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Gransolar Development Australia

**Deniliquin East Battery
Energy Storage System
(BESS)**

Noise and Vibration Impact
Assessment (NVIA)

wsp

May 2025

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Deniliquin East Battery Energy Storage System (BESS) Noise and Vibration Impact Assessment (NVIA)

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	Name	date	signature
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Table of contents

Glossary	iii
Abbreviations	v
Executive summary	6
1 Introduction	8
1.1 Purpose of report	8
1.2 Project description	8
1.3 Project site	9
2 Existing environment	11
2.1 Noise Catchment Areas	11
2.2 Receivers	11
2.3 Noise monitoring	13
3 Legislation	17
3.1 Relevant guidelines and standards	17
3.2 Construction noise	17
3.3 Operational noise criteria	19
3.4 Traffic noise objectives	22
3.5 Vibration	22
3.6 Cumulative impact	23
4 Construction assessment	24
4.1 Construction noise impact assessment	24
4.2 Construction vibration impact assessment	26
4.3 Construction traffic impact	27
5 Operational assessment	28
5.1 Operational noise impact assessment	28
5.2 Operational vibration impact assessment	34
5.3 Operational traffic noise impact	34
6 Cumulative impact	35
6.1 Review of developments	35

6.2	Cumulative operational noise	36
6.3	Discussion regarding cumulative impact	38
7	Management and mitigation	39
7.1	Construction	39
7.2	Operation.....	40
7.3	Cumulative impact.....	44
8	Conclusion.....	45
9	Limitations	47
9.1	Permitted Purpose.....	47
9.2	Qualifications and assumptions	47
9.3	Use and reliance	47
9.4	Disclaimer	48

List of appendices

Appendix A Detailed noise monitoring results

Appendix B Corrections for annoying noise characteristics

Appendix C Construction staging and equipment

Appendix D Construction – Noise contour lines (Unmitigated)

Appendix E Operational – Noise contour lines

Glossary

Noise terms	
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Audible range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Avenis Deniliquin BESS	Proposed project adjacent to the Deniliquin substation. Deniliquin BESS by Avenis Energy on behalf of AE BESS 4 Pty Ltd as Trustee for AE BESS 4 Unit Trust.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).
dB(A) A-weighted decibels	The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the “A” filter. A sound level measured with this filter switched in is denoted as dB(A). Most environmental noise is measured using the A filter.
dB(C) C-weighted decibels	C weighted adjustments are relatively flat across lower frequencies, and as such are better suited for the assessment of low frequency noise.
Decibels (dB)	The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound is heard. The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping. Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day steady or quasi-steady sounds. <i>20dB quiet bedroom at night</i> <i>50dB typical office space or ambience in the city at night</i> <i>80dB kerbside of a busy road</i> <i>120dB 70m from a jet aircraft</i>
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
Frequency	Of a periodic quantity: the time rate of repetition. The reciprocal of the period. Frequency is measured in Hertz (Hz).
Gransolar	Gransolar Development Australia (the Client)
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{A90} noise level expressed in units of dBA.

L_{eq}	Equivalent sound pressure level – the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring. The sound weighting of the noise measurement is commonly added, for example L_{Aeq} or L_{Ceq} .
L_{max}	Maximum noise level
Sound Level Meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Power Level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Sound Pressure Level	The level of sound pressure, expressed in decibels, as measured by a standard sound level meter with a microphone.
The Project	Deniliquin East BESS Project. A lithium-ion battery energy storage system with a 100 MW/200 MWh capacity and associated power conversion systems, switchgear, and a control room to be located at 21356 Riverina Highway, Deniliquin NSW.
WSP	WSP Australia Ltd Pty

Abbreviations

Acronym	Definition
AC	Alternating current
AGL	Average Ground Level
ANL	Amenity Noise Level
AS	Australian Standard
BESS	Battery Energy Storage System
BoM	Bureau of Meteorology
CIA	Cumulative Impact Assessment
CNVG	Transport for NSW's Construction Noise and Vibration Guideline, July 2023
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
HV	High Voltage
ICNG	Interim Construction Noise Guideline
ISO	International Organization for Standardization
NCA	Noise Catchment Area
NML	Noise Management Level
NPfI	Noise Policy for Industry (2017), NSW Environment Protection Authority
NSW	New South Wales
NVIA	Noise and Vibration Impact Assessment
OOHW	Outside of hours work
PCU	Power Conversion Unit
RBL	Rating Background Level
SEARs	Planning Secretary's Environmental Assessment Requirements
SPL	Sound Pressure Levels
SWL	Sound Power Level
TL	Transmission Line

Executive summary

WSP Australia (WSP) has been engaged by Gransolar Development Australia (Gransolar) to prepare a Noise and Vibration Impact Assessment (NVIA) for inclusion in an Environmental Impact Statement (EIS) to accompany the State Significant Development Application for the Deniliquin East BESS Project (the Project). The Project would include a lithium-ion battery energy storage system with a 100 MW/200 MWh capacity and associated power conversion systems, switchgear, and a control room. The Project is to be located at 21356 Riverina Highway, Deniliquin NSW, and will be connected to the nearby Deniliquin Substation via a 132 kV overhead transmission line crossing the Mulwala Canal and Riverina Highway.

The NVIA has been conducted with reference to guidelines outlined in the SEARs, in addition to other relevant guidelines and standards.

Existing environment

Identification of noise sensitive receivers within 2 km of the Project has been carried out, identifying 10 residential receiver locations. Both long-term and short-term attended noise monitoring was carried out to establish the existing noise environment. Unattended noise monitoring was carried out at two representative locations between 27th March and 11th April 2024. The existing noise environment within the study area is generally characterised as rural, the existing noise sources include road traffic noise from the Riverina Highway, local road traffic, and agricultural activities.

Findings

This NVIA has been developed to assess potential impacts from the Project relating to environmental noise and vibration, key findings are summarised in table below.

Impact item		Key findings	Recommended mitigation and management	Key report sections
Construction	Noise	Understood to be proposed for standard hours only. Noise is predicted to have minor impact on up to eight (8) properties. One property is predicted to experience more notable noise impact (between 10 and 20 above NMLs). It should, however, be noted that the predicted levels are representative of worst-case scenario, the duration of any exceedances is expected to be very limited (e.g., on day of laying slab).	A series of noise management and mitigation measures have been recommended for implementation. If out-of-hour works are required, additional mitigation measures will likely be required.	Criteria: 3.2.3 Assessment: 4.1 Mitigation: 7.1.1
	Vibration	All identified receivers are according to the assessment low risk of being affected by construction-induced vibration.	To ensure that there is no structural damage to existing structures within the project site it is recommended the safe working distances are considered when planning the works.	Criteria: 3.5 Assessment: 4.2 Mitigation: 7.1.2
	Traffic	The noise impact is predicted to be minor and to comply with the RNP guidelines.	No specific actions are expected to be required to manage construction traffic impact.	Criteria: 3.4 Assessment: 4.3 Mitigation: 7.1.3

Impact item		Key findings	Recommended mitigation and management	Key report sections
Operational	Noise	Unmitigated noise levels are predicted to exceed the requirements at three noise sensitive receivers. It should be noted prediction are based on conservative worst-case approach and exceedances, while predicted to occur, are only expected during shorter periods e.g., batteries charging/ discharging during evening/ night time.	Following the adoption of the recommended mitigation measures, noise criteria are predicted to be achievable during all time periods at full operating capacity. Where the final sound power levels or noise characteristics (e.g., if the battery has a noise spectrum exhibiting tonality) of the final equipment differ from what has been assessed in this report, further assessment may be required.	Criteria: 3.3.3 Assessment: 5.1 Mitigation: 7.2.1
	Vibration	The assessment shows no risk of operational vibration impact at affecting sensitive receivers, and low risk for impact to structures within the Project site.	To manage the vibration impact within the project site it is recommended standard vibration isolation mounts nominated by the respective manufacturers is implemented.	Criteria: 3.5 Assessment: 7.2.2 Mitigation: 7.2.2
	Traffic	The noise impact is predicted to be minor and to comply with the RNP guidelines.	No specific actions are expected to be required to manage operational traffic impact.	Criteria: 3.4 Assessment: 5.3 Mitigation: 7.2.3
Cumulative impact	Construction	One potential development in close proximity to the project has been identified (a similar BESS development), which has been considered in this assessment. Due to the limited information available, the cumulative assessment is qualitative and high level in nature.	If construction schedules overlap the following is recommended: parties coordinate so that simultaneous construction works with high noise generation, and/ or works with high vibration generation in closer proximity is avoided.	Criteria: 3.6 Assessment: 6 Mitigation: 7.3
	Operation	Future assessments for developments in the area should consider the findings of this assessment.	Cumulative impact of operational noise is predicted to not exceed the NPfI amenity noise levels and is therefore expected to be acceptable. No specific actions are expected to be required to manage cumulative vibration.	

1 Introduction

1.1 Purpose of report

WSP Australia has been engaged by Gransolar (the client) to assess potential noise, and vibration impacts during construction and operational works associated with the Project at 21356 Riverina Highway, Deniliquin, New South Wales. The NVIA has been developed to assess potential impacts from the Project relating to environmental noise and vibration. It aims to achieve the following:

- Identify relevant legislative requirements
 - Identify potential sensitive receivers in the vicinity of the Project
 - Identify potential noise and vibration impacts associated with construction of the Project
 - Identify potential noise and vibration impacts associated with operation of the Project
 - Outline systems and management measures to reduce or eliminate identified noise or vibration impacts.
-

1.2 Project description

The Project would include a lithium-ion battery energy storage system with a 100 MW/200 MWh capacity and associated power conversion systems, switchgear, and a control room. Associated infrastructure as part of the project would include overhead lines and collector units, storage area, internal access tracks, on-site parking, security fencing, temporary construction laydown area and landscaped screening.

The Project will be connected to the nearby Deniliquin Substation (Deniliquin 132/66 kV TS) via a 132 kV overhead transmission line crossing the Mulwala Canal and Riverina Highway. Site access to the Project will be provided through three different six-metre-wide vehicular access roads connecting onto an unnamed road crossing the Moulamein Channel, itself connecting to the Riverina Highway.

1.2.1 Project overview

The key elements of the Project will include:

- Containerised lithium-ion battery modules with up to 100 MW/200 MWh capacity
- Power conversion units, which convert the DC power from the battery modules to 330 kV AC
- On-site 33/132 kV substation, including power transformer and oil containment system
- A 33 kV switch-room
- Control room
- Maintenance container
- A 132 kV overhead Transmission Line (TL) connecting the Deniliquin Substation.

Permanent supporting infrastructure will include:

- Upgraded site vehicle access road and bridges to provide access to Riverina Highway
- Internal access roads and car parking for maintenance vehicles
- Three 25,000 litre water tanks
- Security fencing and CCTV security system

- Landscape screening
- Lightning mast.

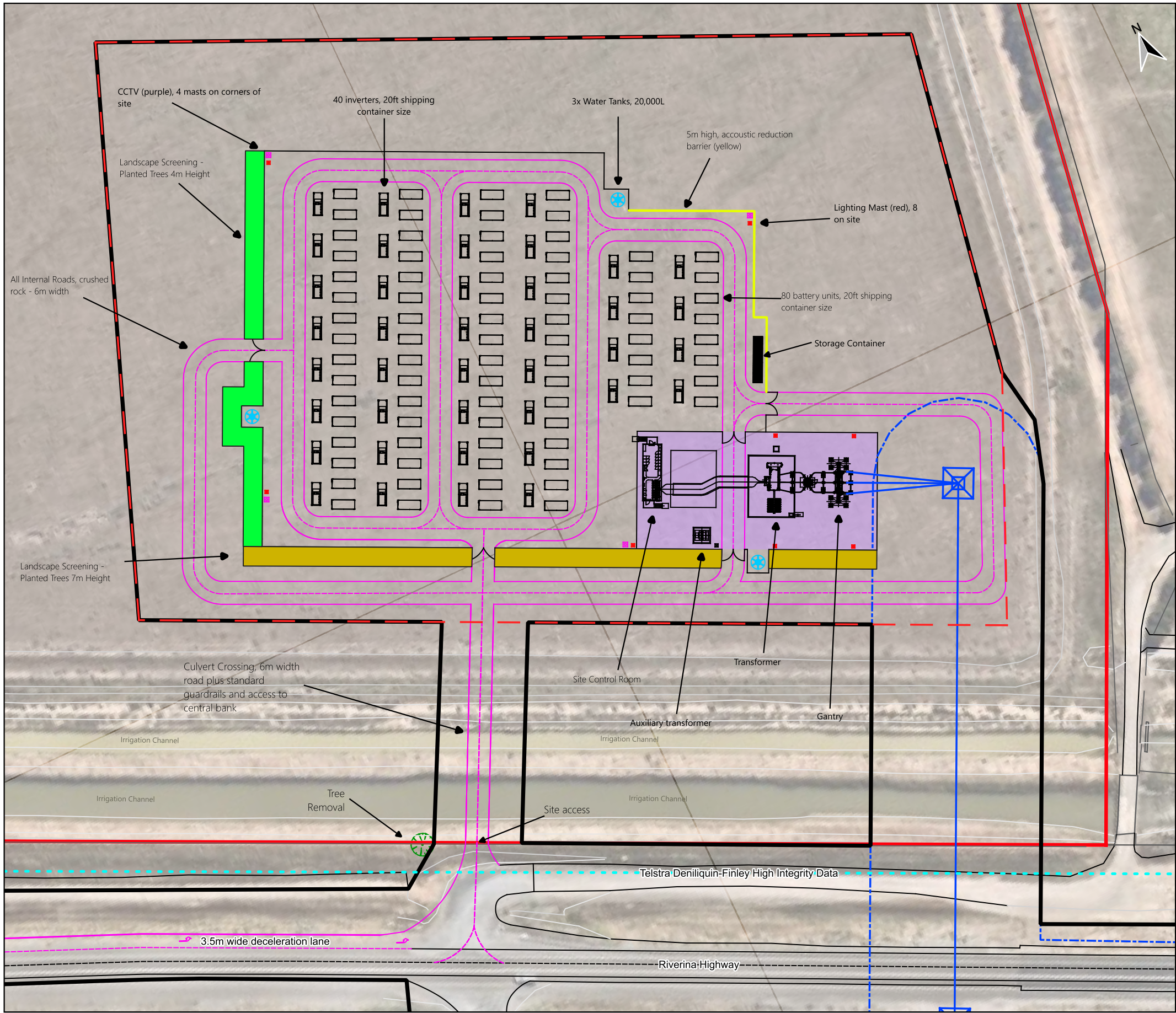
Temporary construction facilities will include:

- Laydown area
 - Construction materials storage.
-

1.3 Project site

Deniliquin is in the Riverina region of NSW, close to the border with Victoria, approximately 725 km southwest of Sydney and 285 km north of Melbourne. The Project is located approximately 6.5 km southeast of the Deniliquin CBD.

Key items of the Project including the BESS equipment (batteries and PCUs), HV transformer, transmission line, and other associated infrastructure are presented on the following page (provided by Gransolar). This site layout is based on design information provided by Gransolar.



LEGEND

Proposed Works

- Project Area
- Proposed road and access tracks
- Proposed Transmission Line
- Lease Area Boundary
- Concrete Pad

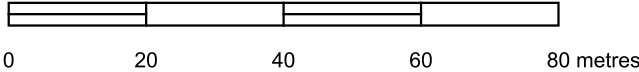
Existing Site Features

- Existing TG UG Comms
- Existing Telstra UG Comms
- Site Boundary
- Existing Easement
- Roads/Tracks
- Fence
- Toe Bank (bottom)
- Top Bank (top)
- Existing Vegetation
- Irrigation channel

Scale at A3
1:1100

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DEVELOPER: 		PROJECT: DENILQUIN BESS			
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 55		SHEET TITLE: SITE PLAN			
		REFERENCE: DEN-PD-13052025		PAPER SIZE: A3: 297 x 420mm	
		DRAWING NO: DEN-PD-13052025-SIT-A9			

2 Existing environment

2.1 Noise Catchment Areas

Two Noise Catchment Area (NCAs) have been defined to classify groups of sensitive receivers that are likely to have a similar noise environment. As outlined in Section 2.3.5, the dominant noise source is the Riverina Highway, which does not affect all receivers. The two NCAs have, therefore, been determined based on distance from the Highway, with NCA 1 including receivers within 300 metres of the highway, and NCA 2 for all other receivers.

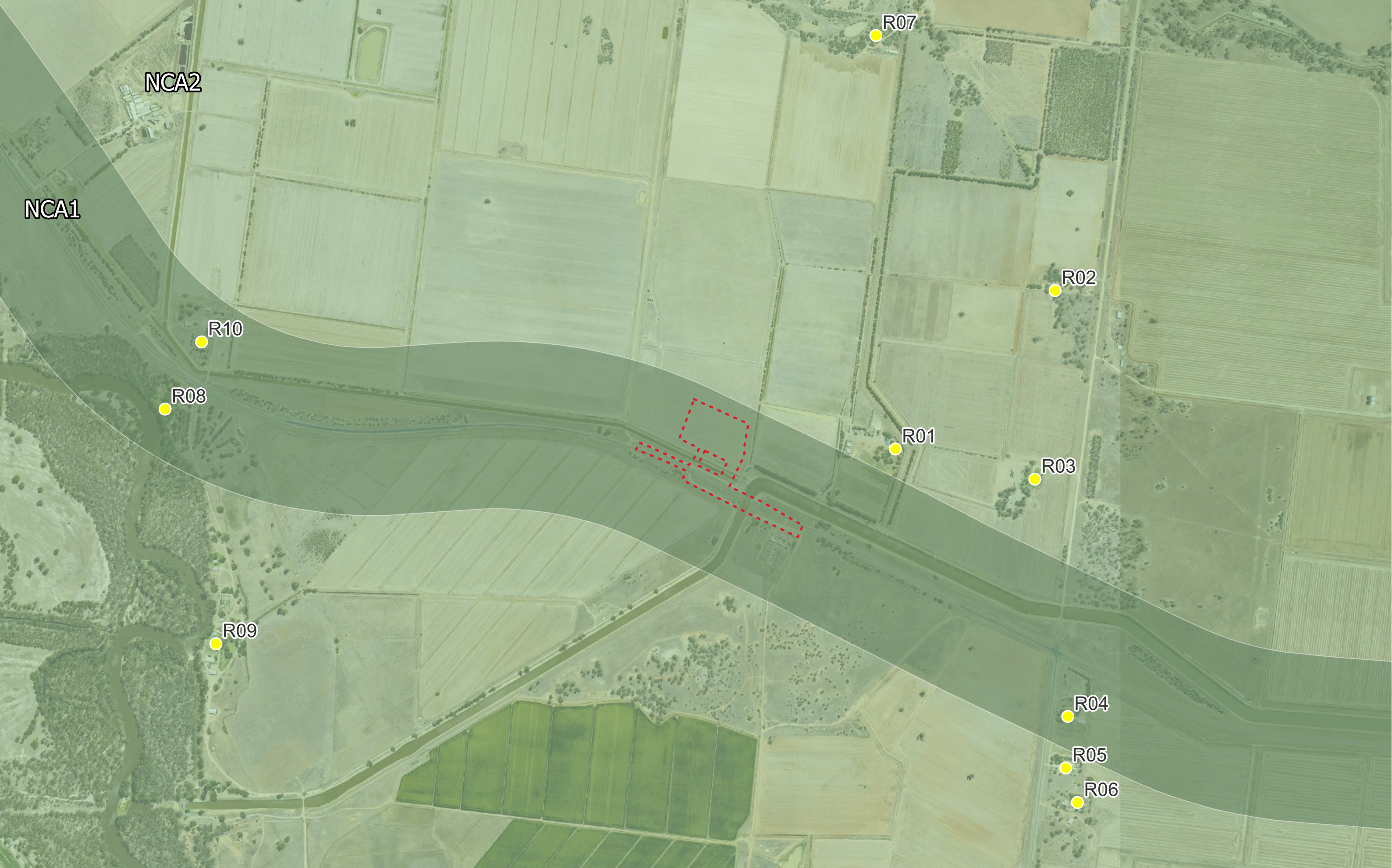
2.2 Receivers

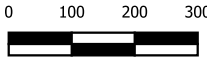
A noise study area of 2 km of the Project has been adopted for the purpose of receiver identification. Ten (10) noise-sensitive residential receiver locations have been identified within this study area.

Receivers are presented in Table 2.1 and represented graphically on the following page.

