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Appendix J:
Noise Impact Assessment

Noise Impact Assessment

Armidale BESS

24 August 2023

Noise Impact Assessment
Armidale Battery Energy Storage System

AE1184

August 2023

Version V3			
Issued to			
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Abbreviations

AHD	Australian Height Datum
dB	decibel
dB(A)	A-weighted sound levels
dB(A) LA90	the A-weighted sound pressure level that is exceeded for 90% of the measured time period
BESS	battery energy storage system
CRS	coordinate reference system
DEC	Department of Conservation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DGA	dense graded aggregate
DPIE	Department of Planning, Industry and Environment
EIS	environmental impact statement
EPA	Environment Protection Authority
GMR Energy	GMR Energy Pty Ltd
ha	hectares
HV	Heavy vehicle
ICNG	Interim Construction Noise Guidelines
kg	kilograms
km	kilometres
kN	kilonewtons
kV	kilovolts
L_{Aeq}	equivalent continuous sound pressure level
LGA	local government area
LV	light vehicle
Lw	sound power level
m	metres
mm	millimetres
MV	medium voltage

MW	megawatt
MWh	megawatt hour
NPI	Noise Policy for Industry
NSR	noise sensitive receiver
NSW	New South Wales
OD	Over dimensional vehicles
PCS	power conversion systems
PCU	power control unit
PSNL	project specific noise level
R	receiver
RBL	rating background noise
RMS	Roads and Maritime Services, now Transport for NSW
RMU	ring main unit
SEAR	Secretary's Environmental Assessment Requirements
t	tonnes
TfNSW	Transport for New South Wales includes NSW Roads and Maritime Services
Transformer HV	high voltage transformer

1 Introduction

1.1 Project overview

The proposed Armidale Battery Energy Storage System (BESS) is a 150-megawatt (MW)/300-megawatt hour (MWh) utility-scale battery storage project located southeast of the township of Armidale in New South Wales (NSW) (Figure 1.1) that is being developed to provide reliability and security to the network during peak periods.

The proposed project site has been selected due to its proximity to State-significant electrical infrastructure – including the adjacent Armidale Substation which has capacity to accept up to 150 MW of energy from the BESS – and its low environmental sensitivity and lack of locational constraints.

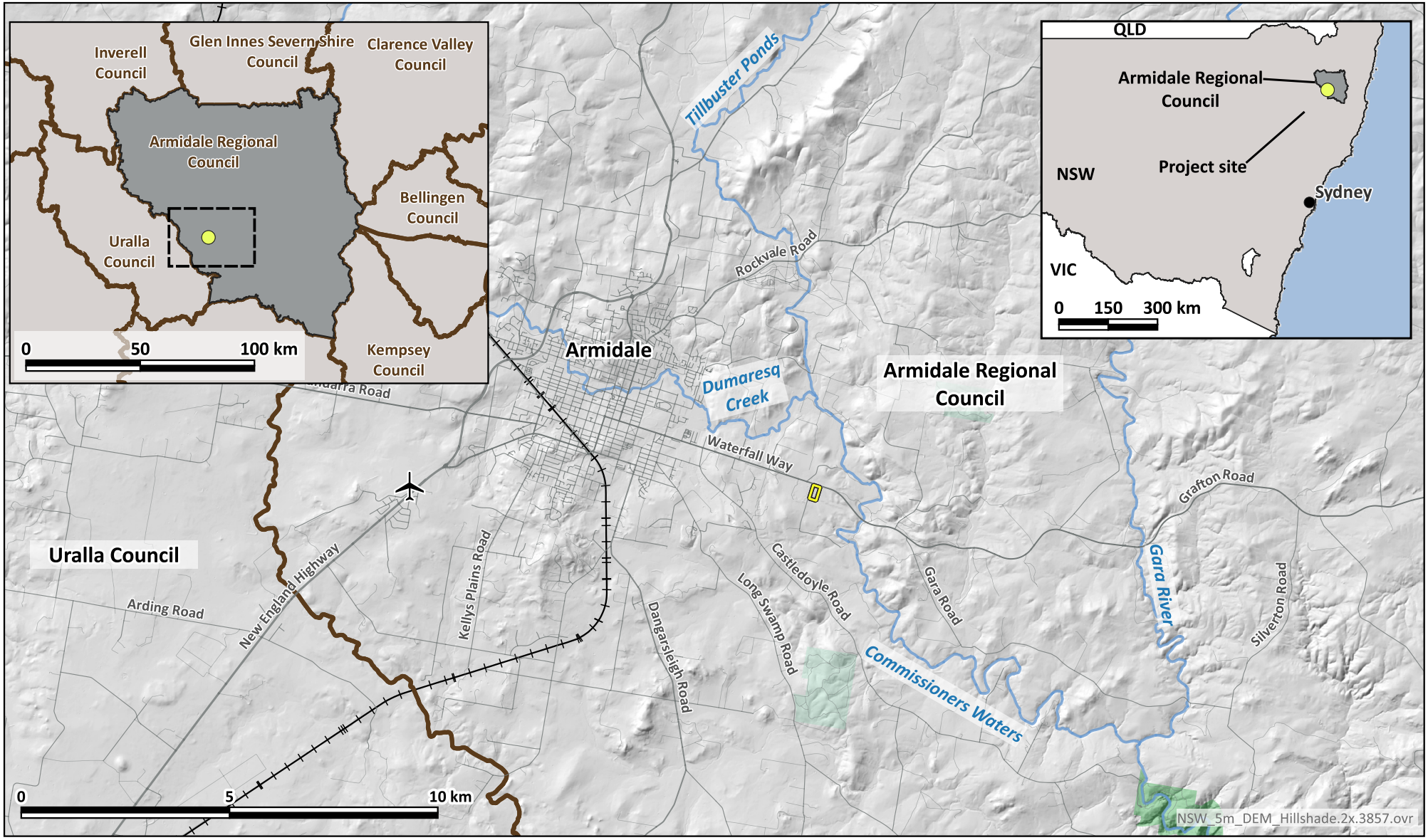
The project will have a maximum capacity of 150 MW/300 MWh. Key elements of the development will include:

- up to 52 power conversion units, lithium-ion battery racks housed in 104 battery enclosures
- medium voltage transformers, switchgear, and auxiliary equipment
- a 33 kilovolt (kV) switch-room, a control room and an on-site 33/132kV substation
- internal access tracks, operations and maintenance building, temporary construction laydown area, vehicle parking, water tanks for firefighting purposes, security fencing and landscaping.

Figure 1.2 shows the potential project disturbance area, which includes possible access construction works on Waterfall Way, options for the site access road, and options for the transmission line between the BESS, the on-site substation and the existing Armidale Substation.

Access to the site during construction and operation is expected to be from Waterfall Way via Eathorpe Road or directly from Waterfall Way.

Electricity will be delivered to/from the proposed on-site substation to the Armidale Substation via a new overhead or underground transmission line.



