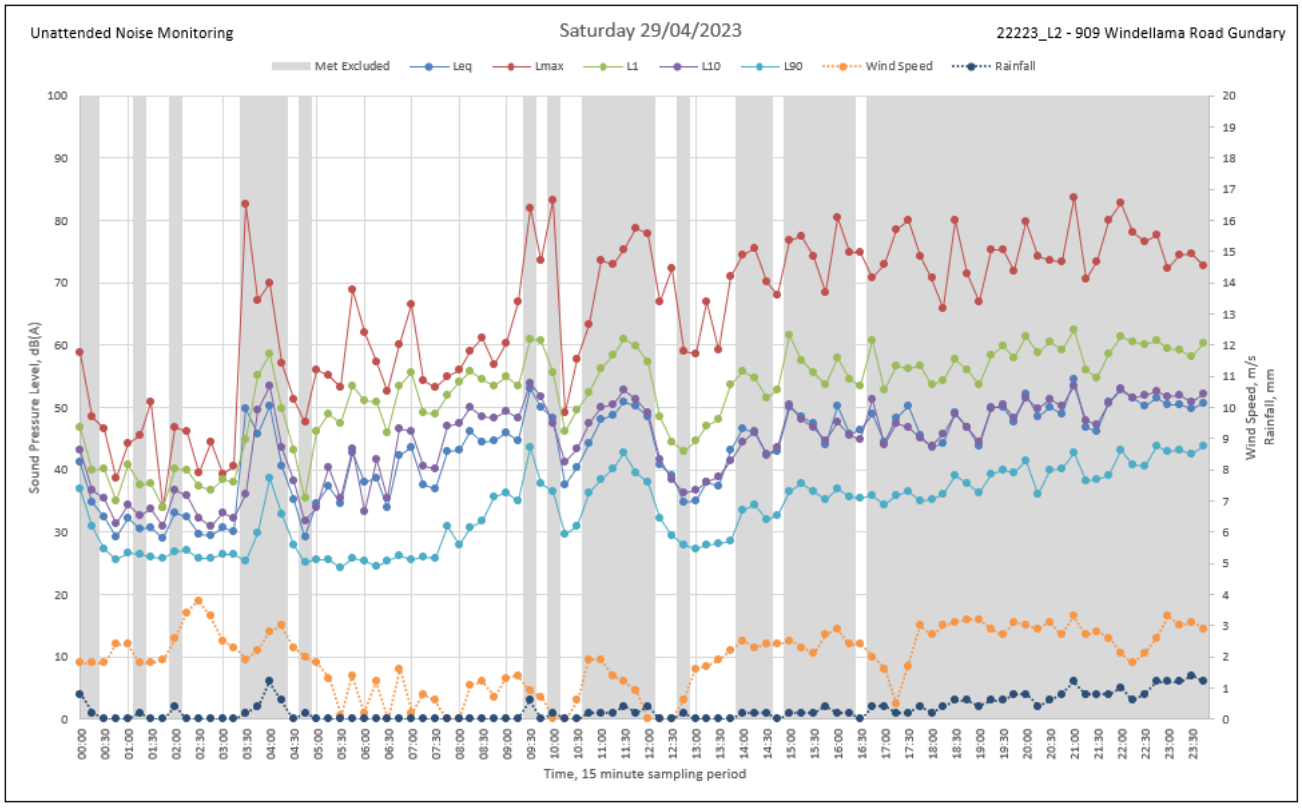


Figure C2.12 Unattended noise measurement at L2 – 29/4/2023

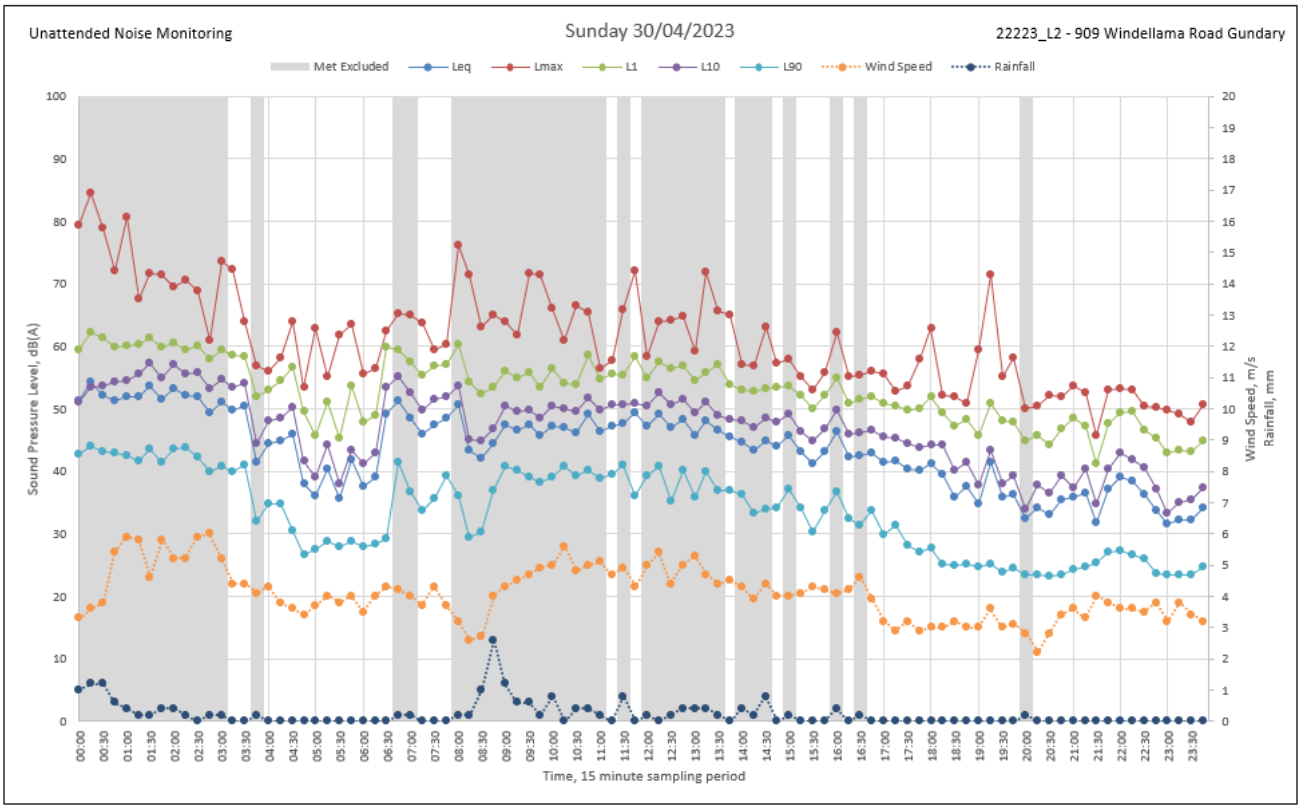


Figure C2.13 Unattended noise measurement at L2 – 30/4/2023

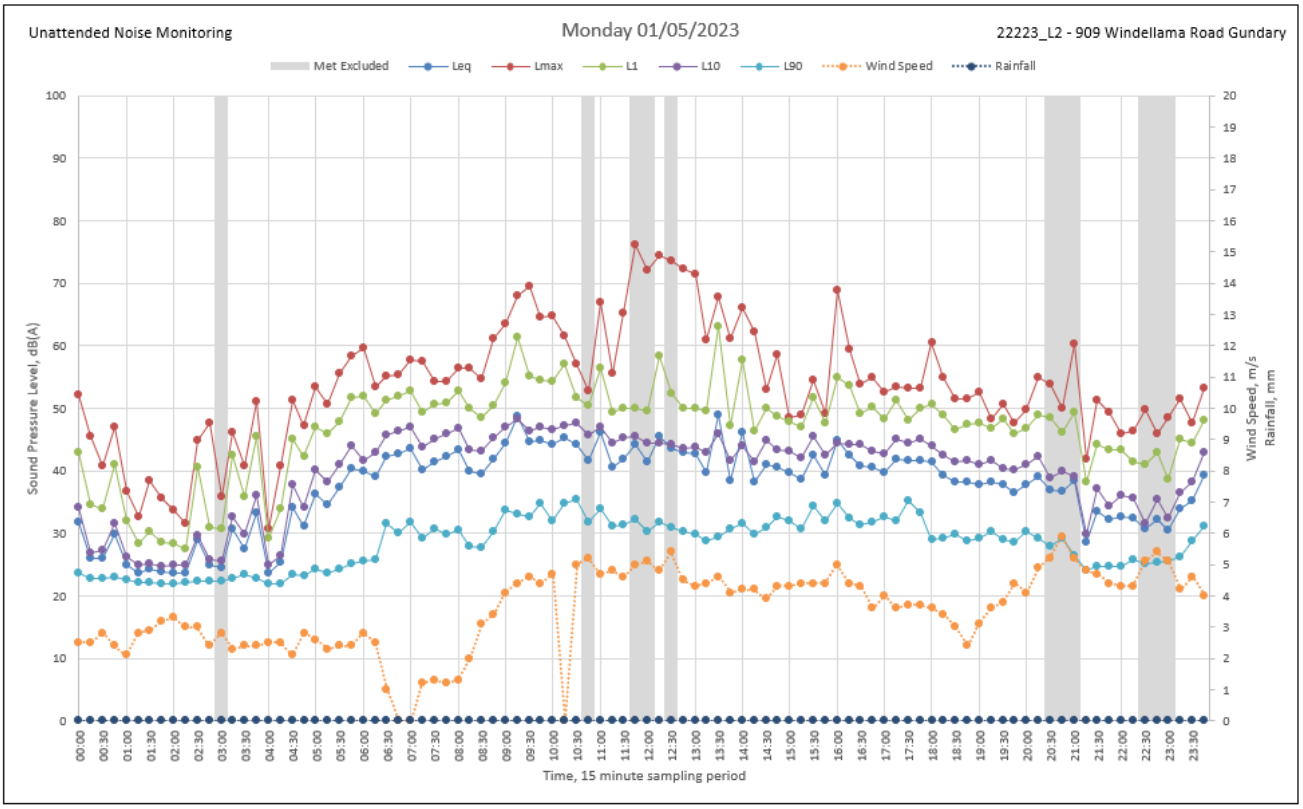


Figure C2.14 Unattended noise measurement at L2 – 1/5/2023

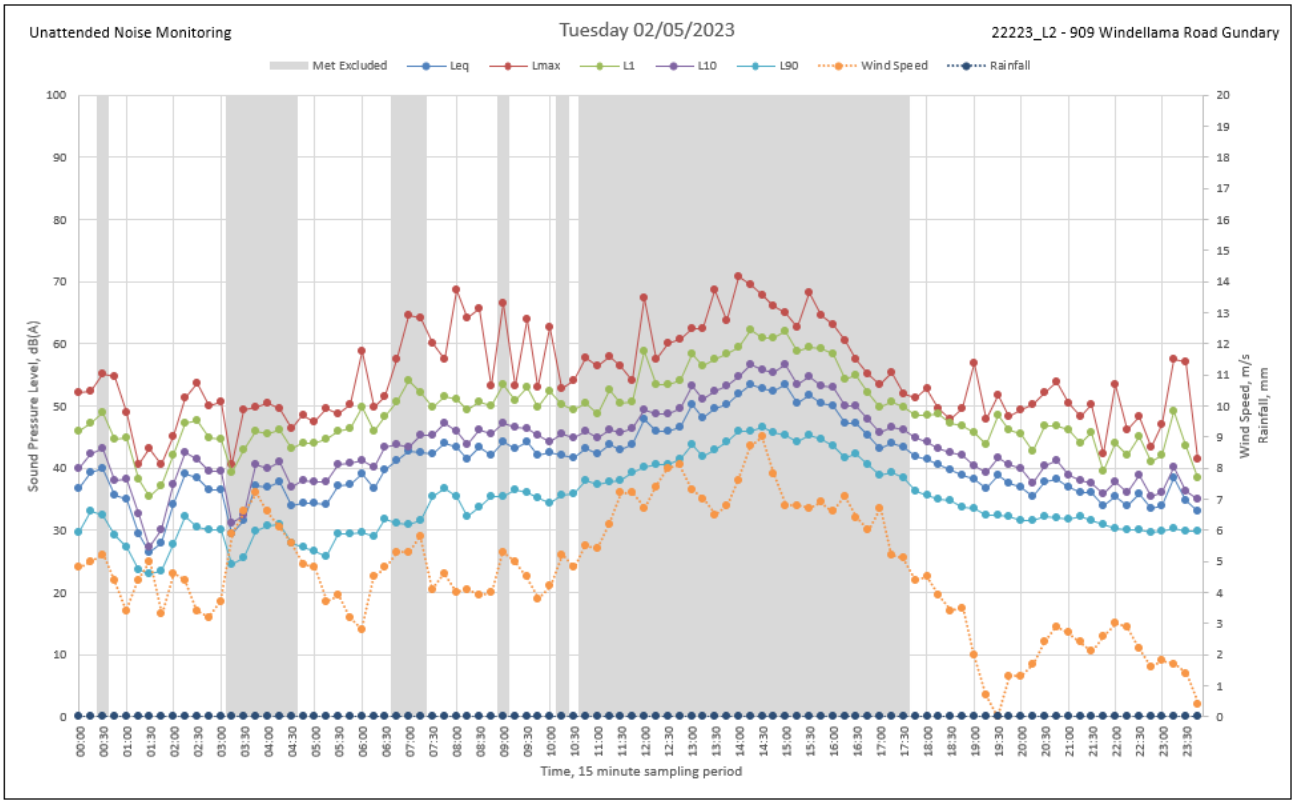


Figure C2.15 Unattended noise measurement at L2 – 2/5/2023

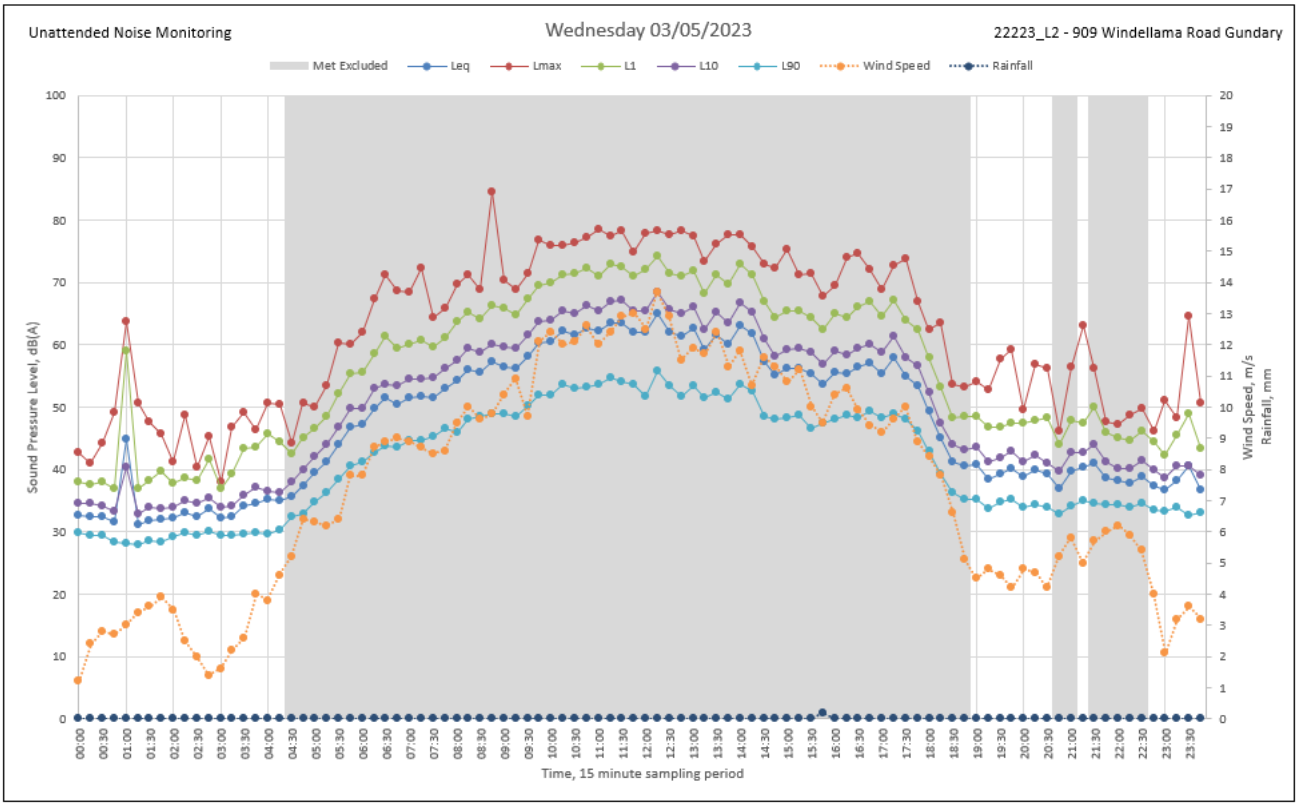


Figure C2.16 Unattended noise measurement at L2 – 3/5/2023

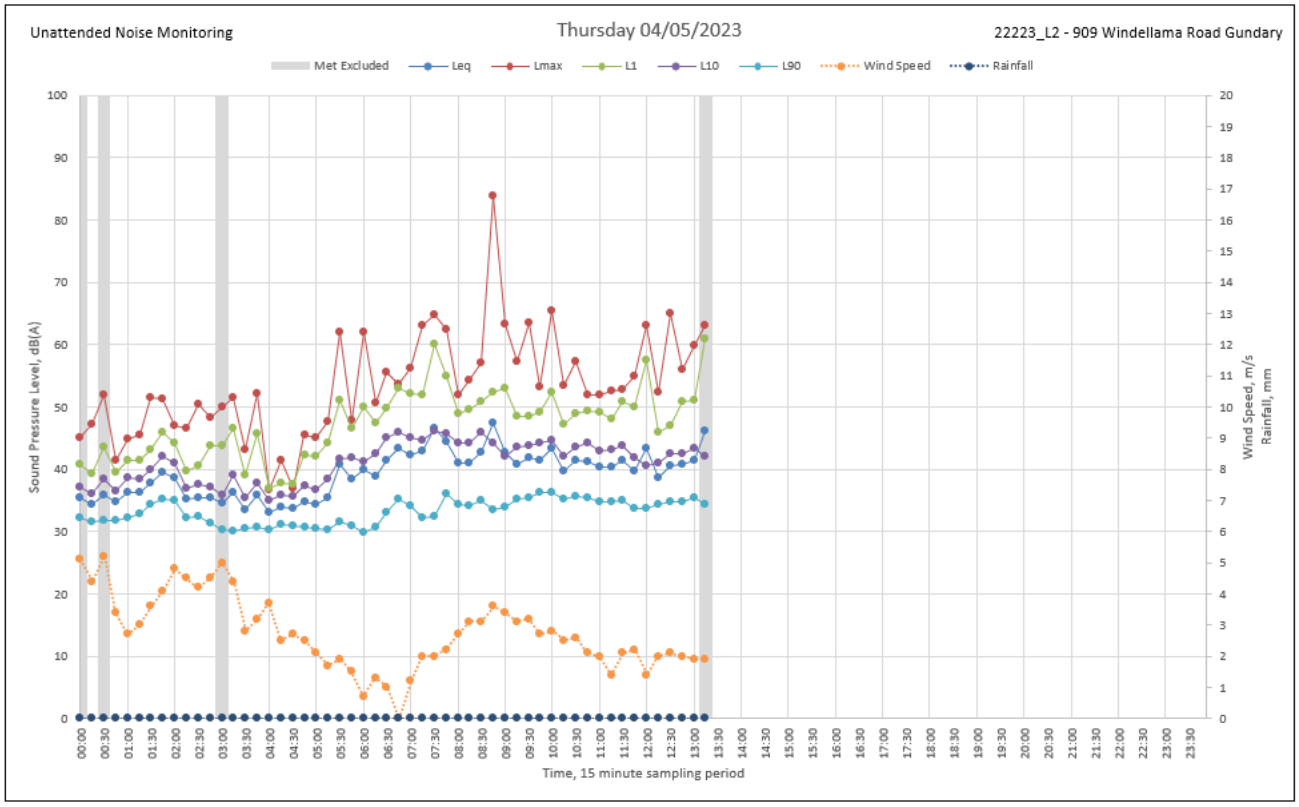


