



Noise & Vibration Impact Assessment

Wongalea BESS

Ekü Energy

Site 1, Level 34
360 Collins Street
Melbourne, VIC

Prepared by:

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SLR Project No.: 640.031705.00001

16 April 2025

Revision: 1.1

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.1	16 April 2025	Benjamin French	Gustaf Reutersward	Gustaf Reutersward
1.0	7 April 2025	Benjamin French	Gustaf Reutersward	Gustaf Reutersward
0.1	13 March 2025	Benjamin French	Gustaf Reutersward	Gustaf Reutersward

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Eku Energy (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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Executive Summary

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Eku Energy (Eku) to prepare a Noise and Vibration Impact Assessment (NVIA) for the Wongalea Battery Energy Storage System (BESS) development. The Wongalea BESS will involve the development, construction and operation of a BESS with a capacity of 300 MW / 1,200 MWh connecting to the Armidale Substation.

The predicted noise levels at the closest noise sensitive receivers (one being the project host) during the construction and operation of the BESS were assessed against the various requirements of the NSW Noise Policy for Industry (NPfI) and the Interim Construction Noise Guideline (ICNG).

The key project impacts in relation to noise is as follows:

- Noise from construction activities: All construction works will be completed during standard construction hours (Mon. to Fri. 7 am to 6 pm, Saturday 9 am to 1 pm, no work on Sunday or public holidays). The project host will be potentially Noise Affected at various times during the construction of the BESS. Other receivers are less likely to be Noise Affected. Community engagement and best practice noise management controls to minimise residual risk of harm to nearby receivers are to be applied to reduce noise impacts as far as reasonably practicable.
- Construction vibration is unlikely to be perceptible at the nearest receivers.
- Noise from operational activities: Compliance with the NPfI is demonstrated at all non-project involved receivers for each time period. Acoustic treatment of the host receiver will be investigated during detailed design to reduce residual noise impacts and protect the internal amenity of the dwelling.
- Cumulative noise emissions from the approved Eathorpe BESS and Armidale BESS developments and the existing Armidale Substation were also assessed. Cumulative noise impacts are not expected to exceed the most stringent recommended amenity criterion during the evening and night period.

All plant, equipment and design layout will be reviewed during the detailed design stage to ensure that compliance with the noise criteria is achieved as the acoustic performance of the plant and layout is refined.



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- A.2 Mitigation and Management Measures
- A.3 Monitoring
- A.4 Complaints Management
- A.5 Contingency Plan
- A.6 Internal Auditing and Improvement of Noise Management Plan

Appendix B Noise Contours



1.0 Introduction

Eku Energy (Eku) is proposing to develop a utility-scale Battery Energy Storage System (BESS) and substation at 475 Grafton Road, Armidale, NSW (the Project).

SLR Consulting Pty Ltd (SLR) has been engaged by Eku to undertake a Noise and Vibration Impact Assessment (NVIA) for the Wongalea BESS to support the Scoping Assessment / Request for SEARs.

2.0 Project Area

The site is located 5 km east of Armidale township and is surrounded by rural land, Armidale Substation and some isolated dwellings. The Project is located approximately 480 m north east of the Armidale Substation on Grafton Road. Two proposed BESS projects; Armidale BESS and Eathorpe BESS are planned for construction to the south of the site, adjacent to Armidale Substation.

The BESS is proposed on a portion of a 48 hectares lot (Lot 1/-/DP777437). The area is zoned Primary Production Small Lots (RU4). The BESS will link into via a 132 kV cable from the onsite substation.

The Project site is predominately cleared and farmed land with few trees scattered across the site. The Site of Abattoir 'Wongalea' and a dwelling occupied by farm workers are located within the Project site, approximately 300m from the BESS footprint. This dwelling is identified as the project host receiver, R1 in **Table 1** and **Figure 1**.

2.1 Noise Sensitive Receivers

The sensitive receivers, which comprise existing land uses that may be impacted by the Project, within a 2 km radius of the Project site, are identified in **Figure 1**. A total of 133 sensitive receivers have been identified.

A subset of six of the closest receivers in all directions around the Project were selected for assessment (shown in red in **Figure 1**). Compliance at these closest receivers will result in compliance at all other receivers.

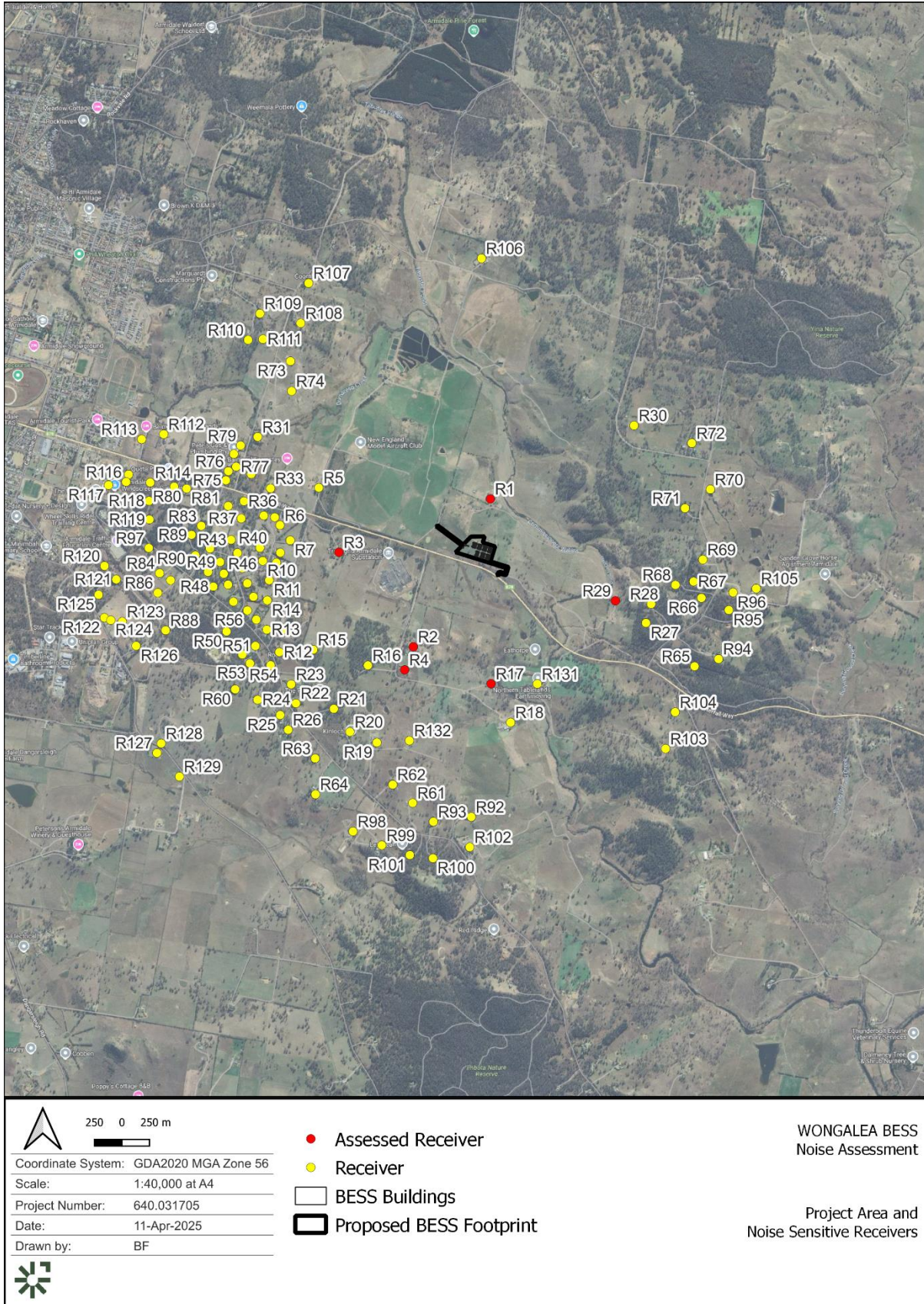
Table 1 shows the six assessed receivers and the distance to the boundary of the BESS.