AE1235 Armidale BESS
Figure 1.1 Regional context
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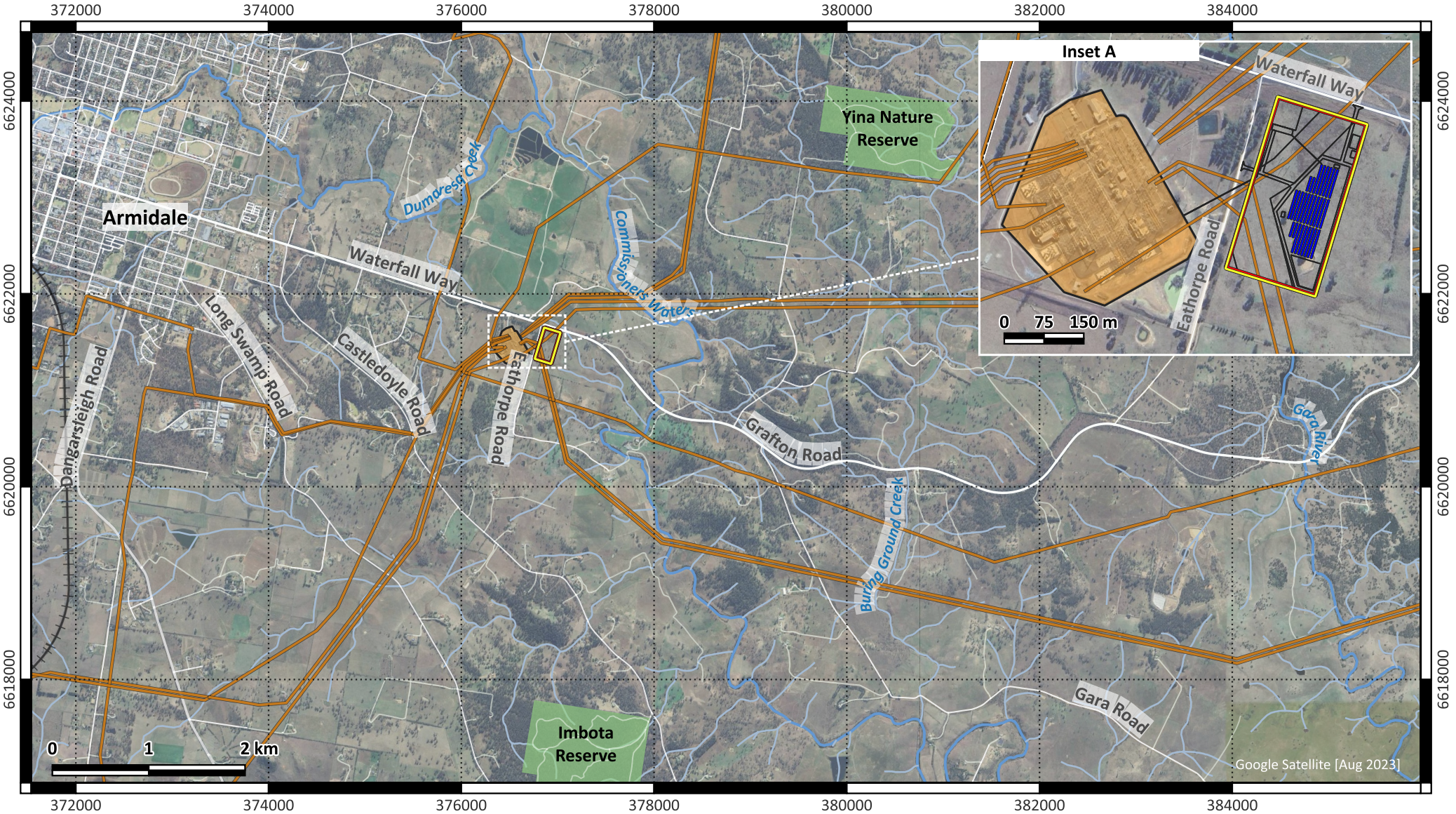

- Road
- Railway
- Existing transmission line
- Main watercourse
- Watercourse, tributary
- Project site
- Lot boundary
- Proposed site layout outline
- Armidale Substation

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AE1235 Armidale BESS
Figure 1.2 Local context

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Additional data: NSW Hydroline, NSW RoadSegment and NSW ElectricityTransmissionLine

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1.2 Site details

General information about the project is provided in Table 1.1 as well as in Figure 1.2.

Table 1.1 Project details

Component	Description
Name	Armidale BESS
Address	89 Eathorpe Road, Armidale, NSW
Proponent	GMR Energy Pty Ltd
Council	Armidale Regional Council
Titles	Lot 737 DP755808
Development site	Secured land tenure: approximately 6.7 ha Area required for BESS: 2.30 ha
Land Use	Rural land used largely for grazing
Capacity	150 MW/300 MWh
No. of batteries	Up to 936 batteries in 104 enclosures
Connection	Via a new transmission line (likely underground) from the on-site substation to the existing Armidale Substation, located immediately west of the site. Grid connection is expected to be via a TransGrid 132 kV line.

2 Noise assessment

2.1 Project brief

An Environmental Impact Statement (EIS) is being prepared by GMR Energy Pty Ltd (GMR Energy) for the Armidale BESS project in accordance with the Secretary's Environmental Assessment Requirements (SEARs) and agency comments, issued by the Department of Planning and Environment (DPIE) on 30 August 2021, and outcomes of community and stakeholder consultation. This noise assessment report has been prepared in support of the EIS. The report has been prepared to address the following SEAR:

> *Noise - including an assessment of the construction noise impacts of the development in accordance with the Interim Construction Noise Guideline (ICNG), operational noise impacts in accordance with the NSW Noise Policy for Industry (2017), cumulative noise impacts (considering other developments in the area), and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria.*

2.2 Existing conditions

The site is relatively flat and generally drains to the southeast towards Commissioners Waters (Figure 2.1). Due to a long history of agriculture and grazing, the site is highly modified. The project site contains three large paddock trees, but no other significant mid-storey or over-storey vegetation.

The project area is bounded to the west by a local road, Eathorpe Road, and to the north by a major road, Waterfall Way. The New England Highway, which passes through Armidale, is located approximately 8.4 kilometres (km) to the west (see Figure 1.1).

The Armidale Substation (operated by TransGrid) is located immediately west of the project site (see Figure 1.2). A TransGrid 132 kV transmission line connects into the existing substation and is expected to provide the BESS with its connection into the grid.

Background noise levels are expected to reflect the site's location just outside Armidale in a rural setting. The existing Armidale Substation and traffic on Waterfall Way are a likely source of local noise.

Land use in the vicinity of the development site is predominantly agricultural; therefore, the operation of noise generating machinery and equipment such as harvesters, boom sprayers and tractors are a further source of external noise.

Residences in the landscape are sparse. These residences would be expected to generate low levels of noise as a result of equipment such as generators or on-site water pumps.

Noise from insects and wind through trees and vegetation would also contribute to background noise levels within and in the vicinity of the development site.

- Associated receiver (host landholder)
- Non-associated receiver
- Project site
- Lot boundary
- Battery array
- Easement
- Radius from project site
- Armidale Substation
- Proposed transmission lines
- Existing transmission line
- Main watercourse
- Watercourse, tributary
- Contour 10 m AHD
- Contour 2 m AHD

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AE1235 Armidale BESS

Figure 2.1 Sensitive receivers and topography

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Additional data: NSW Hydroline, NSW RoadSegment and NSW ElectricityTransmissionLine, NSW Six Contour-AHD_56+_2m

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2.2.1 Sensitive land uses and receivers

Sensitive land uses were identified in the area surrounding the development site in accordance with the *Interim Construction Noise Guideline* (ICNG) (DECC 2009). Residences have been identified as a sensitive land use potentially impacted by noise from the development site.

The site is located entirely within the property of a single landholder, Lot737 DP755808. Six receivers are located within 1 km of the project site (see Figure 2.1).

The site landholder residence (R1) is part of the commercial venture of the project and is therefore not considered a sensitive receiver for the purposes of this report.

The closest non-associated noise sensitive receivers (NSRs) R6 and R2 are 670 metres (m) and 730 m away, respectively. NSRs R2, R3, R4 and R6 are expected to be shielded from noise by topography (see Figure 2.1). The remaining NSRs R5 to the west of the development is obscured by the existing Armidale Substation and associated buildings.

The five identified NSRs have been assessed for noise impacts. Table 2.1 provides details on the NSRs.