Figure C2.17 Unattended noise measurement at L2 – 4/5/2023

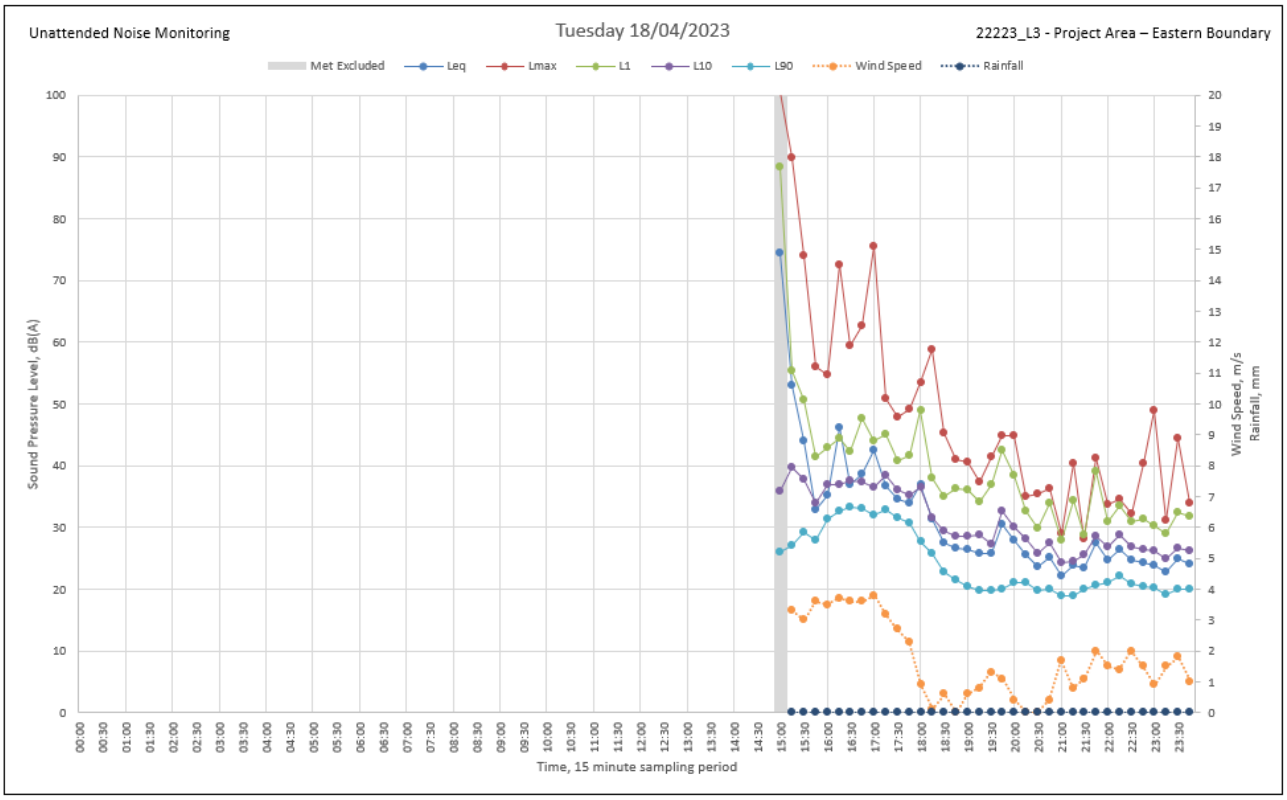


Figure C3.1 Unattended noise measurement at L3 – 18/4/2023

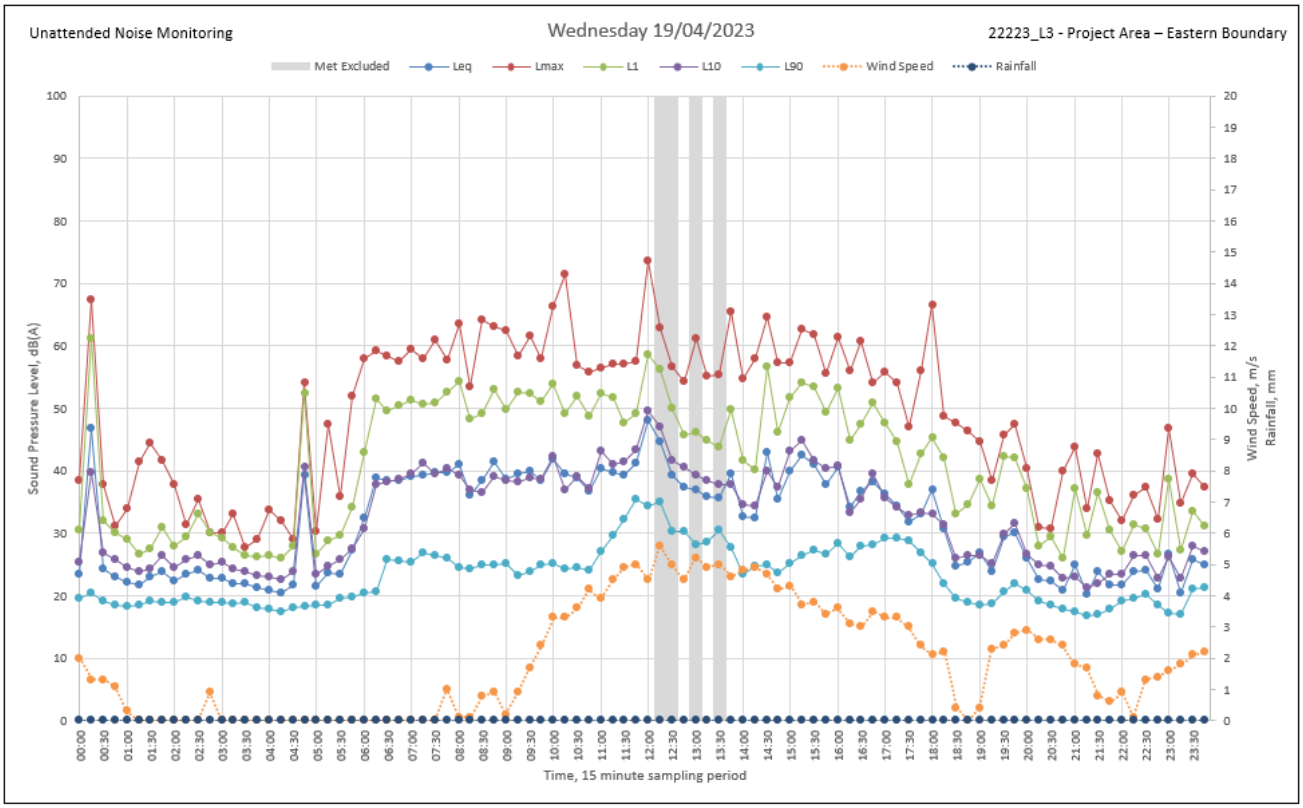


Figure C3.2 Unattended noise measurement at L3 – 19/4/2023

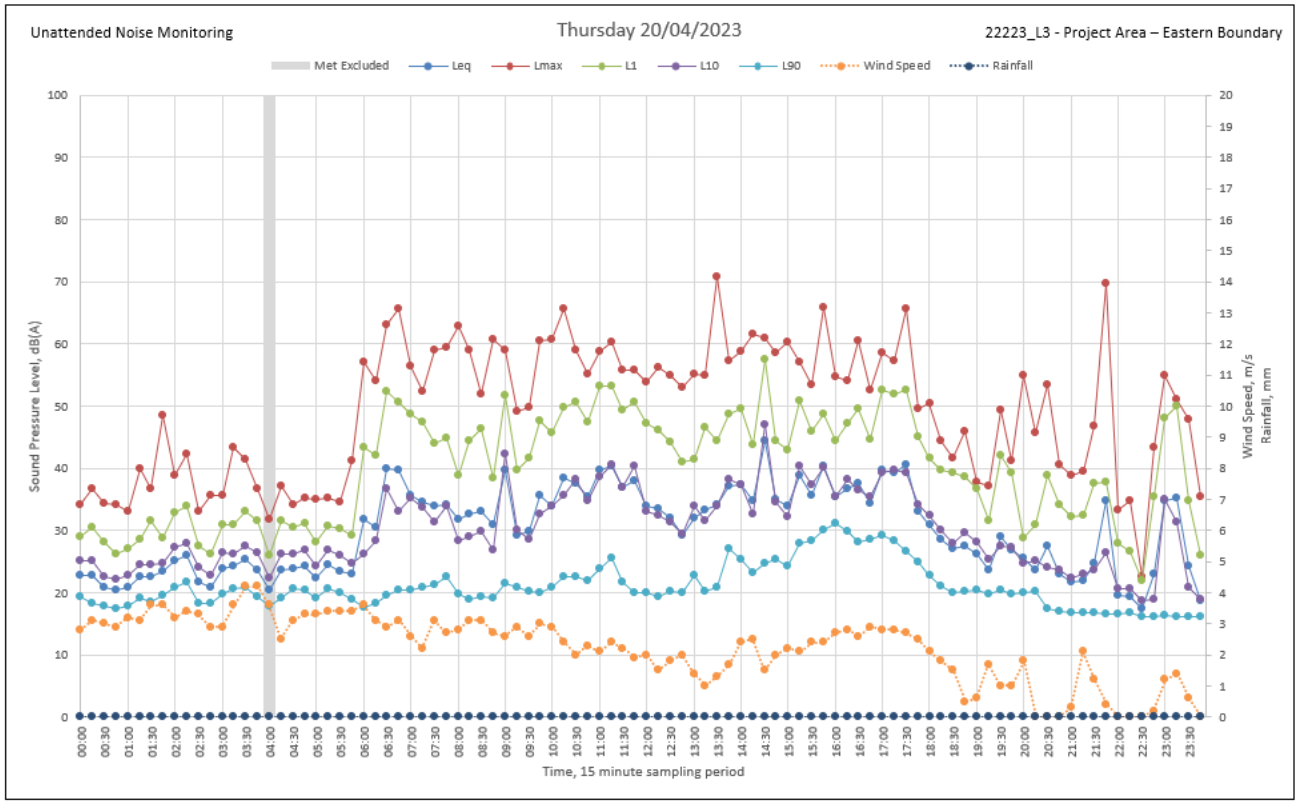


Figure C3.3 Unattended noise measurement at L3 – 20/4/2023

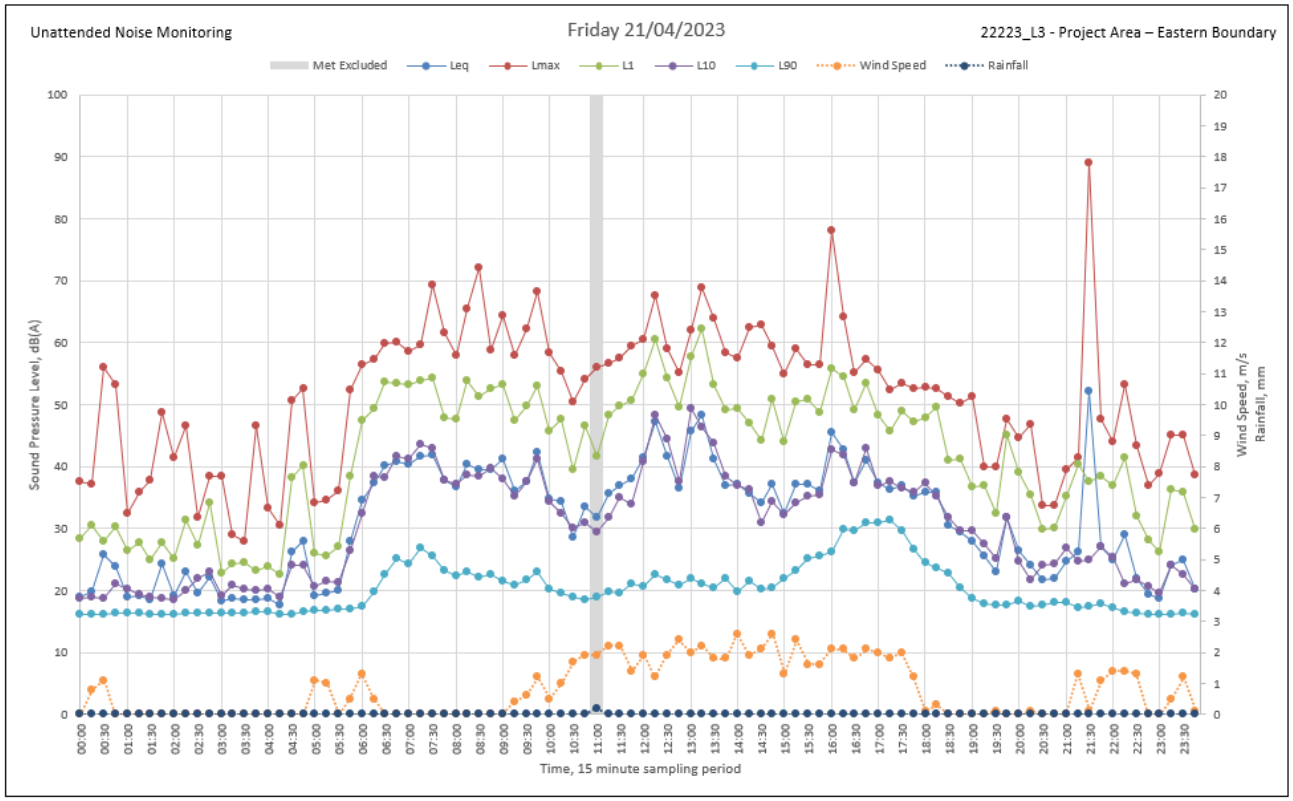


Figure C3.4 Unattended noise measurement at L3 – 21/4/2023

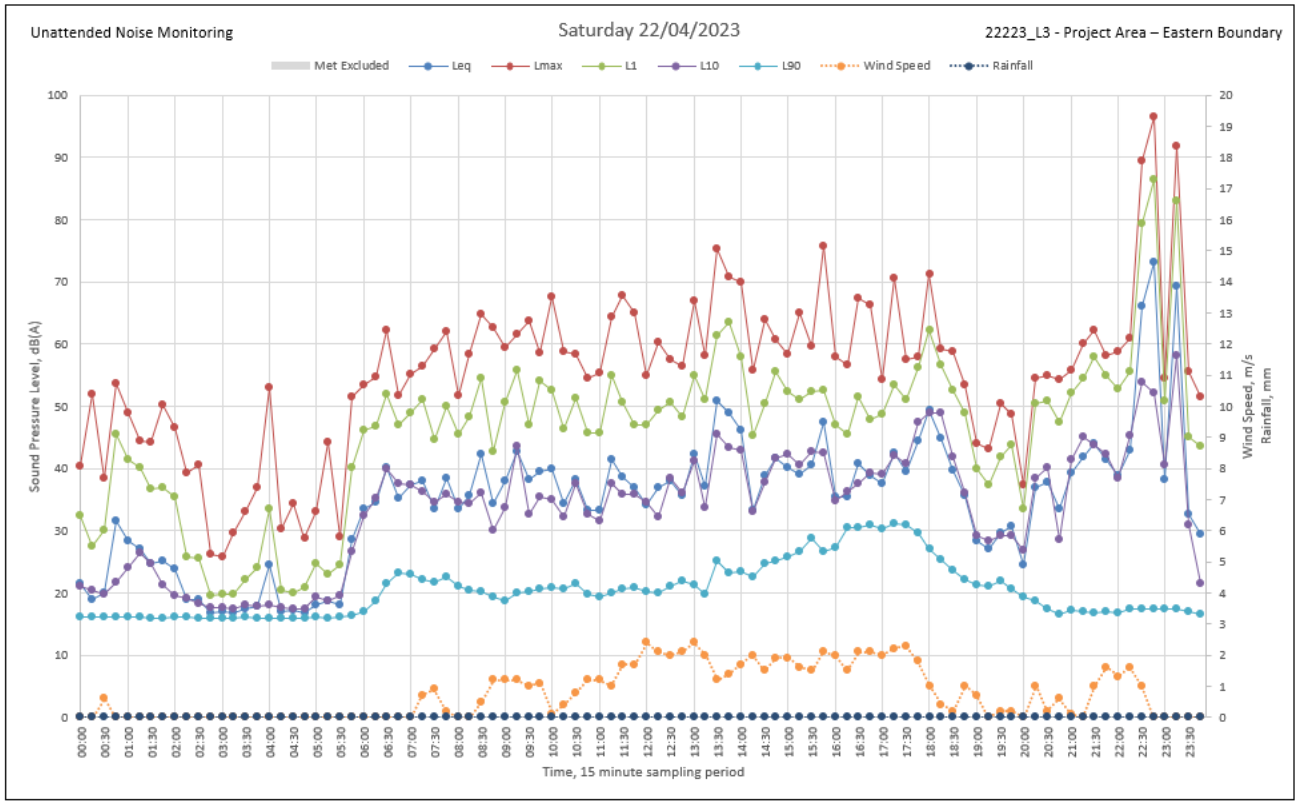


Figure C3.5 Unattended noise measurement at L3 – 22/4/2023

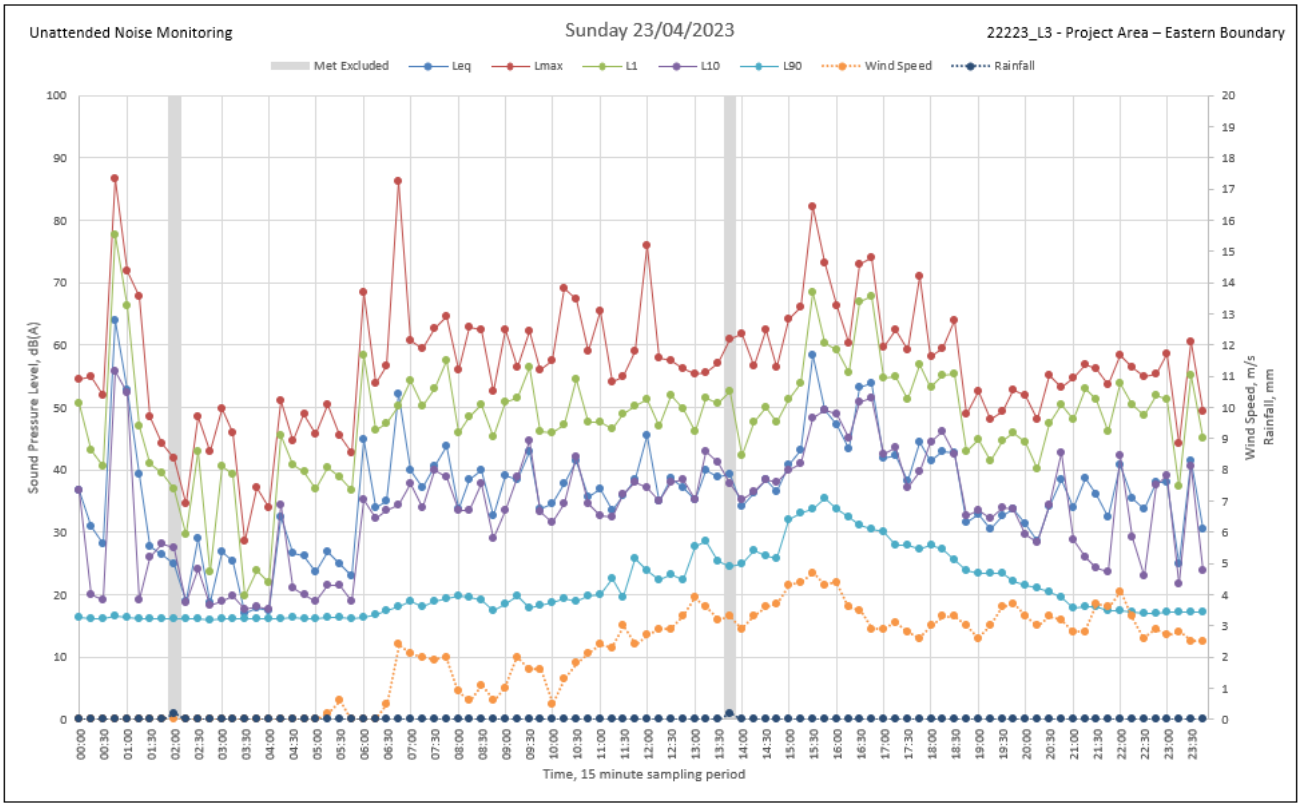