Table 1 Identified Receivers within 2 km of the Project Site

Receptor ID	Address	Distance to BESS Boundary, m
R1 ¹	475 Grafton Rd, Armidale	300
R2	89 Eathorpe Rd, Armidale	930
R3	402 Grafton Rd, Armidale	1,060
R4	108 Eathorpe Rd, Armidale	1,160
R17	Eathorpe Rd, Armidale	1,100
R29	653 Grafton Rd, Armidale	1,190
Note 1: Host Receiver		



Figure 1 Sensitive Receivers within 2 km



3.0 Project Noise Criteria

3.1 Construction Noise Criteria

3.1.1 Interim Construction Noise Guideline

The NSW *Interim Construction Noise Guideline* (ICNG) is used to assess and manage impacts from construction noise on residences and other sensitive land uses in NSW.

The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area. The 'worst-case' noise levels from construction of a proposal are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impact of the proposal.

The NMLs are not mandatory limits, however, where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are to be investigated.

Residential Receivers

The ICNG approach for determining NMLs at residential receivers is shown in **Table 2**.

Table 2 ICNG NMLs for Residential Receivers

Time of Day	NML L _{Aeq} (15minute)	How to Apply
Standard Construction Hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	Noise affected RBL ¹ + 10 dB	<ul style="list-style-type: none"> The noise affected level represents the point above which there may be some community reaction to noise Where the predicted or measured L_{Aeq}(15minute) 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	<ul style="list-style-type: none"> The Highly Noise Affected (HNA) 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 restructuring the hours that the very noisy activities can occur, taking into account: <ul style="list-style-type: none"> 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.
Outside Standard Construction Hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> 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 practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.
Note 1:	The RBL is the Rating Background Level and the ICNG refers to the calculation procedures in the NSW Industrial Noise Policy (INP). The INP has been superseded by the NSW EPA <i>Noise Policy for Industry</i> (NPfI).	



Construction Noise Management Levels

The construction NMLs are summarised in **Table 3**. Out of hours NMLs would be applicable to works undertaken outside the ICNG standard construction hours. No works are expected to be undertaken out of hours.

Table 3 Construction Noise Management Levels

Time of Day	Minimum RBL ¹	NML (L _{eq, 15 min}) dBA		Sleep Disturbance Screening Level ² (L _{Max})
		Standard Construction Hours (RBL+10dB)	Out of Hours (RBL+5dB)	
Day	35	45	40	-
Evening	30	40	35	-
Night	30	40	35	52
Note 1: RBL = Rating Background Level.				
Note 2: Sleep disturbance screening level is RBL+15 or 52 dBA, whichever is higher.				

3.2 Construction Vibration Criteria

The effects of vibration in buildings can be divided into three main categories (in increasing levels of vibration exposure);

1. Annoyance or disturbance of occupants
2. Disturbance of objects within the structure and cosmetic damage
3. Structural damage

Vibration limits are commonly designed to minimise the risk of cosmetic damage and are set well below the levels that have potential to cause structural damage. The British Standard BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2*, provides frequency-dependent vibration limits related to cosmetic damage risk.

The German Standard DIN 4150-3: 1999 *Structural Vibration Part 3: Effects of vibration in structures* provides guideline values for evaluating the effect of vibration on sensitive structures, such as buried pipework.

The EPA publication *Assessing Vibration: a technical guide (DEC 2006)* provides preferred values for continuous and impulsive vibration levels associated with a low probability of annoyance from occupants. The applicable damage risk and annoyance risk vibration velocity criteria are summarised in **Table 4**.



Table 4: Vibration Velocity Damage Risk and Annoyance Risk Criteria (mm/s Peak)

Receiver Area	Damage Risk (mm/s)		Annoyance Risk (mm/s)	
	Horizontal	Vertical	Horizontal	Vertical
Residential/Dwellings	7.5	7.5	1.2	0.45
Commercial/Offices	25	25	1.6	0.6
Industrial/Workshops			3.2	1.2
Reinforced structures (ie concrete buildings)			-	-

3.3 Operational Noise Criteria

The NSW EPA Noise Policy for Industry, 2017 (NPfI) defines a process framework for determining of project noise trigger levels that are used to assess potential impacts of industry noise.

3.3.1 Project Intrusiveness and Project Amenity Noise Levels

The NPfI specifies how to determine ‘trigger levels’ for noise emissions from industrial developments. Where a development is likely to exceed the trigger levels at existing noise sensitive receivers, feasible and reasonable noise management measures are required to be considered to reduce the impacts.

There are two types of trigger levels – one to account for ‘intrusive’ noise impacts and one to protect the ‘amenity’ of particular land uses:

- The **intrusiveness** of an industrial noise source is generally considered acceptable if the L_{Aeq} noise level of the source, measured over a period of 15-minutes, does not exceed the representative background noise level by more than 5 dB. Intrusive noise levels are only applied to residential receivers. For other receiver types, only the amenity levels apply.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended **amenity** levels specified in the NPfI for that particular land use.

For this assessment, the area surrounding the proposal is considered to be ‘Rural’ as per the NPfI definitions.

3.3.2 Project Noise Trigger Levels

The project trigger level is the lower of the intrusiveness noise level and project amenity noise level. The intrusiveness noise level protects against significant changes in noise levels, and the project amenity noise level protects against cumulative noise impacts from industry. Generally, the intrusiveness noise level is more stringent in areas with little industry (i.e. where background noise levels are low).

The intrusiveness noise level is defined as the rating background level (RBL) + 5 dB. The minimum RBL for night-time is deemed to be 30 dBA, therefore the minimum project intrusiveness noise limit is 35 dBA $L_{Aeq(15\text{ minute})}$. Where the existing night-time RBL noise level is higher, a higher project intrusiveness noise limit would apply.