Table 2.1 Noise sensitive receiver locations

Sensitive receiver	Location	Direction from project	Distance to site lot boundaries (m)	Distance from Waterfall Way (m)
R2	Eathorpe Road	South	730	1150
R3	Eathorpe Road	Southwest	820	1150
R4	Eathorpe Road	Southeast	930	700
R5	Waterfall Way	West	820	250
R6	Waterfall Way	Northeast	670	600

2.3 Construction noise

2.3.1 Construction activity

Project construction will last for approximately nine months. Construction will involve the following activities:

- Stage 1: Site establishment, including demolition of existing farm shed, earthworks and any drainage requirements, construction of concrete hardstands, civil works – approximately 2 months.
- Stage 2: Delivery of BESS infrastructure – approximately 3 months.
- Stage 3: Installation of BESS infrastructure (containerised units, transformer, switchroom, control room and O&M) and electrical works – approximately 4 months (partially overlapping with stage 2).

- Stage 4: Commissioning and joint testing – approximately 3 months.

2.3.2 Interim Construction Noise Guideline

The aim of the ICNG is to provide guidance on managing construction works to minimise noise (including airborne noise, ground-borne noise and blasting), with an emphasis on communication and cooperation with all involved in, or affected by, construction noise.

The steps for managing noise impacts from construction are:

- identify sensitive land uses that may be affected
- identify hours for the proposed construction works
- identify noise impacts at sensitive land uses
- select and apply the best work practices to minimise noise impacts.

Construction hours

The construction hours will be in accordance with the ICNG recommended standard construction hours for construction work, unless otherwise agreed with the Secretary (DPIE), with construction activities occurring during daytime, as follows:

- Monday to Friday, 7.00 am to 6.00 pm
- Saturday, 8:00 am to 1:00 pm
- no construction work on Sunday and public holidays.

Project noise management levels

The rating background noise level (RBL) is the level used in this report for noise assessment purposes. The RBL is the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (EPA 2017).

Where noise from construction works is above the 'noise affected' levels presented in Table 2.2, the ICNG states that the proponent should apply all feasible and reasonable work practices to minimise noise.

Noise levels are to be rounded to the nearest integer (EPA 2017). The ICNG specifies the noise thresholds at NSRs for construction activities as listed in Table 2.2.

Background noise monitoring was not undertaken as part of this assessment. As a worst-case scenario, it has been assumed that background levels will be less than 30 decibel A-weighted sound levels (dB(A)) during all time periods, and the minimum assumed RBLs have been adopted. In accordance with the Noise Policy for Industry (NPI) (EPA 2017), where the rating background noise level is to be less than 30 dB(A) for the evening and night periods, then it is set to 30 dB(A). Where it is to be less than 35 dB(A) for the daytime period, then it is set to 35 dB(A).

For the current assessment, therefore, a value of 30 dB(A) for evening and night periods and 35 dB(A) for daytime periods has been adopted as the RBL.

Table 2.2 Noise management levels at dwellings

Day time hours	Management level LAeq 15 min	Day time hours
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ 15\ min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • 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 dB(A)	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: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near dwellings 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Based on the adopted day time period RBL of 35 dB(A) for standard hours, the noise affected management level has a threshold of 45 dB(A) before specific management is required.

2.3.3 Construction noise sources

The construction activities include four distinct stages over nine months (Section 2.3.1), from site preparation, delivery, installation and commissioning.

Noise sources included in the construction noise calculation include:

- Stage 1: Site establishment, including demolition of existing farm shed, earthworks and any drainage requirements, construction of concrete hardstands, civil works:
  - dozer
  - grader
  - excavator
  - smooth drum roller
  - bobcat
  - front end loader
  - truck and dog
  - concrete truck
  - drilling rig
  - generator
  - light vehicle.
- Stage 2: Delivery of BESS infrastructure:
  - forklift
  - truck
  - Franna crane
  - light vehicle
  - hand power tools and equipment.
- Stage 3: Installation of BESS infrastructure:
  - truck
  - Franna crane
  - light vehicle
  - hand power tools and equipment.
- Stage 4: Commissioning:
  - light vehicle
  - hand power tools and equipment.

2.3.4 Sound power levels

Sound power levels (Lw) data for noise sources were sourced from *Table A1 Typical sound level of construction plant and equipment (AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites. Appendix B: Estimating Noise from Sites*) (Standards Australia 2010) and are listed in Table 2.3 along with the period of use on-site. Lw is the intrinsic noise output of a piece of plant or equipment and does not depend on distance or orientation of the machine.

2.3.5 Assessment

Consistent with the requirements of the ICNG, construction noise impacts have been quantified by:

- predicting the realistic worst-case or conservative noise levels from the identified sources

- applying them to assessment locations representing the most noise-exposed dwellings
- taking into account the construction activities in Section 2.3.3.

Table 2.3 Sound power levels for construction noise sources and construction stage

Noise source	Sound power level (Lw) dB(A)	Construction Stage
Dozer	108	1
Grader	110	1
Excavator	107	1
Smooth drum roller	108	1
Bobcat	104	1
Front end loader	113	1
Concrete truck	107	1
Drilling rig	108	1
Generator	99	1
Forklift	116	1,2
Truck and dog	106	1,2,3
Franna crane	108	1,2,3
Light vehicle	110	1,2,3,4
Hand tools	116	1,2,3,4

The assessment has assumed that one of each plant item listed in Section 2.3.3 is concurrently in operation at the nearest point to the receiver and generating the Lw values listed in Table 2.3. The assessment is conservative as it does not take the usage factors into account, instead assuming continuous operation. In accordance with the ICNG, a calculation was used to estimate the magnitude of expected noise levels.

The noise assessment equations and allowances are taken from: *AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites. Appendix B: Estimating Noise from Sites*, as set out below.

> ***Soft ground*** *Where soft ground exists between item of plant and point of interest (applies only when R is greater than 25 m)*
>
> *The relationships between the sound power and sound pressure level enables a prediction of attenuation over distance:*
>
> $Lp = LW - [25 \times \log10 (r)] - 1\ dB$
>
> *LW = Sound Power level (dB(A))*

Lp = Sound Pressure level (dB(A))

r = distance (m)

The formula for combining the sound pressure levels to calculate the sum level of noise sources operating concurrently is:

$L_{pATot} = 10 \times log10\ (10^{LpA1/10} + 10^{LPA2/10} + \ldots + 10^{LpAn/10})$

Where:

L_{pATot} *= Total A weighted sound pressure level of sources 1 to N*

L1, L2,.. Ln = sound pressure level of the separate sources.

Screening effects of a barrier

A barrier in the form of a screen or earth bank between the source of noise and the receiving position can be used to reduce the sound level at the receiving position.

A reduction in the total A-weighted sound pressure level of up to 15 dB(A) can be achieved, though, as a working approximation, it would be safer to assume a reduction of about 7 dB(A) to 10 dB(A).

For this assessment a conservative reduction of 5 dB(A) is adopted for shielding.

The noise level predictions take into account the influence of topographical features where the 'line of sight' (the straight line between the noise source and the receiver) is obstructed by topography. Solid barriers in the form of site offices, sheds and fixed plant can also provide shielding.

In relation to other allowances, AS2436-2010 also states that:

> *Where noise travels from the source to the listener by a path that is close to the ground the sound level may be reduced by ground attenuation. Provided there is no effective barrier between the source and the receiver noise attenuated as it passes over sound absorbing surfaces, i.e., unpaved surface. At distances between the source and the receiver greater than 25 m noise levels may be reduced when the sound propagates over soft ground. The approximate values of additional reduction attainable due to soft ground is given in* Table 2.4.