Figure C3.6 Unattended noise measurement at L3 – 23/4/2023

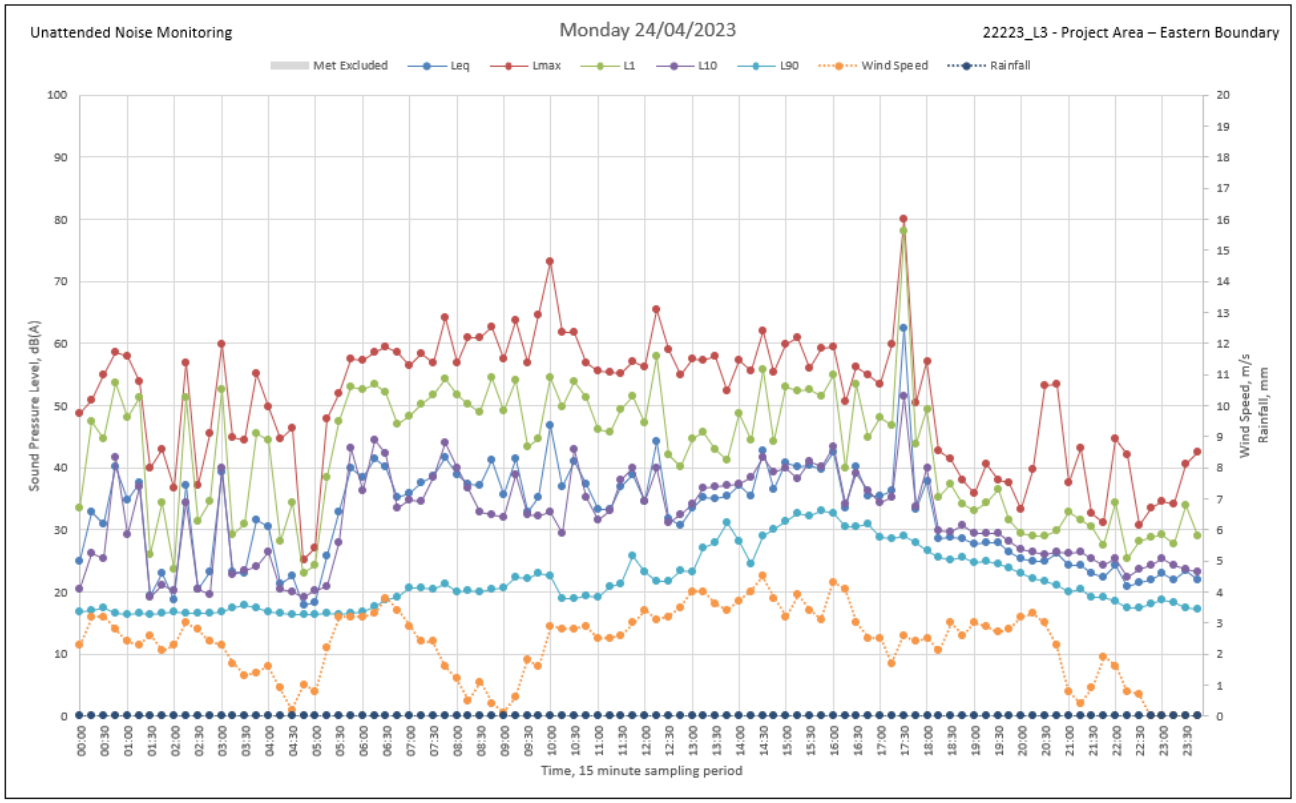


Figure C3.7 Unattended noise measurement at L3 – 24/4/2023

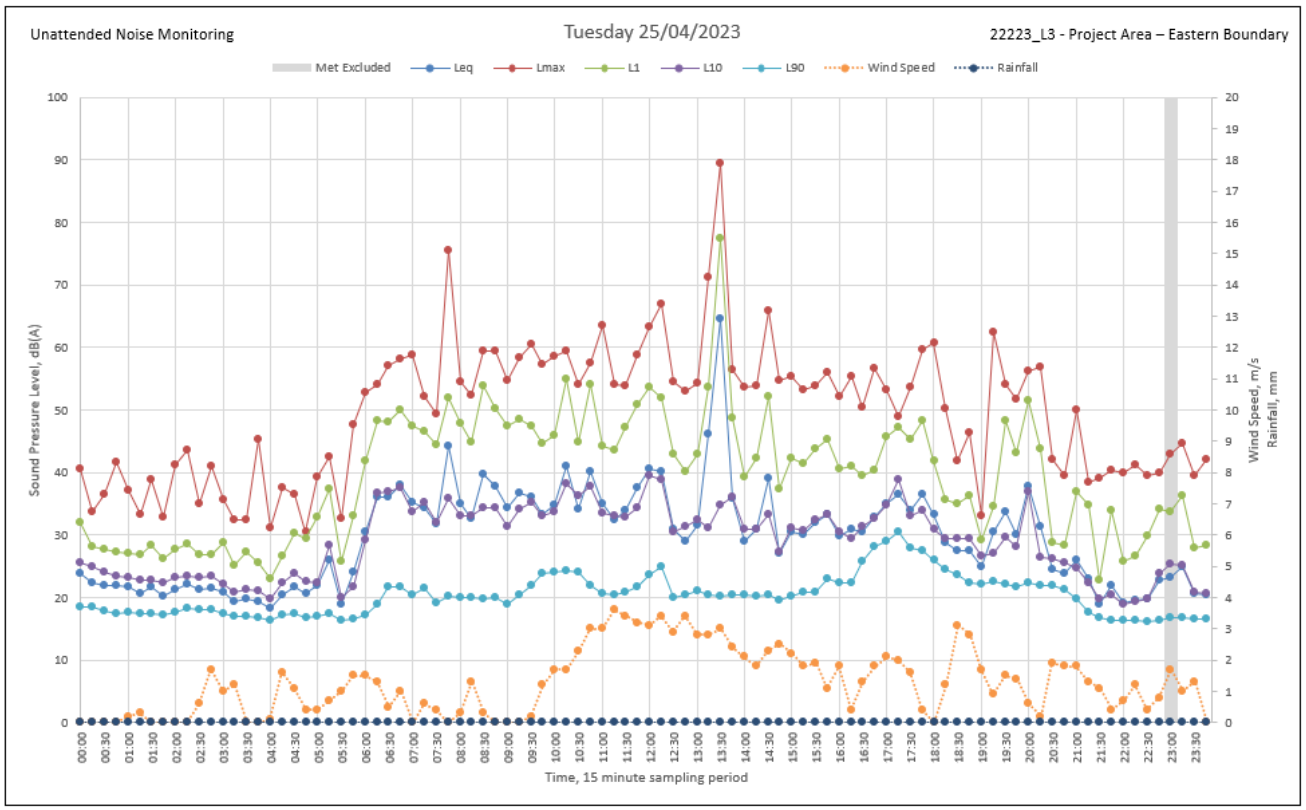


Figure C3.8 Unattended noise measurement at L3 – 25/4/2023

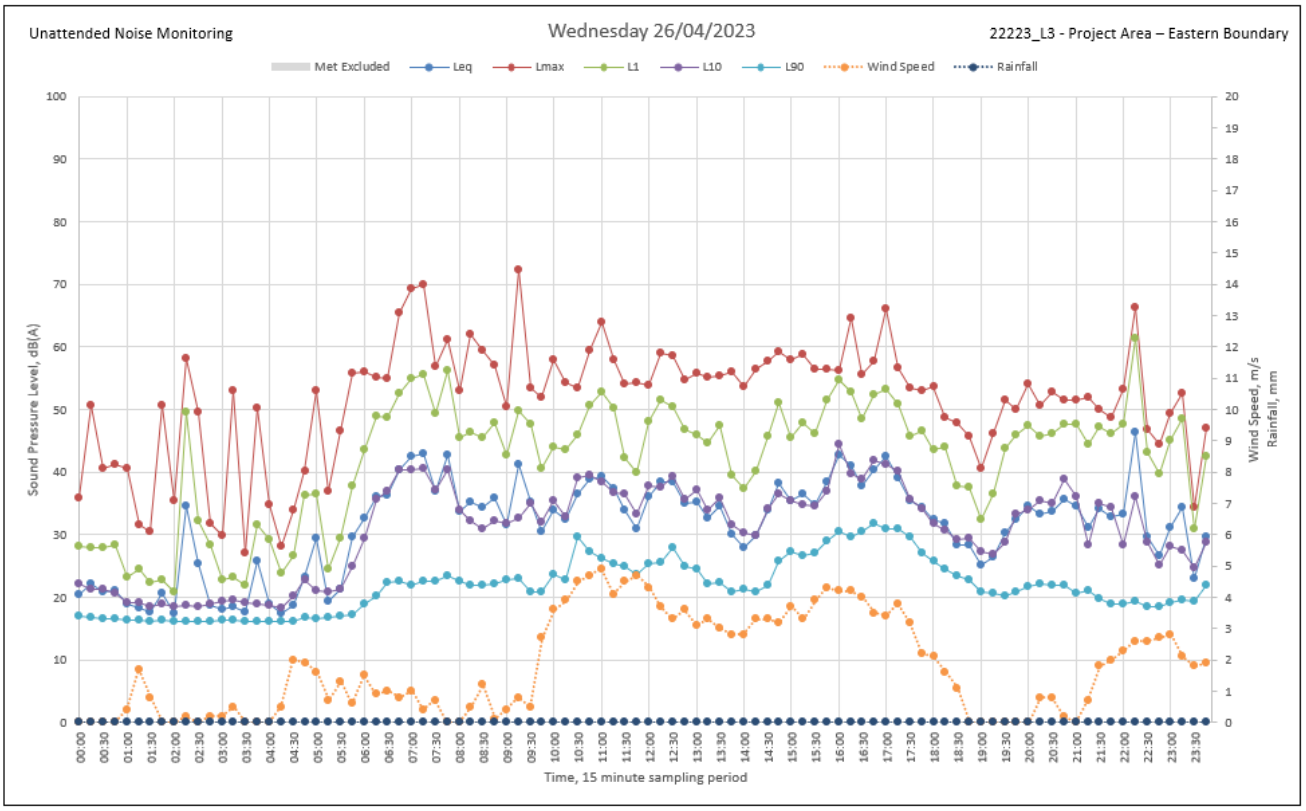


Figure C3.9 Unattended noise measurement at L3 – 26/4/2023

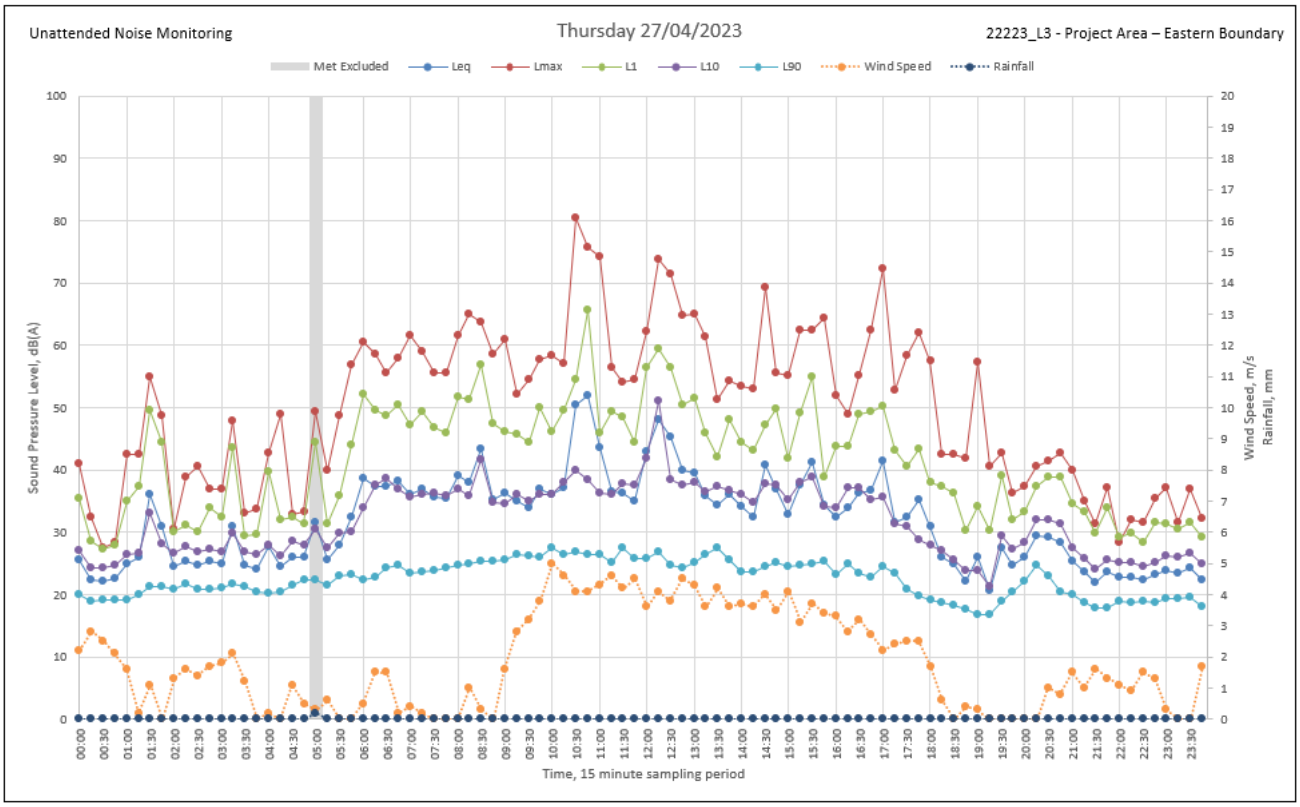


Figure C3.10 Unattended noise measurement at L3 – 27/4/2023

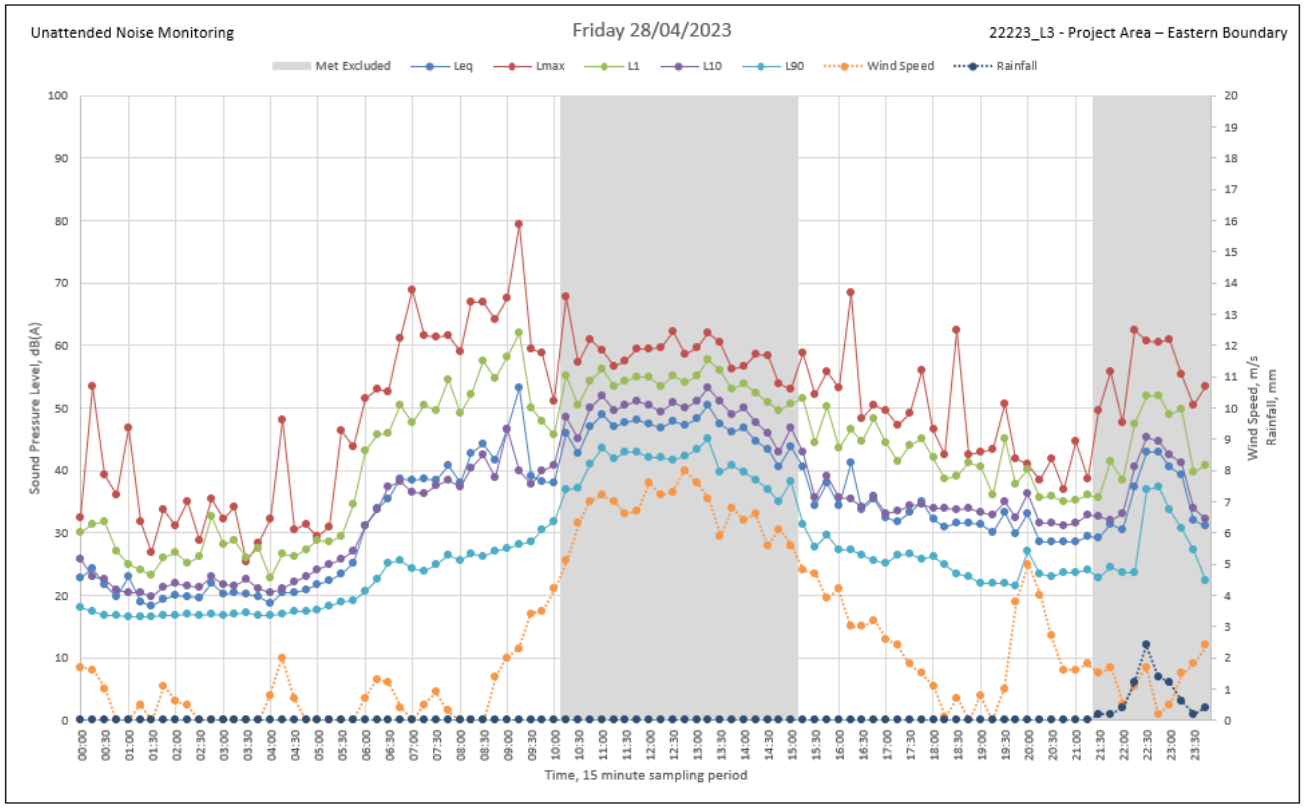


Figure C3.11 Unattended noise measurement at L3 – 28/4/2023