The recommended amenity noise levels, minimum RBLs and intrusiveness noise levels for all time periods are shown in **Table 5**. For each time period, the lowest of the intrusiveness and amenity noise levels applies.



Time period definitions are shown in **Table 6**.

Table 5 Minimum Amenity Noise Levels (Residential Receivers), RBLs and Intrusiveness Noise Levels

Time of Day	Recommended Amenity Noise Level, dBA	Minimum Rating Background Level (RBL)	Minimum Project Intrusiveness Noise Level ($L_{eq, 15 \text{ min}}$, dBA)
Day	50	35	40
Evening	45	30	35
Night	40	30	35

Table 6 Time Period Definitions

Time of Day	Definition
Day	Monday to Saturday: 7 am to 6 pm Sunday and Public Holiday: 8 am to 6 pm
Evening	All days: 6 pm to 10 pm
Night	Monday to Saturday: 10 pm to 7 am Sunday and Public Holidays: 10 pm to 8 am

The project trigger level is the minimum project intrusiveness noise level:

- Day period: 40 dBA, LA_{eq} , 15 min
- Evening: 35 dBA, LA_{eq} , 15 min+
- Night: 35 dBA, LA_{eq} , 15 min

3.3.3 Corrections for Annoying Noise Characteristics

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, intermittency or dominant low-frequency content. The NPfI specifies the following modifying factor corrections, shown in **Table 7**, which are to be applied where annoying characteristics are present. **Table 8** shows the low frequency noise thresholds which indicate the possibility of problematic low frequency noise.

Details of the modifying factor corrections applied in the assessment are provided in **Section 4.4.3**.

Table 7 NPfI Modifying Factors

Factor	Assessment/ Measurement	When to Apply	Correction ¹
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by the levels defined in the NPfI.	5 dB ²
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements	Measure/assess source contribution C and A weighted Leq,t levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and the level to which the thresholds defined in Table 8 are exceeded.	2 or 5 dB ²



Factor	Assessment/ Measurement	When to Apply	Correction ¹
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level	The source noise heard at the receiver varies by more than 5 dB and the intermittent nature of the noise is clearly audible. The NPfI further defines intermittent noise as noise where the level suddenly drops/increases several times during the assessment period, with a noticeable change in source noise level of at least 5 dB, for example, equipment cycling on and off. The intermittency correction is not intended to be applied to changes in noise level due to meteorology.	5 dB ³
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated.	Maximum correction of 10 dB ² (excluding duration correction)
<p>Note 1: Corrections to be added to the measured or predicted levels.</p> <p>Note 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.</p> <p>Note 3: Adjustment to be applied to night-time only.</p>			

Table 8 Low Frequency Noise Thresholds

Hz/dBZ	One-third Octave L _{Zeq, 15 min} Threshold Level												
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dBZ	92	89	86	77	69	61	54	50	50	48	48	46	44

3.3.4 Residual Impacts

The NPfI defines residual noise impacts as exceedances of the Project Noise Trigger Levels which remain after all feasible and reasonable source and pathway mitigation measures have been considered.

The significance of residual noise impacts, as defined in the NPfI, is shown in **Table 9**. Examples of receiver-based treatments that can be used to mitigate residual impacts are shown in **Table 10**.



Table 9 NPfl Significance of Residual Noise Impacts

If the Predicted Noise Level minus the Project Noise Trigger Level is:	And the Total Cumulative Industrial Noise Levels is:	Then the Significance of the Residual Noise Level is:
≤ 2 dBA	Not applicable	Negligible
≥ 3 but ≤ 5 dBA	< recommended amenity noise level or > recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from the development is less than or equal to 1dB	Marginal
≥ 3 but ≤ 5 dBA	> recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is more than 1 dB	Moderate
> 5 dBA	≤ recommended amenity noise level	Moderate
	> recommended amenity noise level	Significant

Table 10 NPfl Examples of Receiver-based Treatments to Mitigate Residual Noise Impacts

Significance of Residual Noise Impact	Example of Potential Treatment
Negligible	The exceedances would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls.
Marginal	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
Moderate	As for 'marginal', but also upgraded facade elements, such as windows, doors or roof insulation, to further increase the ability of the building facade to reduce noise levels.
Significant	May include suitable commercial agreements where considered feasible and reasonable.



4.0 Noise and Vibration Assessment

4.1 Assessment Methodology

A 3D noise model was constructed within the modelling software SoundPLAN 8.2 to predict noise levels at the nearby sensitive receivers.

Noise modelling was conducted using the algorithms of ISO 9613-2¹, which predicts the A-weighted sound pressure levels under meteorological conditions favourable to propagation from sources of known sound power levels. This enhanced propagation is equivalent to downwind propagation or a moderate ground-based temperature inversion. The model also includes attenuation due to air absorption, ground attenuation and shielding.

4.2 General Modelling Assumptions

The following general assumptions are made based on best-practice modelling methods to suit the project:

- A reflection-order of three (3).
- Source height were set according to the source item.
- Receivers are in the acoustic free field, 1.5 m above ground level.
- All equipment is assumed to be in operation for the entire 30 minute assessment period.
- Ground topography around the Wongalea BESS site was sourced from NSW Spatial Services (2 metre digital elevation data).
- The BESS footprint was modelled as two hardstands, the BESS was modelled on a level hardstand with an RL of 980 m. The substation was modelled on a level stand with an RL of 974 m. Earthworks will be further developed when the BESS layout is refined.
- Ground absorption is modelled by a single number parameter between 0 (hard – reflective) and 1 (soft – absorptive). The substation and BESS infrastructure was modelled as hard ground, all other ground surfaces were modelled with a ground absorption parameter of 0.6, which is suitable for rural farmland.

4.3 Scenarios

4.3.1 Site Construction

The following standard construction hours are proposed for the Project:

- Monday to Friday - 7 am to 6 pm.
- Saturday – 8 am to 1 pm.
- Sunday and Public Holidays - No works to be undertaken.

¹ ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*



No works are proposed to be undertaken outside of the standard construction hours. In the event they are required, out of hours (OOH) approval would be sought, and all works would be undertaken in accordance with the appropriate OOH protocols and approval processes.

Site establishment and the initial construction of roads are thought to be the most impactful stages with regards to noise. Subsequent construction stages would likely include flatbed trucks, franna cranes, forklifts, concrete trucks/pumps, elevated work platforms and hand tools. Their total noise emission however is not expected to be greater than what is proposed as part of the initial site establishment stage, and therefore the site establishment and initial road construction stage was considered worst case for the construction of the site and hence why it has been modelled.

Sound power levels of typical mobile construction plant and equipment, taken from SLR's noise database of filed measurements and BS 5228-1:2009² are summarised in **Table 11**. For a worst-case assessment it was assumed that all equipment is operating continuously over the assessment period, due to sequencing of equipment usage that often occurs on site, this represents a conservative approach.