Table 2.1 Identified receivers

ID	NCA	Address	Lot / DP	Approximate distance from the Project, m
R01	2	21354 Riverina Hwy	Lot 112 / DP1008891	500
R02	2	135 Aratula North Rd	Lot 15 / DP856212	1,200
R03	2	65 Aratula North Rd	Lot 16 / DP856212	1,000
R04	1	21 Aratula South Rd	Lot 32 / DP812941	1,500
R05	2	41 Aratula South Rd	Lot 31 / DP812941	1,600
R06	2	55 Aratula South Rd	Lot 41 / DP736642	1,700
R07	2	221 Aratula North Rd	Lot 113 / DP1008891	1,500
R08	1	21545 Riverina Hwy	Lot 12 / DP840477	1,800
R09	2	21541 Riverina Hwy	Lot 1 / DP563000	1,800
R10	1	21536 Riverina Hwy	Lot 279 / DP1134962	1,800



Project No: PS210338		Author: LE				Legend NCA1 NCA2 Project Area Receivers		Deniliquin East BESS Receiver Map 	
Date: 13/05/2025		Approved by: ZL							
To be read in conjunction with WSP report: PS210338-ACO-REP-1_Deniliquin NVIA									
Map Source: MetroMap									
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2.3 Noise monitoring

2.3.1 Methodology

A baseline environmental noise survey was conducted, involving unattended and attended noise monitoring to quantify the existing noise environment at locations representative of the NCAs. The monitoring was carried out in accordance with the following documents:

- *Australian Standard 1055:2018 Acoustics – Description and measurement of environmental noise*
- *Noise Policy for Industry* (2017), NSW EPA (NPfI)
- *Approved methods for the measurement and analysis of environmental noise in NSW* (2022), NSW EPA

Equipment was installed at 1.5 metres above ground, a minimum of 3 metres away from any reflective surfaces, and as far as practical from vegetation (e.g. trees and bushes).

Monitoring locations are presented graphically in Figure 2.1.



Figure 2.1 Noise monitoring locations

2.3.2 Instrumentation and quality control

The monitoring equipment was fitted with windshields and field calibrated before and after monitoring. No significant drifts in calibration were noted (± 0.5 dB).

Details of equipment used to conduct the noise survey are presented in Table 2.2. All monitoring equipment had a current certified calibration certificate (National Association of Testing Authorities, NATA) at the time of use. Copies of the calibration certificates can be provided upon request.

Table 2.2 Noise monitoring equipment

NCA ID	Purpose	Manufacturer and Model No.	Serial No.	Calibration status
NCA 1 (21545 Riverina Hwy)	Noise logging	Ngara	878097	Current (06/03/2023)
NCA 2 (21356 Riverina Hwy)	Noise logging	Ngara	8781CB	Current (20/06/2023)
All locations	Attended measurement	NTi XL2	A2A-05718-E0	Current (01/11/2023)
All locations	Field calibration	Rion NC-74	34315156	Current (17/04/2023)

2.3.3 Unattended noise monitoring results

Unattended noise monitoring was carried out at two locations in each NCA between 27th March and 11th April 2024.

Unattended monitoring results are summarised in Table 2.3, and charts for the monitoring period presented in Appendix A. In accordance with the *Protection of the Environment Operations Act 1997*, the lowest calculated ‘period-average’ $L_{A90, 1 \text{ hour}}$ for each of the day, evening and night periods (during the time the premises operates) has been adopted.

Weather data for the monitoring period was obtained from the closest BOM station at Deniliquin Airport AWS(ID 074258) to filter data for any adverse meteorological conditions. Time periods where wind exceeded 5m/s or there was any observable rainfall were excluded from the processed noise monitoring data. In addition to this, in accordance with Section B1.3 of the NPfI, the entire period was excluded where more than 8, 2, and 4 15-minute periods for day, evening, and night respectively.

The NPfI’s minimum required amount of data (7 days) was achieved for each time period after data filtering.

Table 2.3 Unattended noise measurement results

NCA	Measured lowest ‘period-average’ background noise level, dB $L_{A90,15\text{min}}$		
	Day ⁽¹⁾	Evening ⁽¹⁾	Night ⁽¹⁾
NCA 1 (21545 Riverina Hwy)	33	31	32
NCA 2 (21356 Riverina Hwy)	29	30	30

(1) Day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays; evening – the period from 6 pm to 10 pm; night – the remaining periods.

2.3.4 Attended noise monitoring results

Short term attended monitoring was carried out to provide additional information on the primary noise sources, and assist with the characterisation of the noise environment of the area surrounding the Project. This monitoring was undertaken for a 15-minute period, during daytime and evening hours.

Attended monitoring results are summarised in Table 2.3 with a description of the observed noise sources at the time of the measurements.

Table 2.4 Attended noise measurement results

NCA	Time period	Date and start time	Measured sound pressure level, dBA			Observations by operator
			L _{90,15MIN}	L _{eq,15MIN}	L _{10,15MIN}	
NCA 1 (21545 Riverina Hwy)	Day	27 th March 2024 2:51pm	36	51	55	Traffic at distance dominating background noise levels. Noise events noted as passbys at Riverina Hwy (55 to 75 dBA, relatively even mix between cars and trucks), and natural sounds e.g. birds (35 to 50 dBA).
	Evening	26 th March 2024 7:01pm	36	55	57	Traffic at distance dominating background noise levels. Noise events noted as passbys at Riverina Hwy (65 to 75 dBA, mostly cars but occasional trucks), and nature sounds e.g. birds and dogs barking (35 to 50 dBA).
NCA 2 (21356 Riverina Hwy)	Day	27 th March 2024 10:34am	38	47	51	Traffic at distance dominating background noise levels. Noise events noted as occasional wind in vegetation (40 to 50 dBA), passbys at Riverina Hwy (50 to 60 dBA, mostly cars but occasional trucks), and nature sounds e.g. birds and insects (35 to 40 dBA).
	Evening	26 th March 2024 6:25pm	36	61	63	Traffic at distance dominating background noise levels. Noise events noted as passbys at Riverina Hwy (65 to 80 dBA, a relatively large portion of trucks), and nature sounds e.g. insects, birds, and other animals (35 to 50 dBA).

2.3.5 Description of existing noise environment

The existing noise environment within the study area is generally characterised as rural and is primarily dominated by agricultural and rural residential land uses. The primary local noise sources which dominate the existing noise environment levels include road traffic noise from the Riverina Highway, local road traffic, and agricultural activities. Other noise sources would include natural noises (e.g. birds and insects), farming noise and road traffic on local roads.

3 Legislation

In accordance with the Project Planning Secretary's Environmental Assessment Requirements (SEARs) from the NSW Government Department of Planning and Environment, the Project EIS is required to comply with the requirements in Part 8, Division 5 of the *Environmental Planning and Assessment Regulation 2021* and must have regard to the State Significant Development Guidelines.

This section describes the legislation and policy relevant to the assessment of noise and vibration impacts.

3.1 Relevant guidelines and standards

The assessment has been conducted with reference to the following primary guidelines, as outlined in the SEARs, in addition to other relevant guidelines and standards:

- NSW *Environmental Planning and Assessment Act 1979* (EP&A Act)
 - NSW *EPA Noise Policy for Industry 2017* (NPfI)
 - *Interim Construction Noise Guideline* (DECC 2009) (ICNG).
 - NSW *Cumulative Impact Assessment Guidelines for State Significant Projects*, October 2022
 - *Assessing Vibration: a technical guideline* (DECC, 2006)
 - Transport for NSW's *Construction Noise and Vibration Guideline*, July 2023 (CNVG)
 - NSW *Road Noise Policy* (DECCW 2011).
-

3.2 Construction noise

3.2.1 *Interim Construction Noise Guidelines*

The NSW EPA's *Interim Construction Noise Guideline* (ICNG) provides guidance for the assessment of construction noise. The following sections detail the applicable site-specific construction noise objectives based on ICNG.

3.2.1.1 Recommended standard construction hours

The ICNG establishes noise management levels according to the hours in which construction may take place. The ICNG recommended standard hours for construction are:

- Monday to Friday: 7 am to 6 pm
- Saturday: 8 am to 1 pm, and
- No work on Sundays or Public Holidays.

The ICNG acknowledges that it may be necessary to conduct some activities outside the recommended standard construction hours, and allows the following activities when all feasible and reasonable mitigation measures are implemented to minimise the impacts to any surrounding sensitive land uses:

- The delivery of oversized plant or structures that police or other authorities determine requires special arrangements to transport along public roads.
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm.
- Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours.

- Public infrastructure works that shorten the length of the Project and are supported by the affected community.
- Works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours.
- Works which maintain noise levels at receivers to below the Noise Management Level (NML) outside of the recommended standard construction hours. A strong justification is required for these activities and a lower NML is applied compared with works during standard hours.

3.2.2 Construction noise management levels

The ICNG states that the potential for construction noise impacts can be assessed by comparing the predicted noise at the assessment locations with the NMLs provided by the ICNG. Construction is considered to have the potential to cause a noise impact if the predicted noise exceeds the NMLs.

Table 3.1 details the ICNG construction NMLs for residential receivers. No non-residential sensitive land uses have been identified in the study area.

Table 3.1 Construction noise management level at residential receivers

Time of day	Management level, $L_{eq,15min}$	How to apply
Recommended standard hours: — Monday to Friday 7am to 6pm — Saturday 8am to 1pm — No work on Sundays or public holidays	Noise affected — Rating Background Level (RBL) + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. — Where the predicted or measured $L_{eq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. — The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected — 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: — times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) — if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of day	Management level, $L_{eq,15min}$	How to apply
Outside recommended standard hours (OOH) — All other times including Public Holidays	Noise affected — Rating Background Level (RBL) + 5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

3.2.3 Project specific construction noise management levels

Based on the results of noise monitoring outlined in Section 2.3.3 and the ICNG definitions outlined in Table 3.1, the Project specific NMLs for construction activities at surrounding receivers are presented in Table 3.2.

As outlined in Section 3.2.1.1, construction is proposed for standard hours only and as such night time and sleep disturbance impacts are not discussed in this document.

Table 3.2 NMLs at residential receivers

Receiver	RBL, $L_{90,15min}$ dBA	Allowance	NML, $L_{eq,15min}$ dBA	
			Standard hours	Highly affected
NCA 1 & NCA 2	35 ⁽¹⁾	+10 dB	45	75

(1) Where background levels are below the minimum assumed RBLs outlined in the NPfI (Section 2.3), they have been adjusted to 35 dBA during the day period, and 30 dBA during the evening and night periods.

3.3 Operational noise criteria

The assessment of on-site operational noise sources is guided by NPfI, which is applicable to all industrial noise sources from activities such as the Project.

The assessment procedure for industrial noise sources outlines two components:

- Controlling intrusive noise impacts in the short-term for residences
- Maintaining noise level amenity for particular land uses for residences and other land uses.

In assessing the noise impact of industrial sources, both components must be taken into account for residential receivers. As the Project is expected to operate 24 hours a day, the night time criteria are likely to be the controlling time criteria and have been used as the basis of the assessment.

3.3.1 Project intrusiveness noise level

The project intrusiveness noise level for residential receivers prescribed in the NPfI is summarised as:

$$L_{eq,15min} \leq \text{Rating Background Level } (L_{90}) + 5 \text{ dBA}$$

The project intrusiveness noise levels have been established for the Project based on the RBLs as outlined in Section 2.1 in accordance with the NPfI and are presented in Table 3.3.

Table 3.3 Established Project intrusiveness noise level (dBA $L_{eq,15min}$)

NCA	Time period ⁽¹⁾	RBL, L_{90} dBA ⁽²⁾	Project intrusiveness noise level ⁽³⁾ (RBL + 5 dB) dBA $L_{eq,15min}$
NCA 1 (21545 Riverina Hwy)	Day	35	40
	Evening	31	36
	Night	32	36
NCA 2 (21354 Riverina Hwy)	Day	35	40
	Evening	30	35
	Night	30	35

- (1) Day: the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays evening: the period from 6 pm to 10 pm night: the remaining periods.
- (2) In accordance with NPfI, where the measured rating background level is less than 30 dBA for the evening and night periods, it is set to 30 dBA. When it is found to be less than 35 dBA for the day period, it is set to 35 dBA.
- (3) In accordance with the NPfI, it is recommended that evening criteria is set no higher than the day criteria and the night criteria should not be set any higher than the evening criteria.

3.3.2 Project amenity noise levels

To limit continuing increases in ambient noise levels (i.e. background noise level creep), the maximum amenity noise level within an area from industrial noise sources should not normally exceed the amenity noise levels prescribed in the NPfI.

The recommended amenity noise levels represent the objective for total industrial noise from all sources at a receiver location, whereas the Project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

Identified NCAs are zoned as RU1 – Primary Production in accordance with the NSW Government Planning Portal.

The established amenity criteria applicable to the Project are presented in Table 3.4.

Table 3.4 Established Project amenity noise level

NCA	Type of receiver	Time period ⁽¹⁾	Recommended amenity noise level (ANL), dBA $L_{eq,period}$ ⁽¹⁾	Project amenity noise level, dBA $L_{eq,15min}$ ⁽²⁾⁽³⁾
NCA 1 & NCA 2	Rural – Residential	Day	50	48
		Evening	45	43
		Night	40	38

- (1) Day: the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays; evening: the period from 6 pm to 10 pm; night: the remaining periods.
- (2) A +3 dB factor has been applied to $L_{Aeq,period}$ to convert to $L_{Aeq,15min}$ in accordance with Section 2.2 of NPfI.
- (3) A -5 dB factor is applied to recommended amenity noise levels in accordance with Section 2.4 of the NPfI.

3.3.3 Summary of Project noise trigger levels

In assessing the operational noise impact of the Project on surrounding residential receivers, both the intrusiveness and amenity criterion must be considered. In most cases, only the strictest criterion will become the limiting criterion and form the Project noise trigger levels (PNTL) for the Project under assessment.

A summary of all relevant criteria is presented in Table 3.5.

Although the use of equipment may fluctuate, for conservative assessment purposes, all equipment is assumed to operate concurrently at any time. The noise assessment has focused on night time operations as the most stringent period for compliance. Where noise levels comply with the night time criteria, the evening as well as the less stringent daytime criteria will also be achieved.

Table 3.5 Summary of PNTL

Receiver location	Assessment/ receiver type	PNTLs dBA $L_{eq,15min}$ ⁽¹⁾		
		Day	Evening	Night
NCA 1 (21545 Riverina Hwy)	Intrusiveness	40	36	36
	Amenity	48	43	38
	PNTL – Residential	40	36	36
NCA 2 (21354 Riverina Hwy)	Intrusiveness	40	35	35
	Amenity	48	43	38
	PNTL – Residential	40	35	35

(1) Day: the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays; evening: the period from 6 pm to 10 pm; night: the remaining periods.

3.3.4 Corrections for annoying noise characteristics

Certain noise characteristics have a higher potential to cause annoyance, generally requiring additional considerations during assessment. Tonality, low frequency emphasis, and intermittency are generally considered to be attention-drawing noise characteristics and can cause greater disturbance. On the other hand, short-term single noise events, such as steady engine noise are likely to be less disturbing and may warrant some relaxation in the applicable noise criteria.

Since there is a possibility of tonal and/ or low-frequency noise, a spectral analysis has been carried out for the predicted noise levels. Analysis has been carried out in accordance with Fact Sheet C of the NPfI which is outlined in detail in Appendix B and summarised below:

- **Tonality:** One-third octave band analysis of unweighted spectrum assessing the audibility of the tones. If identified, a 5 dB correction factor is to be applied to predicted levels.
- **Low-frequency:** Assessment of difference between A-weighted and C-weighted levels, as well as level above defined threshold levels in the range of 10 to 160 Hz bands. If identified, a 2- or 5-dB correction factor is to be applied to predicted levels, pending level above the threshold levels.

It is, based on current information, not expected that the noise sources connected to the project are intermittent in nature and no further assessment of this has been carried out at this stage.

3.3.5 Maximum noise levels and sleep disturbance

The potential for operational noise impacts resulting from transient maximum noise level events and sleep disturbance during the night time period is detailed in the NPfI. Maximum noise impacts may cause awakening events, while maintained elevated levels of noise may disturb the quality of sleep. As such, the sleep disturbance criteria for noise are in two forms are presented as:

- **Sleep disturbance criteria:** $L_{eq,15min}$ 40 dBA or the rating background level plus 5 dB, whichever is the greater, and/or
- **Awakening criteria:** L_{Fmax} 52 dBA or the rating background level plus 15 dB, whichever is the greater.

Where this level is predicted to be exceeded, further analysis should be undertaken to the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night time period.

Out of all the potential noise generators associated with the Project, noise generated during the triggering of circuit breakers is expected to be only event that is potentially impulsive, with a high sound power level and over a short duration. The awakening criteria outlined above has been applied to this project to assess if there is a risk associated with sleep disturbance.

3.3.6 Meteorological conditions

Meteorological conditions applied by WSP are summarised in Table 3.6. These are based on the standard and noise-enhancing meteorological conditions outlined in Fact Sheet D of the NPfI.

Table 3.6 Meteorological parameters assessed.

Period	Description	Temp, °C	Humidity, %	Wind velocity, m/s	Wind direction	Air pressure, mbar	Pasquill stability class
Standard	Stability categories A-D with wind speed up to 0.5 m/s at 10m Average Ground Level (AGL)	20°C	70%	0.5	Source to receiver	1013.3	D
Noise enhancing (Day)	Stability categories A-D with light wind (up to 3 m/s at 10m AGL)	20°C		3			D
Noise enhancing (Night)	Stability categories A-D with light wind (up to 3 m/s at 10m AGL) and/or stability category F with winds up to 2 m/s at 10m AGL	10°C		2			F

3.4 Traffic noise objectives

Application notes for the *NSW Road Noise Policy*¹ (RNP), (DECCW, 2011) state the following:

“...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.”

The Roads and Maritime Services (RMS) *Construction Noise and Vibration Guideline* (CNVG) notes that this guidance also applies to traffic noise associated with construction activities.

3.5 Vibration

Potential vibration impacts during the works have been assessed for two potential aspects as follows:

- Cosmetic building damage
- Loss of amenity due to perceptible vibration, termed human comfort.

¹ <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/noise/road-noise-pol-app-notes.pdf>

Importantly, cosmetic damage is regarded as minor in nature, is readily repairable, and does not affect a building's structural integrity. If there is no significant risk of cosmetic damage, then structural damage is not considered a risk.

3.6 Cumulative impact

Assessment of cumulative impact for state significant projects is outlined in the NSW Government's *Cumulative Impact Assessment Guidelines for State Significant Projects* (October 2022) (Cumulative Impact Guideline), where cumulative impacts are defined as:

“Cumulative impacts are a result of incremental, sustained and combined effects of human action and natural variations over time and can be both positive and negative. They can be caused by the compounding effects of a single project or multiple projects in an area, and by the accumulation of effects from past, current and future activities as they arise.”

The described Cumulative Impact Assessment (CIA) requires that the cumulative impact of the Project and other relevant future projects and determining whether these combined effects will be acceptable. It is acknowledged in the Cumulative Impact Guideline that due to potential limitation in available information a combination of a quantitative (where there is sufficient information), and a qualitative approach (where information is lacking) is likely going to be used. The relevant key issues for the Project that will be addressed in this NVIA is noise and vibration.

The management of cumulative impacts is stated in the Cumulative Impact Guideline as a shared responsibility and requires collaboration between government, industry, and the community.

The Cumulative Impact Guideline states that where there is a clear government guidance on cumulative impacts this should be used. As such, to assess the acceptability of the cumulative operational noise, the guidance provided in NPfI has been used in this assessment. Cumulative noise impact from industrial sources as addressed in Section 2.1 of the NPfI and described to be controlled through the amenity noise levels. It is stated in A2 of the NPfI that as long as noise impacts are below the amenity noise levels, no additional assessment of cumulative impacts is required to enable the significance of residual impacts to be determined in accordance with Section 4 of the NPfI.

4 Construction assessment

To assess the potential noise and vibration impacts during construction, typical plant, and equipment likely to be used during each work stage have been developed based on indicative staging information provided by Gransolar.

4.1 Construction noise impact assessment

4.1.1 Hours of work

It is currently understood that all construction works will be undertaken during standard hours, as defined in Section 3.2.1.1. If work outside of these hours is required, an additional out-of-hours assessment would be required.

4.1.2 Construction stages

The construction stages and equipment to be used are not yet finalised. Assessment has been based on initial information and similar projects as outlined in Table 4.1, detailed equipment information for each stage is presented in Appendix C.

Table 4.1 Construction stages

Scenario	Construction stage (activity)	Estimated noise level, dBA	
		SWL $L_{eq,15min}$	L_{max} (loudest item)
1	Vegetation clearance	124	128
2	Access and earthworks	126	126
3	Foundations and pads	125	125
4	Equipment installation	122	122
5	Demobilisation and rehabilitation	120	121

4.1.3 Assessment methodology

It has been assumed that equipment is operating continuously and simultaneously at the closest point to the receiver. In reality, some items of equipment are not expected to be operating over the full duration of the assessment, and this adds a further conservatism to the noise predictions. Actual noise levels from the construction site would be expected to be somewhat lower than those predicted.

A three-dimensional noise model was created to predict the construction noise impact for all scenarios of the Project at all receivers. Key parameters used in establishment across all noise model predictions are summarised Table 4.2.

Table 4.2 Key parameters used for construction noise modelling

Item	Description
Software	SoundPLAN 8.2
Standard	CONCAWE (noise propagation model available in SoundPLAN 8.2). This propagation model include consideration of: — Locations of noise sources and receivers — Geometrical spread of noise (divergence) — Atmospheric absorption — Ground effects — Screening from barriers and topographical features — Reflections from surfaces — Meteorological conditions
Meteorological conditions	In line with the Standard meteorological conditions outlined in Table 3.6.
3-dimensional ground topography data	Elevation around the Project site is based on provided groundworks design from the Client. For all other areas, 1-metre elevation lines from Geoscience Australia's website ELVIS (Elevation Information System) was used.
Ground absorption	A ground absorption factor of 0.5 has been applied. Which is indicative of the mixed grass/open vegetation around the Project. (0=hard ground, 1=soft ground)
Receivers	Point receivers at 1.5 meters AGL have been used in free field predictions (no buildings).
Construction area	BESS site and TL corridor, as illustrated in Section 1.3.