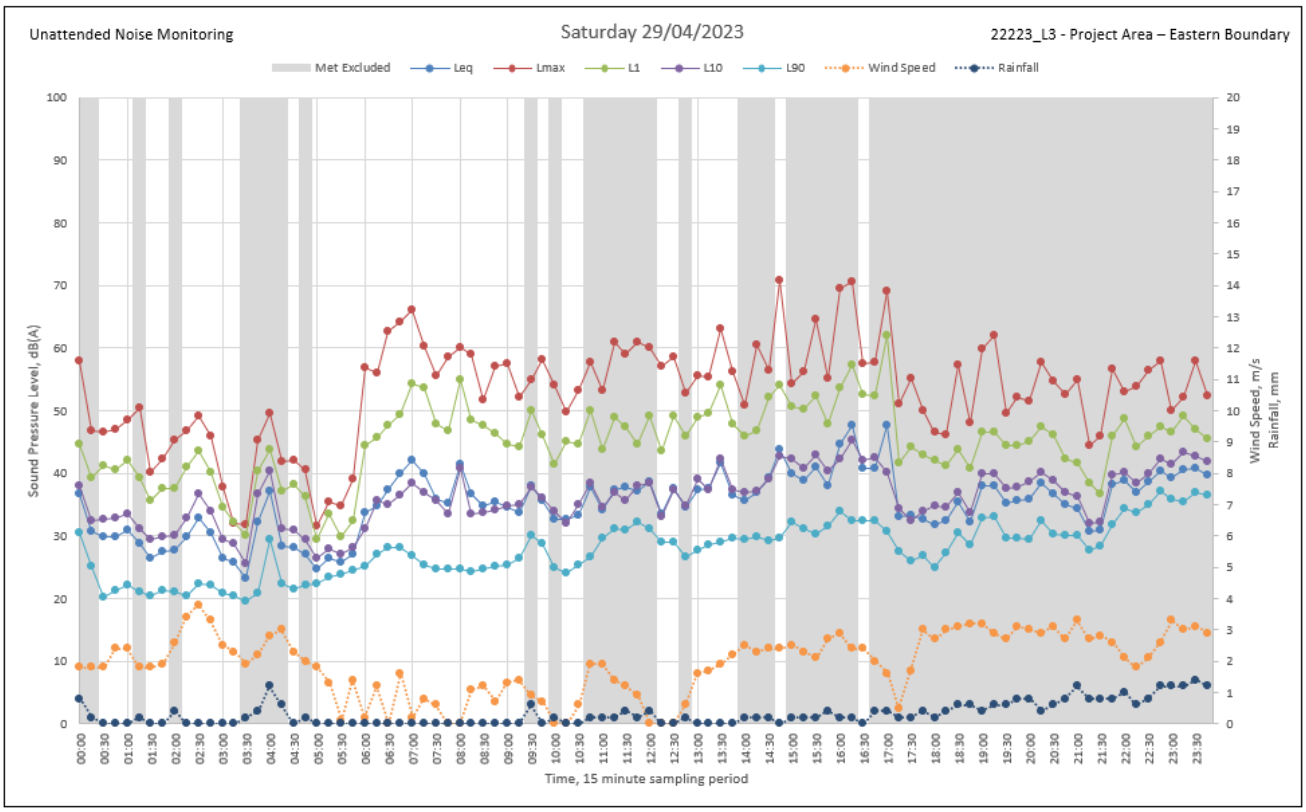


Figure C3.12 Unattended noise measurement at L3 – 29/4/2023

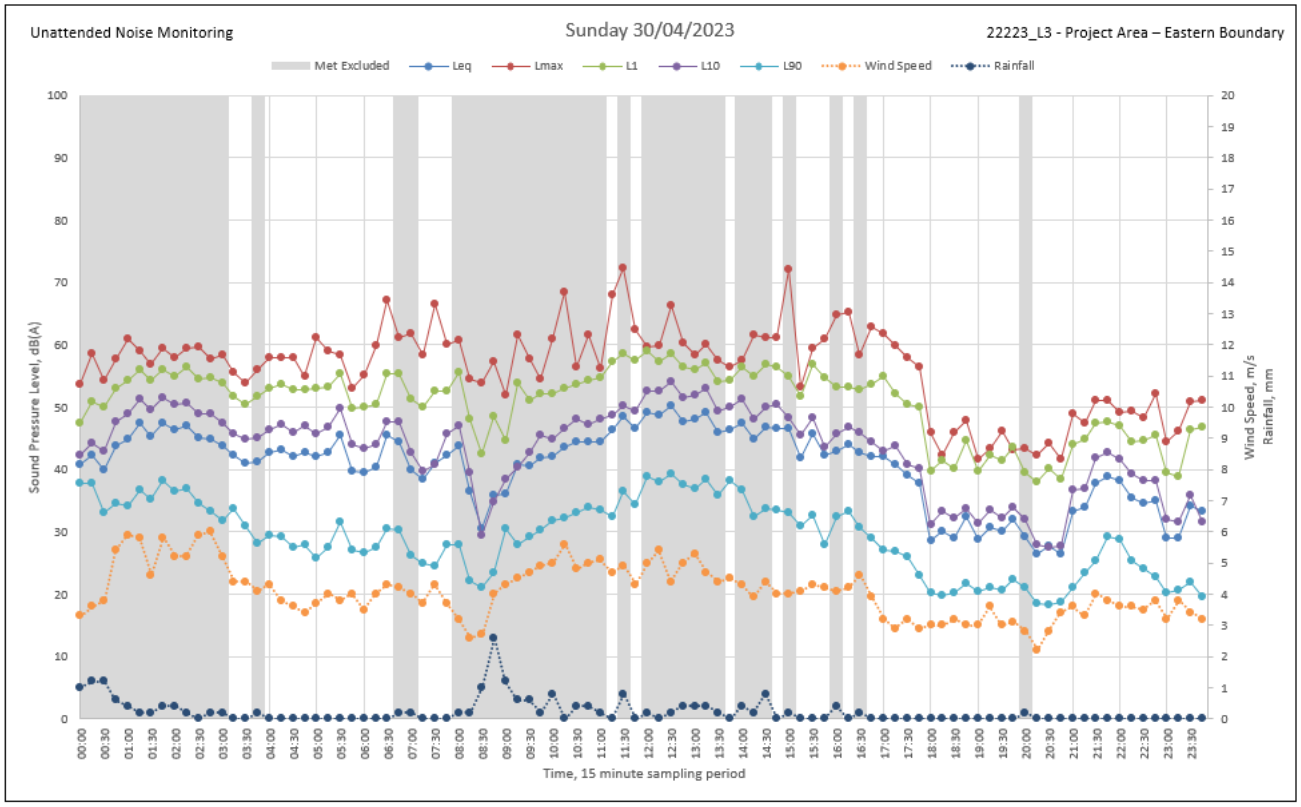


Figure C3.13 Unattended noise measurement at L3 – 30/4/2023

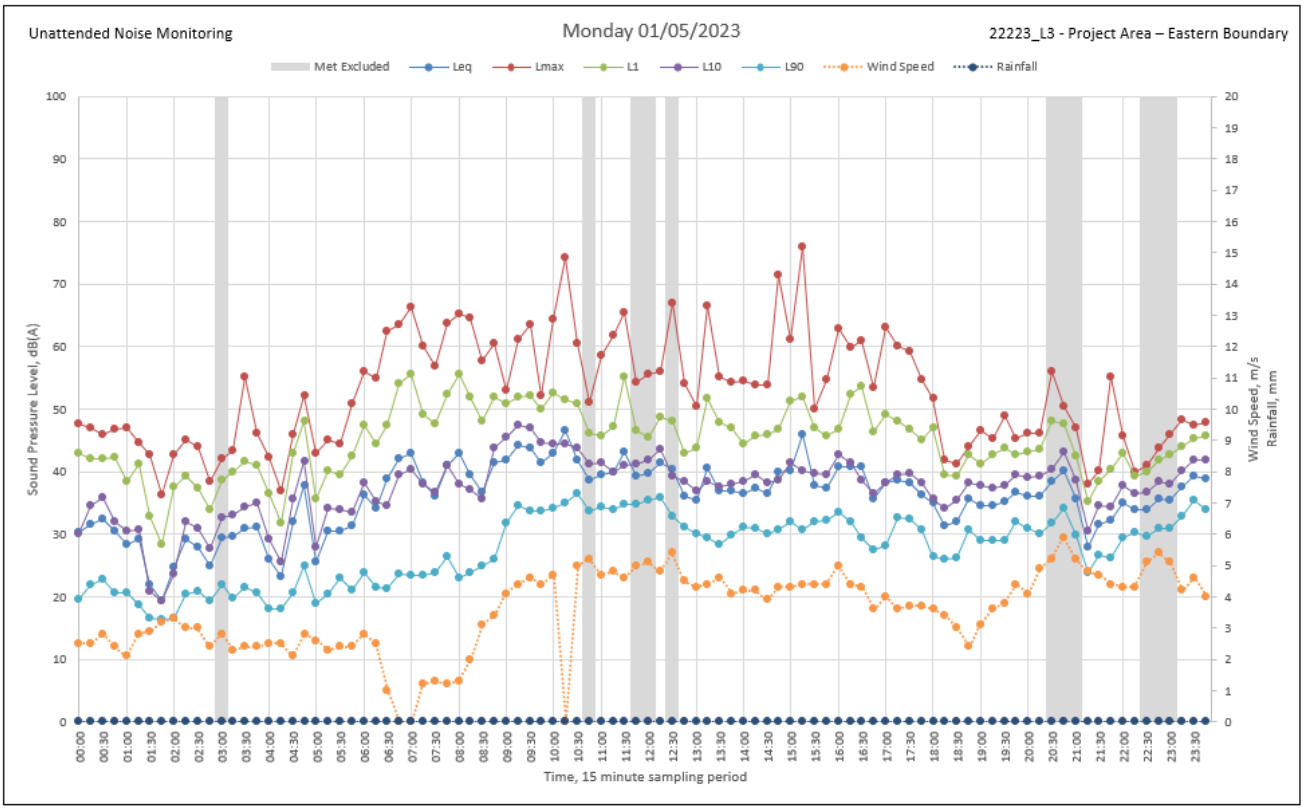


Figure C3.14 Unattended noise measurement at L3 – 1/5/2023

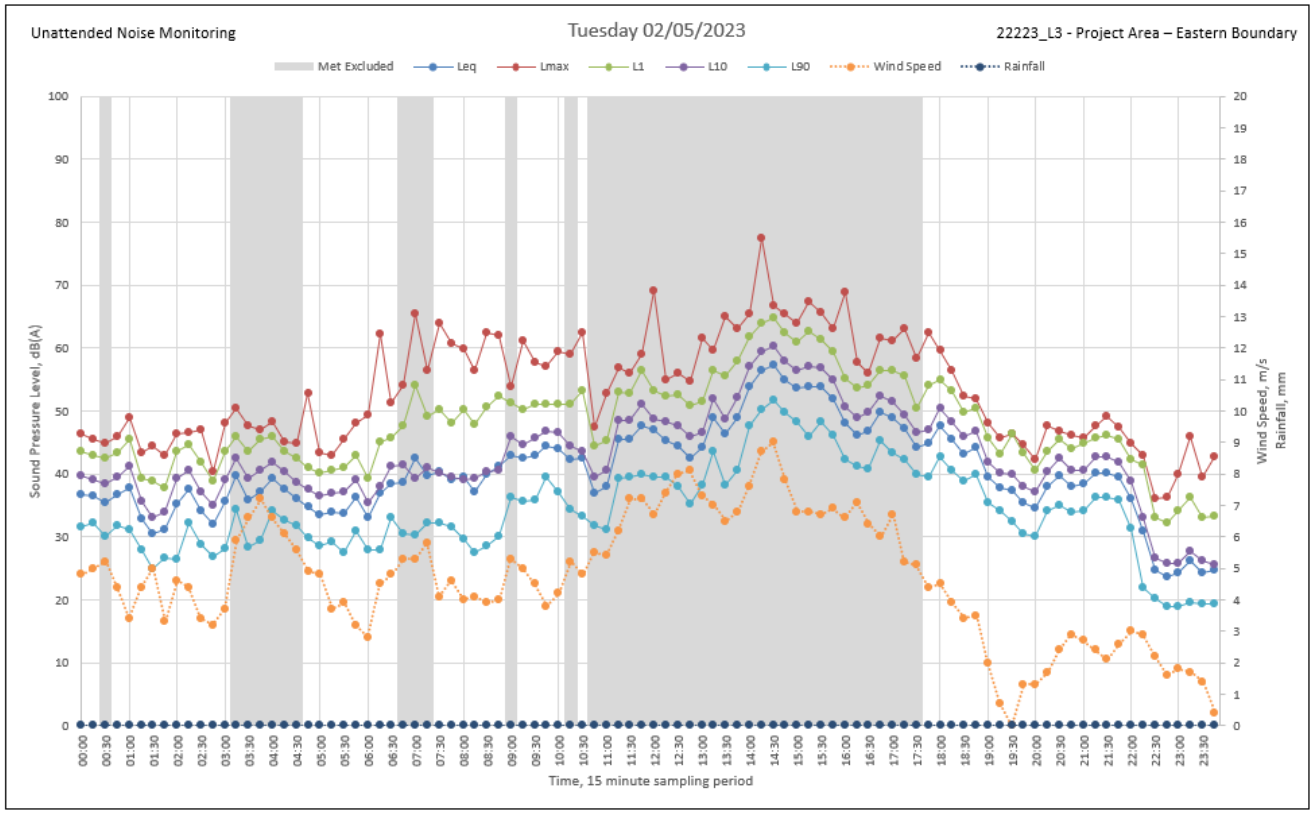


Figure C3.15 Unattended noise measurement at L3 – 2/5/2023

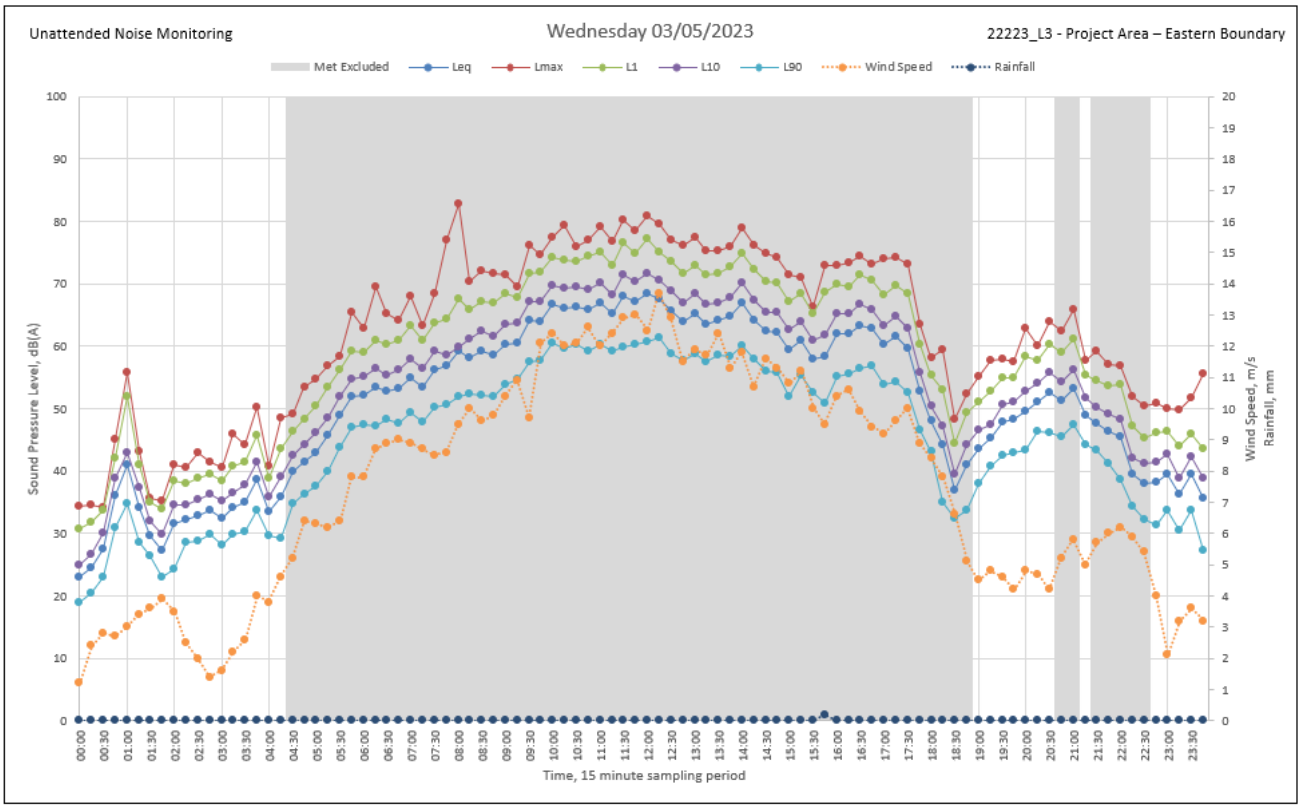


Figure C3.16 Unattended noise measurement at L3 – 3/5/2023

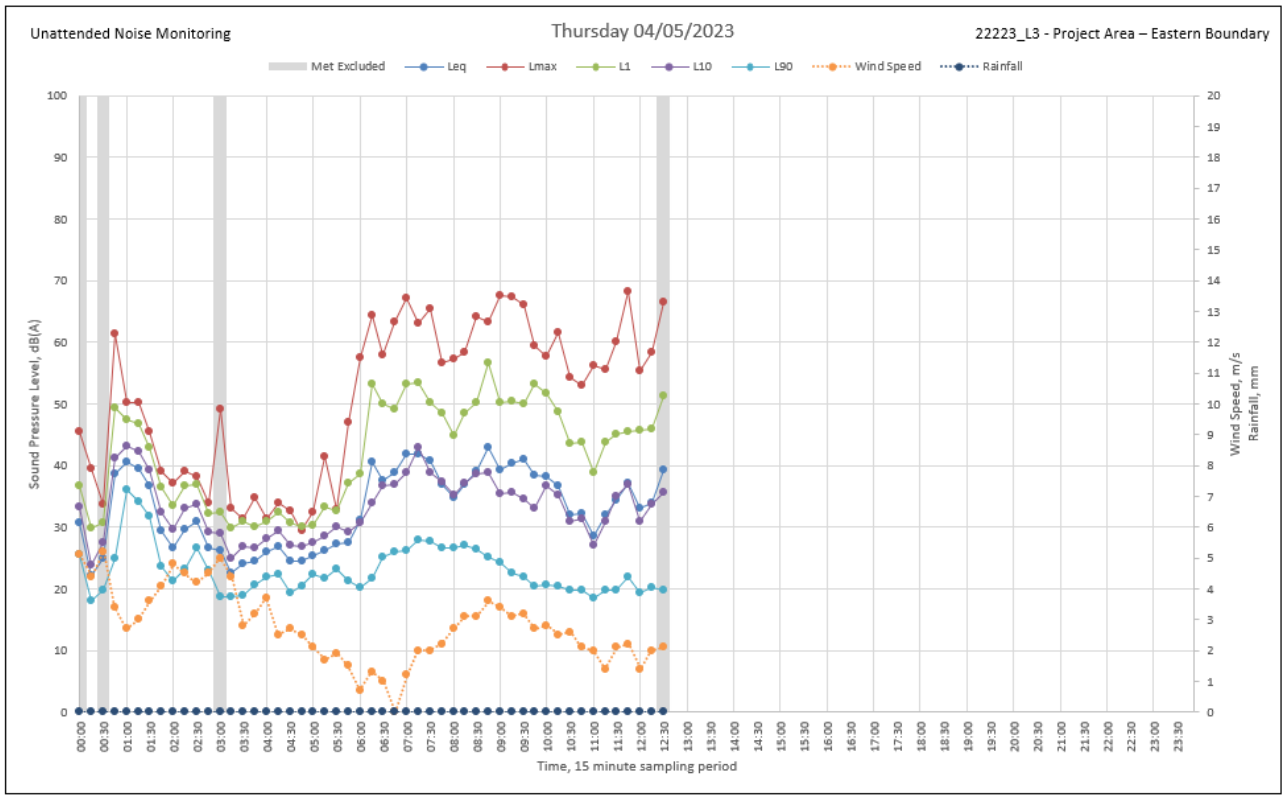
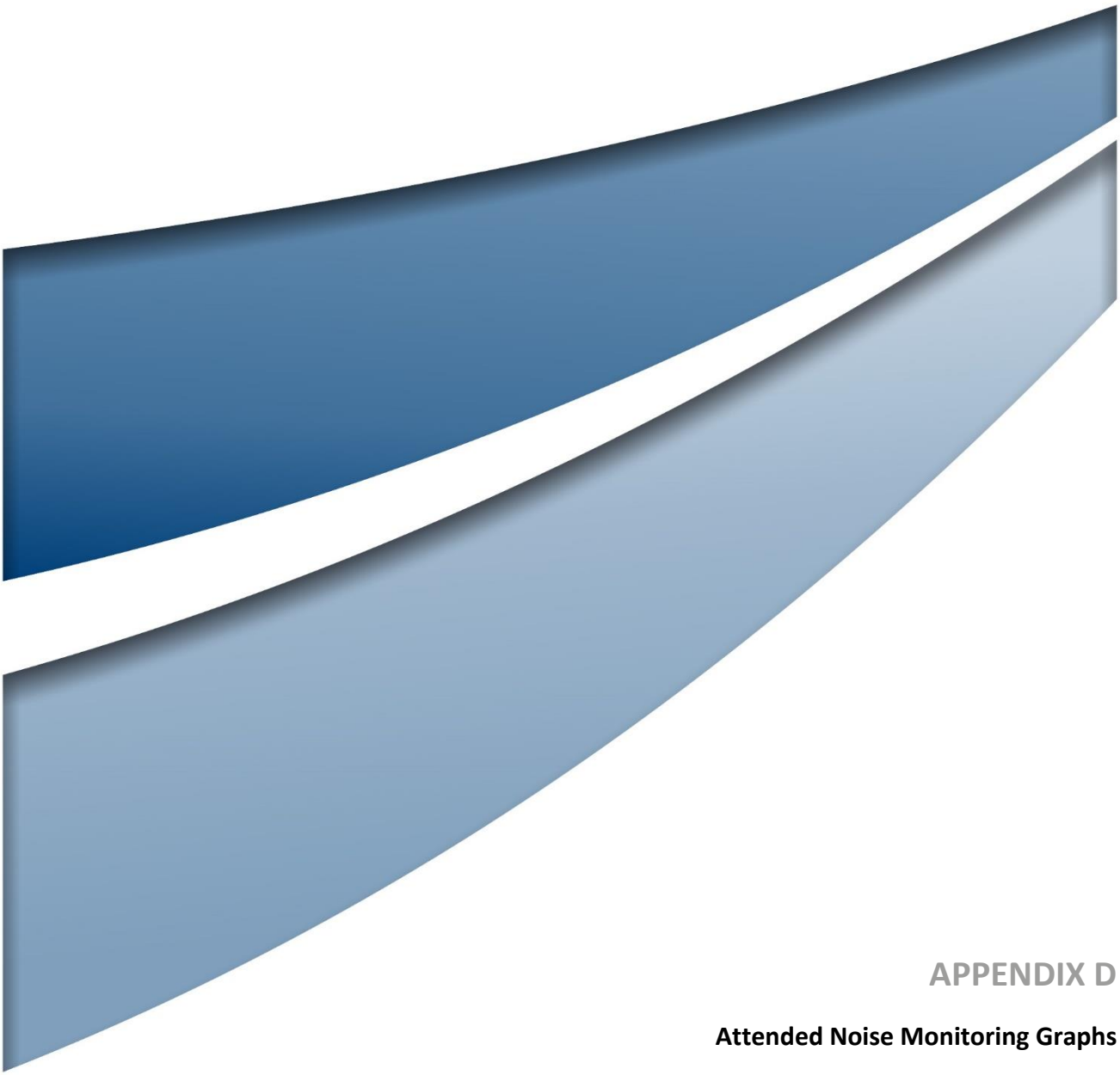