Table 2.4 Effect of a soft ground attenuation on a total A-weighted sound pressure level

Mean height of propagation path above soft ground (m)	Approximate additional reduction in Total A-weighted sound pressure level L_{pA} (dB)
6	1
4.5	2
3	3
1.5	4
0.7	5

2.3.6 Predicted construction noise levels

Table 2.5 shows the resultant maximum noise levels predicted at the NSRs during project construction compared with the relevant noise management levels derived in Section 2.3.2.

Table 2.5 Predicted maximum construction noise levels at NSRs, LAeq,15min dB(A)

NSR	Stage 1	Stage 2	Stage 3	Stage 4	Noise management level dB(A)	Stage No. exceeding noise management level
R2	39	36	36	35	45	None
R3	37	34	34	33	45	None
R4	36	33	33	32	45	None
R5	43	40	40	39	45	None
R6	40	37	37	36	45	None

As shown in Table 2.5, the predicted maximum construction noise levels at the development site would attenuate to a level that remains below 45 dB(A) at the NSRs. Note, the predicted construction noise levels are based on a worst-case scenario:

- All plant and equipment are assumed to be operating together and at the closest point of the development site boundary to each sensitive receiver. This situation would not occur on site due to the spatial and temporal separation of civil work and construction activities.
- Construction noise levels would also vary over the construction period due to the location, type and duration of construction being undertaken. Equipment utilisation would vary throughout the day and these factors would also see a reduction in the above predicted noise levels.
- It is expected there may be elevated background noise levels, such as associated with the Armidale Substation. As such, the actual RBLs in the vicinity of the Armidale Substation may be higher than the adopted minimum values.
- The noise level predictions do not take into account the implementation of noise attenuation measures, such as introducing barriers for shielding, or possible noise control treatments on plant and equipment.

As construction noise levels at all NSRs are predicted to be substantially lower than the 'highly noise affected' level of 75 dB(A) (as defined by the ICNG and listed in Table 2.2), a strong community reaction to noise levels is unlikely.

2.4 Operational noise

2.4.1 Operational activities

The expected operational life of the battery infrastructure is 20 years. The operational hours will be 24 hours, 7 days a week. No permanent on-site staff are required during operations as the BESS will be operated remotely. Maintenance staff will access the site as required during operations (one full-time equivalent job).

2.4.2 Noise Policy for Industry

Noise from the operation of the development site has been assessed in accordance with the NPI. Assessment under the NPI has two components:

- controlling intrusive noise impacts in the short term for dwellings
- maintaining noise level amenity for particular land uses for dwellings and other land uses.

The NPI defines the time of day as follows:

- 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.

Intrusiveness criteria

The intrusiveness criterion for residential noise receivers as set out in the NPI is as follows:

$$L_{Aeq,\ 15\ min} \leq \text{RBL (dB(A) } L_{A90}) + 5 \text{ dB(A)}$$

The applicable intrusiveness noise criteria are presented in Table 2.6.

Table 2.6 Intrusive noise level

Time of day	Minimum assumed RBL dB(A)	Minimum project intrusive L_{Aeq} dB(A)
Day	35	40
Evening	30	35
Night	30	35

Amenity criteria

The nearest NSRs are dwellings located in a rural area. Based on the nature of these receivers, the amenity criteria (L_{Aeq}) for rural residential properties will be applied. The applicable amenity noise criteria are presented in Table 2.7.

Table 2.7 Amenity noise level

Receiver	Noise amenity area	Time of day	Amenity noise level L_{Aeq} dB(A)
Residential	Rural	Day	50
		Evening	45
		Night	40

Project specific noise levels

The intrusiveness and amenity criteria that apply for day, evening and night periods are shown in Table 2.8 under the NPI, the lower of the two (intrusiveness or amenity) is adopted as the project specific noise level (PSNL).

Table 2.8 Project specific noise levels based on NSW NPI

Time of day	RBL dB(A)	Intrusive criteria LAeq dB(A)	Acceptable amenity criteria LAeq dB(A)	Adopted PSNL LAeq dB(A)
Day	35	40	50	40
Evening	30	35	45	35
Night	30	35	40	35

Table 2.8 shows that the intrusiveness criteria are lower than the amenity criteria for day, evening and night periods. Therefore, the intrusiveness criteria have been adopted as the PSNL.

Noise prediction

The important parameters for predicting noise are listed below. These will set the boundaries of the noise prediction process. They need to be determined and clearly identified for noise impacts to be predicted adequately. The parameters are:

- all noise sources related to the proposed development, including vehicles on site
- source noise levels, site location and effective height of the noise source – references should be provided for all source noise levels used in the assessment
- annoying characteristics of the noise sources that may be experienced at receiver locations
- all stages of project development, including whether noise emissions may vary depending on site operations, for example, during delivery/despatch activities
- all receivers potentially affected by the development

- meteorological conditions applicable to the site to determine the meteorological conditions that should be adopted for the noise impact assessment
- site features (including natural and constructed, development and surrounding land uses) that affect noise propagation
- operating times of the development.

To quantify the noise impact, the noise levels from the source at all potentially affected receivers should be predicted, taking account of the parameters identified.

The predicted noise level from the source may be calculated manually for simpler projects, taking into account the distance from the source to receiver and any shielding between the source and receiver.

Worst-case adjustments

Corrections for annoying noise characteristics

Where a noise source contains certain characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level (EPA 2017). The NPI provides guidance on applying adjustments where the noise may be considered annoying. An adjustment of 5 dB(A) is added to the predicted value for each aspect.

Accounting for noise-enhancing weather conditions

The prediction adopts the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur. An adjustment of 5 dB(A) is added to the predicted value for adverse weather conditions (i.e., with noise-enhancing meteorology).

2.4.3 Operational noise sources

The key elements of the development will include:

- battery banks (up to 26)
- medium to high voltage transformer (2).

Noise sources shown in the Schematic arrangement for the battery banks in Figure 2.2 includes:

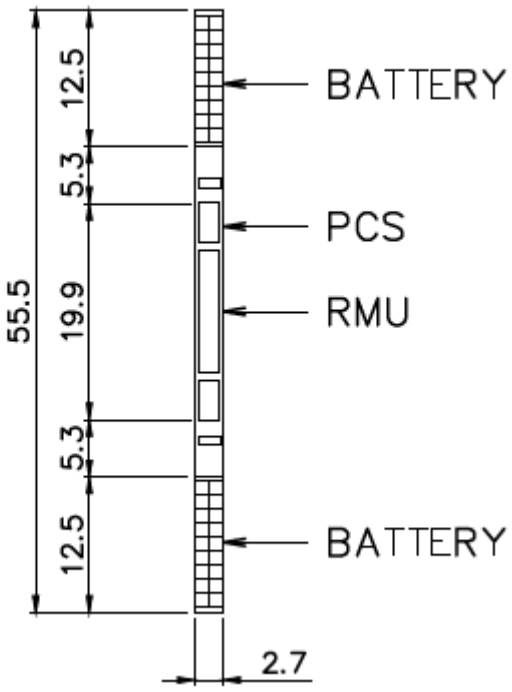
- batteries
- ring main unit (RMU), switchgear includes medium voltage transformer
- power conversion system (PCS).

2.4.4 Sound power levels

Sound power data for noise sources during operations and estimated acoustic usage factor were provided by GMR Energy (sourced from equipment suppliers). Sound power totals used in the noise calculations are shown in Table 2.9. It is understood that the charge and discharge rates of typical BESS facilities generally do not occur at the rated capacity of the BESS. The

maximum utilisation for a BESS is typically 80% of peak system capacity during day and evening periods, and usually less than 40% during the night-time period (Resonate 2023).

However, the worst case BESS operational utilisation of 100% is used in the calculations.