4.1.4 Predicted construction noise levels

Construction noise levels have been predicted for each construction activity. Noise contour maps illustrating the predicted noise levels for each construction scenario are provided in Appendix D.

Noise levels have been calculated assuming all construction activities within each work stage occur simultaneously, anywhere within the construction area. Therefore, construction noise predictions have been presented as a worst case, conservative scenario to represent the potential construction noise impact. A summary of total number of properties exceeding the Project NMLs is presented in Table 4.3.

The assessment shows that construction noise levels are predicted to be the highest during the first three construction stages. Noise levels during this stage have been predicted to potentially exceed NMLs at up to nine properties, but only at one property is the exceedance predicted to be above 10 dB. As such, all exceedance but the one, are considered minor with levels ≤ 10 dB above NMLs. One property (R01) is predicted to experience more notable noise impact with levels predicted between 10 and 20 above NMLs.

Management measures for construction noise are provided in Section 7.1.1.

Table 4.3 Summary of total exceedances for the different construction stages (Standard hours)

Work stage	Predicted number of properties exceeding NML			
	0 to 10 dB	10 to 20 dB	>20 dB	Highly affected (>75 dBA)
SC1: Vegetation clearance	6	1	0	0
SC2: Access and earthworks	9	1	0	0
SC3: Foundations and pads	7	1	0	0
SC4: Equipment installation	5	1	0	0
SC5: Demobilisation and rehabilitation	2	0	0	0

Where: 0 total exceedances, 1 – 5 total exceedances, 6 – 10 total exceedances, >10 total exceedances

4.2 Construction vibration impact assessment

This section describes potential vibration impacts associated with construction of the Project.

4.2.1 Vibration generating equipment

Certain work activities would require the use of vibration-generating equipment that may affect the identified receivers (refer to Section 2.2). For the construction of the Project the list of equipment likely to be associated with each activity is presented in Appendix C. This includes vibratory rollers which has been identified as vibration intensive equipment.

4.2.2 Cosmetic building damage and human response

Table 4.4 presents the indicative safe working distances to minimise the risk of structural damage and human response to vibration based on CNVG. The minimum distances for cosmetic damage should be complied with at all times.

No heritage sites that could be sensitive to vibration have been identified in the area surrounding the Project.

Table 4.4 Recommended minimum working distances for vibration intensive plant from sensitive receivers

Plant item	Rating	Minimum working distances, m ⁽¹⁾	
		Cosmetic damage ⁽²⁾	Human response ⁽³⁾
Vibratory roller (Pad foot roller / Smooth drum roller)	<50 kN (typically 1 to 2 tonnes)	5	15 to 20
	<100 kN (typically 2 to 4 tonnes)	6	20
	<200 kN (typically 4 to 6 tonnes)	12	40
	<300 kN (typically 7 to 13 tonnes)	15	100
	<300 kN (typically 13 to 18 tonnes)	20	100
	>300 kN (typically >18 tonnes)	25	100

- (1) The minimum working distances are indicative and will vary depending on the particular item of plant, local geotechnical conditions and the dominant frequency of the construction vibration levels. As such they should be seen as indicative only.
- (2) Cosmetic damage is identified for typical light-framed residential buildings under typical geotechnical conditions and assume that construction vibration could include low frequency content with associated increased risk of cosmetic damage.
- (3) Based on continuous vibration levels, and as outlined in *Assessing Vibration: a technical guideline* higher levels are acceptable if the vibration source is intermittent, which is common for construction equipment.

4.2.3 Distance between receivers and Project area

As outlined in Section 2.2 all identified receivers are >300 metres away from the Project area which is well beyond the safe working distances outlined in Table 4.4. All receivers are therefore considered to not be at risk of being affected by construction-induced vibration.

4.3 Construction traffic impact

During the construction phase of the Project, heavy vehicles would be required for the delivery of materials and equipment and light vehicles would transport workers to and from the site. This additional road traffic will increase existing levels of road traffic noise along the Riverina Highway, which is a major arterial road and classified as designated heavy vehicle routes by Transport for NSW.

Construction traffic forecasts are provided in Table 4.5 together with existing traffic volume on the Riverina Highway. All construction traffic to the site is forecasted to be limited to the Riverina Highway and to enter the site through the internal road towards the south.

Table 4.5 Traffic volumes on Riverina Highway (number of vehicles)

Peak Period (1hr)	Forecasted construction traffic volumes		Existing volumes	
	Eastbound	Westbound	Eastbound	Westbound
AM	14	8	134	77
PM	2	8	148	92

Mathematically, a doubling of road traffic numbers would result in a 3 dB increase in road noise and a 60 per cent increase in traffic is required to increase traffic noise levels by 2 dB. The increase in traffic volumes is less than 10% across all directions and periods, and as such the increase in noise levels is predicted to be below 2 dB.

Given the preliminary nature of this assessment, precise traffic numbers during construction are unknown. However, in consideration of existing road traffic on these routes, it is considered highly unlikely that the project would generate increases in road traffic numbers of more than 60 per cent along the Riverina Highway and as such would comply with the RNP guidelines along this route.

5 Operational assessment

5.1 Operational noise impact assessment

5.1.1 Battery energy storage system (BESS) and on-site substation

5.1.1.1 Operation

The BESS is likely to only operate at full capacity during periods of charging and discharging. The assessment has, however, been based on the assumption that all plant has is required be available to operate at maximum power during all time periods (24 hour operation). As such, the Project will need to demonstrate that it is able to comply with the most stringent criteria (night time).

5.1.1.2 Assessment methodology

A three-dimensional noise model was created to predict the operational noise impact for all scenarios of the Project. Key parameters used in establishment across all noise model predictions are summarised Table 4.2.

Table 5.1 Key parameters used for construction noise modelling

Item	Description
Software	SoundPLAN 8.2
Standard	CONCAWE (noise propagation model available in SoundPLAN 8.2). This propagation model include consideration of: — Locations of noise sources and receivers — Geometrical spread of noise (divergence) — Atmospheric absorption — Ground effects — Screening from barriers and topographical features — Reflections from surfaces — Meteorological conditions.
Meteorological conditions	In line with the noise enhancing night time conditions outlined in Table 3.6.
3-dimensional ground topography data	Elevation around the Project site is based on provided groundworks design from the Client. For all other areas, 1-metre elevation lines from Geoscience Australia's website ELVIS (Elevation Information System) was used.
Ground absorption	A ground absorption factor of 0.5 has been applied. Which is indicative of the mixed grass/open vegetation around the Project. (0=hard ground, 1=soft ground)
Receivers	Point receivers at 1.5 meters AGL have been used in free field predictions (no buildings).
Site layout	As illustrated in Section 1.3.
Noise sources	Outlined in Section 5.1.1.3.

5.1.1.3 Sound Power Levels (SWL) and orientation of sound sources

The key noise emitting components associated with the Project and their noise emission are outlined Table 5.2.

Sound power levels and 1/3 spectral data for the battery pack system and power conversion system are both based on detailed noise reports provided by the suppliers: FinDreams Battery - Noise Test Report (October 2023), and SMA Inspection Report Acoustic Environmental Test: Sound Power Kodiak 2.0 SC4xxx-UP - Noise Measurement - Coil Comparison Trafotek J. Schneider (December 2020). It is noted that neither spectrum are identified as tonal, as identified in NPfI, which forms an important part of this assessment. It should be noted that if future information shows a change where tonality is detected for the battery and/or inverter spectrum this might require an update to the operational noise assessment.

Since the make and model of the substation transformer and circuit breaker was not known at the time of the assessment, a potential range for the SWL has been assumed based on the following:

- The SWL range for the substation transformer is based on the assumption that a 110 MVA rating would be sufficient for the site (based on the BESS site capacity), and the SWL has then been collected from AS 2374.6—1994 *Power Transformers – Part 6: Determination of transformer and reactor sound levels*.
- The SWL range for the circuit breaker is based on WSP's experience with similar projects. It is noted that circuit breaker switches would operate infrequently and would be a very short-term impulsive type of noise event, which does not likely to impact L_{Aeq} noise levels and as such have been assessed separately as a short-term impulsive noise source (L_{max}).

Table 5.2 Primary noise generating equipment at the Project site

Section	Equipment	Make	Number of plant	SWL per unit, dBA	Noise source height AGL, m
BESS	Battery Pack System	Lithium-ion battery modules (FinDreams) with 40 Hz (1200 RPM) HVAC units	80	2 x 75 $L_{eq,15min}$ (front & back) 63 $L_{eq,15min}$ (sides)	1.2 to 2.7 ⁽¹⁾
	Power Conversion units (PCU) with inverter and MV transformer	SMA SC4xxx-UP: J-Schneider 4600 kVA with silencer	40	90 $L_{eq,15min}$	0.25 to 0.85 ⁽¹⁾
Substation	HV (Grid) transformer	Unknown	1	95 to 102 $L_{eq,15min}$ ⁽²⁾	4 ⁽³⁾
	Circuit breaker switch	Unknown	1	95 to 115 L_{max}	4 ⁽³⁾

- (1) Modelled as industrial buildings with area sources located at weaknesses in casing e.g., air intake / exhaust for the HVAC units.
- (2) Spectral data for the transformer unit is based on measurements performed at an oil-based grid transformer and contains tonal characteristics at 100 and 200 Hz, which is a common feature of this type of equipment.
- (3) Modelled as point sources at an assumed height of unit.

Base (unmitigated) noise models simulated a worst-case inverter orientation where the exhaust is facing either north east or southwest, pending which side boundary they are closest to. Orientation of the noise sources are illustrated in Figure 5.1.

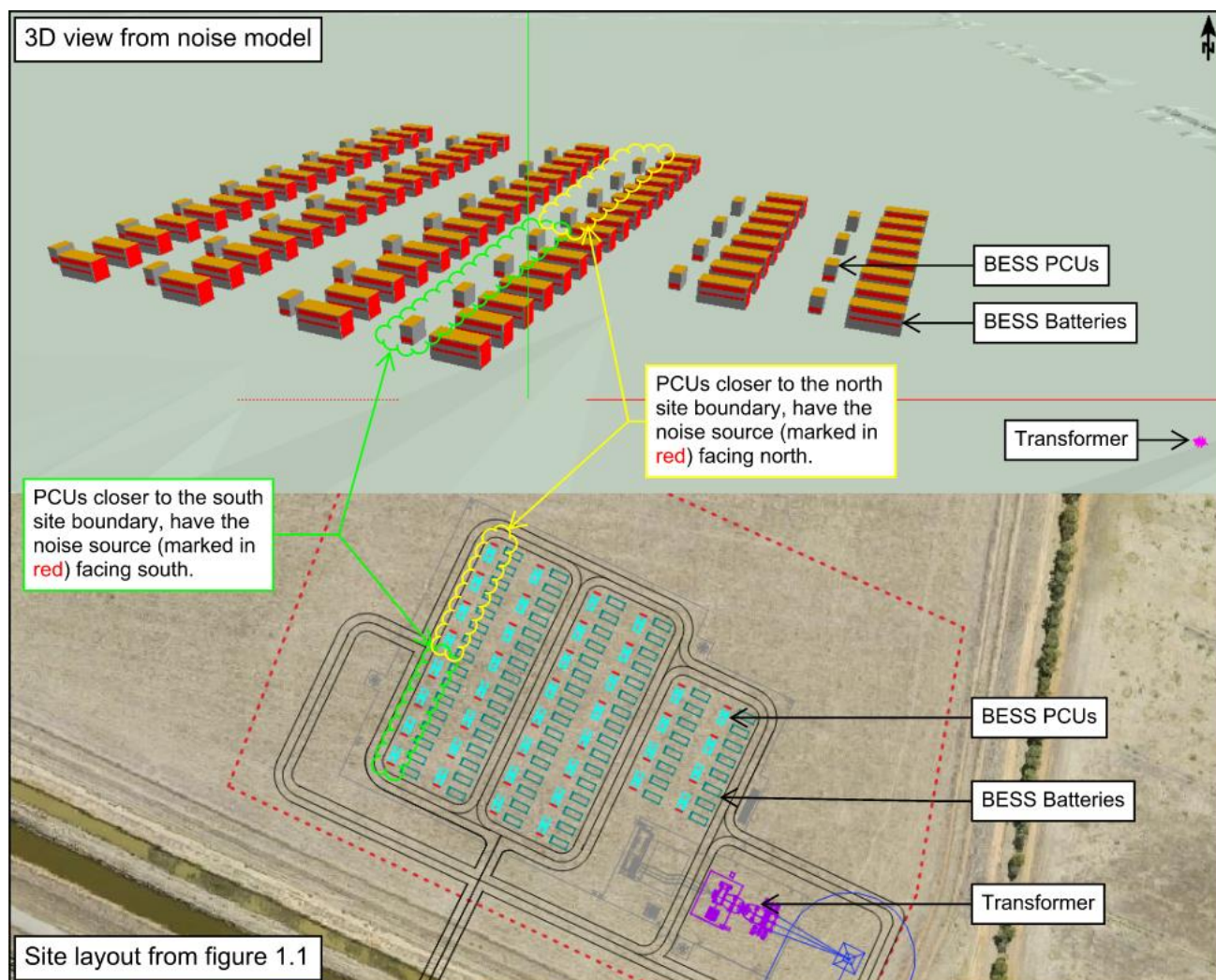


Figure 5.1 Orientation of the noise sources

5.1.1.4 Corrections for annoying noise characteristics

The predicted spectral data at each receiver was assessed for tonal and low-frequency characteristics in line with criteria outlined in Appendix B. If detected, the predicted operational noise levels in Section 5.1.1.5 has been adjusted with applicable correction factor.

5.1.1.5 Predicted operational noise levels

A summary of the predicted noise levels without any mitigation controls in place at each receiver is provided in Table 5.3. Noise contours are presented in Appendix E.

The modelling results show:

- With the exception of R01, R02 and R03, compliance with requirements outlined in Section 3.3.3 is predicted for all time periods at all receivers.
- Potential exceedances have been noted at R01, R02, and R03 for evening and night periods. Exceedances up to 9 dB are predicted (including noise corrections).

- Tonal correction has been applied to all receiver locations (+5 dB correction). The 1/3 octave analysis show that these corrections are driven by the substation transformer.
- Analysis of the contributing noise sources show that all three key noise emitters contribute to the predicted noise level at the most affected receivers (BESS battery, BESS PCU, and substation transformer). The noise emitter with the highest contribution is the substation transformer.
- It should be noted that the predicted noise levels are presented as a range, this due to the transformer and circuit breaker make and model not yet being selected. A likely noise emission range for this equipment has therefore been modelled, please refer to Section 5.1.1.3 for details.

Management measures are provided in Section 7.2.1 with focus both on dominant noise sources and noise characteristics.

Table 5.3 Predicted operational noise levels and assessment – Unmitigated levels at noise sensitive receivers

ID	Address	Criteria, $L_{eq,15min}$ dBA			Operational noise level, $L_{eq,15min}$ dBA ⁽¹⁾
		Day	Evening	Night	Night
R01	21354 Riverina Hwy	40	35	35	42 to 44 ⁽²⁾
R02	135 Aratula North Rd	40	35	35	34 to 37
R03	65 Aratula North Rd	40	35	35	36 to 38
R04	21 Aratula South Rd	40	36	36	28 to 33
R05	41 Aratula South Rd	40	35	35	28 to 32
R06	55 Aratula South Rd	40	35	35	27 to 31
R07	221 Aratula North Rd	40	35	35	33 to 35
R08	21545 Riverina Hwy	40	36	36	28 to 30
R09	21541 Riverina Hwy	40	35	35	30 to 32
R10	21536 Riverina Hwy	40	36	36	31 to 33

- (1) Includes +5 dB penalty for potential tonal characteristics (refer to section 3.3.4)
- (2) Screening test indicated that low-frequency characteristics were detected but no additional correction has been applied since detailed tonality was detected within the allowable low frequency range (below 160 Hz) in line with NPfI (refer to section Appendix B).

Table 5.4 Predicted maximum operational noise levels – Unmitigated levels at noise sensitive receivers

ID	Address	Impulsive noise level, L _{max} dBA		
		Criteria (awaken)	Predicted level	Compliant?
R01	21354 Riverina Hwy	52	≤50	Yes
R02	135 Aratula North Rd	52	≤45	Yes
R03	65 Aratula North Rd	52	≤45	Yes
R04	21 Aratula South Rd	52	≤40	Yes
R05	41 Aratula South Rd	52	≤40	Yes
R06	55 Aratula South Rd	52	≤40	Yes
R07	221 Aratula North Rd	52	≤40	Yes
R08	21545 Riverina Hwy	52	≤35	Yes
R09	21541 Riverina Hwy	52	≤40	Yes
R10	21536 Riverina Hwy	52	≤40	Yes

5.1.2 Transmission line (TL)

5.1.2.1 Noise generating conditions

The operation of HV transmission lines carry the risk of generating audible noise during certain meteorological conditions, for example during wet weather. Audible noise associated with the operation of the HV transmission line is primarily due to corona discharges on transmission lines. Such phenomena are driven by the conductor's Surface Voltage Gradient (SVG) and accumulation of pollution and water droplets on the transmission line's conductor surface. Corona discharge noise is therefore more prominent during weather conditions with rain, mist / fog or dust.

Such audible noise is understood to be typically characterised by a broadband crackling noise with a possible, more prominent, tonal component at 100 Hz.

The extent and level of noise associated with corona discharges are primarily influenced by the following factors:

- Maximum surface voltage gradient
- Meteorological/ air pollution conditions (including mist, dust, or light rain).

5.1.2.2 Assessment methodology

A semi-quantitative assessment of operational noise impacts on surrounding receivers has been undertaken with relation to the operation of the 132 kV overhead transmission line connecting the Deniliquin Substation.

To assess the noise risk associated with corona noise from transmission lines, based off a publicly available Audible Noise Assessment², a single 132 kV transmission line can output a SPL of 35 dBA under the centre line at ground level, while operating at full load. To estimate the SWL from the transmission line, it was assumed that the measurements were conducted 1.5 m above ground under a 20-metre tower. Noise predictions have been made assessing the transmission line as a line source with this SWL output, and layout shown in Section 1.3.

² Project EnergyConnect Audible Noise and Radio Frequency Interference Study, Beca, September 2020

5.1.2.3 Predicted noise impact

Based on a high-level analysis of transmission line noise data, the noise emission from the transmission line is expected to be below 25 dBA at all receivers and is considered low risk. Current predicted noise levels would not have any impact on the cumulative levels and is expected to be inaudible at the receiver locations.

5.2 Operational vibration impact assessment

The equipment detailed in Section 5.1.1.3 is assessed to not have any potential of inducing a vibration impact at the receiver locations (e.g. risks of inducing vibration perceptible by building occupants) at the distances reported in Table 2.1.

The risk of inducing vibration impact within the site (e.g., affecting equipment and/ or structures) is assessed to be low risk and standard vibration isolation mountings nominated by the respective manufacturers is expected to be sufficient.

5.3 Operational traffic noise impact

Forecasted operational traffic data show up to three vehicles visiting the site during operation, six trips in total. All operational traffic to the site is forecasted to be limited to the Riverina Highway and to enter the site through the internal road towards the south.

Mathematically, a doubling of road traffic numbers would result in a 3 dB increase in road noise and a 60 per cent increase in traffic is required to increase traffic noise levels by 2 dB.

Given the preliminary nature of this assessment, precise traffic numbers during operation are unknown. However, in consideration of existing road traffic on these routes (indicated in Table 4.5), it is considered highly unlikely that the project would generate increases in road traffic numbers of more than 60 per cent along the Riverina Highway and as such would comply with the RNP guidelines along this route.

6 Cumulative impact

6.1 Review of developments

An initial review of existing and future developments has been provided in order to assess the potential of cumulative impacts in line with requirements outlined in Section 3.4. The review identified one existing and one future development near the Project.

6.1.1 *Existing development*

Deniliquin Substation was understood to be fully operational at the time of the noise survey and has therefore been considered as part of the establishment of existing noise environment outlined in Section 2.3. This has therefore not been further addressed in this NVIA.

6.1.2 *Future development*

The proposal of Deniliquin BESS by Avenis Energy on behalf of AE BESS 4 Pty Ltd as Trustee for AE BESS 4 Unit Trust (Avenis Deniliquin BESS). Information about the project is based on publicly available information which is very limited at this stage. The information has been collected from Avenis BESS project website³.

The BESS is proposed to be located adjacent to the Deniliquin substation with a maximum development footprint of 7 hectares and expected capacity of 120 MW/ 480 MWh. An indicative site layout and location of Avenis Deniliquin BESS is provided in Figure 6.1. The operation of the project is understood to include the following key components:

- Battery containers
- Inverters
- Transformers
- Cooling and fire suppressions systems if required
- Switch rooms and switch yard
- New access road to the site
- Parking site, site office, and amenities for operational use.