Figure C3.17 Unattended noise measurement at L3 – 4/5/2023



APPENDIX D

Attended Noise Monitoring Graphs

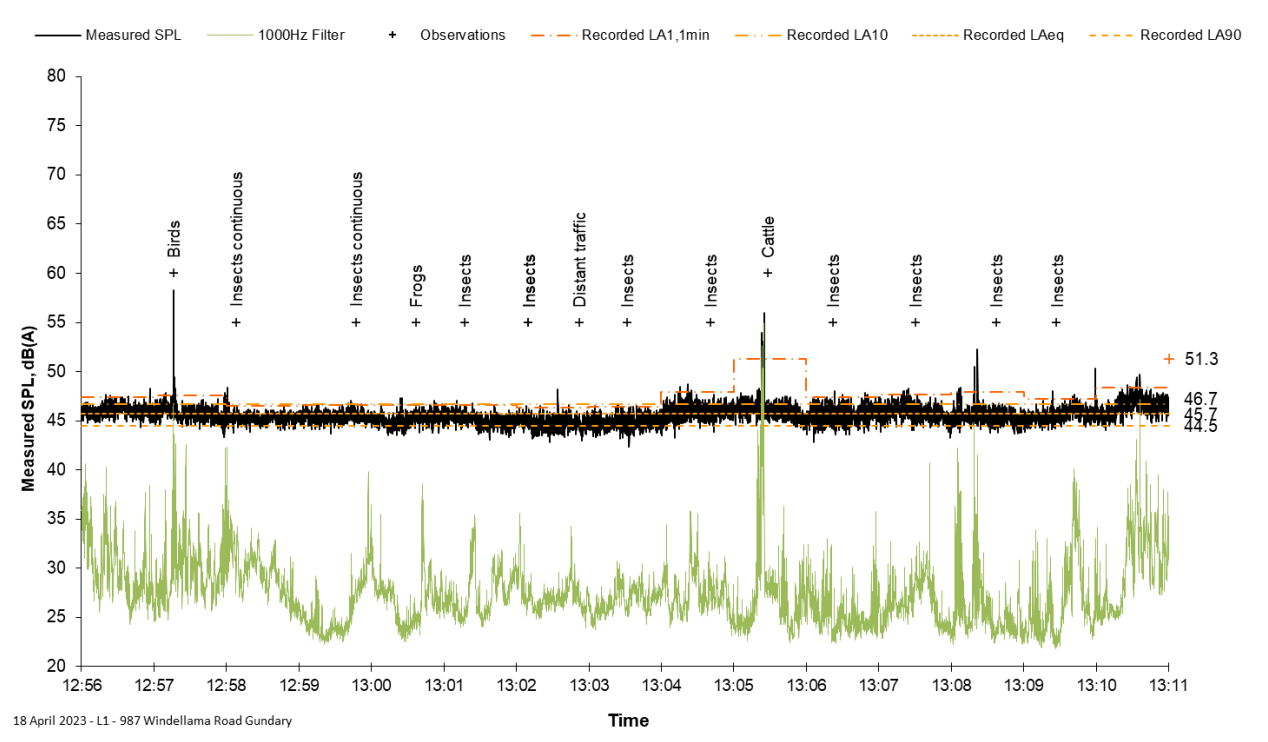


Figure D.1 Monitoring Results for L1 – 987 Windellama Road Gundary

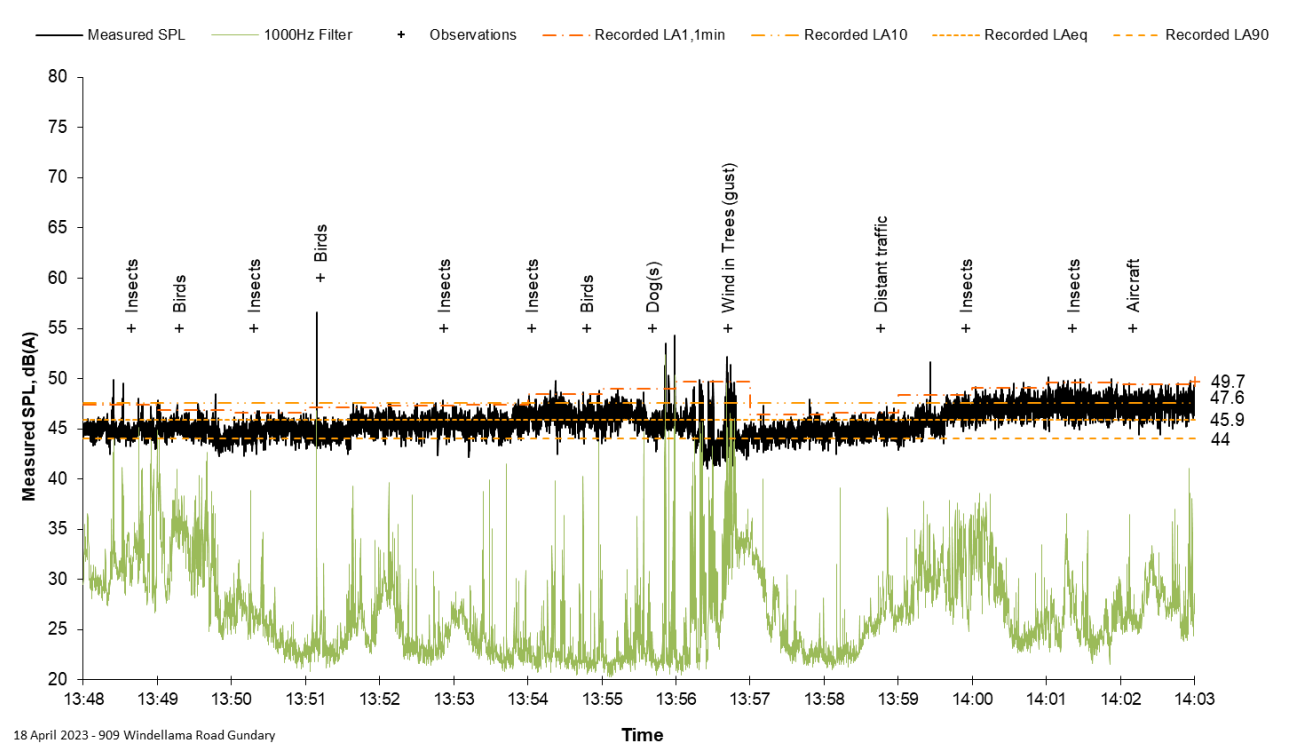


Figure D.2 Monitoring Results for L2 – 909 Windellama Road Gundary

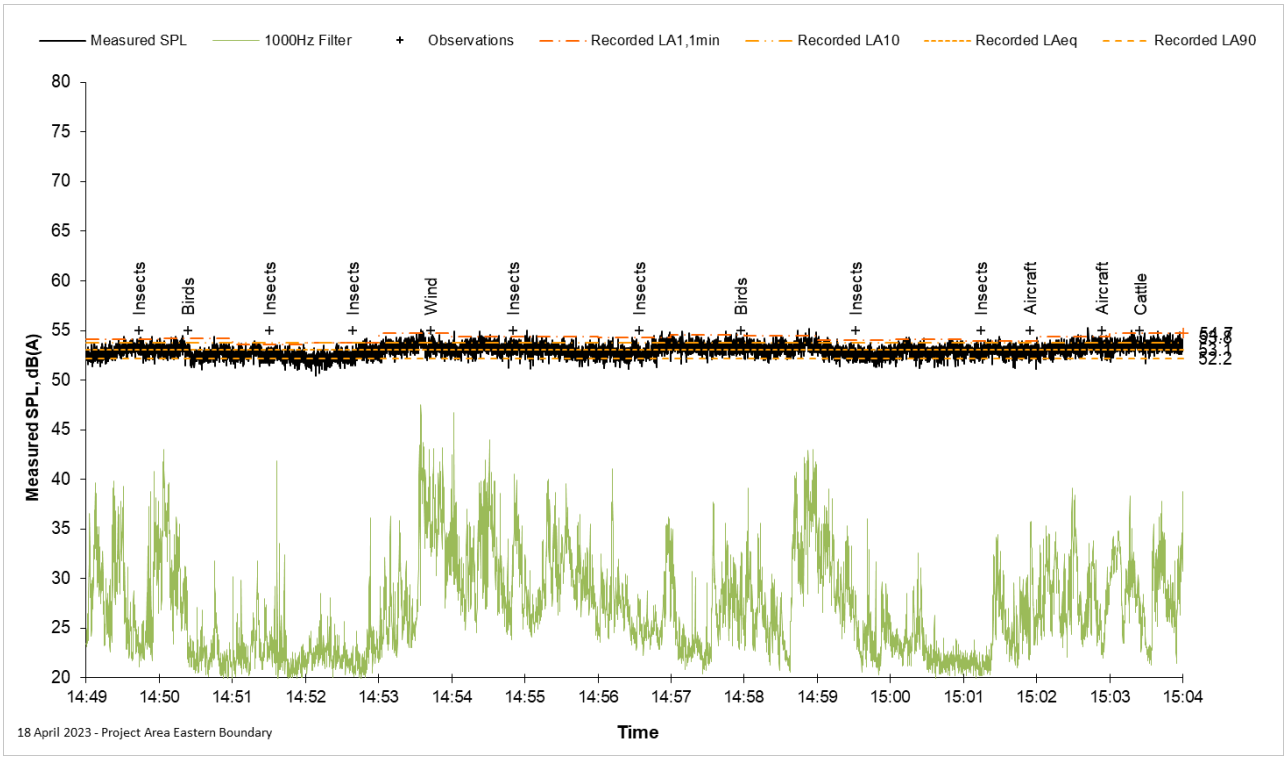
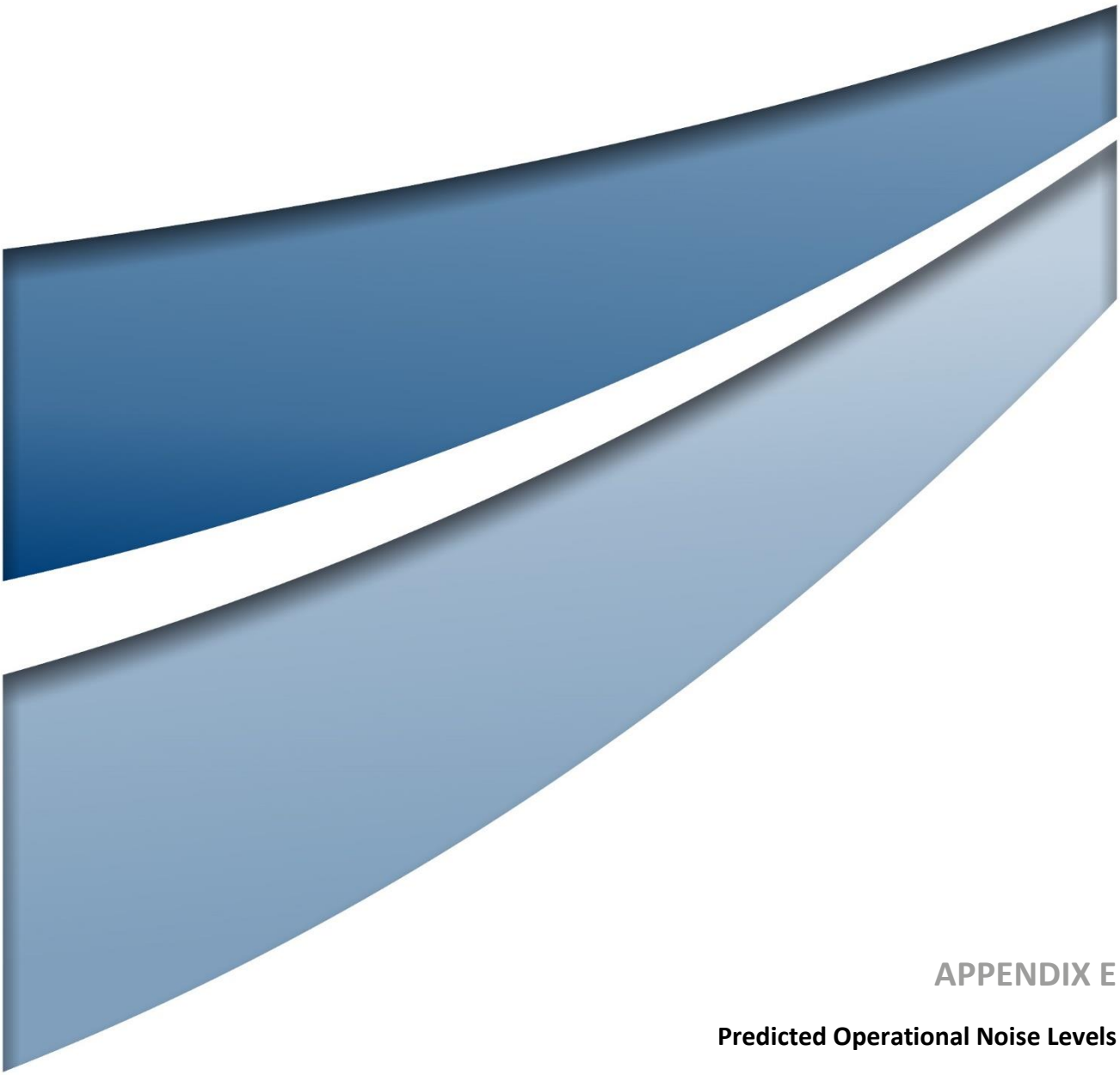


Figure D.3 Monitoring Results for L3 – Project Area Eastern Boundary



APPENDIX E

Predicted Operational Noise Levels

Table E.1 Predicted Operational Levels, $L_{Aeq,15minute}$ dB(A)

Rec ID [1]	Structure	PNTL [1], D/E/N [2]	Operational Noise for S/F and BESS Options		
			Centralised	Decentralised	Centralised and Decentralised
R1	Residence	40/35/35	< 20	24	24
R2	Residence	40/35/35	< 20	25	25
R3	Residence	40/35/35	< 20	< 20	< 20
R4	Residence	40/35/35	< 20	31	31
R5	Residence	40/35/35	< 20	28	28
R6	Residence	40/35/35	< 20	28	28
R7	Residence	40/35/35	< 20	27	27
R8	Residence	40/35/35	< 20	24	24
R9	Residence	40/35/35	22	34	34
R10	Residence	40/35/35	< 20	29	30
R11	Residence	40/35/35	< 20	< 20	< 20
R12	Residence	40/35/35	< 20	< 20	< 20
R13	Residence	40/35/35	20	< 20	21
R14	Residence	40/35/35	20	< 20	22
R15	Residence	40/35/35	21	< 20	23
R16A	Residence	40/35/35	21	22	25
R16B	Residence	40/35/35	22	22	25
R16C	Residence	40/35/35	21	21	24
R17	Residence	40/35/35	< 20	< 20	< 20
R18	Residence	40/35/35	< 20	< 20	< 20
R19	Residence	40/35/35	< 20	< 20	< 20
R20	Residence	40/35/35	23	23	26
R21A	Residence	40/35/35	23	24	27
R21B	Residence	40/35/35	23	24	27
R22	Residence	40/35/35	31	28	33
R23	Residence	40/35/35	< 20	< 20	< 20
R24	Residence	40/35/35	< 20	< 20	< 20
R25	Residence	40/35/35	31	31	34
R26	Residence	40/35/35	< 20	< 20	< 20
R27	Residence	40/35/35	29	33	35
R28	Residence	40/35/35	< 20	< 20	< 20
R29	Residence	40/35/35	22	25	27
R30	Residence	40/35/35	27	28	30
R31	Residence	40/35/35	27	29	31
R32	Residence	40/35/35	20	23	24
R33	Residence	40/35/35	< 20	< 20	< 20
R34	Residence	40/35/35	< 20	24	25
R35	Residence	40/35/35	< 20	25	25