Table 11 Construction Noise Sources

Qty	Plant Item	Individual SWL, L _{eq} dBA
2	Excavator CAT 330 – 30T	109
1	Dozer CAT D8	113
2	Grader	109
2	Dump Truck	109
1	Vibratory Roller	112
1	Water Cart	109

4.3.2 BESS Operations

All equipment items are assumed to be in operation for the entirety of a 30-minute assessment period. Noise emissions of the BESS equipment is typically dominated by cooling noise sources, which can be variable depending on the percentage of maximum power (charge/discharge) and the subsequent temperatures, both ambient and that being generated by the equipment.

The Tesla Megapack 2 XL is currently considered the OEM (original equipment manufacturer) of choice and is modelled in this assessment. The Megapack contains an integrated inverter, and has cooling units dedicated to cooling the battery and power electronics (i.e. inverter) components. The Megapack operates five fans in the four hour configuration, two fans cool the battery and three fans cool the power electronics. The two cooling systems are independent and may operate at different loads.

The following three scenarios were developed based on thermodynamic modelling undertaken by the OEM of the BESS operating in conditions similar to the site climate and expecting charging/discharging times.

Scenario 1: 100% battery fan duty / 50% power electronics fan duty – Day period

This is considered a typical day-time scenario for Megapacks operating in similar or warmer climates compared with the Project location during the charging cycle. Thermal modelling by

² Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise



the OEM shows the battery fans generally operating at 100% for the duration of the assessment, while the power electronics fans ramp up as required. The power electronics fans are observed to not operate at greater loads than 30%.

Predicted noise levels at the receptors are assessed against the day criterion of 40 dBA.

Scenario 2: 70% battery fan duty / 20% power electronics fan duty – Evening period

Similarly to Scenario 1, thermal modelling by the OEM shows that the Megapack typically operates at less than 70% battery fan duty and 20% power electronics fan duty during the evening period.

Predicted noise levels at the receptor are assessed against the evening criterion of 35 dBA.

Scenario 3: 40% battery fan duty / 20% power electronics fan duty – Night period

Based on thermal modelling from the OEM, it is apparent that a 40% fan duty cycle can be achieved during night-time hours even for days with a peak ambient temperature of 35°C in the afternoon and when the asset discharges in the early morning, prior to 7am.

Predicted noise levels at the receptor are assessed against the night criterion of 35 dBA.

Table 9 summarises the sound power level of equipment in the operational scenarios.

Table 12 Equipment and Sound Power Levels

Qty	Item	Sound Power Level (SWL), per unit L _{eq} 15 min, dBA
324	Megapack 2 XL	89 (Scenario 1: day) 86 (Scenario 2: evening) 79 (Scenario 3: night)
82	Medium Voltage Transformers	60 ¹
1	High Voltage Transformer	93 ²
Notes:		
1: The medium voltage transformers (MVT) are at least 10 dB quieter than the battery units, and there are more battery sources as MVTs, therefore the source contribution of the MVT to noise levels at the closest sensitive receiver are negligible.		
2: Based on AS 60076.10:2009 reduced maximum (3 MVA rating).		



4.4 Assessment Results

4.4.1 Construction Noise Assessment

Table 13 presents the construction noise results for the earthworks scenario. These works will occur during the day period, therefore predicted noise levels have been assessed against the standard construction hours Noise Management Levels.

The project involved receiver, R1, is predicted to be Noise Affected at some points during construction. However, it should be noted that the results represent the worst-case noise levels where all equipment in each scenario is working concurrently. Accordingly for most construction activities, it is expected that the construction noise levels would frequently be lower than predicted.

Given the potential for construction noise to exceed the Noise Management Level, a draft Construction Noise Management Plan is discussed in **Appendix A**.

Table 13 Construction Noise Assessment Results

Receptor	Predicted Noise Level, dBA	Noise Affected NML (RBL+10)	Margin of Compliance
R1 ¹	51	45	-6
R2	45	45	0
R3	43	45	2
R4	42	45	3
R17	43	45	2
R29	42	45	3

Note 1: R1 is Project involved

4.4.2 Qualitative Construction Vibration Assessment

Minimum working distances for typical vibration intensive construction equipment are provided in the NSW Roads and maritime *Construction Noise and Vibration Guideline (CNVG)* and shown in **Table 14**.

The minimum working distances are for cosmetic damage (from BS 7385) and human comfort (from the EPA *Assessing Vibration: A Technical Guide*). Works that occur further from receivers the minimum distances are unlikely to result in vibration impacts.

Table 14 CVNG Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Rating/Description	Minimum Working Distance	
		Cosmetic Damage	Human Comfort
Vibratory Roller	1-2 tonne	5 m	15 m to 20 m
	2-4 tonne	6 m	20 m
	4-6 tonne	12 m	40 m
	7-13 tonne	15 m	100 m
	13-18 tonne	20 m	100 m
	>18 tonne	25 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	7 m



Plant Item	Rating/Description	Minimum Working Distance	
		Cosmetic Damage	Human Comfort
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	73 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	2 m

Note: More stringent conditions may apply to heritage or other sensitive structures

Based on the equipment and activities identified for the proposed construction, potential sources of vibration are limited and would likely only occur during site preparation, bulk earthworks and road works. Given the large distance offsets to receivers (the closest receiver R1 is 400m from the Project boundary, the next closest are of the order of 900m to 1km), vibration is unlikely to be perceptible and impacts unlikely to occur.

It is therefore expected that vibration generated by the construction works will comply with the requirements of the human comfort and cosmetic damage criteria.

4.4.3 Operational Noise Assessment

The predicted noise levels at the identified sensitive receivers for the three operational scenarios are shown in **Table 15** to **Table 17** and assessed against the relevant noise criterion; 40 dBA for day time and 35 dBA for evening and night time.

Section 3.3.3 describes the corrections for annoying noise characteristics that may be applied if the noise character at the receiver is tonal, intermittent or contains excessive low frequency energy.

Tonality

The OEM data of the BESS units show minor tonality at 400 Hz for 100% battery cooling loads and the tone is observed to shift down in frequency to 250 Hz at lower duty cycles.

However analysis of the predicted noise spectra at the assessment locations did not show tonality as defined by the NPfI. Therefore no tonality corrections were included.

Low Frequency

Low frequency noise contains significant acoustic energy in one-third octave bands ranging from 10 Hz to 160 Hz. The OEM supplier provided noise spectra for their units between 100 Hz to 10 kHz.

Although the OEM data is incomplete in the low frequencies, the difference between the A-weighted and C-weighted spectra ranged from 4 to 5 dB. A difference less than 15 dB indicates that the risk of problematic low frequency noise is low. Furthermore the low frequency noise thresholds (see **Table 8**) were not exceeded.

Therefore no low frequency noise adjustments were included.

Intermittency

Intermittency is present when the noise increases in level rapidly, and by at least 5 dB, on at least two occasions during the assessment period.