³ Deniliquin BESS, Avenis Energy. Website: <https://www.avenisenergy.com.au/projects/deniliquin>.



Figure 6.1 Indicative site layout for Deniliquin BESS. Source: Deniliquin BESS Fact Sheet by Avenis Energy

6.2 Cumulative operational noise

6.2.1 Impact assessment

As an EIS and/ or NVIA was not publicly available at the time this assessment was prepared, only a high-level assessment of the noise impact from this development can be made. The publicly available design information indicates that the proposed project could have a similar noise impact as the Project (Deniliquin East BESS).

The potential increase in noise levels from Section 5.1.2.3 have been estimated based on the following assumptions:

- Avenis Deniliquin BESS has, based on its stated capacity, been assumed to have a similar noise impact as the Project.
- Distance between receivers and the Avenis Deniliquin BESS site boundary as illustrated on the following page.
- Increase in noise level has been capped at +3 dB, which would be equivalent of doubling in noise sources affecting the receiver (where the sources have an equal noise emission level).
- Where Avenis Deniliquin BESS is predicted to be the dominant site it is expected the cumulative assessment and potential mitigation measures are addressed in the EIS for Avenis Deniliquin BESS.



Project No: PS210338		Author: LE				Legend - - - Project Area Receivers Avenis Deniliquin BESS Existing substation	Deniliquin East BESS Location of future development
Date: 13/05/2025		Approved by: BI					
To be read in conjunction with WSP report: PS210338-ACO-REP-1_Deniliquin NVIA				Map Source: MetroMap			

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6.2.2 Predicted operational noise contribution

The predicted contribution from the identified Avenis Deniliquin BESS to Project levels is presented in Table 6.1.

Table 6.1 Predicted contribution from Avenis Deniliquin BESS

ID ⁽¹⁾	NCA	Address	Approximate distance to Avenis Deniliquin BESS, m	Dominant site (estimated)	Predicted increase to the Project noise levels, dB
R01	2	21354 Riverina Hwy	600	Close to equal contribution	+2
R02	2	135 Aratula North Rd	1,400	Close to equal contribution	+2
R03	2	65 Aratula North Rd	800	Close to equal contribution	+3
R04	1	21 Aratula South Rd	850	Avenis Deniliquin BESS	N/A
R05	2	41 Aratula South Rd	950	Avenis Deniliquin BESS	N/A
R05	2	55 Aratula South Rd	1,050	Avenis Deniliquin BESS	N/A
R07	2	221 Aratula North Rd	2,000	Deniliquin East BESS	+1
R08	1	21545 Riverina Hwy	2,300	Deniliquin East BESS	+2
R09	2	21541 Riverina Hwy	2,000	Close to equal contribution	+2
R10	1	21536 Riverina Hwy	2,300	Deniliquin East BESS	+1

6.3 Discussion regarding cumulative impact

The cumulative assessment takes into consideration all operational noise sources proposed as part of the Project as well as known future and existing developments. As outlined in Section 6.1, one future development has been identified as potentially contributing to the cumulative impact.

The approach taken for this assessment, to assess if the predicted cumulative impact for operational noise is likely to be acceptable is to assess it against the amenity noise levels:

- The project criteria outlined in Section 3.3.3 shows that the PNTL are ≤ 3 dB the amenity noise level for all cases but night time for NCA 1, where the PNTL is ≤ 2 dB below.
- The predicted increase in noise levels presented in Section 6.2.2 indicate that all receivers within NCA 1 are predicted to experience increases of ≤ 2 dB, and receivers within NCA 2 ≤ 3 dB.
- It is, therefore, concluded that the cumulative impact is unlikely to exceed the amenity noise level at any receiver.

It should be noted that this assessment is based on very high-level project information from Avenis Deniliquin BESS and should be seen as semi-quantitative and preliminary in nature. Further detailed noise assessment should consider the noise inputs and predicted impacts from the proposed development.

Given separation distances between the two sites and nearby vibration sensitive receivers, cumulative ground vibration impacts are considered very low risk and have not been predicted.

No schedule for construction has been made available, and as such a quantitative assessment of construction noise and vibration cannot be made at this stage. If construction schedules for the two projects overlap it will need to be closely managed.

High level discussion regarding potential management is provided in Section 7.3.

7 Management and mitigation

Due to the Project being in early stages of planning with multiple variables remaining uncertain, including the make and model of the on-site substation transformer, a specific set of solutions cannot be confirmed at this stage. This section focuses on providing possible options and/ or combination of options for management and mitigation measures to ensure compliance with requirements set out in Section 3.

7.1 Construction

7.1.1 Construction noise impact

As part of the project detailed design and prior to commencement of works, a project specific Construction Environmental Management Plan (CEMP) should be prepared and implemented. This would include measures for the mitigation and management of noise in accordance with the requirements of the ICNG.

It is proposed that works are carried out only during standard hours.

Further reasonable and feasible noise mitigation measures would include:

- Ensuring deliveries are made during standard hours.
- The selection and duration of use for equipment which is generating noise.
- Switching off any equipment not in use for extended periods.
- Keeping truck drivers informed of designated vehicle routes, parking locations, and acceptable delivery hours for the site.
- Using the most suitable equipment necessary for the works at any one time.
- Regularly inspecting and maintaining plant to avoid increased noise levels from rattling hatches, loose fittings etc.
- Use of quieter methods where feasible and reasonable.
- Use of temporary noise screens around noisy construction plant. Screens will be positioned to interrupt a direct line of sight between the major noise source and potentially affected receivers.

Table 7.1 Estimated noise reduction for standard mitigation measures

Measure	Estimated noise reduction, dB
Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers.	2 to 5
Orienting equipment away from sensitive receivers.	3 to 5
Carrying out loading and unloading away from sensitive receivers.	3 to 5
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks.	5 to 10
Selecting site access points and roads as far as possible away from sensitive receivers.	3 to 6

7.1.2 Construction vibration impact

As concluded in Section 4.2, all receivers are at low risk of being affected by construction-induced vibration and no mitigation measures are necessary.

It should, however, be noted that the distances also apply to structures within the Project site, the existing substation, and potential underground services. It is recommended, that the safe working distances advice outlined in Table 4.4 are referenced when planning works to limit risk of vibrational damage to structures/ services within respective site.

7.1.3 Construction traffic impact

The noise impact of the construction traffic generated by the project are predicted to be minor and to comply with the RNP guidelines.

7.2 Operation

7.2.1 Operational noise impact

During the assumed worst-case operation, noise criteria are predicted to be exceeded at some receivers (as outlined in Section 5.1.1.5). As such, consideration of mitigation strategies to reduce the operation noise impact is required for the BESS and on-site substation transformer.

From an acoustic perspective, possible strategies to mitigate noise are typically investigated in the following order (decreasing preference):

- 1 Noise control at the noise source
- 2 Noise control along the noise transfer path
- 3 Noise control at the receiver.

7.2.1.1 Battery Energy Storage System (BESS) and on-site substation

Based on the predicted noise levels and the key sources outlined in Section 5.1.1.5, priority in mitigation of the sources is as follows:

- **On-site substation transformer** as the most dominant noise source, and reason for noise characteristic corrections for tonal/ low-frequency noise. It is noted that the make and model of the transformer has not yet been selected, and that the equipment's noise emission might be considered in the selection.
- **BESS batteries and PCUs** as the secondary contributing noise sources of close to equal weight. It is noted that the equipment for the battery and PCUs have already been selected, and that a low noise option has been selected for the PCU as it is fitted with a silencer.

For brevity, only the impact and results for the exceeding receivers (R01, R02, and R03) have been outlined in this section.

Mitigation option 1 – Select transformer with lower sound power level

The method outlined in Section 5.1.1.2 was updated to include the replacement of the transformer with a noise attenuated unit. The new unit was modelled with a Sound Power Level of 86 dBA (reduced from a range of 95 – 102dB).

The predicted noise levels are presented in Table 7.2, conclusions are as follow:

- Compliance with requirements outlined in Section 3.3.3 is predicted for the daytime period at all receivers
- Compliance with requirements outlined in Section 3.3.3 is predicted for the evening and night periods at all receivers except for one location: R01. During evening and night hours a potential exceedance of 1 dB is predicted for this receiver.

- Spectral analysis shows no tonal or low-frequency characteristics, and as such no correction has been added
- Analysis of the contributing noise sources show that only the batteries and PCUs contribute to the predicted overall noise level at R01, with no contribution to the overall noise level from the transformer unit.

Table 7.2 Predicted noise levels – Mitigation option 1: Reduced SWL for on-site substation transformer

ID	Address	Noise criteria, $L_{eq,15min}$ dBA (night)	Predicted operational noise level, $L_{eq,15min}$ dBA (night)	
			Low noise transformer SWL 86 dBA	
			Predicted level	Compliant?
R01	21354 Riverina Hwy	35	36	No
R02	135 Aratula North Rd	35	29	Yes
R03	65 Aratula North Rd	35	30	Yes

Mitigation option 2 – Optimisation of inverter layout and eastern BESS barrier

The method outlined in Section 5.1.1.2 was used, with the following adjustments:

- Low noise (86 dBA) substation transformer. Please refer to Mitigation option 1 for details.
- Optimising the site layout to limit the noise emission from the PCUs in the direction of the most affected receivers. PCUs were modelled so that the exhaust was facing west. Please see Figure 7.1 for illustration.
- Addition of a noise protection wall (noise wall) around the eastern site boundary of the BESS. A two-sided noise wall was utilised and is presented in Figure 7.1.

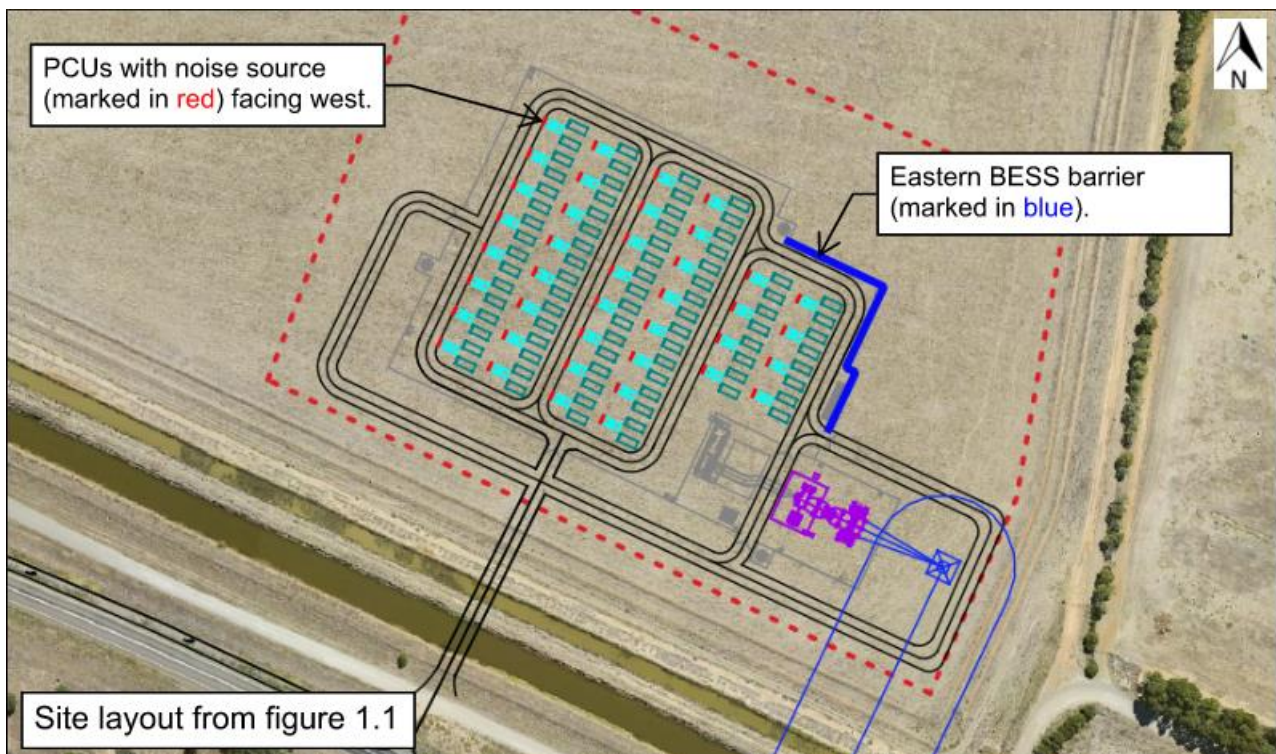


Figure 7.1 Site layout – Mitigation option 2

The barrier design was chosen to protect the most affected receivers while still allowing easy access to the transformer, BESS batteries and PCUs for maintenance and access.

The barrier was modelled as follows:

- With a height of 5 metres (i.e. 1 metre above height of equipment) (a range of barrier heights were examined, however only the 5-metre barrier resulted in compliance).
- Along the fence boundary, close to the noise source at a distance of approximately 9 metres from the eastern BESS units. For the barrier to be effective it is critical it is placed as close as possible to the source.
- As a solid reflective material (representative of e.g., concrete panels).

The predicted noise levels are presented in Table 7.3, conclusions are as follows:

- Compliance with requirements outlined in Section 3.3.3 is predicted for all time periods at all receivers for a 5-metre noise wall.
- Spectral analysis of the mitigated results shows no tonal or low-frequency characteristics, and as such no correction has been added.
- Analysis of the contributing noise sources show that two key noise emitters (batteries and PCUs) contribute to the predicted overall noise level at R01.

Table 7.3 Predicted noise levels – Mitigation option 2: Optimised layout for PCUs and noise protection wall at north-east corner of site

ID	Address	Noise criteria, Leq,15min dBA (night)	Predicted operational noise level, Leq,15min dBA (night)	
			5-metre noise wall ⁽¹⁾	
			Predicted level	Compliant?
R01	21354 Riverina Hwy	35	33	Yes
R02	135 Aratula North Rd	35	25	Yes
R03	65 Aratula North Rd	35	26	Yes

(1) Height of noise wall at north-east corner of site.

Mitigation option 3 – Noise control at the receiver

Considering the exceedances are only predicted a few isolated receivers in rural areas, mitigation at the receiver might be a possible solution, especially if combined with Mitigation option 1 or 2. For control at the receiver, the mitigation measure needs to be negotiated and be acceptable for all parties but could typically include:

- A structure that provides shielding to the residence, for example, a courtyard wall, or
- Architectural controls such as upgrades to insulation and glazing of windows.

Discussion of mitigation options for operational noise

From the results in Mitigation options 1 and 2, it is shown that mitigating the noise emissions, and the tonal and low-frequency noise characteristics, associated with the on-site substation transformer is critical to reducing the noise emission of the Project. However this cannot solely be relied upon to achieve compliance with requirements outlined in Section 3.3.3.

A combination of mitigation measures is required, and the following mitigation approach is recommended:

- Selecting a substation transformer with a SWL ≤ 90 dBA
- Optimising the layout and facing the PCUs towards the north west
- The installation of a 5 m noise barrier along the eastern side of the site.

It is noted that final equipment types and specifications may change as design of this Project progresses. Where equipment louder than the assessed items is selected, further assessment is likely to be required. As this assessment shows compliance is expected under the Mitigation 2 scenario, where quieter equipment is selected, further assessment may not be required.

7.2.1.2 Transmission line (TL)

Based on the noise impact assessment outlined in Section 5.1.2.3, there is a very low risk of a noise impact from the 132 kV transmission line at the receivers. As such no mitigation measures would be required.

However, to support the Project the following high level design principles have been presented for consideration to ensure a low noise impact:

- Regular maintenance to reduce e.g., dust build-up which can create corona noise
- Install corona rings
- Minimise surface voltage gradients
- Maximise distance between insulators

- Avoid parts with sharp points or sharp edges.

7.2.2 Operational vibration impact

No mitigation is required to mitigate operational vibration at sensitive receivers.

However, to prevent ground-borne vibration within the site (e.g. affecting equipment and/ or structures) it is recommended that any vibration-generating equipment that can cause environmental impact to be placed on anti-vibration mounts. The suppliers shall take responsibility to ensure that all mountings are appropriate for the design loads, operating and environmental conditions that will prevail.

7.2.3 Operational traffic noise impact

The noise impact of the operational traffic generated by the project are predicted to be minor and to comply with the RNP guidelines.

7.3 Cumulative impact

Discussion and initial advice on cumulative impact management is provided in Table 7.4. It should, however, be noted that that control of cumulative impact would only be required if both proposals go ahead (or additional developments are identified), and in the case of construction impact, if the schedules overlap.

Table 7.4 Cumulative impact – Discussion and initial direction on mitigation measures

Aspect	Discussion and initial direction on mitigation	
	Noise	Vibration
Cumulative construction impact	Plan noisy construction activities in consultation with any projects within approximately 2 km. Simultaneous construction works with high noise generation should be avoided.	Coordinate vibration generating activities if carried out in close proximity, e.g. when connection to existing substation. Simultaneous vibration generating construction works in close proximity should be avoided.
Cumulative operational impact	If the PNTL is achieved at all receivers for the Project, the cumulative impact is likely to be acceptable since it is predicted to not exceed the amenity noise levels set out in NPfI. It should however be noted that this conclusion is qualitative and high level in nature and that if both developments go ahead (or additional ones are identified), more detailed assessment for operational noise recommended.	Due to distance between identified development and project, in combination with the assessed low risk for the Project, no specific actions are expected to manage cumulative impact.

8 Conclusion

WSP Australia (WSP) has been engaged by Gransolar to prepare a NVIA for inclusion in an EIS to accompany the State Significant Development Application.

Construction

Noise

Construction is proposed for standard hours only and night-time and sleep disturbance impacts have as such not been assessed in this document.

Construction noise is predicted to have minor impact on up to eight (8) properties, with NMLs to be exceeded by ≤ 10 dB. One property is predicted to experience more notable noise impact (between 10 and 20 above NMLs). It should, however, be noted that the predicted levels are representative of a conservative worst-case approach, and that the duration of any exceedances is expected to be very limited (e.g., on day of laying slab).

A series of noise management and mitigation measures have been recommended outlined in Section 7.1.

Vibration

All identified receivers have a low risk of being affected by construction-induced vibration.

To ensure that there is no structural damage to existing structures within the Project site, as well as existing substation and potential underground services, it is recommended the safe working distances, outlined in Section 4.2.2, are considered when planning the works to limit risks of vibrational damage.

Traffic noise

The noise impact of the construction traffic generated by the project are predicted to be minor and to comply with the RNP guidelines. No mitigation measures are nominated.

Operation

Noise

Battery Energy Storage System (BESS) and on-site substation

The noise emission from the BESS with the on-site substation is predicted to exceed the requirements outlined in Section 3.3.3 at three receivers and mitigation measures need to be considered.

It should, however, be noted that the predicted noise levels are based on a conservative worst-case approach with all plant items operating at full capacity simultaneously with meteorological conditions representative of noise enhancing night time conditions. This approach was chosen since it is likely to occur occasionally, and the Project therefore needs to be designed to achieve compliance during these most stringent conditions. It should be noted that most of the time noise emissions are expected to be lower, e.g. since the BESS is only likely to operate at full capacity during periods of charging and discharging.

Due to the Project being in early stages of planning with multiple variables remaining uncertain, including the make and model of the substation transformer, this report has focused on providing possible options and/ or combination of options for management and mitigation measures to ensure compliance with the requirements. The specific selected mitigation measures are expected to be confirmed as the Project progresses and the design is finalised.

Options for mitigation measures are outlined in detail in Section 7.2.1.1, but can be summarised as follows:

- Selecting a substation transformer with a SWL ≤ 90 dBA
- Optimising the layout and facing the PCUs towards the northwest
- The installation of a 5 m noise barrier along the eastern side of the site.

It is noted that final equipment types and specifications may change as design of this Project progresses. Where equipment louder or have different noise characteristics (e.g., if the battery in final selection has a noise spectrum exhibiting tonality) than the assessed items is selected, further assessment is likely to be required. As this assessment shows compliance is expected under the Mitigation 2 scenario, where quieter equipment is selected, further assessment may not be required.

Transmission line (TL)

The noise emission from the 132 kV TL is predicted to be low risk with sound pressure levels at all receivers predicted to be below 25 dBA, see Section 5.1.2.3. No specific mitigation measures are recommended.

However, high level design principles to ensure a low noise impact have been presented for consideration in Section 7.2.1.2.

Vibration

The assessment shows no risk of operational vibration impact at affecting sensitive receivers, and low risk for impact to structures within the Project site. To manage the vibration impact within the Project site it is recommended standard vibration isolation mounts nominated by the respective manufacturers be installed.

Traffic noise

The noise impact of the operational traffic generated by the project are predicted to be minor and to comply with the RNP guidelines. No mitigation measures are nominated.

Cumulative impact

Construction

Construction schedule is not available at this point for any identified development. Consideration of mitigation measures will only be required if the construction schedules overlap, in which case, careful consideration and coordination will be required and the following is recommended:

- **Noise:** Coordination with other developments within 2 km from Project to not simultaneously carry out construction works with high noise impact.
- **Vibration:** Potential coordination might be needed to not concurrently undertake works with high vibration generation in close proximity e.g. when connecting to existing substation.