Details:

RMU - ring main unit switchgear with medium voltage transformer

PCS - power conversion system

Measurements in metres

Figure 2.2 Schematic arrangement of battery banks

Table 2.9 Sound power levels for operational noise sources

Plant	Sound power (Lw) (dB(A))	Number of plant
Battery enclosures	83	104
PCU/Inverter	93	52
Transformer MV	79	52
Transformer HV	84	2

2.4.5 Assessment

Noise impacts from project operations have been quantified by:

- predicting the realistic worst-case or conservative noise levels from the identified sources including penalties for tonal noise and adverse weather conditions
- assuming PCU/inverters are operating at 100% utilisation for all time periods

- assuming, to reflect the generalised form of the proposed BESS layout and the exposure of the sensitive receivers (see Figure 1.2), that:
  - the first skid-based module (the line of battery enclosures, PCU/inverters and MW transformers) is located at the nearest point to the sensitive receiver
  - the middle and final rows of skid-based modules are located further from the sensitive receiver
- a conservative reduction of just 5 dB(A) is adopted for shielding (topography, barriers)
- applying the above assumptions to assessment locations representing the most noise-exposed NSRs.

The calculation used to estimate the magnitude of expected noise levels is the same as used for project construction (see Section 2.3.5).

2.4.6 Predicted noise levels during operations

Tables 2.10 and 2.11 show the noise levels predicted at the NSRs for day, evening and night times, based on the assumptions outlined above, during project operations compared with the relevant PSNLs derived in Section 2.4.2.

Table 2.10 Predicted LAeq 15min noise levels at NSRs during Neutral conditions for operations in dB(A)

NSR	Neutral conditions*	Adopted Daytime PSNL LAeq	Daytime exceeding intrusive criterial	Adopted Evening PSNL LAeq	Adopted Night PSNL LAeq	Evening Night exceeding intrusive criterial
R2	34	40	No	35	35	No
R3	33	40	No	35	35	No
R4	31	40	No	35	35	No
R5	34	40	No	35	35	No
R6	34	40	No	35	35	No

* Includes a 'tonal' adjustment set at +5 dB(A)

The predicted noise levels at all NSRs comply with ALL criteria under Neutral conditions when the 'tonal' penalty is applied.

The predicted noise levels at all NSRs comply with the Daytime criteria under Adverse conditions when both 'tonal' and 'adverse weather' penalties are applied.

The predicted noise levels exceed the evening and night criteria at All NSRs by 1-4 dBA when both 'tonal' and 'adverse weather' penalties are applied.

Table 2.11 Predicted LAeq 15min noise levels at NSRs during Adverse weather conditions for operations in dB(A)

NSR	Adverse weather conditions**	Adopted Daytime PSNL LAeq	Daytime exceeding intrusive criterial	Adopted Evening PSNL LAeq	Adopted Night PSNL LAeq	Evening Night exceeding intrusive criterial
R2	39	40	No	35	35	Yes +4
R3	38	40	No	35	35	Yes +3
R4	36	40	No	35	35	Yes +1
R5	39	40	No	35	35	Yes +4
R6	39	40	No	35	35	Yes +4

** includes an 'adverse weather' adjustment set at +5 dB(A)

Marginal exceedances of 1 to 2 dB(A) are deemed to have negligible impact as ≤ 2 dB exceedance is typically not discernible by the average human ear. Therefore, predicted levels that exceed the noise criteria by 2 dB or less are considered to achieve compliance with the criteria.

Hence, residence R4 is considered to achieve compliance with the criteria.

It should be noted that the noise emissions under normal conditions during operations are predicted to comply without the implementation of noise attenuation measures, such as introducing barriers for shielding, or possible noise control treatments on plant and equipment.

Based on the assessed exceedances under adverse weather conditions, noise mitigation measures have been recommended for Residences R2, R3, R5 and R6 and are presented in Section 3.2.

It is expected there may be elevated background noise levels from sources such as the Armidale Substation. As such, the actual RBLs in the vicinity of the Armidale Substation may be higher than the adopted minimum values.

However, following final selection of equipment and adjustments for final design, a rerun of the noise modelling (using 3D modelling) including any reductions for orientation, shielding, topography or increased accurate distances from an NSR, or allowance for background noise, the noise calculation assessment may predict that noise levels during operations will not exceed the intrusive criteria.

2.5 Vibration

2.5.1 Vibration guidelines

The NSW *Interim Construction Noise Guideline* calls for the application of feasible and reasonable measures to mitigate construction noise and vibration. The NSW Roads and

Maritime Service publication *Construction Noise and Vibration Guideline – August 2016* outlines assessing and mitigating construction noise and vibration impacts.

This guideline provides the detail needed to identify feasible and reasonable noise mitigation measures for construction, minor works and maintenance projects. As a guide, minimum working distances from sensitive receivers for typical items of vibration intensive plant are listed in Table 2.12. The minimum distances are quoted for both 'cosmetic' damage (refer BS7385) and human comfort (refer Assessing Vibration - a technical guideline (DEC 2006)):

- *Assessing Vibration - a technical guideline* is the Department of Environment and Conservation's Assessing Vibration: a technical guideline (February 2006).
- BS7385 is the British Standard *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings.*

Table 2.12 Recommended minimum working distances for vibration intensive plant from sensitive receiver

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

The minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

2.5.2 Assessment of vibration impacts

Vibration issues are expected to be negligible during either construction or operation due to the significant distance (>650 m) between the site and the nearest sensitive receivers.

2.6 Road traffic

2.6.1 Existing traffic activity

Road traffic data for this assessment was sourced from the traffic impact assessment for the development, prepared by Impact Traffic Engineering Pty Ltd (Impact 2023).

It is understood that traffic during construction and operations will access the project site from the west, entering and exiting from Eathorpe Road (Option B) (see Figure 1.2), with Waterfall Way (Option A) an alternative option.

Waterway Way is a State arterial road that generally carries in the order of 1,330 vehicles per day in the locality of the development site. About 133 vehicles (combined east and west) are expected during peak hours on average, with approximately 67 vehicles in each direction.

Eathorpe Road is classified as rural access road which is aligned in a north-south direction and extends between Waterfall Way to the north and a cul-de-sac to the south. Eathorpe Road currently provides access to five residential lots. Based on this, Eathorpe Road is expected to generate five vehicle movements during the peak period and up to 50 daily vehicle movements.

2.6.2 NSW Road Noise Policy

The NSW Road Noise Policy (DECCW 2011) sets out noise assessment criteria for existing dwellings affected by land use development. The policy sets different noise limits dependent upon the road category and type of project and land use as shown in Table 2.13.

The Department of Transport for NSW's *Construction Noise and Vibration Guideline* (RMS 2016) provides an initial screening test for their projects to first be applied by evaluating whether noise levels will increase by more than 2 dB(A) due to construction traffic or a temporary reroute due to a road closure. Where increases are 2 dB(A) or less then no further assessment or management is required.

Noise and vibration assessment of projects is undertaken using the XLS tool *Road Traffic Noise Estimator* (RMS 2015). Where noise levels increase by more than 2 dB(A) further assessment is required using the noise criteria guideline.

Since noise from construction traffic is non-permanent, guidance to feasible and reasonable noise mitigation differs from operational traffic noise.

2.6.3 Noise sensitive receivers

Traffic enters the site from Waterway Way and then on to Eathorpe Road for 200 m to the site entry point (Option B – the proposed option), or directly via Waterway Way (Option A – the alternative option).

For Option B, traffic on Eathorpe Road does not drive past any NSRs on the way to the site entry point. The nearest residents to the Eathorpe Road site entry point or the access corridor along Eathorpe Road to the development is a distance of over 650 m.