The cooling fans are expected to cycle up and down as required to cool the batteries and power electronics. However the duty cycle period exceeds the 15 minute assessment period and is therefore not considered intermittent.

No intermittency adjustments have been applied to the following results.



Table 15 Operational Noise Assessment Results Scenario 1: Day

Receptor	Predicted Noise Level, dBA	Noise Characteristic Adjustment	Adjusted Noise Level	Day Criterion, dBA	Margin of Compliance
R1 ¹	45	-	45	40	-5
R2	39	-	39	40	1
R3	36	-	36	40	4
R4	35	-	35	40	5
R17	36	-	36	40	4
R29	36	-	36	40	4

Note 1: R1 is Project involved

Table 16 Operational Noise Assessment Results Scenario 2: Evening

Receptor	Predicted Noise Level, dBA	Noise Characteristic Adjustment	Adjusted Noise Level	Evening Criterion, dBA	Margin of Compliance
R1 ¹	42	-	42	35	-7
R2	35	-	35	35	0
R3	33	-	33	35	2
R4	32	-	32	35	3
R17	33	-	33	35	2
R29	33	-	33	35	2

Note 1: R1 is Project involved

Table 17 Operational Noise Assessment Results Scenario 3: Night

Receptor	Predicted Noise Level, dBA	Noise Characteristic Adjustment	Adjusted Noise Level	Night Criterion, dBA	Margin of Compliance
R1 ¹	35	-	34	35	0
R2	29	-	28	35	6
R3	26	-	25	35	9
R4	25	-	24	35	10
R17	26	-	25	35	9
R29	26	-	25	35	9

Note 1: R1 is Project involved

The predicted noise levels above show the following:

- Compliance is demonstrated at all non-project involved receivers for day, evening and night operation.
- The highest noise levels are predicted at the host receiver R1. R1 is the closest receiver (approximately 300m) from the proposed development.
- The predicted exceedance at R1 is defined as *Marginal* during the day period and *Significant* during the evening period. Potential treatment at R1 could include upgrading the façade elements of the dwelling to protect internal acoustic amenity



and entering into a suitable commercial agreement, where considered feasible and reasonable.

4.4.4 Cumulative Noise Assessment

The NPfI notes:

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

The NPfI seeks to protect against cumulative noise impacts and by setting the project noise target limits at the more stringent of the project intrusiveness and project amenity criteria, that aims to ensure intrusive noise is limited, and amenity protected.

Notwithstanding, given the potential for cumulative impacts from the Wongalea BESS and surrounding approved BESS developments (Eathorpe BESS and Armidale BESS) and the Armidale Substation, an assessment of cumulative noise impacts has been conducted.

The individual BESS developments must meet their project noise target limits of 35 dBA during the evening and night at all noise sensitive receivers. It was conservatively assumed that that the Eathorpe and Armidale BESS developments contribute 35 dBA each all assessed receivers at during this period. Contributions from the existing Armidale Substation were predicted based on the sizes of the high voltage transformers.

The cumulative sum of the Project and surrounding industry has been established by adding the predicted Project noise levels with the maximum allowable noise levels from the approved BESSes and existing Armidale Substation. The predicted cumulative operational noise levels from the Project and surrounding industry are presented in **Table 18**, however, it should be noted that this unrealistically conservative as the individual projects are likely to actually contribute less than 35 dBA to all receivers.

The cumulative amenity noise levels are below the recommended amenity noise levels at all receivers. As such no significant cumulative impacts are predicted due to the Project and approved solar farms.

Table 18 Cumulative Project and Surrounding Industry Noise Levels

Receptor	Intrusiveness Noise Levels, LA _{eq} (15 min)				Total Cumulative Amenity Noise Level ¹ , LA _{eq(period)} , dBA	NPfI Recommended Amenity Noise Level, LA _{eq(period)} , dBA
	Project Operation	Armidale Substation ²	Eathorpe BESS	Armidale BESS		
R1 ¹	41	15	35	35	40	40
R2	34	10	35	35	36	40
R3	32	15	35	35	36	40
R4	31	26	35	35	37	40
R17	32	19	35	35	36	40
R29	32	28	35	35	36	40

Note 1: Amenity noise levels have been estimated as intrusiveness noise levels minus 3 dBA
 Note 2: Armidale Substation's noise contributions are calculated based on empirical noise data of 2 x 60 MVA and 1 x 375 MVA HV Transformers.



5.0 Mitigation and Management Measures

5.1 Construction Impacts

The impacts during construction of the project are predicted to be typical of major construction works near to sensitive receivers. No works outside of standard construction hours are currently proposed.

The use of standard mitigation measures to minimise the impacts is considered sufficient to control the majority of the impacts.

For instance, when working close to potentially impacted receivers, construction noise management best practices should be applied to meet the noise affected level if reasonably practicable. Potentially impacted residences should also be informed with regards to the nature of the works to be carried out, the expected noise levels and duration, as well as contact details.

A Draft Construction Noise and Vibration Management Plan (Draft CNVMP) has been prepared, refer to **Appendix A**. The Draft CNVMP provide details regarding how the impacts would be minimised through the use of all feasible and reasonable mitigation measures. The Draft CNVMP also contains procedures for handling complaints, should they occur, and detail any compliance monitoring requirements.

The measures outlined in the Draft CNVMP will be included in the Construction Environmental Management that will be prepared prior to the commencement of works.

5.2 Operational Impacts

Compliance with the NPfI was demonstrated at all non-project involved receivers with no additional mitigation.

Predicted levels at the host receiver, R1 exceed the project trigger level by 6 dBA during the evening period and the amenity level by 1 dB. This is considered a significant residual impact and may require receiver treatment as described in **Table 19** to protect internal amenity. A commercial agreement may be put in place for R1 as it is project host.

Table 19 Potential Host Receiver Mitigation Options

Item	Mitigation	Benefit
Receiver treatment	<p>The following options at the host receiver, R1 may include:</p> <ul style="list-style-type: none"> Upgrade façade elements, such as windows, doors or roof insulation to further increase the ability of the building façade to reduce internal noise levels. Providing mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity Entering a suitable commercial agreement with the impacted receiver 	<p>Evaluated on a case to case basis. Upgrading façade elements will ensure internal amenity is protected.</p>



6.0 Conclusions

SLR has been engaged to assess the potential construction and operational noise emissions for the proposed Wongalea Battery Energy Storage System (BESS).

This report presents applicable noise criteria, assessment methodology, results and management strategies to demonstrate compliance with the project's noise criteria as prescribed by the ICNG and NPfI during construction and operation of the BESS.

The predicted noise levels at the closest noise sensitive receivers (one being the project host) for construction and operation were assessed against the various requirements of the NSW Noise Policy for Industry (NPfI) and the Interim Construction Noise Guideline.

Construction noise impacts are controlled by works being limited to standard construction hours and a combination of training/equipment maintenance and community engagement. Construction vibration impacts are unlikely to be perceptible at the nearest receivers.