Operational

- **Noise:** Cumulative impacts of operational noise are not expected to exceed the amenity noise levels set out in NPfI for the relevant usages and are therefore expected to be acceptable. It should, however, be noted that this conclusion is qualitative and high level in nature and that if both developments go ahead, a more detailed assessment for operational noise is recommended.
- **Vibration:** No specific actions are expected to be needed manage cumulative impact due to the low risk of vibration impact from the Project and distances to identified receivers.

Due to the limited information available about the identified future developments in the area, outlined in Section 6.1, the cumulative assessment is qualitative and high level in nature.

Future assessments for developments in the area should consider the findings of this assessment.

9 Limitations

This Report is provided by WSP Australia Pty Limited (WSP) for Gransolar Development Australia (Client) in response to specific instructions from the Client and in accordance with WSP's proposal dated 16 November 2023 and agreement with the Client (Agreement) dated 19 December 2023.

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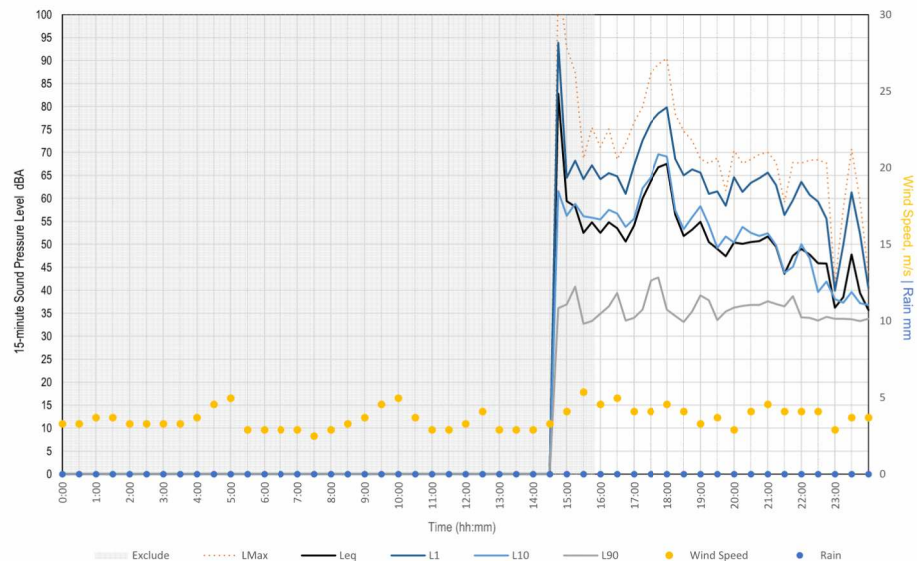
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Appendix A

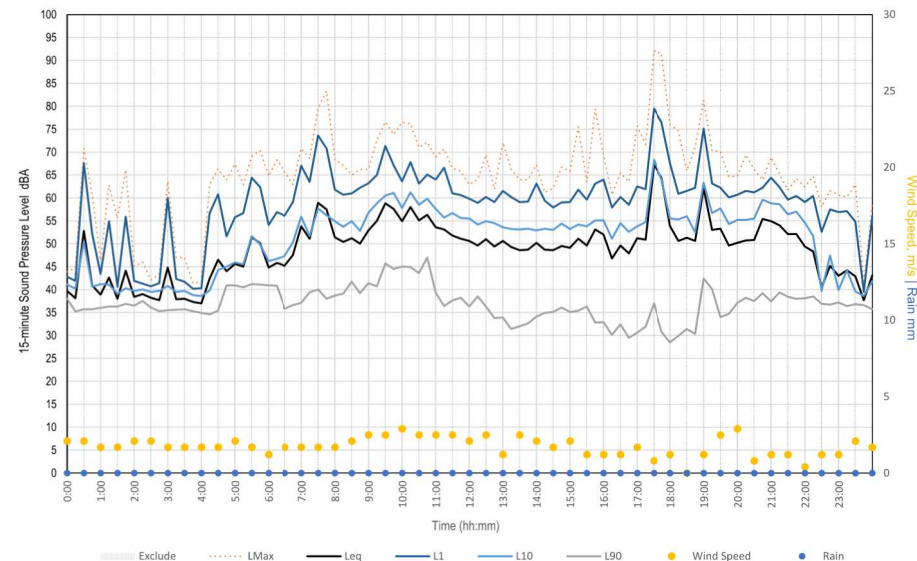
Detailed noise monitoring results



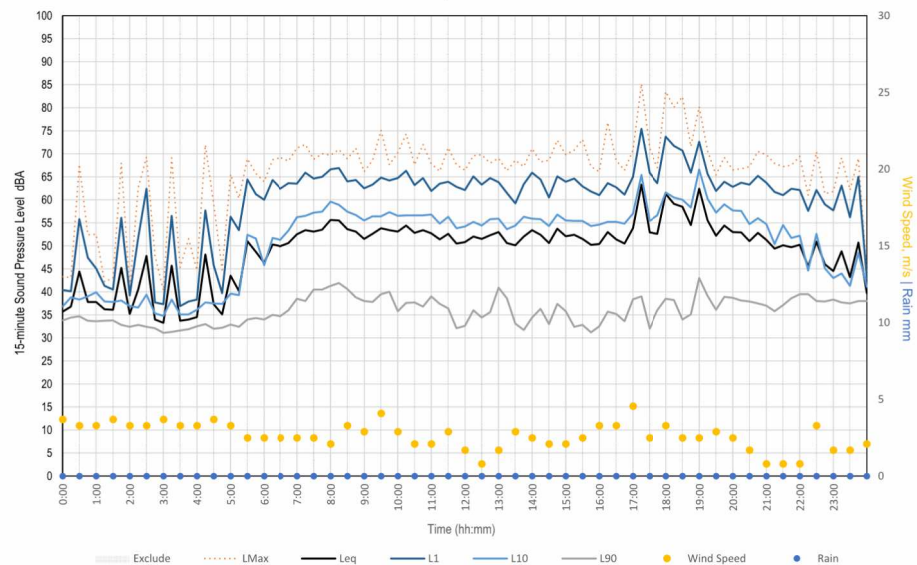
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Wednesday, 27 March 2024



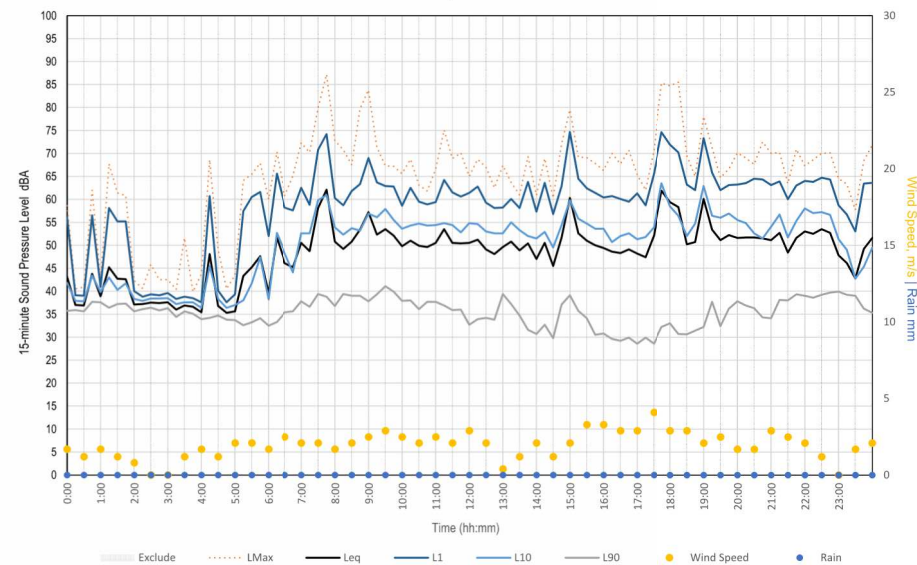
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Friday, 29 March 2024



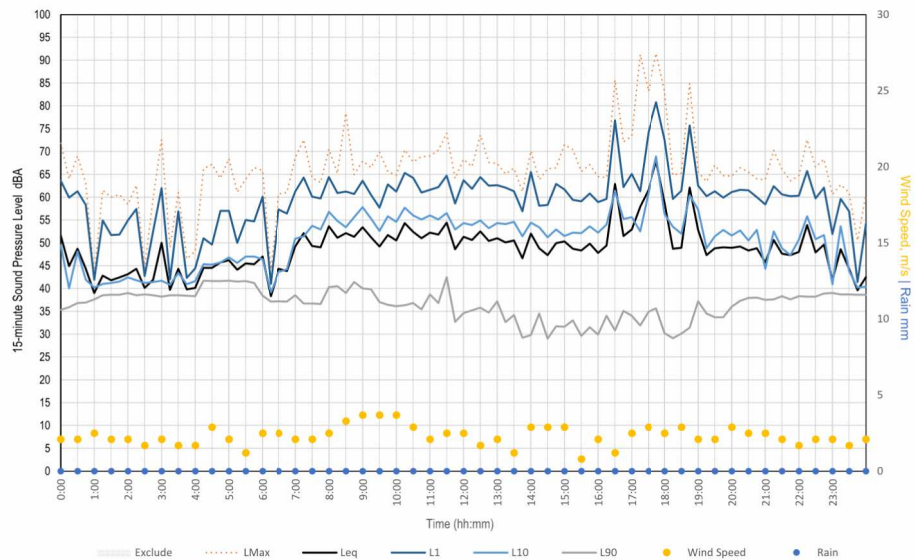
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Thursday, 28 March 2024



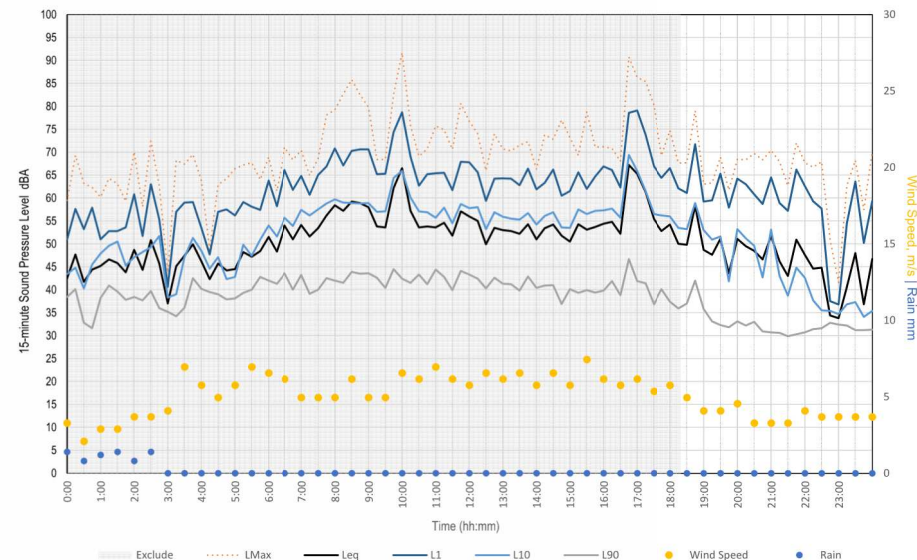
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Saturday, 30 March 2024



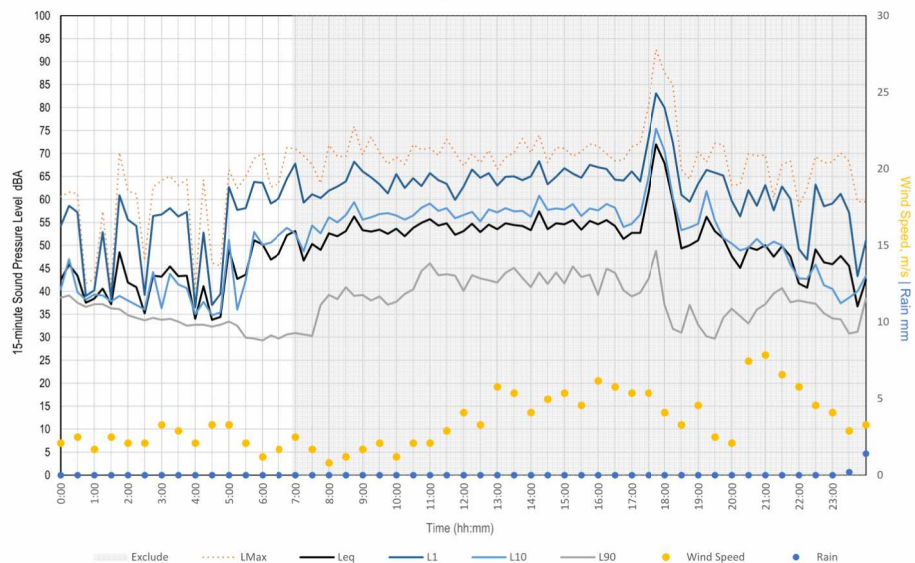
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Sunday, 31 March 2024



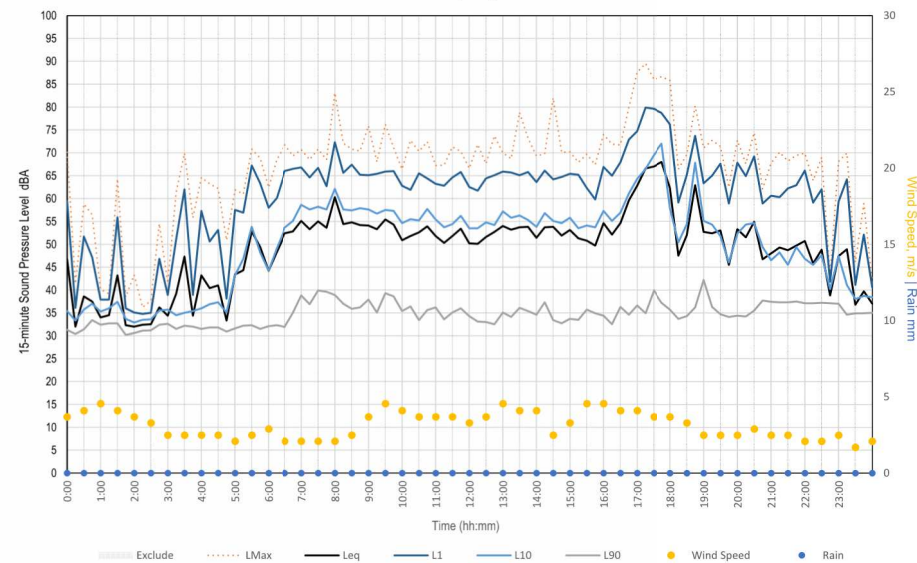
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Tuesday, 02 April 2024



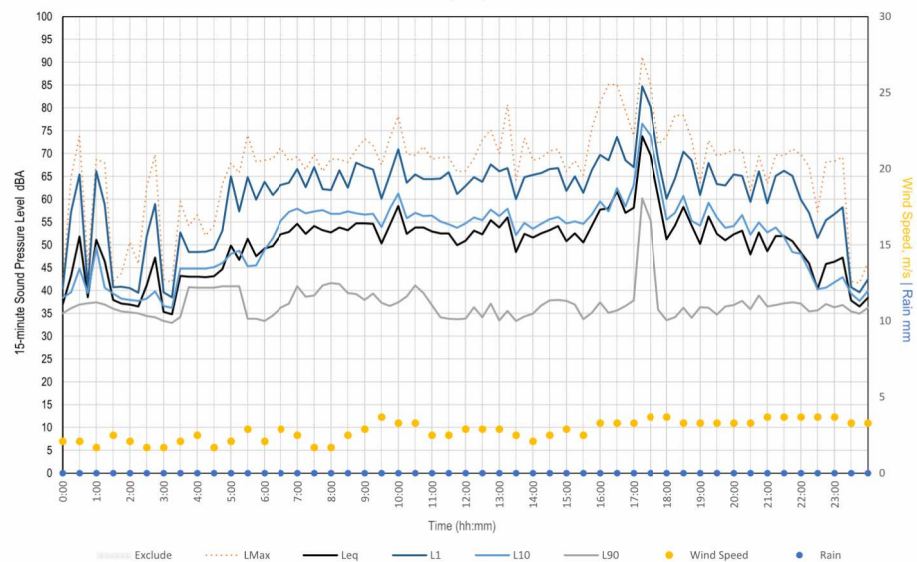
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Monday, 01 April 2024



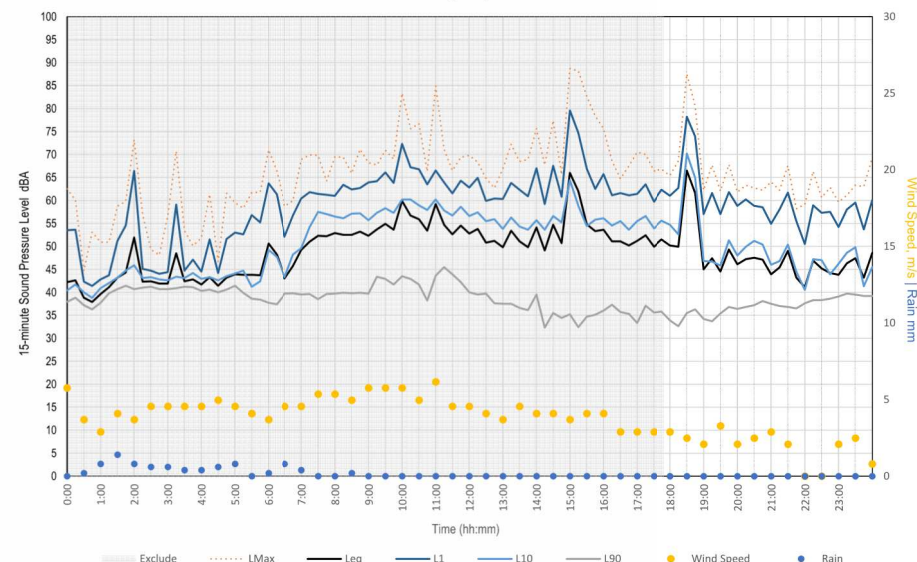
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Wednesday, 03 April 2024



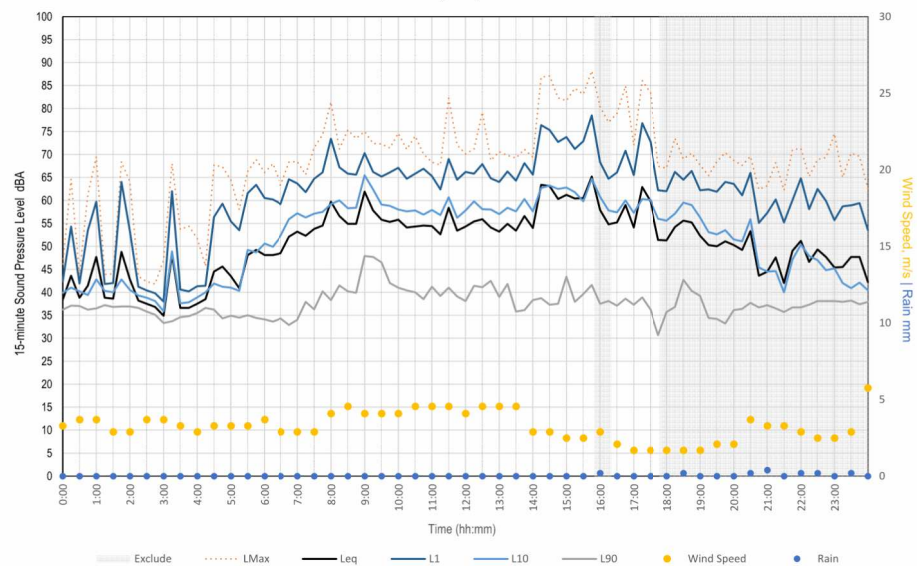
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Thursday, 04 April 2024



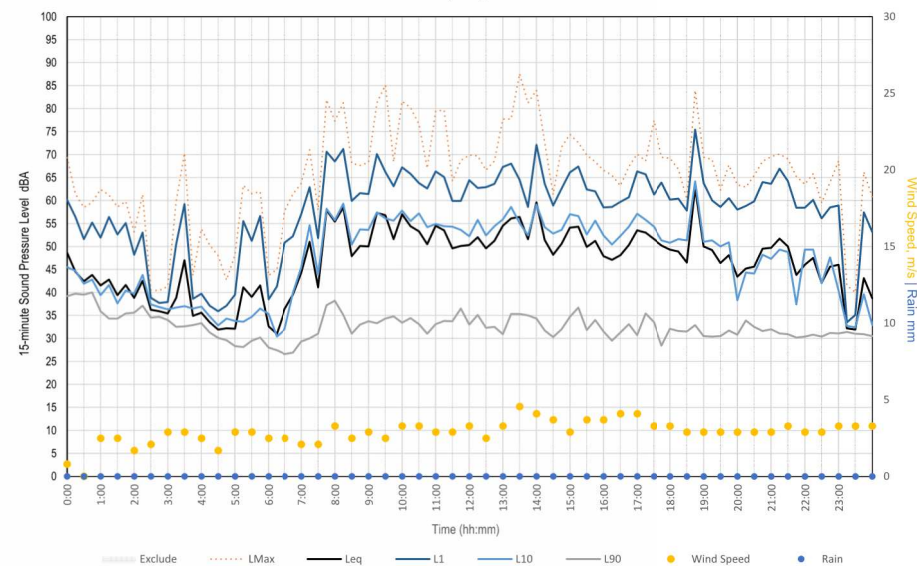
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Saturday, 06 April 2024