Rec ID [1]	Structure	PNTL [1], D/E/N [2]	Operational Noise for S/F and BESS Options		
			Centralised	Decentralised	Centralised and Decentralised
R36	Residence	40/35/35	< 20	22	23
R37	Residence	40/35/35	< 20	25	26
R38	Residence	40/35/35	< 20	< 20	< 20
R39	Residence	40/35/35	< 20	< 20	< 20
R40	Residence	40/35/35	< 20	21	21
R41	Residence	40/35/35	< 20	21	21
R42	Residence	40/35/35	< 20	21	21
R43	Residence	40/35/35	< 20	22	22
R44	Residence	40/35/35	< 20	< 20	< 20
R45	Residence	40/35/35	< 20	< 20	< 20
R46	Residence	40/35/35	< 20	< 20	< 20
R47	Residence	40/35/35	< 20	< 20	< 20
R48	Residence	40/35/35	< 20	< 20	< 20
R49	Residence	40/35/35	< 20	< 20	< 20
R50	Residence	40/35/35	< 20	< 20	< 20
R51	Residence	40/35/35	< 20	< 20	< 20
R52	Residence	40/35/35	< 20	< 20	< 20
R53	Residence	40/35/35	< 20	< 20	< 20
R54	Residence	40/35/35	< 20	< 20	< 20
R55	Residence	40/35/35	< 20	< 20	< 20
R56	Residence	40/35/35	< 20	< 20	< 20
R57	Residence	40/35/35	< 20	< 20	20
R58	Residence	40/35/35	< 20	< 20	< 20
R59	Residence	40/35/35	< 20	< 20	< 20
R60	Residence	40/35/35	< 20	< 20	< 20
R61	Residence	40/35/35	< 20	< 20	< 20
R62	Residence	40/35/35	< 20	< 20	< 20
R63	Residence	40/35/35	< 20	< 20	< 20
R64	Residence	40/35/35	< 20	< 20	< 20
R65	Residence	40/35/35	< 20	< 20	< 20
R66	Residence	40/35/35	< 20	< 20	< 20
R67	Residence	40/35/35	< 20	< 20	< 20
R68	Residence	40/35/35	< 20	< 20	< 20
R69	Residence	40/35/35	< 20	23	24
R70	Residence	40/35/35	< 20	20	21
R71	Residence	40/35/35	< 20	23	23
R72	Residence	40/35/35	< 20	< 20	< 20
R73	Residence	40/35/35	< 20	< 20	< 20
R74	Residence	40/35/35	< 20	< 20	< 20

Rec ID [1]	Structure	PNTL [1], D/E/N [2]	Operational Noise for S/F and BESS Options		
			Centralised	Decentralised	Centralised and Decentralised
R75	Residence	40/35/35	< 20	< 20	< 20
R76	Residence	40/35/35	< 20	< 20	< 20
R77	Residence	40/35/35	< 20	< 20	< 20
R78	Residence	40/35/35	< 20	21	22
R79	Residence	40/35/35	< 20	20	23
R80	Residence	40/35/35	< 20	< 20	< 20
R81	Residence	40/35/35	< 20	< 20	< 20
R82	Residence	40/35/35	< 20	< 20	< 20
R83	Residence	40/35/35	< 20	< 20	< 20
R84	Residence	40/35/35	< 20	< 20	< 20
R85	Residence	40/35/35	< 20	< 20	< 20
R86	Residence	40/35/35	< 20	< 20	< 20
R87	Residence	40/35/35	< 20	< 20	< 20
R88	Residence	40/35/35	< 20	< 20	20
R90	Residence	40/35/35	22	30	30
R91	Residence	40/35/35	< 20	< 20	< 20
R92	Residence	40/35/35	< 20	< 20	< 20
R93	Residence	40/35/35	< 20	< 20	< 20
R94	Residence	40/35/35	< 20	< 20	< 20
R95	Residence	40/35/35	< 20	< 20	< 20
R96	Residence	40/35/35	< 20	< 20	< 20
R97	Residence	40/35/35	< 20	< 20	< 20
R98	Residence	40/35/35	< 20	< 20	< 20
R99	Residence	40/35/35	< 20	< 20	< 20
R100	Residence	40/35/35	< 20	< 20	< 20
R101	Residence	40/35/35	< 20	< 20	< 20
R102	Residence	40/35/35	< 20	< 20	< 20
R103	Residence	40/35/35	< 20	< 20	< 20
R104	Residence	40/35/35	< 20	< 20	< 20
R105	Residence	40/35/35	< 20	< 20	< 20
R106	Residence	40/35/35	< 20	< 20	< 20

Notes:

[1] PNTL - Project Noise Tigger Levels are the operational noise criteria for the Project.

[2] Day period (D) is 7.00 am–6.00 pm Monday–Saturday and 8.00 am–6.00 pm Sunday and Public Holidays, evening period (E) is 6.00 pm–10.00 pm and night period (N) is 10.00 pm to commencement of day period.

Table E.2 Predicted Operational Levels to Vacant Land, $L_{Aeq,15minute}$ dB(A)

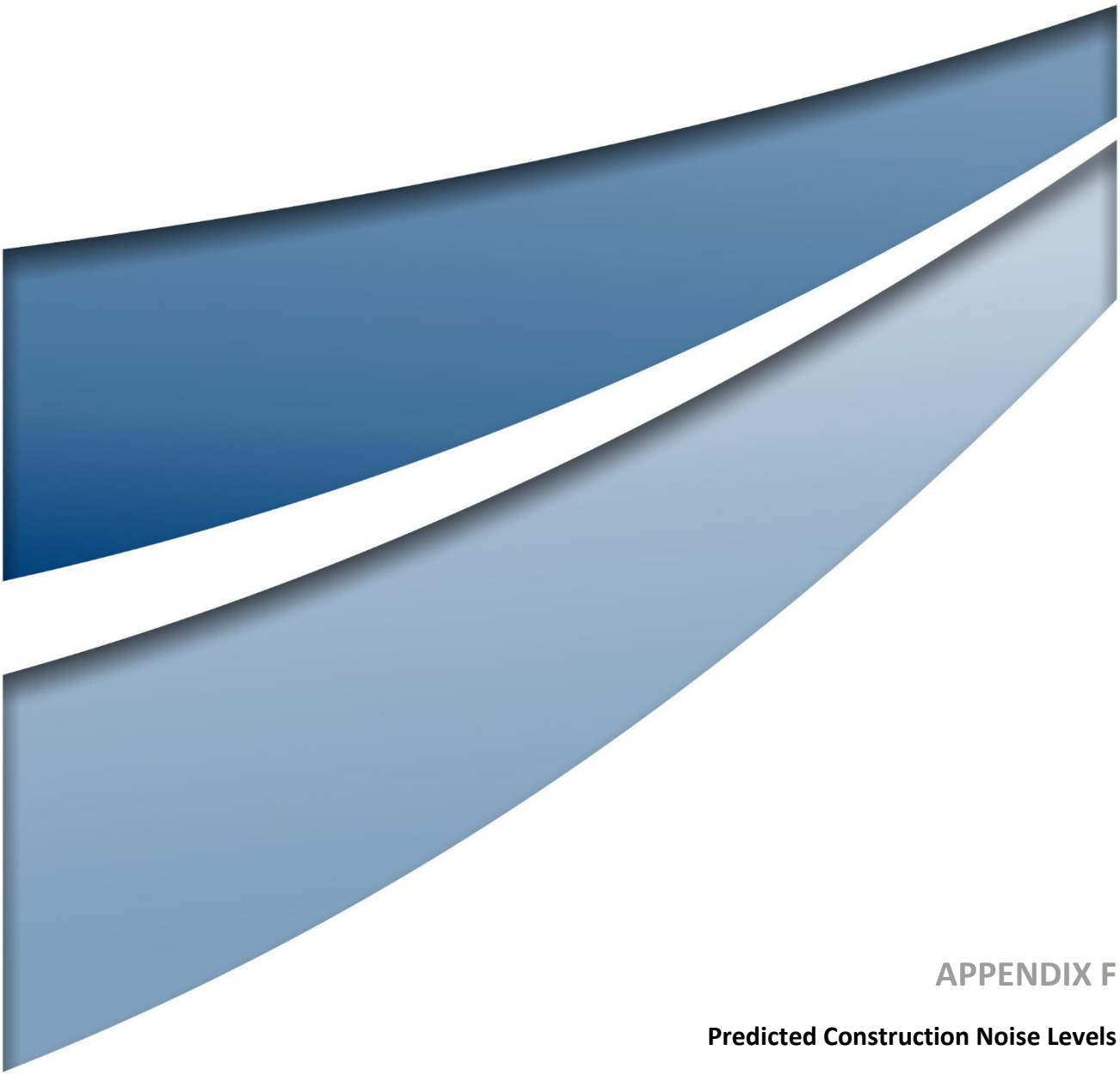
Rec ID [1]	Structure	PNTL [1], D/E/N [2]	Operational Noise for S/F and BESS Options		
			Centralised	Decentralised	Centralised and Decentralised
FR1	Vacant Land [3]	na	< 20	22	23
FR2	Vacant Land [3]	na	< 20	24	25
FR3	Vacant Land [3]	na	< 20	32	32
FR4	Vacant Land [3]	na	< 20	23	23
FR5	Vacant Land [3]	na	< 20	22	22
FR6	Vacant Land [3]	na	< 20	34	34
FR7	Vacant Land [3]	na	20	40	40
FR8	Vacant Land [3]	na	< 20	28	28
FR9	Vacant Land [3]	na	< 20	27	27
FR10	Vacant Land [3]	na	< 20	26	26
FR11	Vacant Land [3]	na	< 20	31	31
FR12	Vacant Land [3]	na	22	42	42
FR13	Vacant Land [3]	na	< 20	35	35
FR14	Vacant Land [3]	na	< 20	33	33
FR15	Vacant Land [3]	na	< 20	28	28
FR16	Vacant Land [3]	na	< 20	28	28
FR17	Vacant Land [3]	na	< 20	< 20	< 20
FR18	Vacant Land [3]	na	< 20	21	22
FR19	Vacant Land [3]	na	< 20	23	23
FR20	Vacant Land [3]	na	< 20	24	24
FR21	Vacant Land [3]	na	< 20	< 20	< 20
FR22	Vacant Land [3]	na	25	33	34

Notes:

[1] PNTL – Project Noise Tigger Levels are the operational noise criteria for the Project.

[2] Day period (D) is 7.00 am–6.00 pm Monday–Saturday and 8.00 am–6.00 pm Sunday and Public Holidays, evening period (E) is 6.00 pm–10.00 pm and night period (N) is 10.00 pm to commencement of day period.

[3] The locations of the receivers on the vacant land were determined by the locations of the potential septic locations on the subdivision approval. The residence could be located elsewhere on the lot to avoid / minimise noise impacts.



APPENDIX F

Predicted Construction Noise Levels

Table F.1 Predicted Daytime Construction Noise Levels, $L_{Aeq(15\ min)}$ dB(A)

Rec ID	Structure	Construction Scenario						
		Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7
R1	Residence	40	35	33	30	30	30	<20
R2	Residence	42	37	35	32	32	32	<20
R3	Residence	<20	<20	<20	<20	<20	<20	<20
R4	Residence	**53**	**48**	**46**	43	43	43	<20
R5	Residence	**48**	43	41	38	38	38	<20
R6	Residence	**51**	**46**	44	41	41	41	<20
R7	Residence	**49**	44	42	39	39	39	<20
R8	Residence	**49**	44	42	39	39	39	21
R9	Residence	**64**	**59**	**57**	**54**	**54**	**54**	20
R10	Residence	**47**	42	40	37	37	37	27
R11	Residence	33	28	26	23	23	23	21
R12	Residence	32	27	25	22	22	22	26
R13	Residence	36	31	29	26	26	26	30
R14	Residence	36	31	29	26	26	26	31
R15	Residence	37	32	30	27	27	27	31
R16A	Residence	**49**	44	42	39	39	39	41
R16B	Residence	**49**	44	42	39	39	39	41
R16C	Residence	**51**	**46**	44	41	41	41	40
R17	Residence	<20	<20	<20	<20	<20	<20	<20
R18	Residence	<20	<20	<20	<20	<20	<20	<20
R19	Residence	21	<20	<20	<20	<20	<20	<20
R20	Residence	**52**	**47**	45	42	42	42	**48**
R21A	Residence	**56**	**51**	**49**	**46**	**46**	**46**	**52**
R21B	Residence	**56**	**51**	**49**	**46**	**46**	**46**	**52**
R22	Residence	**64**	**59**	**57**	**54**	**54**	**54**	**46**
R23	Residence	<20	<20	<20	<20	<20	<20	<20
R24	Residence	<20	<20	<20	<20	<20	<20	<20
R25	Residence	**60**	**55**	**53**	**50**	**50**	**50**	**46**
R26	Residence	23	<20	<20	<20	<20	<20	<20
R27	Residence	**50**	45	43	40	40	40	28
R28	Residence	<20	<20	<20	<20	<20	<20	<20
R29	Residence	**47**	42	40	37	37	37	38
R30	Residence	**48**	43	41	38	38	38	44
R31	Residence	**48**	43	41	38	38	38	40
R32	Residence	43	38	36	33	33	33	37
R33	Residence	22	<20	<20	<20	<20	<20	<20
R34	Residence	39	34	32	29	29	29	34
R35	Residence	38	33	31	28	28	28	33

Rec ID	Structure	Construction Scenario						
		Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7
R36	Residence	36	31	29	26	26	26	31
R37	Residence	35	30	28	25	25	25	31
R38	Residence	<20	<20	<20	<20	<20	<20	<20
R39	Residence	31	26	24	21	21	21	22
R40	Residence	36	31	29	26	26	26	24
R41	Residence	37	32	30	27	27	27	22
R42	Residence	37	32	30	27	27	27	21
R43	Residence	35	30	28	25	25	25	22
R44	Residence	21	<20	<20	<20	<20	<20	<20
R45	Residence	27	22	20	<20	<20	<20	25
R46	Residence	28	23	21	<20	<20	<20	25
R47	Residence	32	27	25	22	22	22	<20
R48	Residence	33	28	26	23	23	23	27
R49	Residence	32	27	25	22	22	22	22
R50	Residence	25	20	<20	<20	<20	<20	<20
R51	Residence	27	22	20	<20	<20	<20	21
R52	Residence	<20	<20	<20	<20	<20	<20	<20
R53	Residence	<20	<20	<20	<20	<20	<20	<20
R54	Residence	<20	<20	<20	<20	<20	<20	<20
R55	Residence	30	25	23	20	20	20	26
R56	Residence	30	25	23	20	20	20	25
R57	Residence	32	27	25	22	22	22	29
R58	Residence	27	22	20	<20	<20	<20	20
R59	Residence	32	27	25	22	22	22	23
R60	Residence	33	28	26	23	23	23	21
R61	Residence	22	<20	<20	<20	<20	<20	<20
R62	Residence	<20	<20	<20	<20	<20	<20	<20
R63	Residence	29	24	22	<20	<20	<20	28
R64	Residence	30	25	23	20	20	20	28
R65	Residence	20	<20	<20	<20	<20	<20	<20
R66	Residence	29	24	22	<20	<20	<20	20
R67	Residence	33	28	26	23	23	23	<20
R68	Residence	36	31	29	26	26	26	<20
R69	Residence	38	33	31	28	28	28	20
R70	Residence	45	40	38	35	35	35	<20
R71	Residence	39	34	32	29	29	29	<20
R72	Residence	32	27	25	22	22	22	<20
R73	Residence	32	27	25	22	22	22	<20
R74	Residence	31	26	24	21	21	21	<20

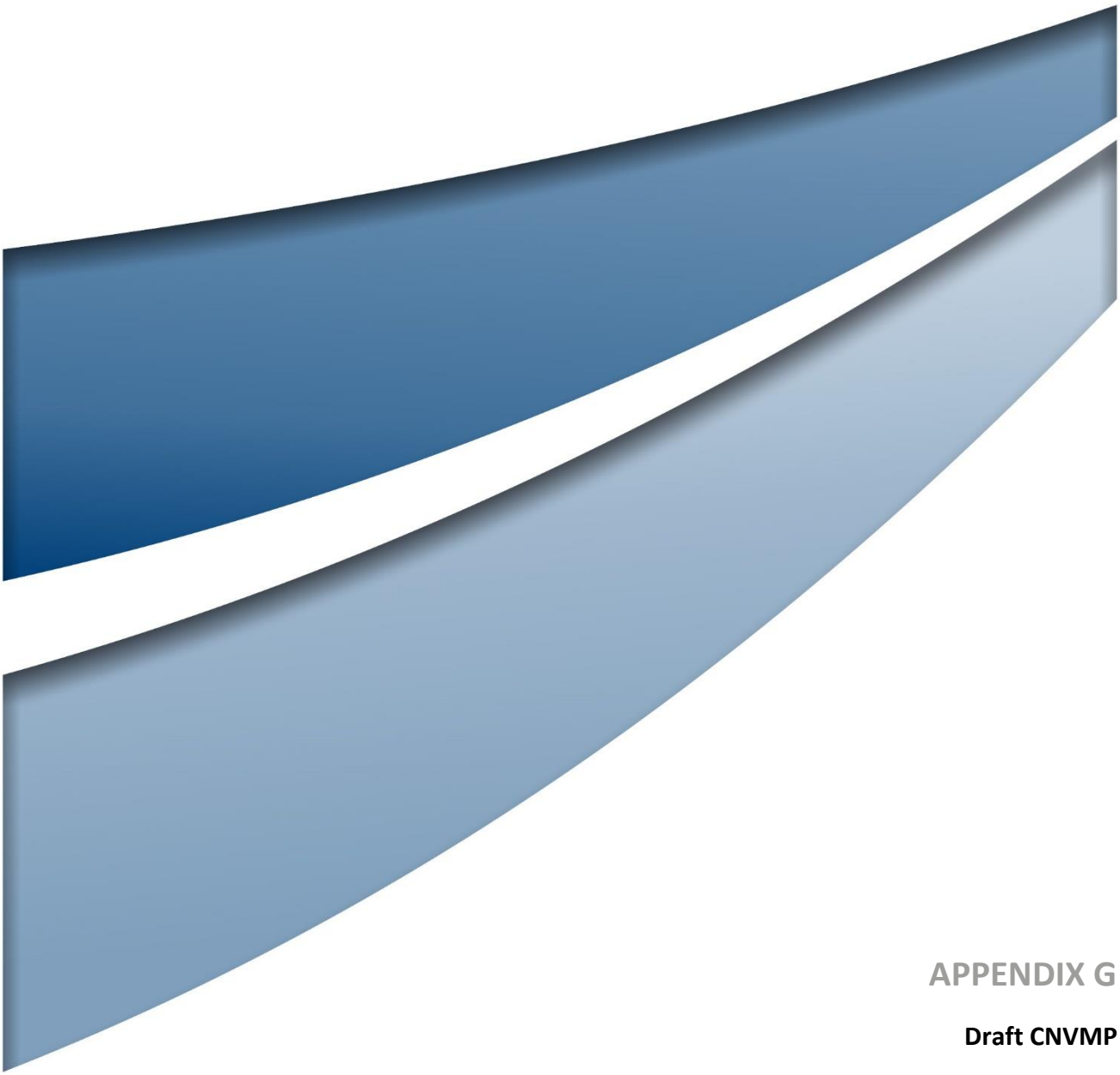
Rec ID	Structure	Construction Scenario						
		Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7
R75	Residence	<20	<20	<20	<20	<20	<20	<20
R76	Residence	28	23	21	<20	<20	<20	27
R77	Residence	26	21	<20	<20	<20	<20	22
R78	Residence	36	31	29	26	26	26	32
R79	Residence	**46**	41	39	36	36	36	48
R80	Residence	28	23	21	<20	<20	<20	26
R81	Residence	30	25	23	20	20	20	28
R82	Residence	27	22	20	<20	<20	<20	24
R83	Residence	<20	<20	<20	<20	<20	<20	<20
R84	Residence	30	25	23	20	20	20	<20
R85	Residence	30	25	23	20	20	20	<20
R86	Residence	23	<20	<20	<20	<20	<20	<20
R87	Residence	29	24	22	<20	<20	<20	24
R88	Residence	35	30	28	25	25	25	23
R90	Residence	**46**	41	39	36	36	36	28
R91	Residence	20	<20	<20	<20	<20	<20	<20
R92	Residence	<20	<20	<20	<20	<20	<20	<20
R93	Residence	<20	<20	<20	<20	<20	<20	<20
R94	Residence	31	26	24	21	21	21	<20
R95	Residence	32	27	25	22	22	22	<20
R96	Residence	32	27	25	22	22	22	<20
R97	Residence	<20	<20	<20	<20	<20	<20	<20
R98	Residence	22	<20	<20	<20	<20	<20	<20
R99	Residence	<20	<20	<20	<20	<20	<20	<20
R100	Residence	<20	<20	<20	<20	<20	<20	<20
R101	Residence	<20	<20	<20	<20	<20	<20	<20
R102	Residence	<20	<20	<20	<20	<20	<20	<20
R103	Residence	<20	<20	<20	<20	<20	<20	<20
R104	Residence	<20	<20	<20	<20	<20	<20	<20
R105	Residence	21	<20	<20	<20	<20	<20	<20
R106	Residence	<20	<20	<20	<20	<20	<20	<20
FR01	Vacant Land [2]	37	32	30	27	27	27	21
FR02	Vacant Land [2]	36	31	29	26	26	26	25
FR03	Vacant Land [2]	47	42	40	37	37	37	25
FR04	Vacant Land [2]	39	34	32	29	29	29	20
FR05	Vacant Land [2]	36	31	29	26	26	26	20
FR06	Vacant Land [2]	51	46	44	41	41	41	20
FR07	Vacant Land [2]	56	51	49	46	46	46	20
FR08	Vacant Land [2]	43	38	36	33	33	33	20

Rec ID	Structure	Construction Scenario						
		Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7
FR09	Vacant Land [2]	38	33	31	28	28	28	20
FR10	Vacant Land [2]	41	36	34	31	31	31	20
FR11	Vacant Land [2]	45	40	38	35	35	35	20
FR12	Vacant Land [2]	59	54	52	49	49	49	20
FR13	Vacant Land [2]	51	46	44	41	41	41	20
FR14	Vacant Land [2]	51	46	44	41	41	41	<20
FR15	Vacant Land [2]	44	39	37	34	34	34	<20
FR16	Vacant Land [2]	45	40	38	35	35	35	<20
FR17	Vacant Land [2]	33	28	26	23	23	23	<20
FR18	Vacant Land [2]	37	32	30	27	27	27	<20
FR19	Vacant Land [2]	37	32	30	27	27	27	<20
FR20	Vacant Land [2]	39	34	32	29	29	29	20
FR21	Vacant Land [2]	32	27	25	22	22	22	20
FR22	Vacant Land [2]	50	45	43	40	40	40	28

Notes:

[1] Predictions below 20 dB(A) have been presented as <20.