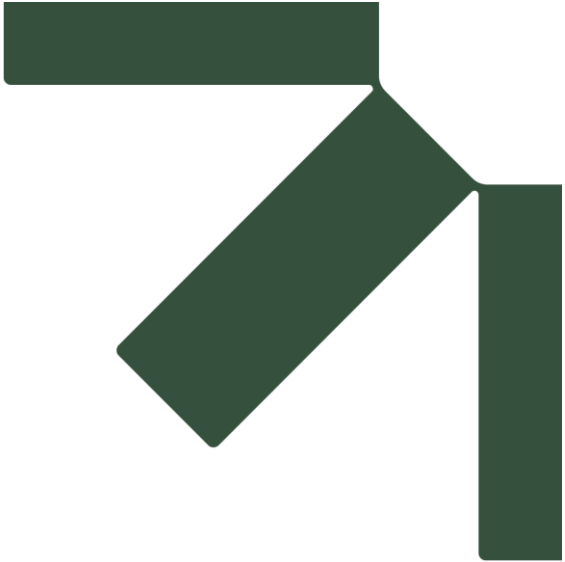
Operational compliance with the NPfI is achieved for all non-project involved receivers without the requirement of additional mitigation. Treatment of the host receiver will be investigated during detailed design to further reduce residual noise impacts and protect internal acoustic amenity to that property.

Cumulative noise emissions from the approved Eathorpe BESS and Armidale BESS and the existing Armidale Substation have been considered. Cumulative impacts are not expected to exceed the most stringent recommended amenity criterion during the evening and night period of 40 dBA.

All plant, equipment and design layout will be reviewed during the detailed design stage to ensure that compliance with the noise criteria is achieved as the acoustic performance of the plant and layout is refined.

Based on the findings of this report and assuming the recommendations and/or safeguards are applied, the proposal is considered appropriate from an acoustic standpoint.





Appendix A Draft Construction Noise Management Plan

Noise & Vibration Impact Assessment

Wongalea BESS

Ekus Energy

SLR Project No.: 640.031705.00001

16 April 2025

A.1 Introduction

The ICNG acknowledges that due to the nature of construction works it is inevitable that there would be impacts where construction work is occurring near sensitive receivers. Three of the nearest receivers are predicted to be Noise Affected at some point during the construction of the Project. This appendix outlines a draft noise management plan to control noise impacts during construction of the Project.

A.2 Mitigation and Management Measures

The principal cause of exceedances of the NMLs are the vegetation clearing, bulk earthworks and road works activities.

All appropriate feasible and reasonable mitigation measures would be applied to the work to minimise the potential impacts, as far as practicable. Potential mitigation measures for construction activities that would be applied to the Project are detailed in **Table 20**.

Table 20 Mitigation and Management Measures

Mitigation / Management Measure	Person Responsible	Timing / Frequency
Project Planning		
Use quieter and less vibration emitting construction methods where feasible and reasonable.	Project Manager	Ongoing
Works would be completed during standard daytime construction hours.		
Scheduling		
Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night-time period (if unavoidable), any operational noise benefits from the works (where applicable) and contact telephone numbers would be undertaken.	Project Manager/ Communications and Community Liaison Representative	Ongoing
Site Layout		
Compounds and worksites would be designed to promote one-way traffic and minimise the need for vehicle reversing.	Project Manager	Ongoing
Where practicable, work compounds, parking areas, and equipment and material stockpiles would be positioned away from noise-sensitive locations and take advantage of existing screening from local topography and the stockpile itself.		
Training		
Training would be provided to all personnel on noise and vibration requirements for the Project. Inductions and toolbox talks to be used to inform personnel of the location and sensitivity of surrounding receivers.	Project Manager	Ongoing
Plant and Equipment Source Mitigation		
All plant and equipment must be maintained in a proper and efficient condition, operated in a proper and efficient manner, and feature standard noise amelioration measures where applicable.	Project Manager	Ongoing
Where practicable, tonal reversing alarms (beepers) would be replaced with non-tonal alarms (squawkers) on all equipment in use (subject to occupational health and safety requirements).		



Mitigation / Management Measure	Person Responsible	Timing / Frequency
Noisy equipment would be sited behind structures that act as barriers, or at the greatest distance from the noise-sensitive area. Equipment will be oriented so that noise emissions are directed away from any sensitive areas, where possible.		
Noise generating equipment would be regularly checked and effectively maintained, including checking of hatches/enclosures regularly to ensure that seals are in good condition and doors close properly against seals.		
Spot checks of equipment in operation would be completed to ensure individual items are operating as expected.		
Dropping materials from a height will be avoided.		
Truck movements would be kept to a minimum, i.e. trucks are fully loaded on each trip.		
Screening		
Where practicable, install purpose-built screening, i.e. the wall on the north and west boundary early in the construction phase to provide shielding for construction equipment that have the potential to impact nearby receivers	Project Manager	Ongoing
Community Consultation		
A notification entitled 'Project Update' or 'Construction Update' (or similar) is produced and distributed to stakeholders via letterbox drop and distributed to the Project postal and/or email mailing lists. Periodic notifications provide an overview of current and upcoming works across the Project and other topics of interest. The objective is to engage, inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic change or noisy works) can assist in reducing the impact on stakeholders. The approval conditions for the Project may specify the requirements for notification to sensitive receivers where works may impact on them.	Communications and Community Liaison Representative	Ongoing
Notifications would be provided to the affected community where high impacts are anticipated or where out-of-hour works are required. Notification would be a minimum of 24 hours.		
Where complaints are received, work practices would be investigated and reviewed. Where the investigation validates the complaint having regard to the relevant approval conditions a review of feasible and reasonable practices would be conducted and implemented where practicable to minimise any further impacts.		
Monitoring		
Noise monitoring would be conducted (as appropriate) when noise/vibration intensive works are being undertaken in close proximity to sensitive receivers.	Environmental Coordinator	Ongoing
Noise monitoring will be conducted (as appropriate) in response to any complaints received following an investigation of work practices to verify that levels are not substantially above the predicted levels.		

A.3 Monitoring

Attended noise measurements would be undertaken at the start of noise intensive works that occur near sensitive receivers to verify the levels are as predicted and to check the effectiveness of mitigation and management measures.



Attended noise monitoring would also be undertaken in response to any formal complaints, as appropriate following an initial investigation into the complaint and work practices at the time. All monitoring would be completed by suitably qualified acoustic specialists. The location and extent of attended monitoring would be determined in consultation with Project staff and would be dependent on the activities taking place.

The monitoring would take place during the expected noisiest construction periods and be representative/indicative of the impacts at the potentially affected sensitive receivers.

A noise monitoring report would be prepared after each attended monitoring survey.

All items of acoustic instrumentation utilised would be designed to comply with AS/NZS IEC 61672.1-2004 *Electroacoustics – Sound level meters* and carry current calibration certificates.