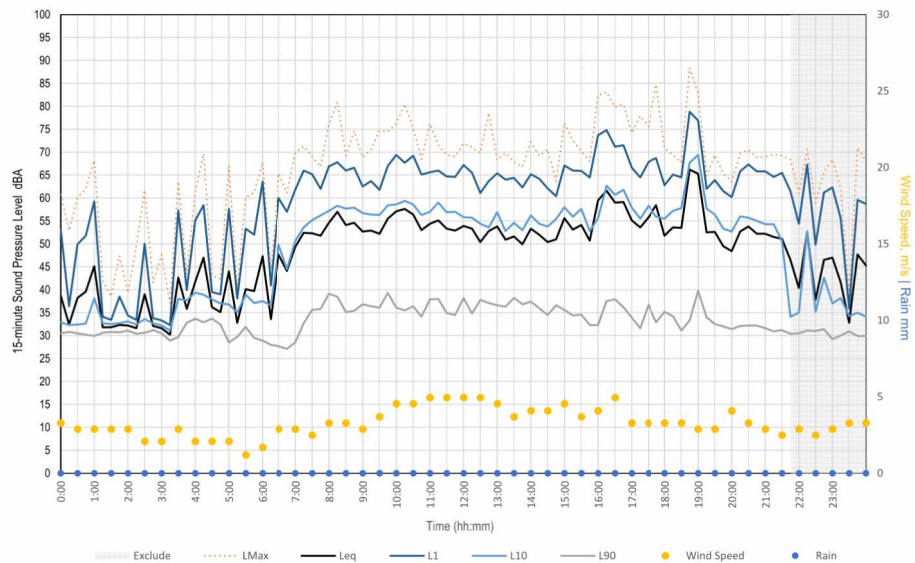
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Friday, 05 April 2024



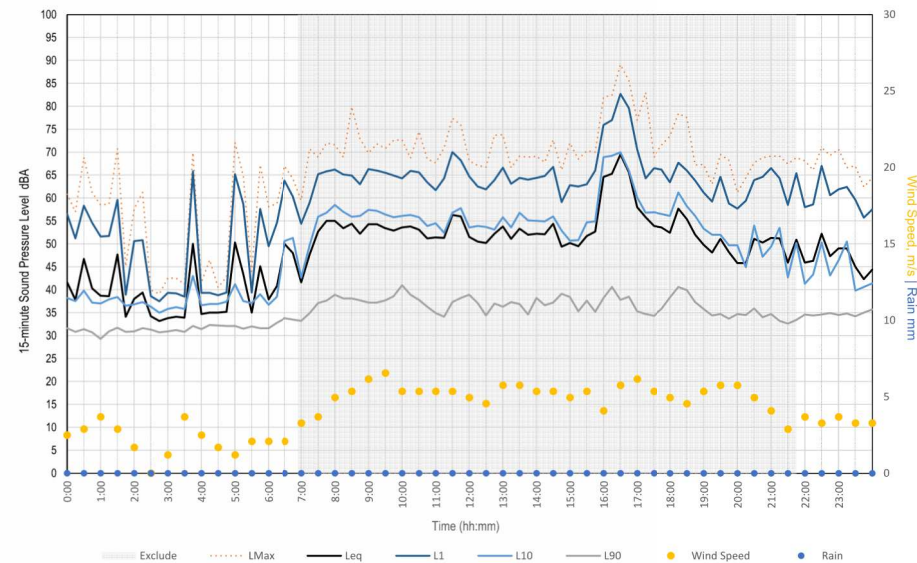
Measured Noise Levels - NCA 1: 21545 Riverina Hwy
Sunday, 07 April 2024



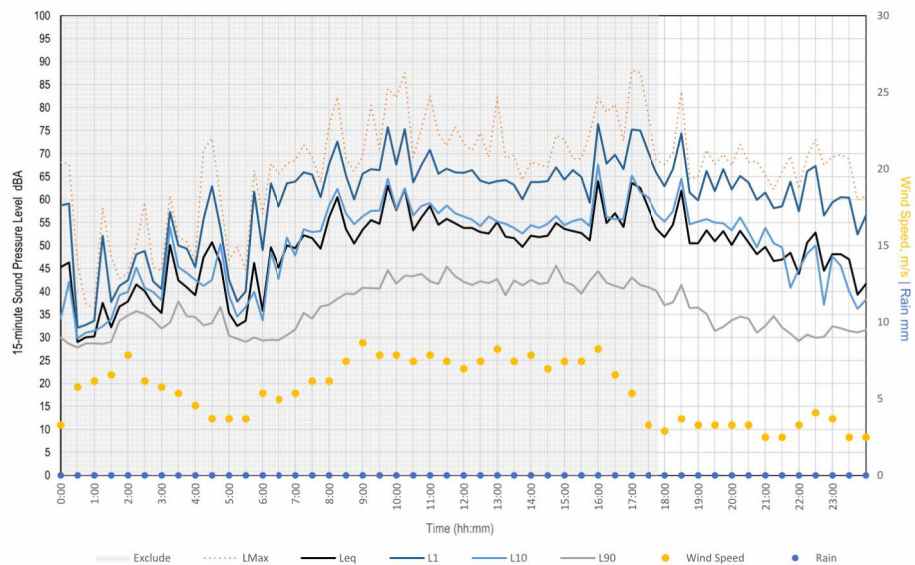
Measured Noise Levels - NCA 1: 21545 Riverina Hwy
Monday, 08 April 2024



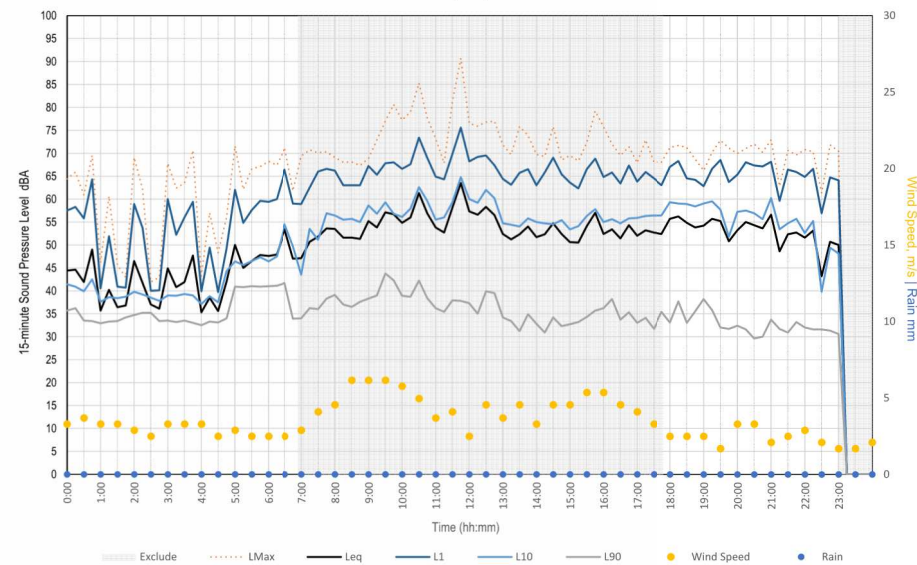
Measured Noise Levels - NCA 1: 21545 Riverina Hwy
Wednesday, 10 April 2024



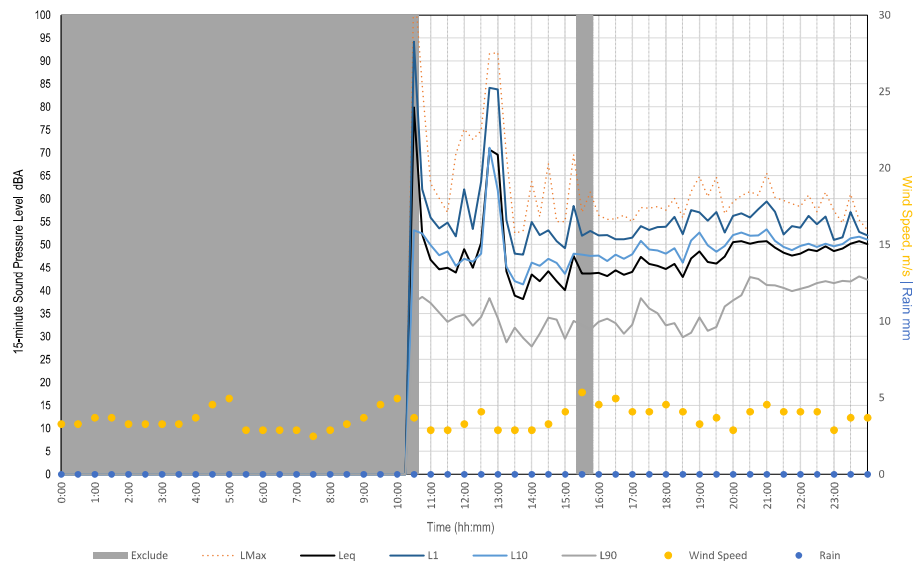
Measured Noise Levels - NCA 1: 21545 Riverina Hwy
Tuesday, 09 April 2024



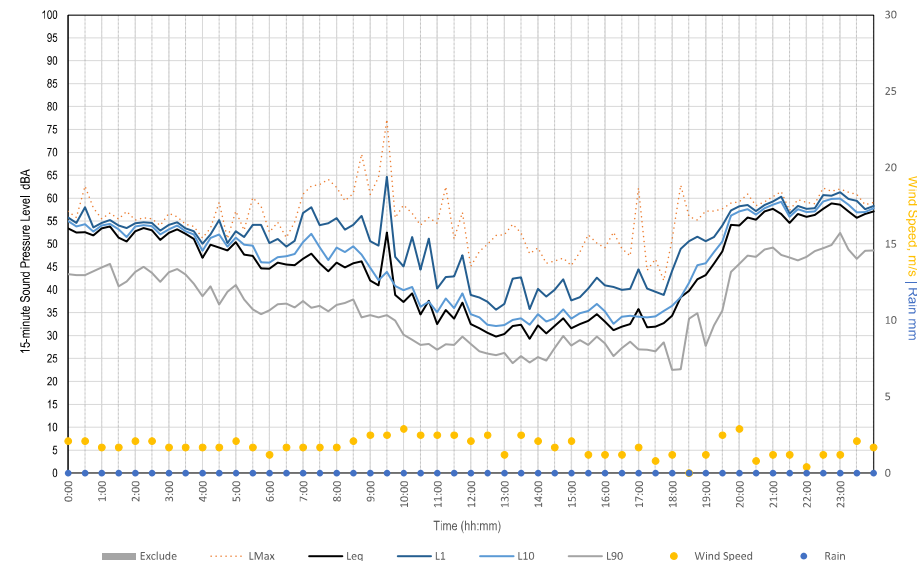
Measured Noise Levels - NCA 1: 21545 Riverina Hwy
Thursday, 11 April 2024



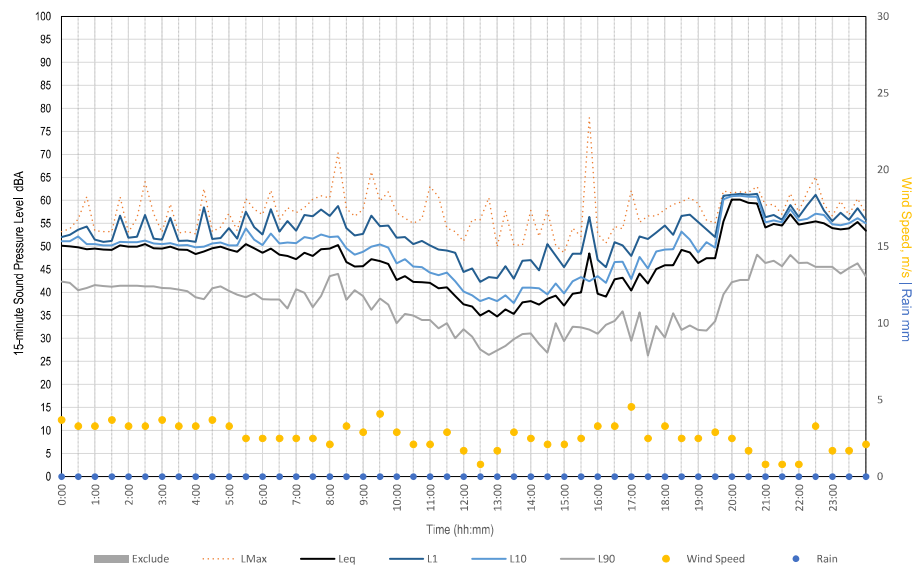
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Wednesday, 27 March 2024



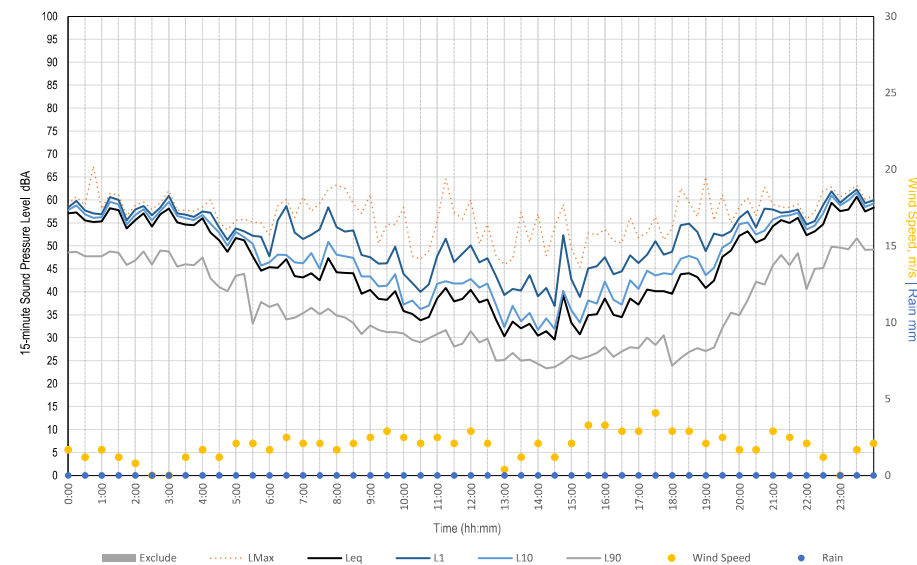
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Friday, 29 March 2024



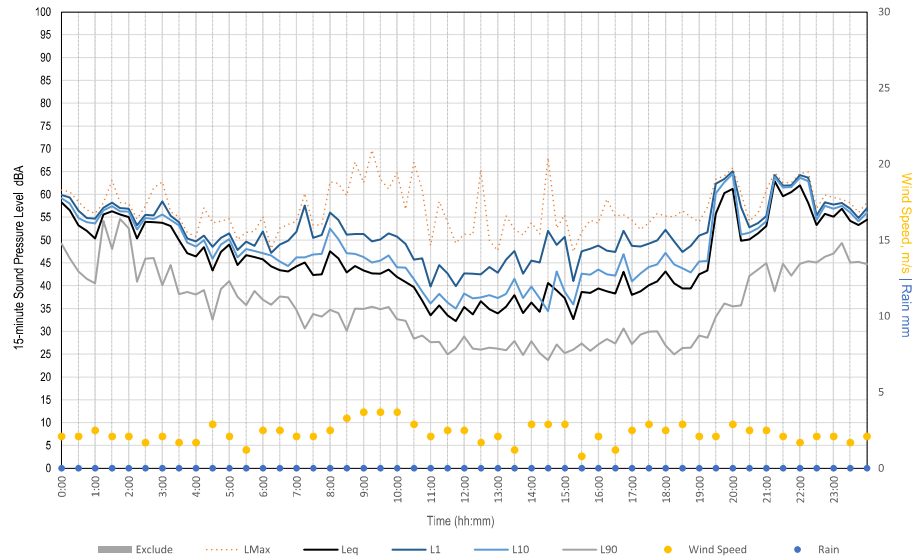
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Thursday, 28 March 2024



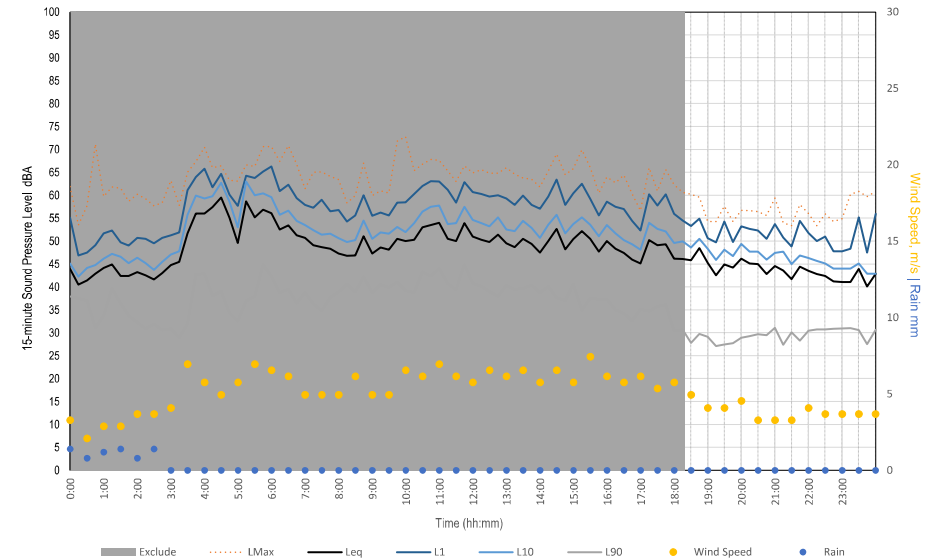
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Saturday, 30 March 2024



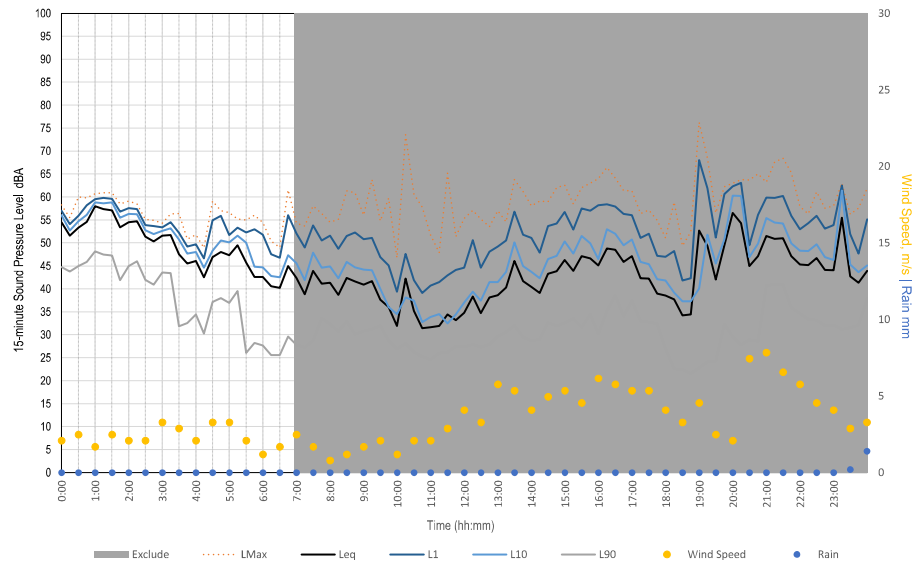
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Sunday, 31 March 2024



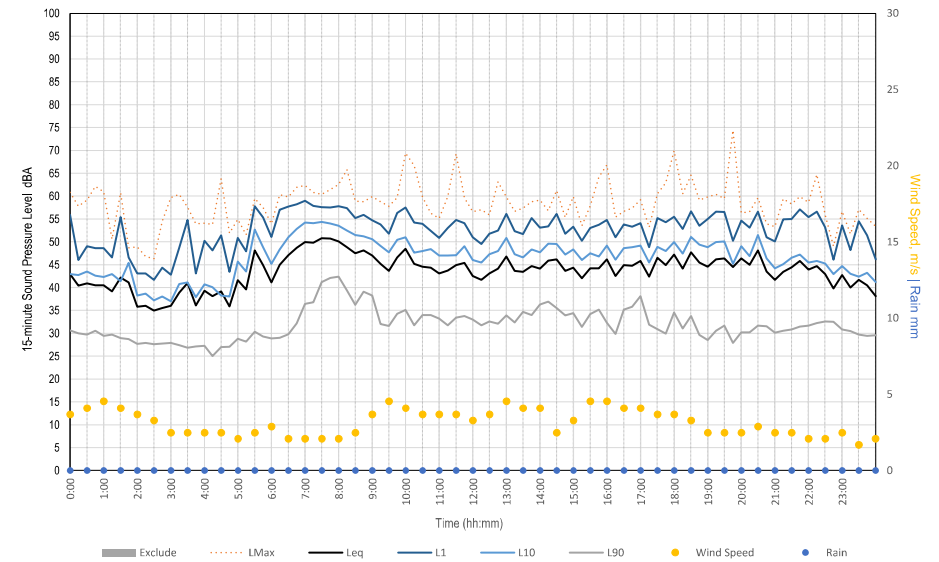
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Tuesday, 02 April 2024