Table 2.13 Road traffic noise assessment criteria

Road category	Type of project/land use	Assessment criteria[1] – dB(A)	
		Day 7am to 10pm	Night 10pm to 7am
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments.	$L_{Aeq,15hr}$ 60 (external)	$L_{Aeq,9hr}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{Aeq,1hr}$ 55 (external)	$L_{Aeq,1hr}$ 50 (external)

[1] The assessment criteria for external noise levels apply at 1 metre from the facade of any affected residential receiver

2.6.4 Standard hours

The ICNG specifies standard construction hours that limit construction activities and traffic movement to the day period hours listed in Section 2.3.2. Operational traffic will also conform to these hours.

2.6.5 Construction phase

The access road network will typically limit internal construction traffic to internal access roads, with only deliveries and staff movements to and from the site required to travel across the external road network.

External traffic generated by the site will generally be split into three broad categories:

- general light vehicle (LV) traffic generated by staff travelling to/from the subject site
- heavy vehicles (HV) which are used for the delivery of BESS components and construction materials such as aggregate and water
- over dimensional (OD) vehicles used for the delivery of the large substation components.

Expected construction traffic movements are summarised in Table 2.14, taken from Impact (2021).

Noise Estimator

The TfNSW *Construction Noise Estimator* (RMS 2015) has been used to firstly assess the road traffic noise for the busiest period of construction for the Armidale BESS using the construction traffic volumes for Stage 2. If mitigation measures are required for Stage 2, the estimation process will be repeated for the remaining stages with lower traffic volumes.

The noise estimator assesses noise levels based on the type of road:

- freeway/arterial/sub-arterial roads look at the total vehicle movements

- local roads look at the worst case 1-hour vehicle movements.

Table 2.14 Estimated peak daily traffic volumes during construction

Stage	Duration months	Total return trips		OD movements (two-way movements)*	Anticipated daily peak construction traffic (movements)
		Light vehicles (per day)	Heavy vehicles (per day)		
Stage 1	2	30	6	8	74
Stage 2	3	40	5	8	92
Stage 3	4	40	5	0	90

* These are the anticipated one-way volumes throughout the entire project Stage (not daily movements) for OD deliveries. Accordingly, for each loaded inbound haulage movement, there is typically one unloaded outbound movement. On average, it is expected that 1 one way OD movement will occur every 4 days across the construction period of 5 months at which the OD deliveries are expected to occur (i.e., during Stage 1 and Stage 2).

Waterfall Way traffic

Background traffic movements have been sourced from the Transport for NSW's *Traffic Volume Viewer* website (TfNSW 2021). The proportions of heavy to light vehicles, night to day flow rates and worst hours for night and day have been estimated using the 2021 data from an equivalent road in northern NSW traffic (1,450 vehicles per day).

Additional construction traffic movements used in the estimation are sourced from the Traffic Impact Assessment (Impact 2021).

Tables 2.15, 2.16 and 2.17 detail the road conditions, estimation of traffic movements and estimation of traffic noise summary for Waterfall Way.

Table 2.15 Road conditions – Waterfall Way

Description	Selections
Ground type	Undeveloped green fields (rural areas with isolated dwellings)
Road surface	14 mm chipseal
Road type	Freeway/arterial/sub-arterial road

Table 2.16 Estimation of traffic movements – Waterfall Way

Traffic parameter	Day (7am to 10pm)		Night (10pm to 7am)	
Existing traffic	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**
Direction (1)	472	133	37	23
Direction (2)	472	133	38	22
Additional traffic				
Direction (1)	80	11	1	0
Direction (2)	80	11	1	0

Table 2.17 Estimation of traffic noise summary – Waterfall Way

Description	Day	Night
Noise criteria (residences)	60	55
Existing speed	100	100
Speed during construction	100	100
Output		
Change in noise levels (dBA)	0.5	0.0
Mitigation level (dBA)	60	55
Is the change in noise level greater than 2.0 dBA?	No	No
Require consideration of additional mitigation measures?	No	No
Mitigation distance (m)	-	-

As an average of 1,330 vehicles per day currently use the Waterfall Way (see Section 2.6.1), the 92 additional daily movements during the peak construction phase comprises an increase of up to about 7%. Accordingly, the assessment shows that the associated increase in traffic noise from the Waterfall Way during the construction stages is also expected to be minor.

Eathorpe Road traffic

All traffic movements used in the estimation are sourced from the Traffic Impact Assessment (Impact 2021).

Tables 2.18, 2.19 and 2.20 detail the road conditions, estimation of traffic movements and estimation of traffic noise summary for Eathorpe Road.

Table 2.18 Road conditions – Eathorpe Road

Description	Selections
Ground type	Undeveloped green fields (rural areas with isolated dwellings)
Road surface	DGA
Road type	Local road

Table 2.19 Estimation of traffic movements – Eathorpe Road

Traffic parameter	Worst Case 1-hour Day		Worst Case 1-hour Night	
Existing traffic	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**
Direction (1)	5	1	5	1
Direction (2)	5	1	5	1
Additional traffic				
Direction (1)	80	11	1	0
Direction (2)	0	0	1	0

Table 2.20 Estimation of traffic noise summary – Eathorpe Road

Description	Day	Night
Noise criteria (residences)	55	50
Existing speed	100	100
Speed during construction	70	70
Output		
Change in noise levels (dB(A))	6.4	0.0
Mitigation level (dB(A))	55	50
Is the change in noise level greater than 2.0 dB(A)?	Yes	No
Require consideration of additional mitigation measures?	Yes	No
Mitigation distance (m)	39	-

The mitigation distance for the Eathorpe road traffic is 39 m. As there will be no construction traffic passing NSRs on Eathorpe Road and as the nearest NSR is over 650 m away the assessment shows that no road noise-related impacts are anticipated at the NSRs.

2.6.6 Operational phase

The Armidale BESS is expected to be operated remotely with limited site visits, generating minimal traffic movements. It is anticipated the Armidale BESS will have a negligible impact upon traffic on the local road network. Details of likely traffic generation during the operation are estimated as follows:

- Daily routine maintenance: it is assumed that the daily traffic generation will not exceed two vehicle movements per day to the local road network, with all other movements being internal to the site.
- Occasional maintenance will occur when components of the development need to be replaced, such as replacing BESS machinery components.
- Visitors to the site such as off-site based staff and courier deliveries etc.

Hence, the operational activities are anticipated to have a negligible impact upon traffic volumes and a minimal impact on associated noise levels.

2.7 Cumulative Impacts

Potential cumulative noise impacts may result should project construction overlap with any other construction or any significant works within the vicinity of the project site.

Cumulative impacts associated with an increase in background noise levels could occur through earthworks, installation activities, traffic/transport and the operation of the BESS.

There is one project currently being undertaken in the vicinity of the project site:

- road improvement works for Waterfall Way (located immediately north of the site).

There are two major projects proposed within 10 km of the development site:

- Eathorpe BESS project (located 100 m to the west of the development site)
- Oxley Solar Farm (located 8 km southeast of the development site) on Waterfall Way.

2.7.1 Construction

Cumulative noise impacts during construction are most likely to result from increases in traffic along Waterfall Way associated with the Armidale BESS project in combination with other construction projects in the area.

The road improvement works for Waterfall Way will be undertaken in sections over four years. These works, along with the potential overlap with the Oxley Solar Farm and other project developments that use Waterfall Way can increase road traffic noise due to increased vehicle numbers, including heavy vehicles.

However, increases in traffic and transport intensity associated with the Armidale BESS project will be limited to the forecast 9-month construction phase and even during the peak construction period, traffic is not expected to increase by more than about 7%. Construction of the Oxley Solar Farm is anticipated to take between 12 and 18 months, with commencement planned in the third quarter of 2023 (NES&E 2021). Peak traffic movements during

construction of the Oxley Solar Farm are expected to be 96 vehicles per day, comparable to that of the Armidale BESS project.