A.4 Complaints Management

Complaints would be able to be made via phone and email via designated contacts. Contact details would be included on site signage, community consultation material and on the Project website (if applicable).

Information recorded in the complaints register with respect to each complaint would include:

- date and time of complaint;
- name, address and telephone number of complainant;
- nature of complaint; and
- response actions taken to date.

A report of complaints would be provided to the relevant regulatory authorities throughout the construction of the Project, or as otherwise agreed by the relevant regulatory authorities.

Where possible, preliminary investigations into the complaint should commence within 48 hours of the complaint receipt and adequate measures to identify and manage would be considered and implemented. Where required, noise monitoring would be undertaken as per **Section A.3**.

A.5 Contingency Plan

Additional mitigation / management measures would be investigated and potentially used to manage noise impacts that are higher than expected, in accordance with the following general steps:

- Re-assess the mitigation / management measures employed at the site to reduce the impact of the noise source in question. Particular attention should be given to the scheduling of noisy activities and the siting of equipment used on site.
- Following the adoption of additional noise mitigation / management measures, a further noise survey would be conducted at the residence (or representative location) to check the success of the mitigation / management measures.

A.6 Internal Auditing and Improvement of Noise Management Plan

Periodic internal audits would be conducted to ensure that the consent conditions and commitments and environmental management controls outlined in the construction noise



management plan developed for the Project are being properly implemented. Audit reports would be used to inform of any corrective actions.

The construction noise management plan developed for the Project will be reviewed and, if necessary, updated in the following circumstances:

- significant changes to the equipment, machinery and plant operated within the site;
- where it is identified via monitoring that the performance of the Project is not meeting the objectives of the Construction Environmental Management Plan; and
- at the request of the relevant regulatory authority or other relevant government agency.

All employees and contractors would be informed of any revisions to the management plan by site management during toolbox talks. The most recent version of the management plan as developed for the Project, would be implemented for the duration of construction works.