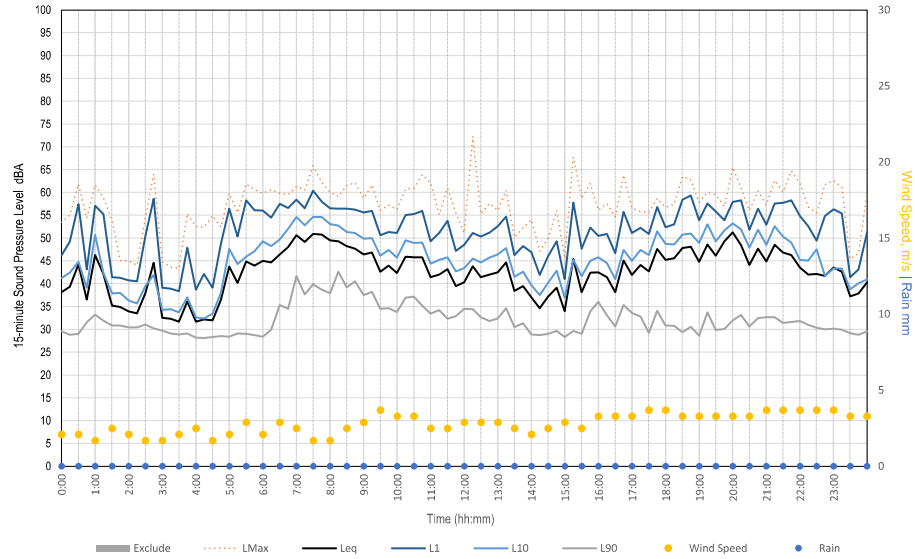
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Monday, 01 April 2024



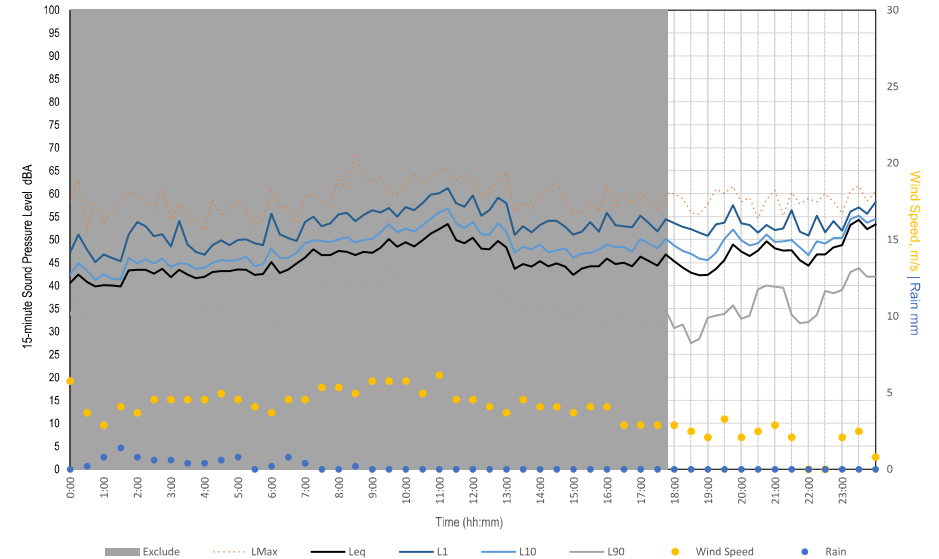
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Wednesday, 03 April 2024



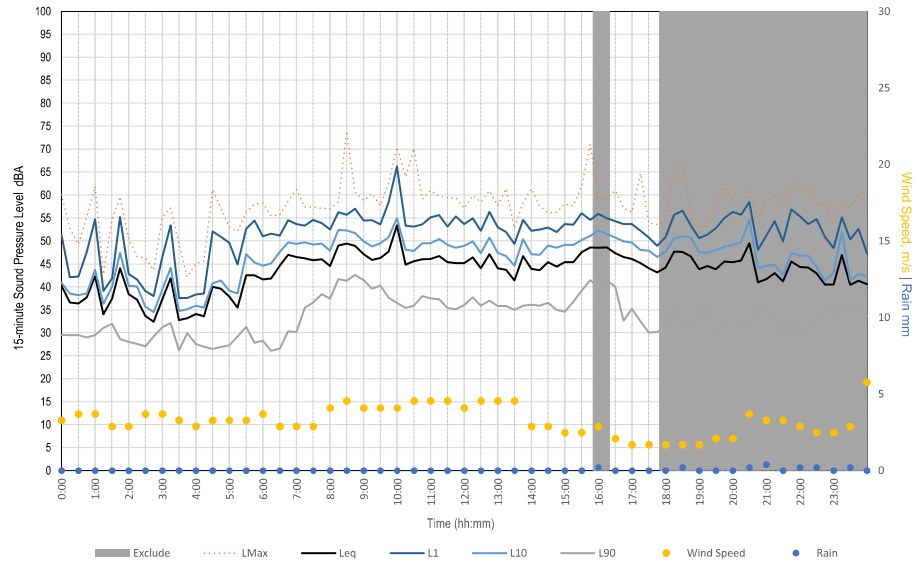
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Thursday, 04 April 2024



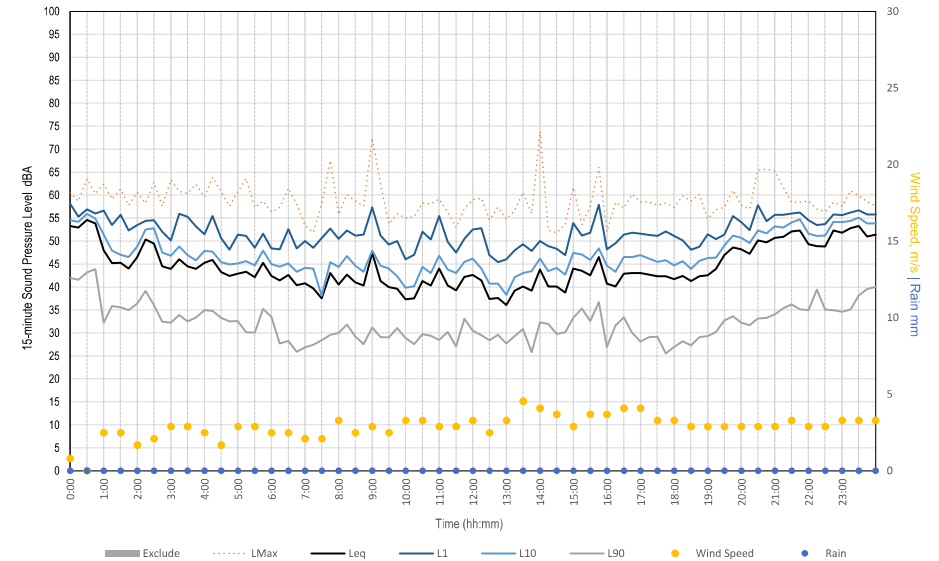
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Saturday, 06 April 2024



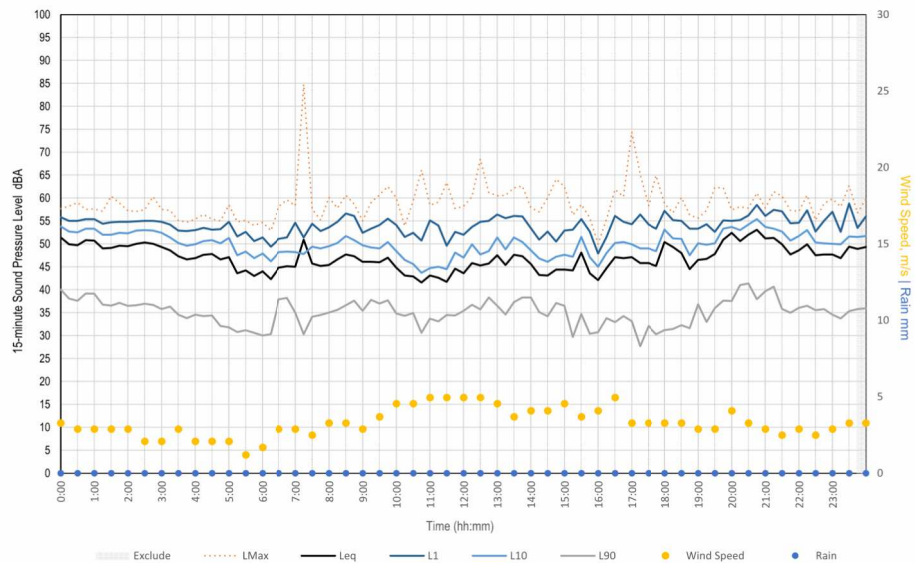
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Friday, 05 April 2024



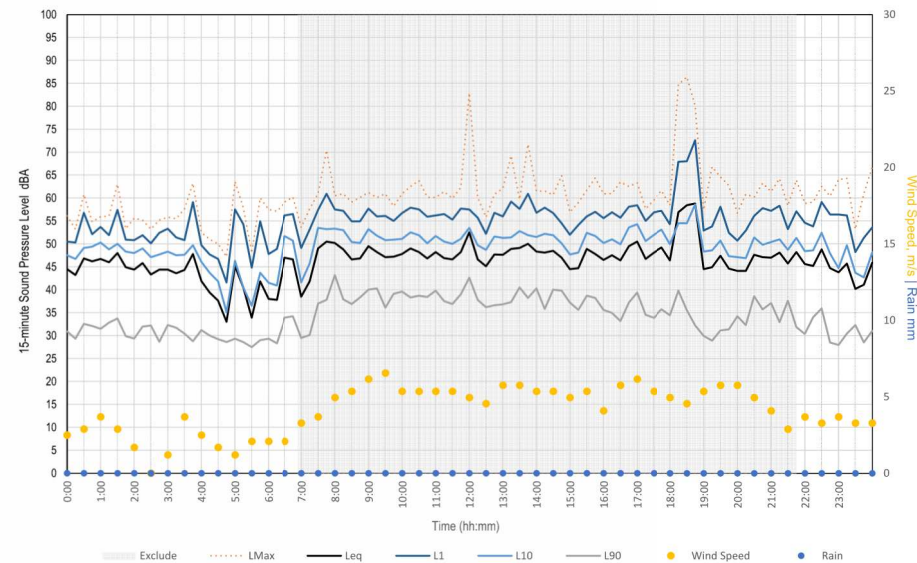
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Sunday, 07 April 2024



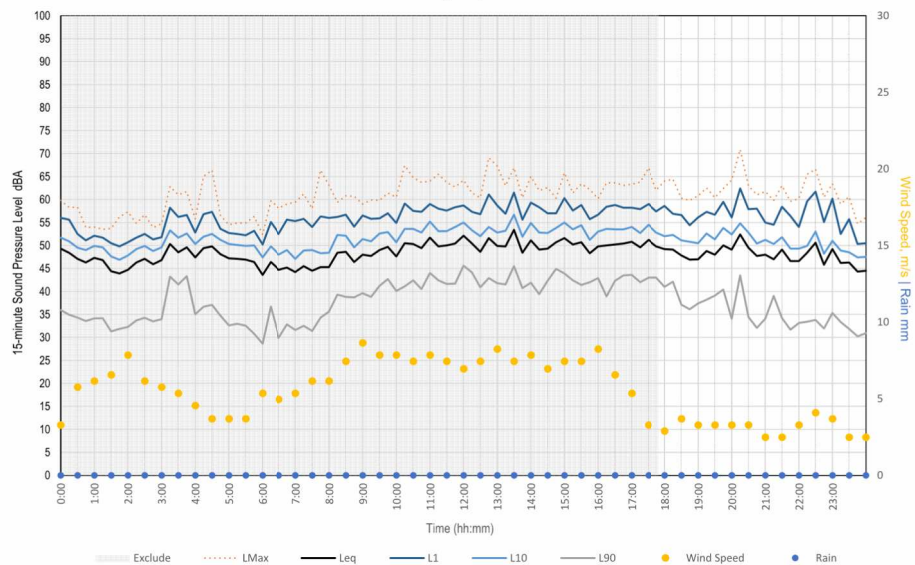
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Monday, 08 April 2024



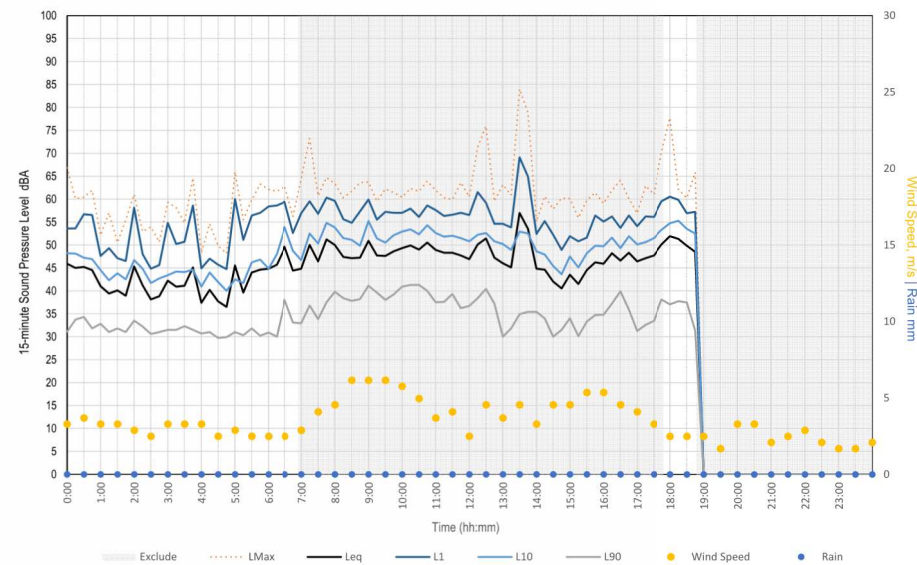
Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Wednesday, 10 April 2024



Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Tuesday, 09 April 2024



Measured Noise Levels - NCA 2: 21356 Riverina Hwy
Thursday, 11 April 2024



Appendix B

Corrections for annoying noise characteristics



Method for determining and applying correction factors for tonal and low-frequency noise characteristics are outlined in Table B.1, following the approach outlined in Fact Sheet C from NPfI.

Table B.1 NPfI – Corrections for annoying noise characteristics (Table C1)

Factor	Assessment / measurement	When to apply	Correction ⁽¹⁾	Comment
Tonal noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – Simplified method (ISO1996.2-2007 – Annex D).	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: — 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10 kHz. — 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz. — 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.	5 dB ⁽²⁾⁽³⁾	Third octave measurements should be undertaken using unweighted measurements.
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10–160 Hz.	Measure/ assess source contribution C- and A-weighted $L_{eq,T}$ levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and: — Where any of the one-third octave noise levels in the Table C2 are exceeding by up to and including 5 dB and cannot be mitigated, a 2-dB(A) positive adjustment to measured/ predicted A-weighted levels applied for the evening/ night period. — Where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applied for the evening/ night period and a 2-dB(A) positive adjustment applied for the daytime period.	2 or 5 dB ⁽²⁾	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.

- (1) Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.
- (2) Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.
- (3) Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

Appendix C

Construction staging and equipment



Construction staging and equipment used for the Project is outlined in Table Appendix C.1. Please note that this is based a conservative approach for the best possible information available at the time of the assessment but is not a finalised list and will be updated as the Project progresses.

Table Appendix C.1 Construction Works Staging and Equipment

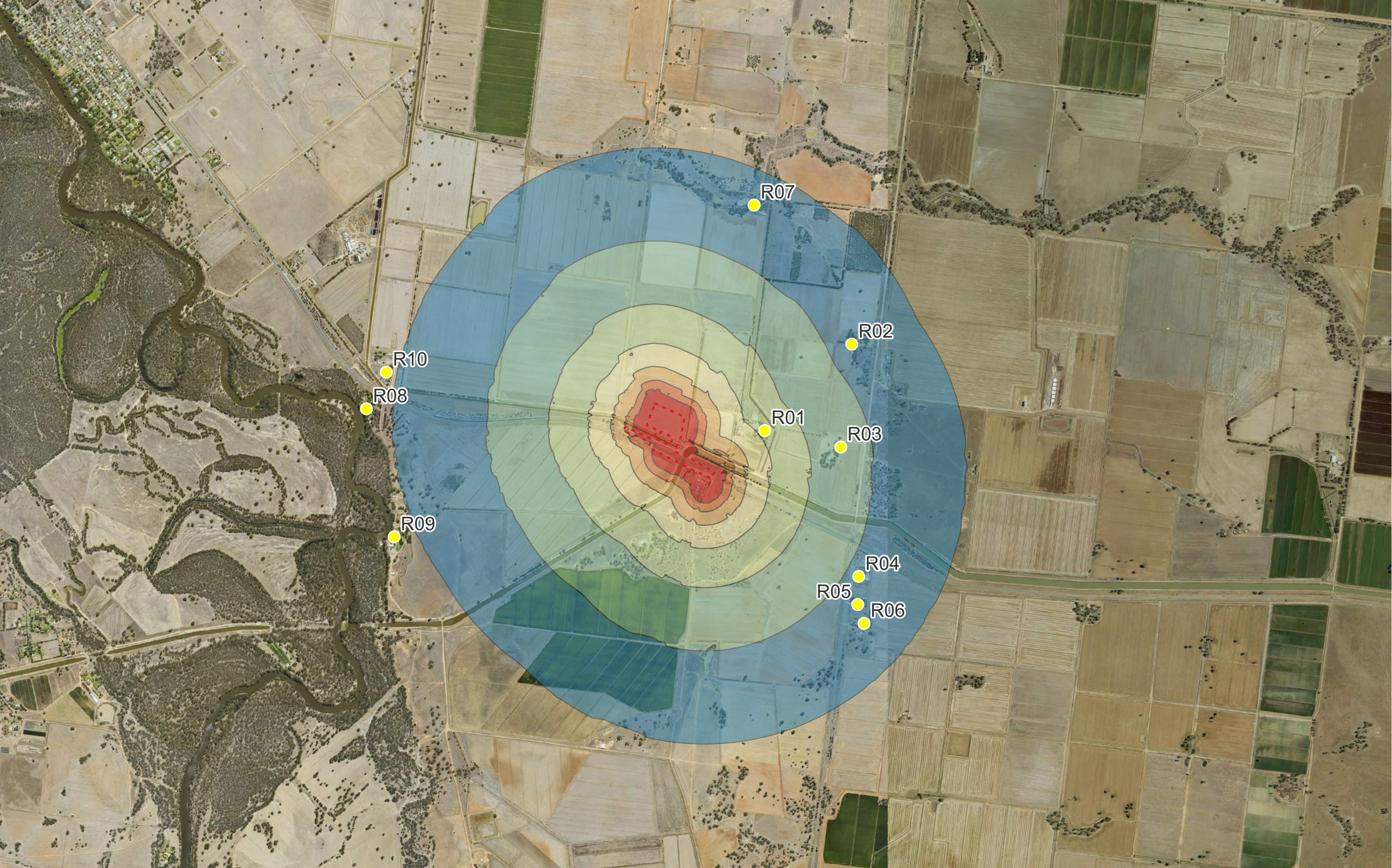
Work stage	Equipment	Number of items	Usage factor per 15 minutes	Base SWL DBA	L _{AMax} (Loudest Item)
Vegetation clearance	20T excavator	4	0.75	110	
	D10 Dozer	2	1	117	
	Generator	8	1	103	
	Hand tools	8	0.5	105	
	Skid Steer	2	1	104	
	Truck and trailer	8	0.25	108	
	Chainsaw	4	0.5	114	
	Mulcher	2	0.5	116	128
	TOTAL	124			128
Access and earthworks	30T excavator	4	0.75	110	
	Pad foot roller	2	1	109	
	Smooth drum roller	2	1	109	
	10kL water cart	2	1	107	
	D10 Dozer	4	1	117	126
	Grader	2	1	113	
	Hand tools	8	0.5	105	
	Scraper	3	1	110	
	Truck and trailer	4	0.25	108	
	30T articulated dump truck	12	0.25	110	
	Telehandler (4T)	1	0.25	98	
	TOTAL	126			126
Foundations and pads	30T excavator	2	0.75	110	
	20T franna crane	6	0.5	113	
	Concrete boom pump	2	0.25	109	
	Pad foot roller	2	1	109	
	Smooth drum roller	2	1	109	

Work stage	Equipment	Number of items	Usage factor per 15 minutes	Base SWL DBA	L _{AMax} (Loudest Item)
	10kL water cart	2	1	107	
	Concrete agitator	4	0.3	109	
	Concrete vibrator	2	1	113	
	Grader	2	1	113	121
	Hand tools	8	0.5	105	
	Bored piling rig	4	1	112	
	Skid Steer	1	1	104	
	Tipper	1	0.5	110	
	Truck and trailer	12	0.25	108	
	TOTAL	125			125
Equipment installation	Telehandler	2	1	113	
	20T franna crane	4	0.5	113	117
	60T mobile crane	2	1	113	
	EWP Boom lift (Cherry picker)	4	0.25	99	
	Generator	8	1	103	
	Hand tools	8	0.5	105	
	Tipper	1	0.5	110	
	TOTAL	122			122
Demobilisation and rehabilitation	20T excavator	2	0.75	110	
	Telehandler	1	1	113	
	20T franna crane	2	0.5	113	
	10kL water cart	2	1	107	
	D7 Dozer	1	1	115	121
	EWP Boom lift (Cherry picker)	2	0.25	99	
	Generator	1	1	103	
	Hand tools	1	0.5	105	
	Skid Steer	1	1	104	
	Truck and trailer	4	0.25	108	
	TOTAL	120			121