Increases in traffic associate with the Waterfall Way roadworks can be expected to be proportionately much less, although the works can be expected to result in increased congestion due to lane closures which may cause noises associated with traffic deceleration and acceleration. The roadworks themselves will also be a source of noise.

It is not anticipated that these projects, even if they do overlap, will result in significant cumulative noise impacts. The TfNSW *Construction Noise Estimator* (RMS 2015) predicted only a 0.5 dB(A) increase in traffic noise levels during the day (and 0.0 dB(A) increase at night) along Waterfall Way as a result of the Armidale BESS project (see Section 2.6.5), well below the 2 dB(A) change triggering a requirement for mitigation. It is considered unlikely that construction traffic associated with the Oxley Solar Farm and Waterfall Way roadworks, even if peak traffic periods overlapped with the Armidale BESS, would exceed the 2 dB(A) threshold.

2.7.2 Operation

Potential cumulative noise impacts during project operation may result from the operation of the Armidale BESS in combination with the Armidale Substation and the Eathorpe BESS project (should it be developed).

The Armidale Substation is located approximately 400 m from its nearest residence R5 and is located between R5 and the project site, which is located 820 m from residence R5.

The noise level from either BESS facility would potentially be lower than the Armidale Substation at residence R5 due to its proximity and as such any impact would be negligible, due to the elevated background noise created by the existing Armidale Substation.

3 Proposed management

The noise assessment undertaken for the Armidale BESS was conservative and the assessment indicates there will be negligible noise impacts from the development.

3.1 Design

The final design and layout of equipment will consider noise attenuation measures such as sourcing quieter equipment, setbacks, orientation, shielding or other treatments on plant and equipment in relation to the sensitive receptors.

Noise modelling (using 3D modelling) will be undertaken during the detailed design phase, once equipment has been selected and final project design and configuration is known, to confirm or otherwise the need for project-specific noise mitigation measures during operation.

Background noise monitoring will be undertaken if required to help determine the need for mitigation measures.

3.2 Construction

The ICNG 2009 notes that work practices that minimise noise levels on site and provide for proper communication with the community are generally the most effective at managing noise.

GMR Energy has committed to preparing an Environmental Management Strategy, including sub-plans, which will include measures to:

- apply all feasible and reasonable work practices to minimise noise levels
- inform all potentially impacted residents the nature of works to be carried out, expected noise levels and duration, work practices applied to minimise noise, as well as contact details.

The noise impact assessment has shown that construction noise levels do not exceed the applicable criteria at the NSRs. However, it is proposed that noise monitoring be undertaken during construction to confirm predictions and determine any need for noise management measures.

If during Stage 1 of construction, noise management levels are exceeded at the NSRs, management measures such as the following will be implemented to achieve compliance:

- locating the equipment within the site so as to maintain a specified minimum distance to the NSRs
- operating the equipment within designated time periods rather than in an ad hoc manner to minimise the frequency of intrusion
- positioning equipment to make use of any natural shielding
- application of noise shielding or noise suppression measures
- consultation with the affected landholders to agree on measures.

3.3 Operation

The noise impact assessment has shown that operational noise levels do not exceed the intrusive criteria under normal conditions of operation.

During “adverse” weather conditions ALL NSRs exceed the intrusive criteria during the Evening and Night periods, although no exceedances are above 5 dB(A).

Based on the assessed exceedances under adverse weather conditions, noise mitigation measures are recommended for Residences R2, R3, R5 and R6 unless further noise modelling undertaken during the detailed design phase confirms that noise mitigation measures are not required.

Potential mitigation may be found through the optimal orientation of equipment, shielding noisy equipment at the source, the constructions of barriers, architectural treatments or a combination of these measures. However, due to the site constraints of existing power easements within the site, the construction of barrier mounds and walls are considered to be unsuitable.

It is predicted that noise level exceedances would only occur under adverse weather conditions (i.e. would not be common) and during the evening and night-time. Architectural treatments (such as double-glazing) at the affected residences may be an appropriate mitigation measure if the orientation or shielding of equipment is not practical or effective and barriers are not feasible.

Other approaches to reduce noise levels that could be considered include:

- requiring suppliers to reselect equipment with lower noise emissions
- installation of external mitigation to equipment such as acoustic louvres or attenuation kits
- adjusting fan speeds to account for reduced cooling capacity overnight.

3.4 Road traffic

Management of construction related traffic or traffic rerouting noise should as a minimum include the following controls (RfTMS 2006):

- scheduling and routing of vehicle movements
- limiting the speed of vehicles
- encouraging responsible driver behaviour and avoidance of the use of engine compression brakes
- ensuring vehicles are adequately silenced before allowing them to access the site.

3.5 Decommissioning

Management and mitigation measures to be implemented as part of decommissioning will be similar to those implemented during construction.

4 Conclusions

A noise assessment has been undertaken for the Armidale BESS. Construction noise impacts have been assessed in accordance with the ICNG and operational noise impacts have been assessed in accordance with the NSW Noise Policy for Industry 2017. Assessment of road noise impacts has also been undertaken in accordance with the NSW Road Noise Policy.

The assessment has concluded the following:

- The nearest sensitive receivers to the development site are residences R6, and R2, located 670 m to the northeast and 730 m south of the development site.
- Noise levels during construction are predicted to comply with noise management levels even when works are conducted at the closest points within the development site to the NSRs.
- Noise monitoring will be undertaken during construction to confirm predictions and determine any need for noise management measures.
- During “adverse” weather conditions NSRs exceed the intrusive criteria during the evening and night-time periods, although no exceedances are above 5 dB(A).
- Based on the assessed exceedances, noise mitigation measures have been recommended for Residences R2, R3, R5 and R6.
- Potential mitigation measures include the optimal orientation of equipment, shielding noisy equipment at the source, the constructions of barriers, architectural treatments or a combination of these measures. However, due to existing power easements within the site, the construction of barrier mounds and walls are considered to be unsuitable.
- Architectural treatment (such as double-glazing) of the affected residences may be an appropriate mitigation measure if other measures are not practical or effective, so that noise impacts are not experienced from within their residence during the evening and night-time.
- Other approaches to reduce noise levels that could be considered include:
  - Requiring suppliers to reselect equipment with lower noise emissions.
  - Installation of external mitigation to equipment such as acoustic louvres or attenuation kits.
  - Adjusting fan speeds to account for reduced cooling capacity overnight.
- Noise modelling during the detailed design phase, once equipment has been selected and final project design and configuration is known, may be able to demonstrate that project-specific noise mitigation measures during operation are not required.
- Vibration issues are expected to be negligible during either construction or operation due to the significant distance between the site and the nearest sensitive receivers.
- Increases in traffic volumes on the access route during construction and the associated increases to noise levels are expected to be minor.

- Increases to traffic volumes and noise impacts during the operation of the BESS will be negligible.
- No significant cumulative noise impacts are anticipated during either project construction or operation.