Appendix B Noise Contours

Noise & Vibration Impact Assessment

Wongalea BESS

Ekus Energy

SLR Project No.: 640.031705.00001

16 April 2025

Figure 2 Predicted Noise Contours – Scenario 1: Day

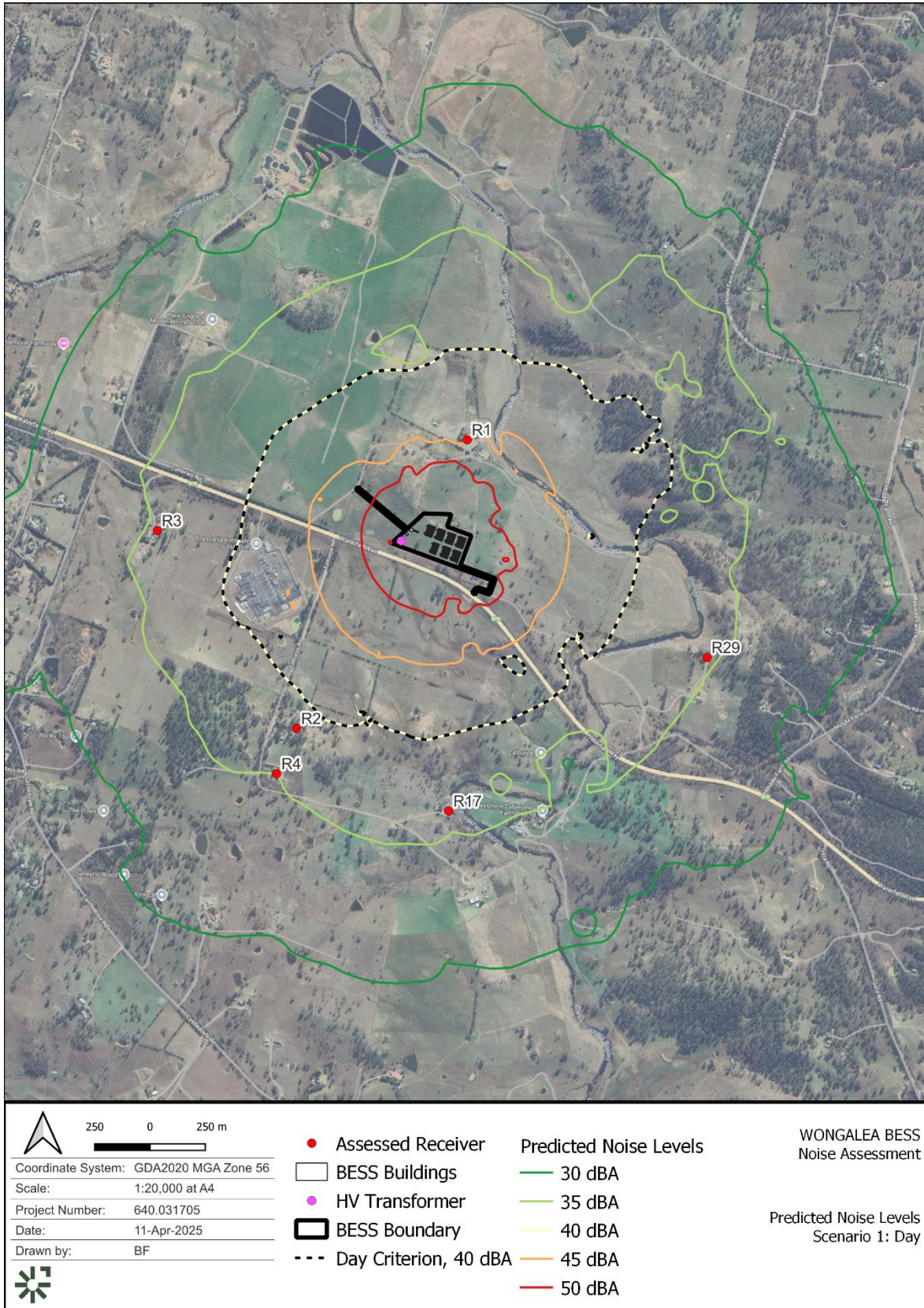


Figure 3 Predicted Noise Contours – Scenario 2: Evening

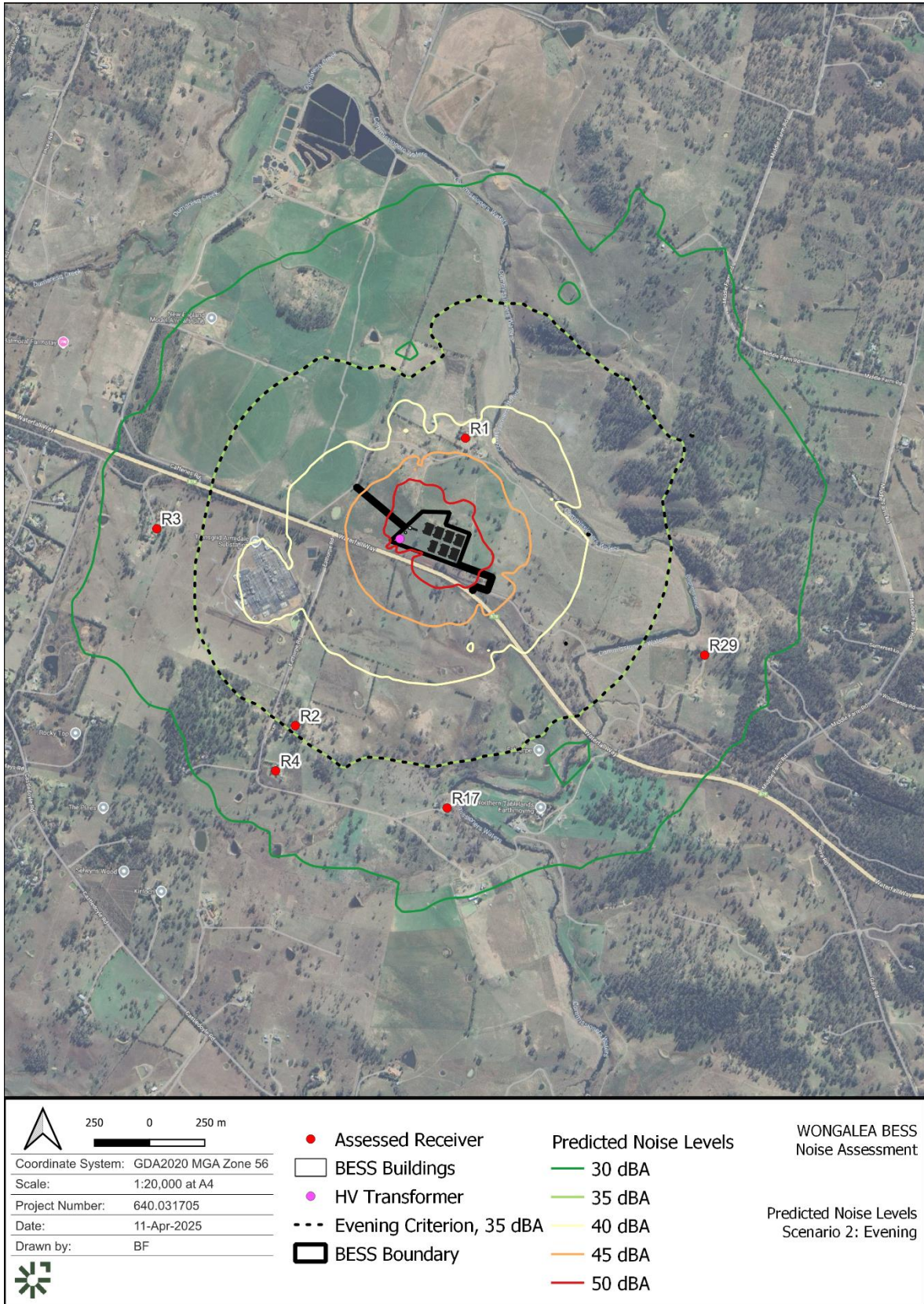
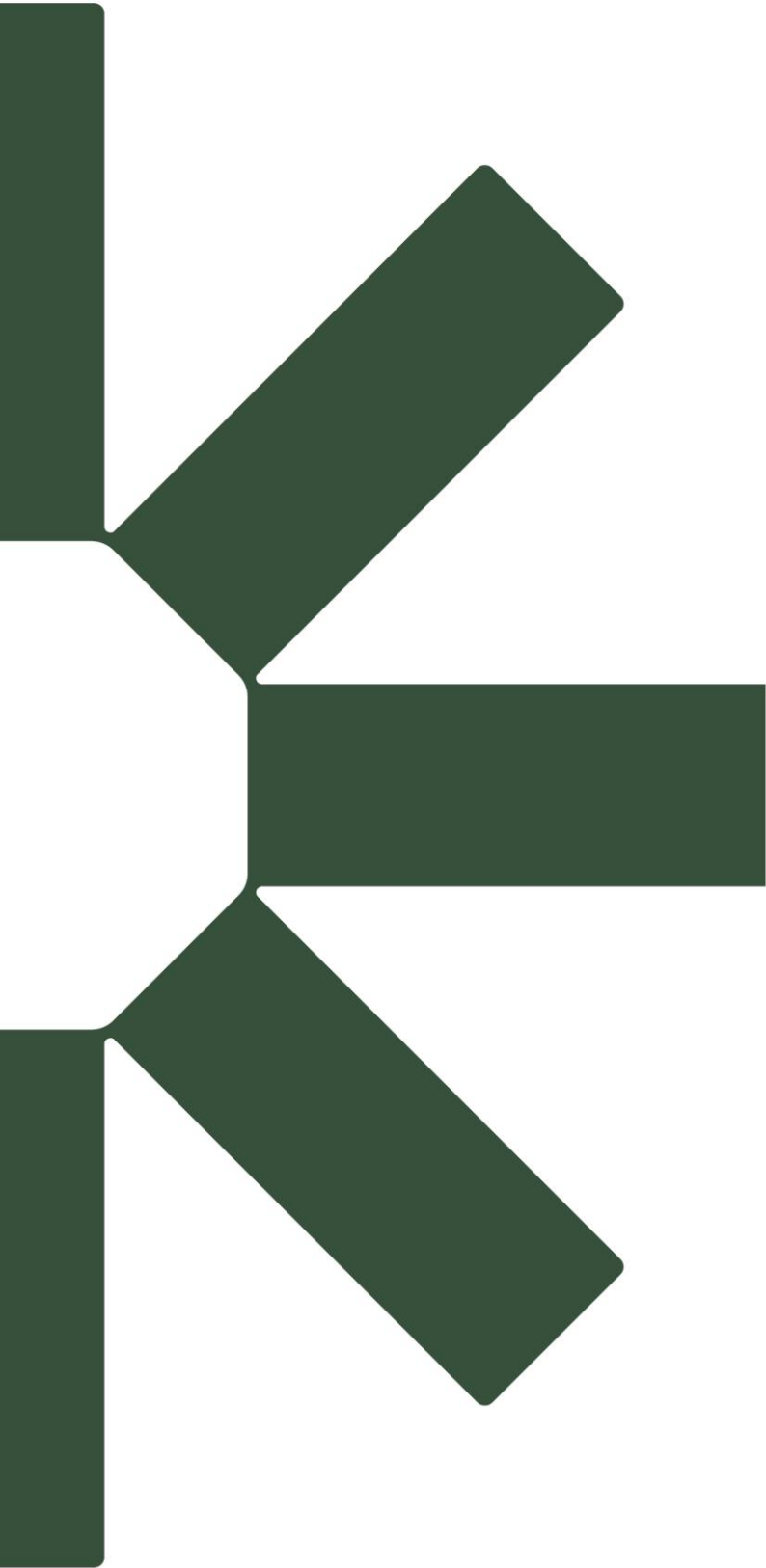


Figure 4 Predicted Noise Contours – Scenario 3: Night





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