Appendix D

Construction – Noise contour lines
(Unmitigated)





Project No: PS210338	Author: LE
Date: 13/05/2025	Approved by: LE
To be read in conjunction with WSP document: PS210338-ACO-REP-1_Deniliquin NVIA	
Map Source: NSW SIX Maps	

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1:22,000 at A3

Legend

Receivers

Project Area

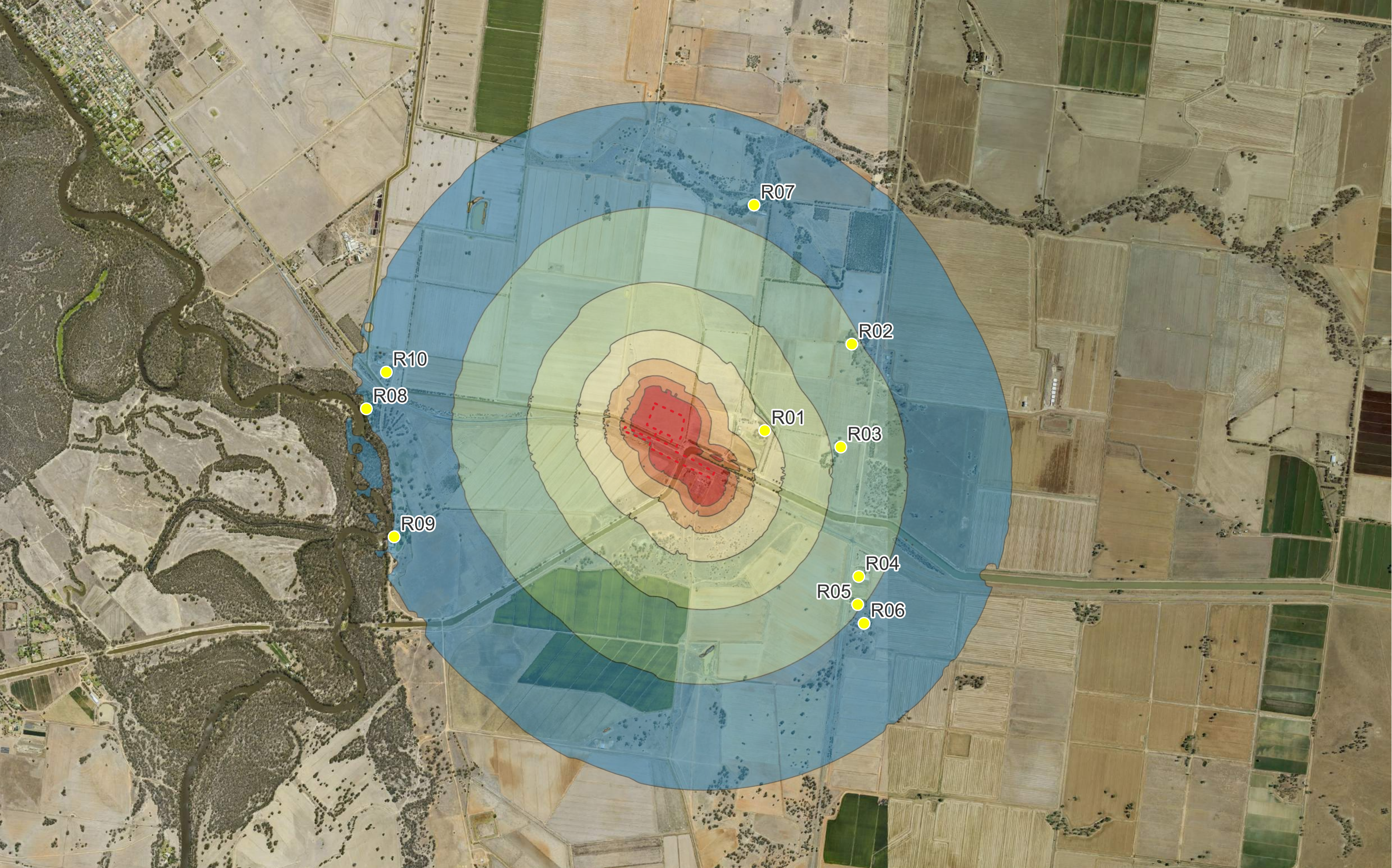
Predicted noise levels, Leq(15min) dBA

45 to 50	60 to 65
50 to 55	65 to 70
55 to 60	70 to 75
	>75

Deniliquin East BESS

Construction Noise Assessment
SC1: Vegetation clearance

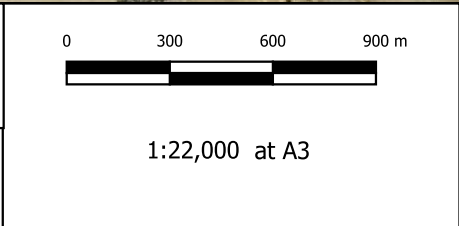
www.wsp.com



Project No: PS210338	Author: LE
Date: 13/05/2025	Approved by: LE
To be read in conjunction with WSP document: PS210338-ACO-REP-1_Deniliquin NVIA	
Map Source: NSW SIX Maps	

1:22,000 at A3

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Legend

- Receivers
- Project Area

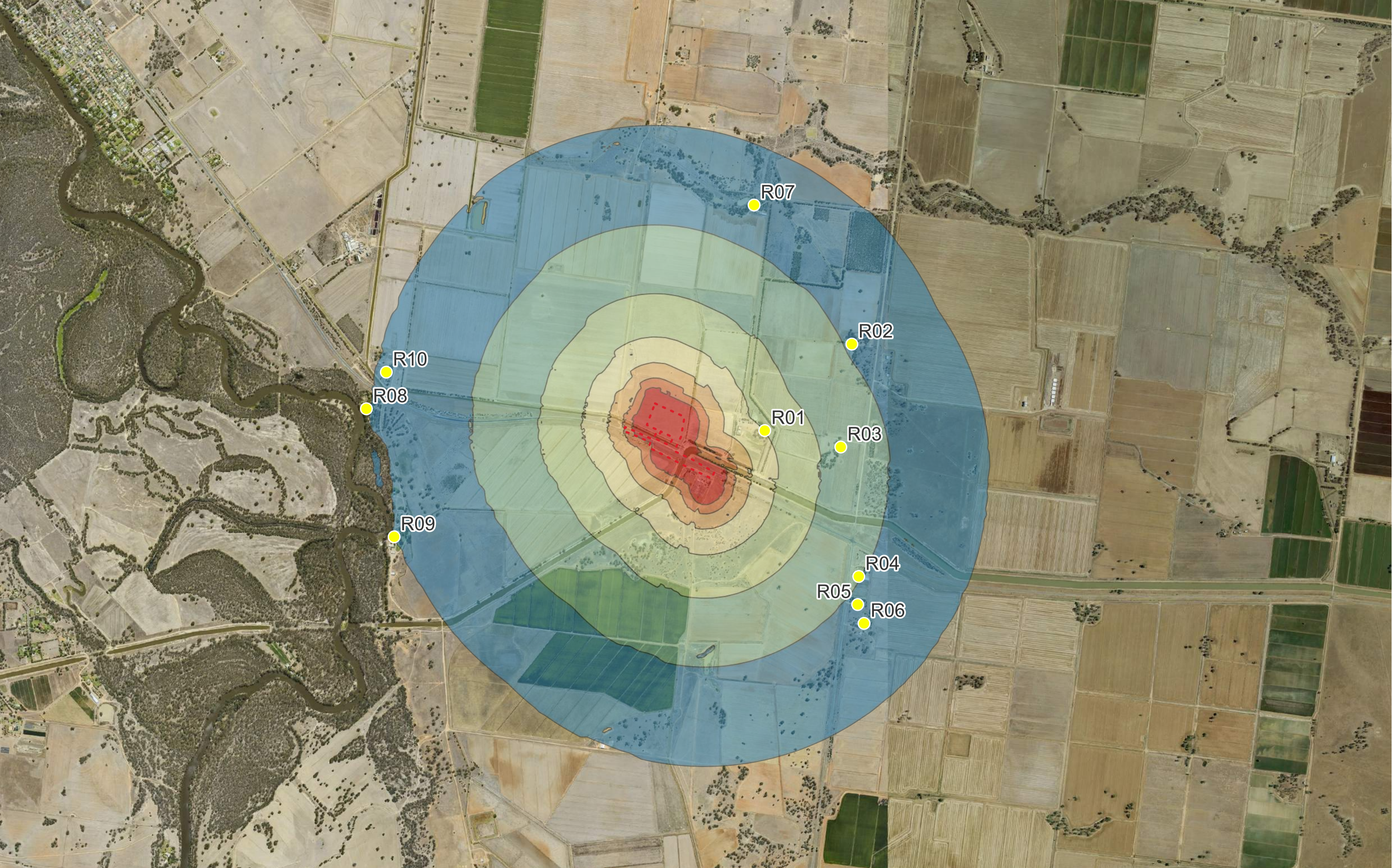
Predicted noise levels, Leq(15min) dBA

45 to 50	60 to 65
50 to 55	65 to 70
55 to 60	70 to 75
	>75

Deniliquin East BESS

Construction Noise Assessment
SC2: Access and earthworks

www.wsp.com



Project No: PS210338	Author: LE
Date: 13/05/2025	Approved by: LE
To be read in conjunction with WSP document: PS210338-ACO-REP-1_Deniliquin NVIA	
Map Source: NSW SIX Maps	

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Legend

Receivers

Project Area

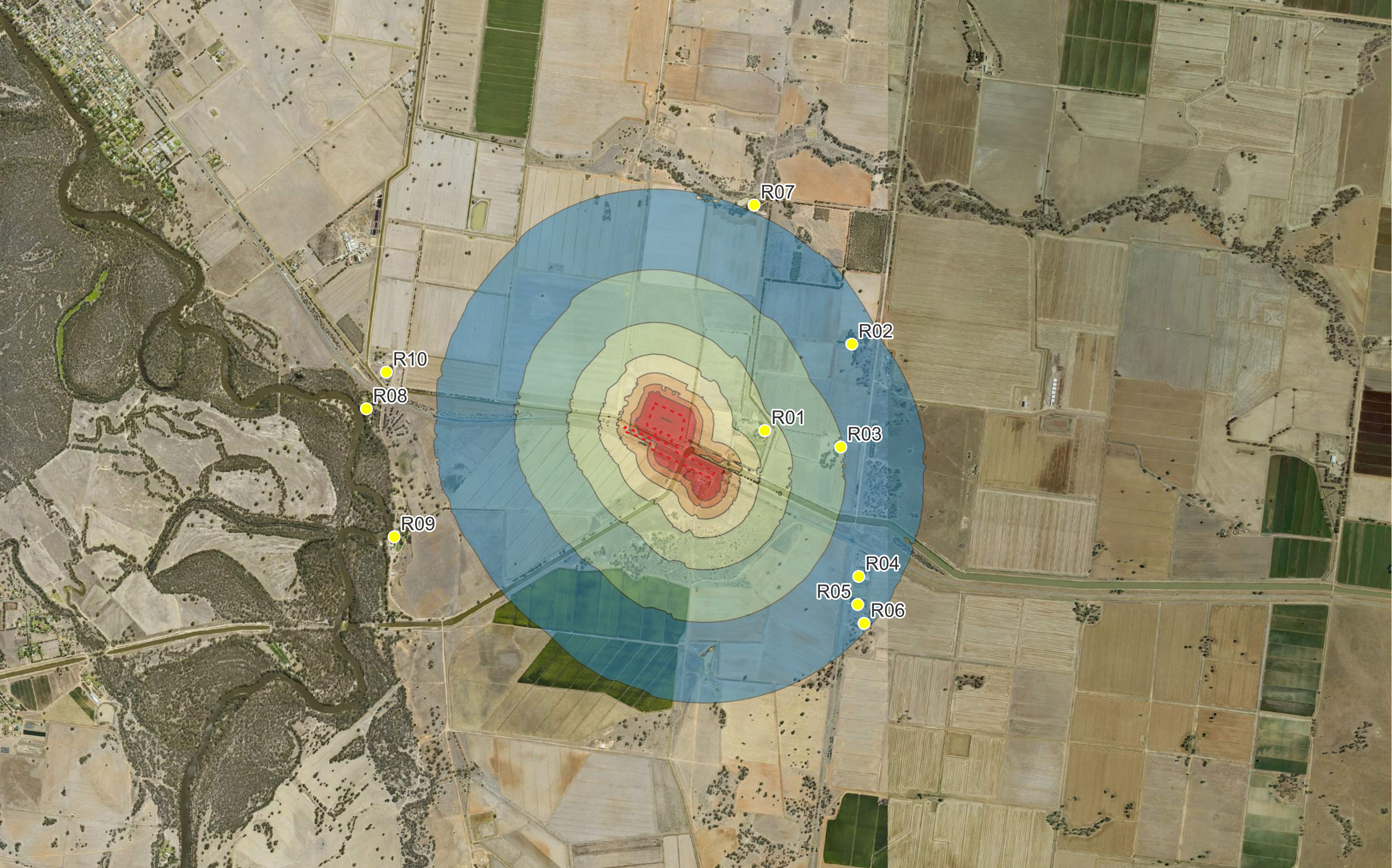
Predicted noise levels, Leq(15min) dBA

45 to 50	60 to 65
50 to 55	65 to 70
55 to 60	70 to 75
	>75

Deniliquin East BESS

Construction Noise Assessment
SC3: Foundations and pads

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Project No: PS210338	Author: LE	
Date: 13/05/2025	Approved by: LE	
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Legend

- Receivers
- Project Area

Predicted noise levels, Leq(15min) dBA

45 to 50	60 to 65
50 to 55	65 to 70
55 to 60	70 to 75
	>75

Deniliquin East BESS
Construction Noise Assessment
SC4: Equipment installation

www.wsp.com



Project No: PS210338	Author: LE
Date: 13/05/2025	Approved by: LE
To be read in conjunction with WSP document: PS210338-ACO-REP-1_Deniliquin NVIA	
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1:22,000 at A3

Legend

Receivers

Project Area

Predicted noise levels, Leq(15min) dBA

45 to 50	60 to 65
50 to 55	65 to 70
55 to 60	70 to 75
	>75

Deniliquin East BESS

Construction Noise Assessment
SC5: Demobilisation and rehabilitation

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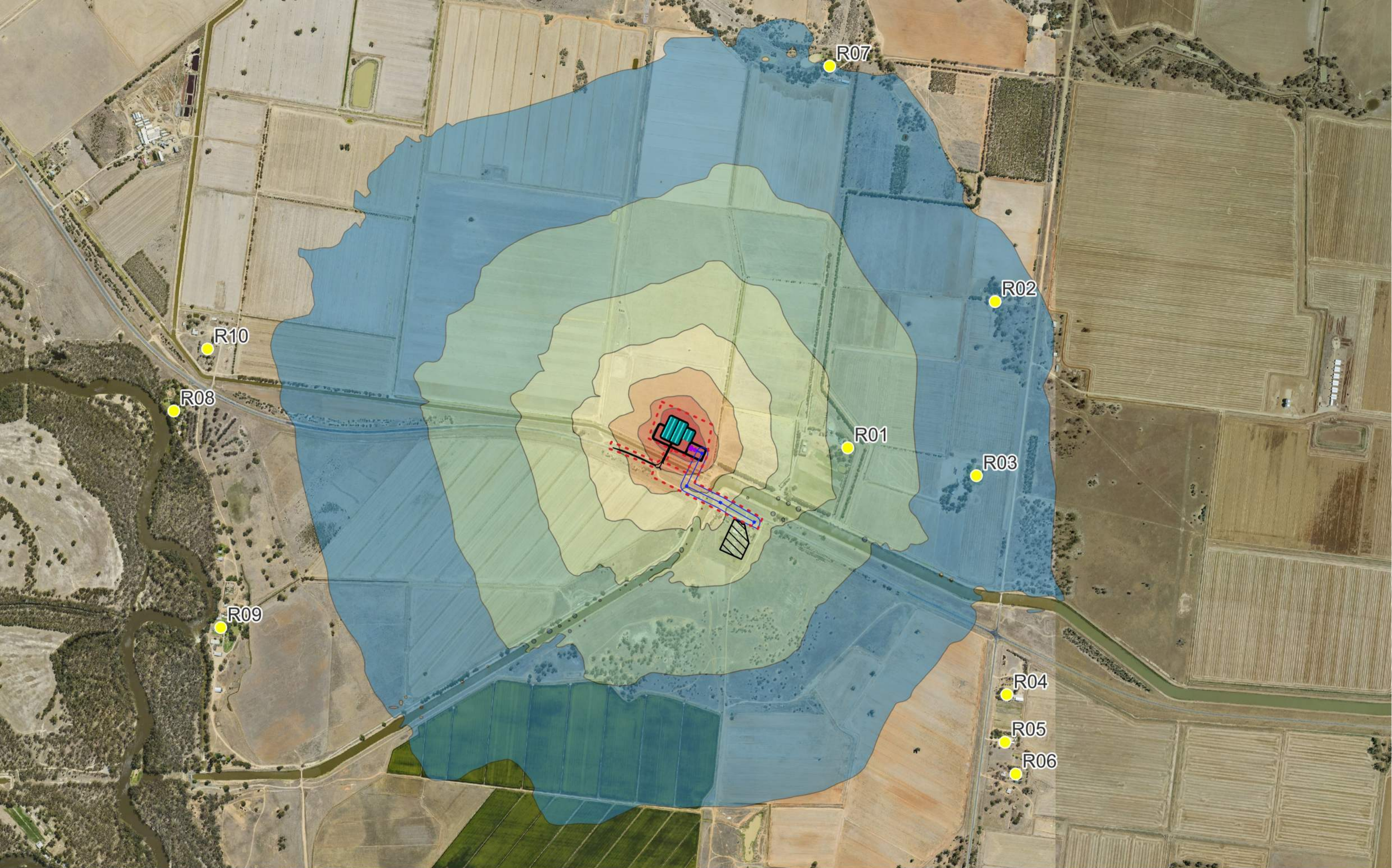
Appendix E

Operational – Noise contour lines



APPENDIX E-1

Unmitigated operational noise contours



Project No: PS210338	Author: LE			Legend Predicted noise levels, Leq(15min) dBA <table border="1"><tr><td>35 to 40</td><td>50 to 55</td><td>>65</td></tr><tr><td>40 to 45</td><td>55 to 60</td><td></td></tr><tr><td>45 to 50</td><td>60 to 65</td><td></td></tr></table>	35 to 40	50 to 55	>65	40 to 45	55 to 60		45 to 50	60 to 65		<table border="0"><tr><td> Receivers</td><td> HV transformer</td></tr><tr><td> Site Area</td><td> Transmission Line</td></tr><tr><td> BESS Battery</td><td> Internal Roads</td></tr><tr><td> BESS Inverter</td><td> Existing substation</td></tr></table>	Receivers	HV transformer	Site Area	Transmission Line	BESS Battery	Internal Roads	BESS Inverter	Existing substation	Deniliquin East BESS Operational Noise Assessment Unmitigated (upper range) with +5 dB tonal correction
35 to 40	50 to 55				>65																		
40 to 45	55 to 60																						
45 to 50	60 to 65																						
Receivers	HV transformer																						
Site Area	Transmission Line																						
BESS Battery	Internal Roads																						
BESS Inverter	Existing substation																						
Date: 13/05/2025	Approved by: LE	1:13,000 at A3																					

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Map Source: NSW SIX Maps

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APPENDIX E-2

Mitigated operational noise contours



Project No: PS210338	Author: LE			Legend Predicted noise levels, Leq(15min) dBA <table border="1"><tr><td>35 to 40</td><td>50 to 55</td><td>>65</td></tr><tr><td>40 to 45</td><td>55 to 60</td><td></td></tr><tr><td>45 to 50</td><td>60 to 65</td><td></td></tr></table>	35 to 40	50 to 55	>65	40 to 45	55 to 60		45 to 50	60 to 65		<table border="1"><tr><td>● Receivers</td><td>— HV transformer</td></tr><tr><td>- - Project Area</td><td>— Transmission Line</td></tr><tr><td>— BESS Battery</td><td>— Internal Roads</td></tr><tr><td>— BESS Inverter</td><td>▭ Existing substation</td></tr></table>	● Receivers	— HV transformer	- - Project Area	— Transmission Line	— BESS Battery	— Internal Roads	— BESS Inverter	▭ Existing substation	Deniliquin East BESS Operational Noise Assessment Mitigated (upper range)
35 to 40	50 to 55				>65																		
40 to 45	55 to 60																						
45 to 50	60 to 65																						
● Receivers	— HV transformer																						
- - Project Area	— Transmission Line																						
— BESS Battery	— Internal Roads																						
— BESS Inverter	▭ Existing substation																						
Date: 13/05/2025	Approved by: LE																						

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