[2] The locations of the receivers on the vacant land were determined by the locations of the potential septic locations on the subdivision approval. The residence could be located elsewhere on the lot to avoid / minimise noise impacts.



APPENDIX G

Draft CNVMP

umwelt
Environmental & Social Consultants

lightsource bp

GUNDARY SOLAR FARM

Draft Construction Noise and Vibration Management Plan

DRAFT

June 2024

GUNDARY SOLAR FARM

Draft Construction Noise and Vibration Management Plan

DRAFT

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Lightsource bp Renewable Energy Limited

Project Director:	Malinda Facey
Project Manager:	Marion O'Neil
Technical Director:	Tim Procter
Technical Manager:	Ben Carlyle
Report No.	22223/R11/Appendix G
Date:	June 2024

Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

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.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
V1 Draft	Tim Procter	27/05/2024	Malinda Facey	03/06/2024

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1.0 Introduction

Lightsource Development Services Australia Pty Ltd (Lightsource bp) proposes to develop the Gundary Solar Farm (the Project) in the Southern Tablelands of New South Wales (NSW), approximately 10 kilometres (km) southeast of Goulburn within the Goulburn Mulwaree Local Government Area (LGA). The location of the Project and its regional context is presented in **Figure 1.1**.

This Draft Construction Noise and Vibration Management Plan (DCNVMP) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) to guide the management of potential noise and vibration impacts associated with the Project, and details mitigation measures / controls where required.

1.1 Project Overview

The Project will involve the construction, operation, maintenance and decommissioning of a 400 Megawatt peak (MWp) solar farm with a Battery Energy Storage System (BESS) of up to 555 MWp and 1,570 Megwatt hour (MWh) capacity and associated infrastructure to connect the Project to the national electricity grid. The Project will be accessed from Windellama Road off the Hume Highway, at 961 Windellama Road. The Project's conceptual layout is included in **Figure 1.2**.

The Project will supply electricity to the National Electricity Market (NEM), via a new onsite connection to the existing 330 kV overhead transmission line traversing through the north-west corner of the Project Area. The Project will generate enough clean energy for about 133,000 homes and reduce carbon emissions by 670,000 tonnes.

The Project would be located on land zoned RU1 – Primary Production. The area surrounding the Project is characterised predominantly by agricultural lands associated with rural residential properties, small settlements, conservation areas and rural tourism. Land within and adjacent to the Project has been subject to extensive cultivation associated with historic and more recent agricultural land uses.

The Project will be developed across five freehold lots and a small section of Windellama Road and the road reserve, covering an area of approximately 702 ha (the Project Area). The freehold properties are primarily used for grazing activities. The Project infrastructure will cover approximately 512 ha (the development footprint).

The Project is expected to generate up to 400 Full Time Equivalent (FTE) jobs over the 18 to 24 month construction period with between two and four FTE jobs during operation.

The Project is a State Significant Development (SSD) under the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP) as the capital 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* (EP&A Act).

1.1.1 Construction Hours

Construction activities proposed to be undertaken during standard construction hours specified in the Interim Construction Noise Guideline (ICNG) (DECC 2009).

The proposed construction hours are as follows:

- Monday to Friday: 7.00 am–6.00 pm.
- Saturday: 8.00 am–1.00 pm.
- Sunday and public holidays: No work.

Exceptions to the above hours may occur, however would be limited to activities with low noise generation where practicable. These activities would be assessed on a case-by-case basis prior to the commencement of those activities. The Goulburn Mulwaree Council would be notified of any foreseeable exceptions. This would include justifying why works are required outside the standard hours and outlining the timing, duration and potentially expected noise levels.

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 within the surrounding area, which are regarded as sensitive receivers. There are no other sensitive land uses (such as schools or places of worship) within or surrounding the Project Area.

One of the residential receivers near the Project Area (approximately 520 m to the southwest) is an involved residence (owned by the host landholder) and is not considered a sensitive receiver. The closest non-involved residential receiver is located approximately 137 m north of the Project Area.

Sensitive receivers in the area surrounding the Project are presented in **Figure 1.3** and **Appendix A**.

To simplify the assessment of residential 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 1.3**.

Table 1.1 Noise Catchment Area Descriptions

NCA	Description
NCA_1	An area in proximity to Windellama Road and representing the rural areas near the western extent of the Project, south of the Windellama Road Project Access point. Background data based on monitoring location L1.
NCA_2	An area in proximity to Windellama Road and representing the rural areas near the western extent of the Project, north of the Windellama Road Project Access point. Background data based on monitoring location L2.
NCA_3	An area representing the rural areas to the northern, east and south of the Project, that are located away from Windellama Road. Background data based on monitoring location L3.

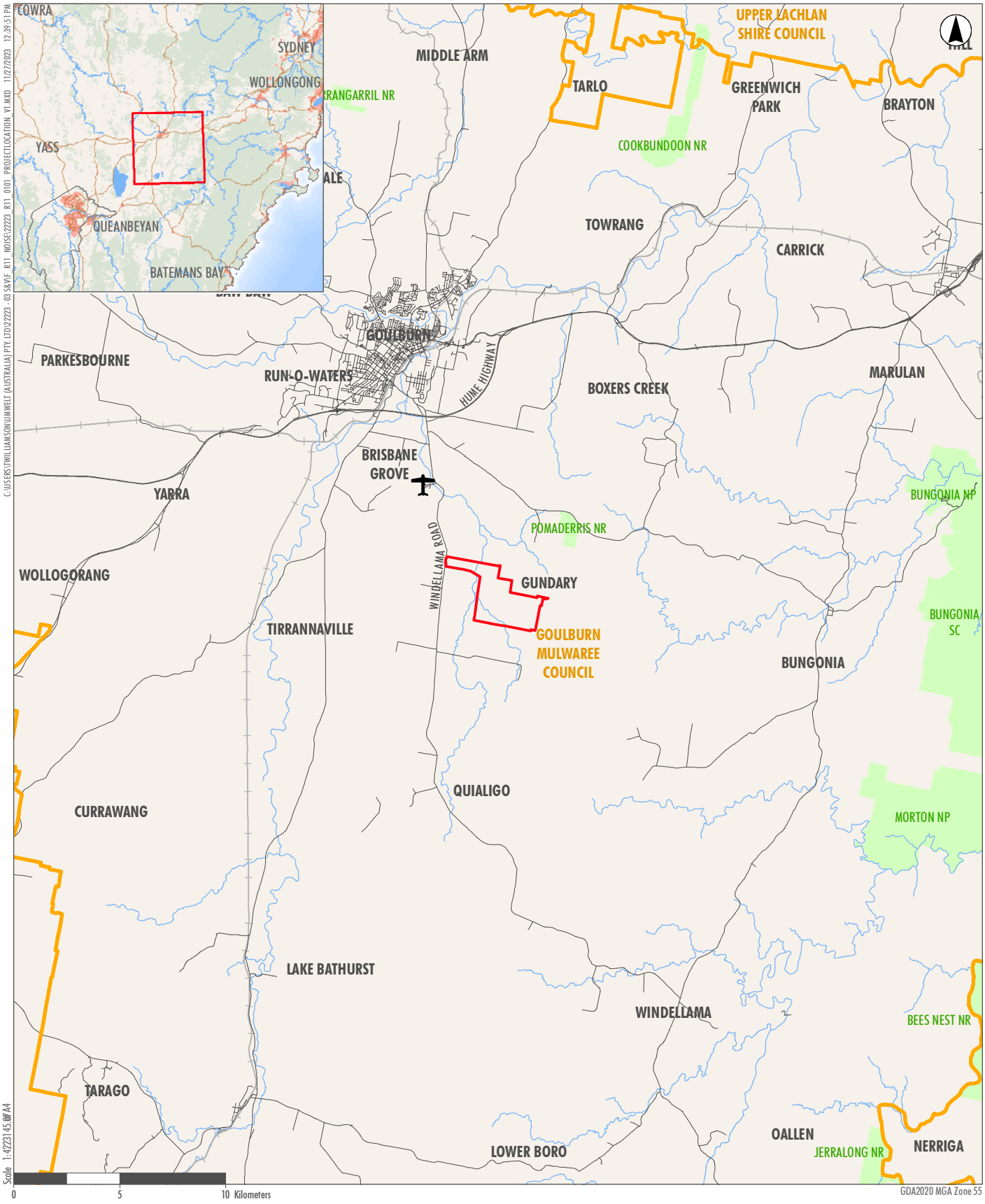


FIGURE 1.1

Project Location

Data source: NSW DSFI (2022); Lightsource BP (2022)

FIGURE 1.2

Gundary Solar Farm Indicative Layout

Legend

- Access Roads
- Security Fence
- Existing Transmission Line
- Roads
- Watercourses
- Watercourse / Bed Level Crossing
- Water Tank (40,000L)
- Water Tank (10,000L)
- Primary Access
- Emergency Access
- Emergency Gate
- Project Area
- Proposed Road Upgrade
- Solar Panels
- Landscaping Buffer (5m)
- Transgrid Line Works
- Centralised AC BESS
- Substation and O&M Facility Area
- Construction Compound Area
- Decentralised DC BESS

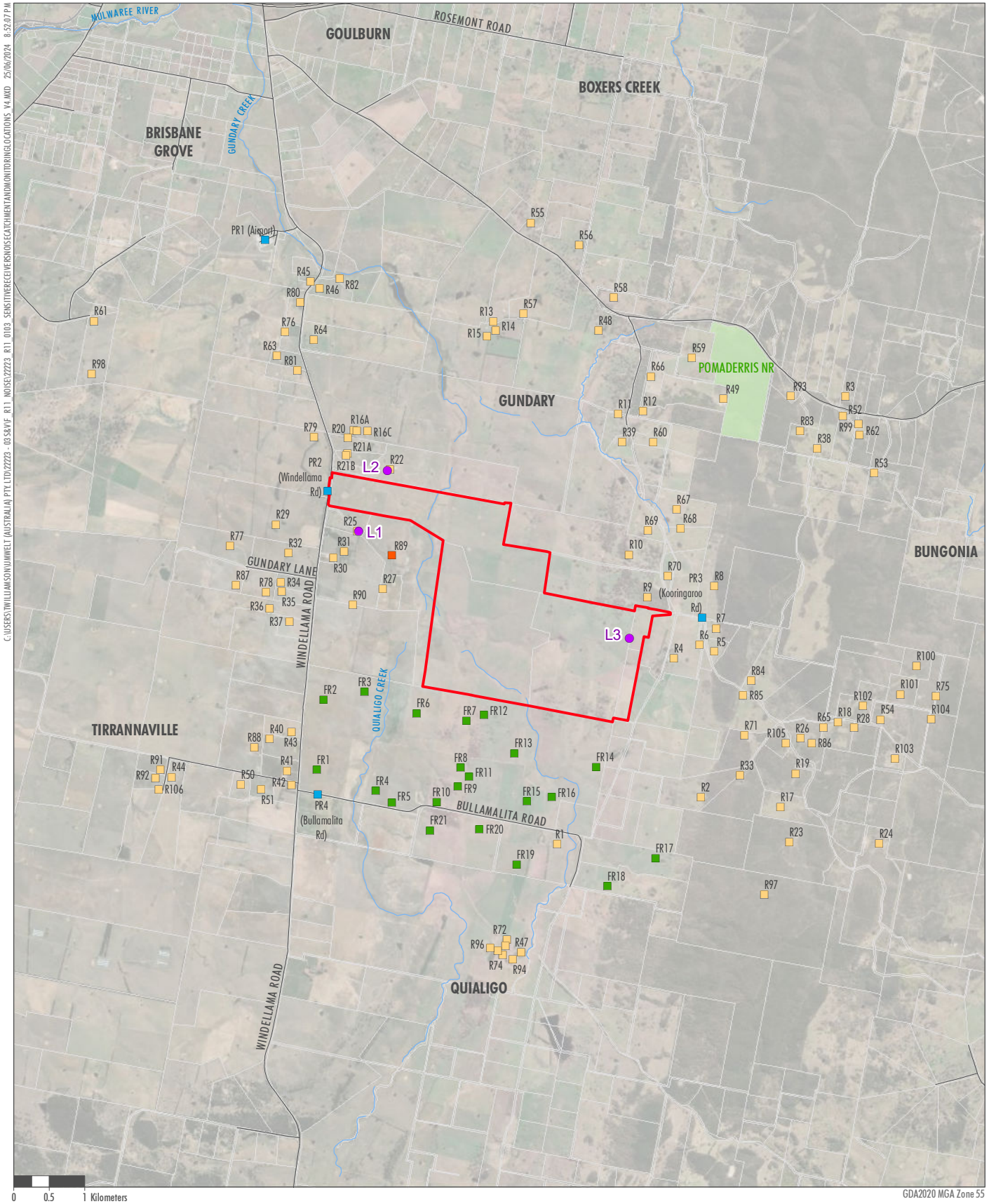
0 500 1,000

Metres

Scale: 1:0 at A4

GDA2020 MGA Zone 55

Image Source: ESRI Basemap (2023) | **Data Source:** NSW DFSI (2023)



Legend

- Project Area
- Lot
- Local Government Area
- NPWS Estate
- Roads
- Railway
- Watercourses
- Noise Monitoring Locations
- Public Receiver
- Non-associated Dwelling
- Host Dwelling
- Potential Future Residences (Rosedale Subdivision)

FIGURE 1.3

Sensitive Receivers, Noise Catchment Areas and Background Noise Monitoring Locations

Data source: NSW DSFI (2022); Lightsource BP (2022)

2.0 Legislative Requirements

2.1 Relevant Noise Guidelines and Polices

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

- *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).
- 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 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.

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's *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 $L_{Aeq(15\ min)}$
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 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
	$L_{Aeq(15\ min)}$	$L_{Aeq(15\ min)}$
All Residences	45	75

Notes: [1] *Recommended standard hours: Monday to Friday 7.00 am–6.00 pm; Saturday 8.00 am–1.00 pm.*

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 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

Notes: [1] *Day time period is 7.00 am–10.00 pm. Night time period is 10.00 pm–7.00 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

Notes: [1] *Day time period is 7.00 am–10.00 pm. Night time period is 10.00 pm–7.00 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.

3.3.2 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 (eg. 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)

Notes: [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.

3.3.3 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 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 the proposed Project-related transport route from the Hume Highway to the Project Area. Under the road category definitions provided in the RNP, the proposed Project-related transport route is classified as a sub-arterial 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 7am to 10pm	Night 10pm to 7am
Freeway/arterial/ sub-arterial road	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,(15\ hour)}$ 60 (external)	$L_{Aeq,(9\ hour)}$ 55 (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 Staging

The construction period for the Project will be undertaken across multiple stages. The total construction timeframe is anticipated to be approximately 18–24 months.

The construction stages will broadly include the following:

1. Site establishment (Scenario 1).
2. Piling and foundations (Scenario 2).
3. Assembly of all equipment (trackers, inverters, modules, balance of system) (Scenario 3).
4. Underground cabling (Scenario 4).
5. Commissioning (Scenario 5).
6. Site rehabilitation, removal of temporary construction facilities (Scenario 6).
7. Primary access upgrade (Scenario 7).

It is likely that some of these stages 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,* 2022 and Umwelts noise source library.

Table 4.1 Indicative Construction Scenarios, Equipment and Sound Power Levels

Construction Stages / Scenarios	Activity description	Equipment	Sound Power Levels $L_{Aeq(15\ min)}$ dB(A)/ unit	Combined Sound Power Level $L_{Aeq(15\ min)}$ dB(A)
Sc.1	Site Establishment and civil works	Excavator w/ rock hammer	120 (115 +5)	123
		Asphalt paver	114	
		Grader	113	
		Dozer	110	
		Dump truck	110	
		Roller	109	
		Delivery trucks	108	
		Water truck	107	
		Excavator	106	

Construction Stages / Scenarios	Activity description	Equipment	Sound Power Levels $L_{Aeq(15\ min)}$ dB(A)/ unit	Combined Sound Power Level $L_{Aeq(15\ min)}$ 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	Primary access upgrade	Dump truck	110	118
		Asphalt paver	114	
		Grader	113	
		Roller	109	
		Water truck	107	

Notes: [1] *Includes a +5 dB 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), has been modelled.

4.4 Spatial Risk Map

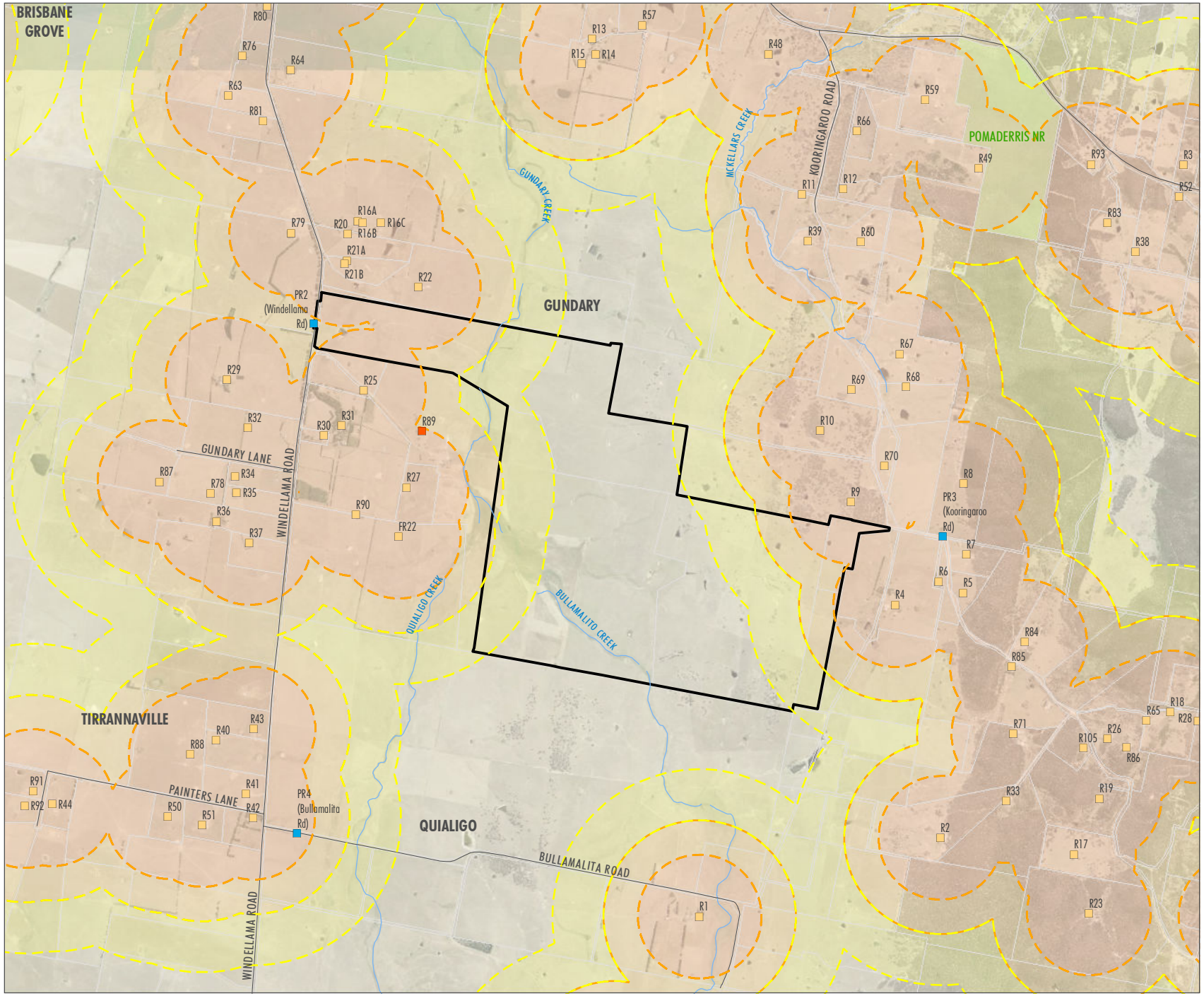
A spatial risk map has been prepared for a worst-case scenario (Scenario 1 combined with Scenario 7), described in **Section 4.0**. The spatial risk map (refer to **Figure 4.1**) presents a 45 dB(A) noise risk contour and buffer zone which has been based on the daytime construction noise management level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

Sc.1 Site Establishment and civil works (worst-case scenario) Noise Risk Contours 45-55 dB(A)



- Non-associated Dwelling
- Host Dwelling
- Public
- Roads
- Watercourses
- Local Government
- Project
- NPWS

Noise Risk Contours

- 45dB(A) Buffer
- 50dB(A) Buffer
- 55dB(A) Buffer

0 500 1,000

Metres

Scale: 1:0 at A4
GDA 1994 MGA Zone 55

Image Source: ESRI Basemap (2023) | **Data Source:** NSW DFSI (2023)

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.

The Historical Heritage Impact Assessment (Umwelt 2023) identified that there are no listed historical heritage items within the Project Area. Further, the nearest local heritage item is 'Pelican' Homestead (Item I599 on the Goulburn Mulwaree LEP 2009), which is located approximately 4 km west of the Project Area.

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

- 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 *Construction Noise and Vibration Guideline* (CNVG) (TfNSW, 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 separation distances between the Project Area boundary and the nearest external sensitive receivers (i.e. approximately 170 m), vibration impacts from construction activities are anticipated to be negligible.

6.0 Road Traffic Noise

Construction traffic noise was assessed in Section 7 of the EIS NIA. The assessment determined that exceedances are predicted for Windellama Rd / Bungonia Rd and Braidwood Rd during the night period. The predictions are reproduced below in **Table 6.1**.

A noise mitigation measure that will be adopted by the Project to reduce construction-related traffic noise will be the use of shuttle buses to reduce the total number of light vehicle movements.

Table 6.1 Windellama Rd / Bungonia Rd / Braidwood Rd Predicted Construction Traffic Noise levels, L_{Aeq}, 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
Windellama Rd / Bungonia Rd / Braidwood Rd North of Project Area	Day (7.00 am–10.00 pm) LAeq(15 hour)	10 m	62	64	60	2.0	Complies – change not > 2 dB
		20 m	59	61	60	1.9	Complies – change not > 2 dB
		30 m	57	59	60	N/A [1]	Complies – limit not exceeded
		40 m	55	57	60	N/A [1]	Complies – limit not exceeded
	Night (10.00 pm–7.00 am) LAeq(9 hour)	10 m	56	60	55	3.8	**Exceeds – limit exceeded & change > 2 dB**
		20 m	52	56	55	3.8	**Exceeds – limit exceeded & change > 2 dB**
		30 m	50	54	55	N/A [1]	Complies – limit not exceeded
		40 m	48	52	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.*

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.

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 Nosie 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)	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. 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. 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). 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.
Specific Notification (SN)	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.

Additional Management Measure	Description
	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. 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.

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 [1]	Structure	Construction Scenario						
		Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7
R4	Residence	-	-	-	-	-	-	-
R5	Residence	-	-	-	-	-	-	-
R6	Residence	-	-	-	-	-	-	-
R7	Residence	-	-	-	-	-	-	-
R8	Residence	-	-	-	-	-	-	-
R9	Residence	PN, V	PN, V	PN, V	-	-	-	-
R10	Residence	-	-	-	-	-	-	-
R16A	Residence	-	-	-	-	-	-	-
R16B	Residence	-	-	-	-	-	-	-
R16C	Residence	-	-	-	-	-	-	-
R20	Residence	-	-	-	-	-	-	-
R21A	Residence	PN, V	-	-	-	-	-	-
R21B	Residence	PN, V	-	-	-	-	-	-
R22	Residence	PN, V	PN, V	PN, V	-	-	-	-
R25	Residence	PN, V	-	-	-	-	-	-
R27	Residence	-	-	-	-	-	-	-
R29	Residence	-	-	-	-	-	-	-
R30	Residence	-	-	-	-	-	-	-
R31	Residence	-	-	-	-	-	-	-
R79	Residence	-	-	-	-	-	-	-
R90	Residence	-	-	-	-	-	-	-

7.3 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 5.1**, 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 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.

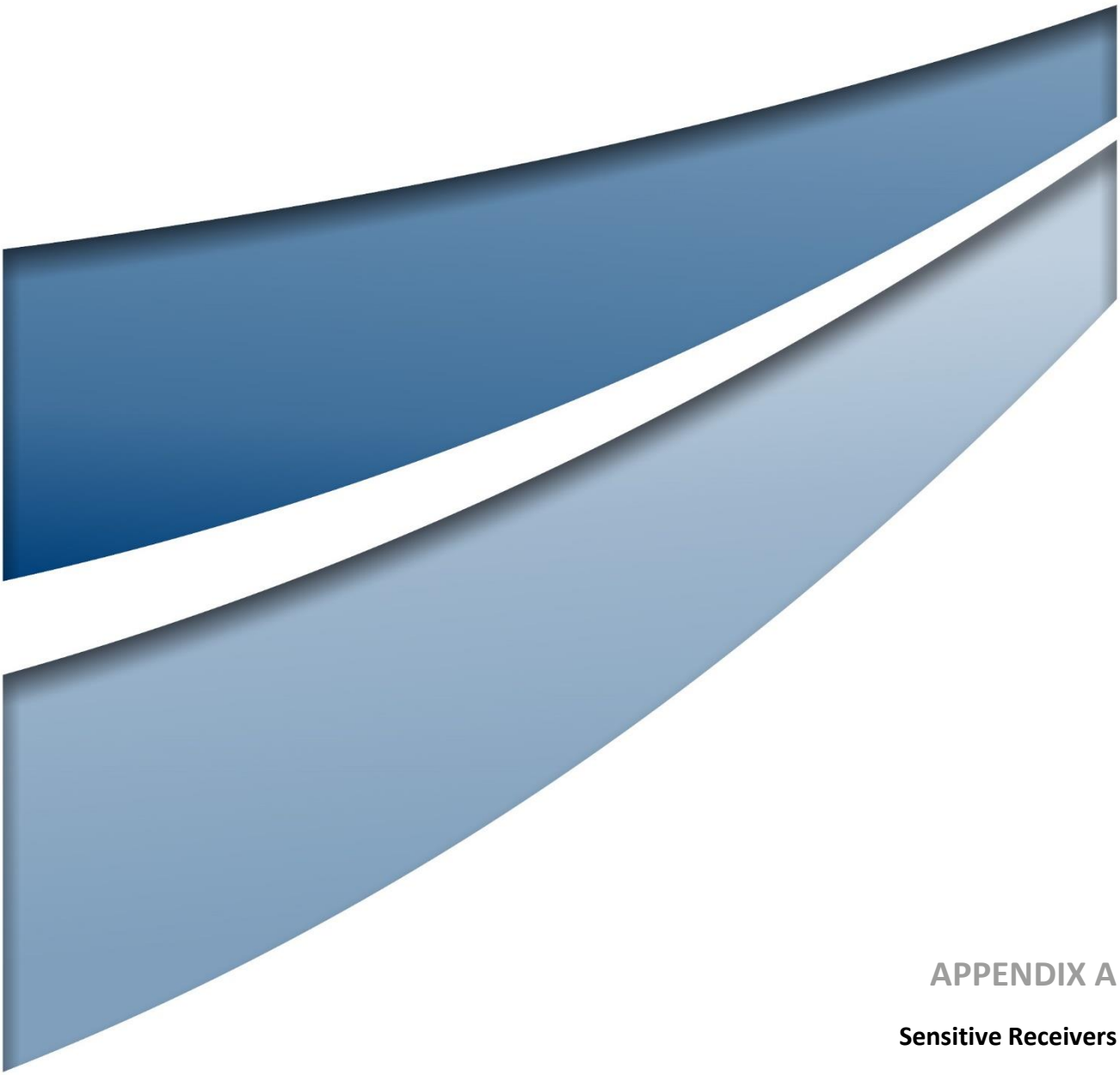
7.4 Complaint Management

In the event of a reasonable noise compliant, 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 compliant 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.



APPENDIX A

Sensitive Receivers

Table A.1 Sensitive Receivers

Receiver ID	Easting	Northing	Approx. distance to Project Area (m)	Approx. distance to nearest Project Feature (m)	Project Feature
Existing receiver					
R001	754289.9	6136361	1,803	1,860	Solar panels
R002	756316	6136997	1,481	1,547	Solar panels
R003	758386.1	6142643	3,938	4,163	Solar panels
R004	755926	6138953	448	494	Solar panels
R005	756500.6	6139048	799	970	Solar panels
R006	756301.5	6139145	587	749	Solar panels
R007	756534.4	6139372	671	946	Solar panels
R008	756518.7	6139962	724	1,011	Solar panels
R009	755566.5	6139800	137	272	Solar panels
R010	755312.5	6140406	718	793	Solar panels
R011	755160.6	6142391	1,970	2,025	Solar panels
R012	755507.8	6142439	2,276	2,330	Solar panels
R013	753394.9	6143702	2,507	2,521	Centralised BESS
R014	753422.4	6143574	2,386	2,400	Centralised BESS
R015	753306.6	6143493	2,286	2,299	Centralised BESS
R016A	751423.4	6142163	639	696	Substation
R016B	751459.1	6142147	629	679	Substation
R016C	751616.9	6142154	665	682	Substation
R017	757449.5	6136841	2,482	2,517	Solar panels
R018	758260.3	6138038	2,818	2,939	Solar panels
R019	757663.7	6137313	2,490	2,514	Solar panels
R020	751364.9	6142043	510	606	Substation
R021A	751327.8	6141824	288	401	Substation
R021B	751309.8	6141797	259	388	Substation
R022	751933.2	6141603	179	393	Solar panels
R023	757574.3	6136345	2,860	2,901	Solar panels
R024	758849.1	6136325	3,961	3,994	Solar panels
R025	751470.6	6140742	281	385	Substation
R026	757732.9	6137815	2,446	2,464	Solar panels
R027	751845.6	6139913	731	886	Solar panels
R028	758493.5	6137963	3,055	3,181	Solar panels
R029	750333.2	6140827	778	1,120	Substation
R030	751143.9	6140362	714	835	Substation
R031	751309.4	6140444	604	706	Substation
R032	750511.5	6140422	881	1,202	Substation
R033	756880.2	6137292	1,768	1,800	Solar panels
R034	750388.3	6140021	1,278	1,551	Substation

Receiver ID	Easting	Northing	Approx. distance to Project Area (m)	Approx. distance to nearest Project Feature (m)	Project Feature
R035	750417.1	6139885	1,382	1,640	Substation
R036	750244.6	6139639	1,681	1,937	Substation
R037	750512.8	6139470	1,724	1,926	Substation
R038	757967.3	6141908	3,107	3,352	Solar panels
R039	755217.5	6141976	1,785	1,846	Solar panels
R040	750229.8	6137803	2,283	2,318	Solar panels
R041	750495.9	6137368	2,230	2,286	Solar panels
R042	750541.2	6137149	2,317	2,351	Solar panels
R043	750544.7	6137899	1,954	1,990	Solar panels
R044	748872.7	6137285	3,735	3,799	Solar panels
R045	750814.8	6144262	2,708	2,873	Substation
R046	750939.5	6144174	2,610	2,753	Substation
R047	753786.4	6134791	3,440	3,454	Solar panels
R048	754879	6143574	2,734	2,786	Solar panels
R049	756644.9	6142612	3,112	3,251	Solar panels
R050	749822.3	6137158	2,918	2,953	Solar panels
R051	750111.5	6137091	2,703	2,738	Solar panels
R052	758333	6142371	3,696	3,939	Solar panels
R053	758776.3	6141562	3,489	3,767	Solar panels
R054	758864.8	6138076	3,325	3,503	Solar panels
R055	753913	6145088	3,960	3,990	Solar panels
R056	754600.2	6144774	3,762	3,817	Solar panels
R057	753808.9	6143813	2,680	2,714	Solar panels
R058	755091.6	6144044	3,249	3,301	Solar panels
R059	756197.5	6143187	3,277	3,332	Solar panels
R060	755656.2	6141997	2,136	2,234	Solar panels
R061	747748.5	6143712	3,991	4,290	Substation
R062	758569.8	6142100	3,666	3,924	Solar panels
R063	750339.7	6143221	1,824	2,106	Substation
R064	750856.3	6143439	1,887	2,068	Substation
R065	758045.8	6137972	2,679	2,753	Solar panels
R066	755623.5	6142924	2,669	2,724	Solar panels
R067	755969.8	6141045	1,441	1,565	Solar panels
R068	756026.3	6140772	1,184	1,320	Solar panels
R069	755567.5	6140750	1,070	1,167	Solar panels
R070	755840.7	6140109	497	630	Solar panels
R071	756939.5	6137856	1,659	1,677	Solar panels
R072	753584.5	6134966	3,306	3,323	Solar panels
R073	753563.5	6134882	3,392	3,410	Solar panels

Receiver ID	Easting	Northing	Approx. distance to Project Area (m)	Approx. distance to nearest Project Feature (m)	Project Feature
R074	753524.5	6134751	3,528	3,546	Solar panels
R075	759649.2	6138408	3931	4,167	Solar panels
R076	750449.5	6143557	2,095	2,335	Substation
R077	749672.5	6140533	1,501	1,836	Substation
R078	750197.2	6139871	1,510	1,798	Substation
R079	750861.5	6142060	552	862	Substation
R080	750670.1	6143969	2,440	2,639	Substation
R081	750633	6143006	1,515	1,772	Substation
R082	751219	6144312	2,744	2,848	Substation
R083	757731.1	6142154	3,151	3,377	Solar panels
R084	757036.1	6138631	1,477	1,598	Solar panels
R085	756925.5	6138421	1,538	1,558	Solar panels
R086	757873	6137759	2,594	2,635	Solar panels
R087	749747.5	6139990	1,726	2,071	Substation
R088	750021.1	6137709	2,511	2,562	Solar panels
R089 (host landholder)	751969.6	6140406	522	567	Solar panels
R090	751406.7	6139701	1,137	1,216	Solar panels
R091	748689.5	6137373	3,881	3,916	Solar panels
R092	748617.2	6137250	3,988	4,023	Solar panels
R093	757592.6	6142645	3,493	3,695	Solar panels
R094	753664.2	6134686	3,566	3,580	Solar panels
R095	753458.6	6134814	3,478	3,494	Solar panels
R096	753349.2	6134854	3,460	3,473	Solar panels
R097	757218.3	6135608	3,124	3,175	Solar panels
R098	747715.5	6142957	3,668	3,954	Substation
R099	758556.8	6142254	3,764	4,017	Solar panels
R100	759372.7	6138830	3,557	3,820	Solar panels
R101	759146.1	6138436	3,444	3,670	Solar panels
R102	758619.7	6138276	3,017	3,206	Solar panels
R103	759069.3	6137527	3,775	3,831	Solar panels
R104	759583.5	6138086	3,977	4,183	Solar panels
R105	757528.3	6137739	2,259	2,277	Solar panels
R106	748665.7	6137095	3,996	4,037	Solar panels
Potential / Future Receiver[1]					
FR01	750898	6137371	1,900	1,930	Solar panels
FR02	750995	6138357	1,406	1,432	Solar panels
FR03	751570.3	6138469	821	848	Solar panels

[1] Locations of the receivers on the vacant land, forming part of the Rosedale subdivision, were determined by the locations of the potential septic locations on the subdivision approval. The residence could be located elsewhere on the lot to avoid / minimise noise impacts.

Receiver ID	Easting	Northing	Approx. distance to Project Area (m)	Approx. distance to nearest Project Feature (m)	Project Feature
FR04	751729.9	6137072	1,617	1,642	Solar panels
FR05	751956.1	6136905	1,700	1,721	Solar panels
FR06	752308.8	6138166	392	412	Solar panels
FR07	753010.5	6138057	373	389	Solar panels
FR08	752928.9	6137398	1,035	1,051	Solar panels
FR09	752893.7	6137132	1,303	1,319	Solar panels
FR10	752590.9	6136908	1,578	1,595	Solar panels
FR11	753048.3	6137273	1,137	1,152	Solar panels
FR12	753258.7	6138142	245	259	Solar panels
FR13	753689.3	6137599	698	717	Solar panels
FR14	754846.8	6137405	673	816	Solar panels
FR15	753868.4	6136920	1,332	1,354	Solar panels
FR16	754216.2	6136988	1,201	1,215	Solar panels
FR17	755685	6136114	1,992	2,051	Solar panels
FR18	755005.3	6135724	2,324	2,418	Solar panels
FR19	753722.5	6136026	2,238	2,258	Solar panels
FR20	753199.5	6136529	1,841	1,855	Solar panels
FR21	752497.9	6136512	1,984	2,001	Solar panels
FR22	751764.4	6139516	757	814	Solar panels

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