5 References

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Appendix A: Calculation sheets

AE1184.1 Armidale BESS (NSW)

Residence I.D.	Distance to (m)
R6 Residence to the northeast	650
R2 Residence to the south	700
R5 Residence to the west	800
R3 Residence to the southwest	830
R4 Residence to the southeast	910

Noise affected RBL+10dB

Day 45

Report table:

	SPL dB(A)
R6 Residence to the nor	40
R2 Residence to the sou	39
R5 Residence to the wes	43
R3 Residence to the sou	37
R4 Residence to the sou	36

R6 Residence to the northeast **650** **40**

Noise Source	Power level	Attenuation shielding	SWL	Distance m	SPL	Iw
Dozer	108	5	103	650	28	586
Grader	110	5	105	650	30	928
Excavator	107	5	102	650	27	465
Smooth drum roller	108	5	103	650	28	586
Bobcat	104	5	99	650	24	233
Front end loader	113	5	108	650	33	1852
Truck and dog	107	5	102	650	27	465
Concrete truck	108	5	103	650	28	586
Drilling rig	116	5	111	650	36	3696
Generator	99	5	94	650	19	74
Light vehicle	106	5	101	650	26	370

R2 Residence to the south **700** **39**

Noise Source	Power level	Attenuation shielding	SWL	Distance m	SPL	Iw
Dozer	108	5	103	700	27	487
Grader	110	5	105	700	29	771
Excavator	107	5	102	700	26	387
Smooth drum roller	108	5	103	700	27	487
Bobcat	104	5	99	700	23	194
Front end loader	113	5	108	700	32	1539
Truck and dog	107	5	102	700	26	387
Concrete truck	108	5	103	700	27	487
Drilling rig	116	5	111	700	35	3071
Generator	99	6	93	700	17	49
Light vehicle	106	5	101	700	25	307

R5 Residence to the west **800** **43**

Noise Source	Power level	Attenuation shielding	SWL	Distance m	SPL	Iw
Dozer	108		108	800	30	1102
Grader	110		110	800	32	1747
Excavator	107		107	800	29	876
Smooth drum roller	108		108	800	30	1102
Bobcat	104		104	800	26	439
Front end loader	113		113	800	35	3486
Truck and dog	107		107	800	29	876
Concrete truck	108		108	800	30	1102
Drilling rig	116		116	800	38	6955
Generator	99		99	800	21	139
Light vehicle	106		106	800	28	695

R3 Residence to the southwest **830** **37**

Noise Source	Power level	Attenuation shielding	SWL	Distance m	SPL	Iw
Dozer	108	5	103	830	25	318
Grader	110	5	105	830	27	504
Excavator	107	5	102	830	24	253
Smooth drum roller	108	5	103	830	25	318
Bobcat	104	5	99	830	21	127
Front end loader	113	5	108	830	30	1005
Truck and dog	107	5	102	830	24	253
Concrete truck	108	5	103	830	25	318
Drilling rig	116	5	111	830	33	2006
Generator	99	6	93	830	15	32
Light vehicle	106	5	101	830	23	201

R4 Residence to the southeast **910** **36**

Noise Source	Power level	Attenuation shielding	SWL	Distance m	SPL	Iw
Dozer	108	5	103	910	24	253
Grader	110	5	105	910	26	400
Excavator	107	5	102	910	23	201
Smooth drum roller	108	5	103	910	24	253
Bobcat	104	5	99	910	20	101
Front end loader	113	5	108	910	29	799
Truck and dog	107	5	102	910	23	201
Concrete truck	108	5	103	910	24	253
Drilling rig	116	5	111	910	32	1594
Generator	99	6	93	910	14	25
Light vehicle	106	5	101	910	22	159

AE1184.1 Armidale BESS (NSW)

Residence I.D.	Distance to (m)
R6 Residence to the northeast	650
R2 Residence to the south	700
R5 Residence to the west	800
R3 Residence to the southwest	830
R4 Residence to the southeast	910

Noise affected RBL+10dB

Day 45

Report table:

	SPL dB(A)
R6 Residence to the nor	37
R2 Residence to the sou	36
R5 Residence to the wes	40
R3 Residence to the sou	34
R4 Residence to the sou	33

R6 Residence to the northeast **650** **37**

Noise Source	Power level	Attenuation shielding	SWL	Distance m	SPL	Iw
Truck and dog	107	5	102	650	27	465
Franna crane	104	5	99	650	24	233
Fork lift	106	5	101	650	26	370
Hand tools	116	5	111	650	36	3696
Light vehicle	106	5	101	650	26	370

R2 Residence to the south **700** **36**

Noise Source	Power level	Attenuation shielding	SWL	Distance m	SPL	Iw
Truck and dog	107	5	102	700	26	387
Franna crane	104	5	99	700	23	194
Fork lift	106	6	100	700	24	244
Hand tools	116	5	111	700	35	3071
Light vehicle	106	5	101	700	25	307

R5 Residence to the west **800** **40**

Noise Source	Power level	Attenuation shielding	SWL	Distance m	SPL	Iw
Truck and dog	107		107	800	29	876
Franna crane	104		104	800	26	439
Fork lift	106		106	800	28	695
Hand tools	116		116	800	38	6955
Light vehicle	106		106	800	28	695

R3 Residence to the southwest **830** **34**

Noise Source	Power level	Attenuation shielding	SWL	Distance m	SPL	Iw
Truck and dog	107	5	102	830	24	253
Franna crane	104	5	99	830	21	127
Fork lift	106	5	101	830	23	201
Hand tools	116	5	111	830	33	2006
Light vehicle	106	5	101	830	23	201

R4 Residence to the southeast **910** **33**

Noise Source	Power level	Attenuation shielding	SWL	Distance m	SPL	Iw
Truck and dog	107	5	102	910	23	201
Franna crane	104	5	99	910	20	101
Fork lift	106	5	101	910	22	159
Hand tools	116	5	111	910	32	1594
Light vehicle	106	5	101	910	22	159

AE1184.1 Armidale BESS (NSW)

Residence I.D.	Distance to (m)
R6 Residence to the northeast	650
R2 Residence to the south	700
R5 Residence to the west	800
R3 Residence to the southwest	830
R4 Residence to the southeast	910

Noise affected RBL+10dB

Day 45

Report table:

	SPL dB(A)
R6 Residence to the nor	37
R2 Residence to the sou	36
R5 Residence to the wes	40
R3 Residence to the sou	34
R4 Residence to the sou	33

R6 Residence to the northeast **650** **37**

Noise Source	Power level	Shielding correction	SWL	Distance m	SPL	Iw
Truck and dog	107	5	102	650	27	465
Franna crane	104	5	99	650	24	233
Hand tools	116	5	111	650	36	3696
Light vehicle	106	5	101	650	26	370

R2 Residence to the south **700** **36**

Noise Source	Power level	Shielding correction	SWL	Distance m	SPL	Iw
Truck and dog	107	5	102	700	26	387
Franna crane	104	5	99	700	23	194
Hand tools	116	5	111	700	35	3071
Light vehicle	106	5	101	700	25	307

R5 Residence to the west **800** **40**

Noise Source	Power level	Shielding correction	SWL	Distance m	SPL	Iw
Truck and dog	107		107	800	29	876
Franna crane	104		104	800	26	439
Hand tools	116		116	800	38	6955
Light vehicle	106		106	800	28	695

R3 Residence to the southwest **830** **34**

Noise Source	Power level	Shielding correction	SWL	Distance m	SPL	Iw
Truck and dog	107	5	102	830	24	253
Franna crane	104	5	99	830	21	127
Hand tools	116	5	111	830	33	2006
Light vehicle	106	5	101	830	23	201

R4 Residence to the southeast **910** **33**

Noise Source	Power level	Shielding correction	SWL	Distance m	SPL	Iw
Truck and dog	107	5	102	910	23	201
Franna crane	104	5	99	910	20	101
Hand tools	116	5	111	910	32	1594
Light vehicle	106	5	101	910	22	159

AE1184.1 Armidale BESS (NSW)

Residence I.D.	Distance to (m)
R6 Residence to the northeast	650
R2 Residence to the south	700
R5 Residence to the west	800
R3 Residence to the southwest	830
R4 Residence to the southeast	910

Noise affected RBL+10dB

Day 45

Report table:

	SPL dB(A)
R6 Residence to the nor	36
R2 Residence to the sou	35
R5 Residence to the wes	39
R3 Residence to the sou	33
R4 Residence to the sou	32

R6 Residence to the northeast **650** **36**

Noise Source	Power level	Shielding correction	SWL	Distance m	SPL	Iw
Hand tools	116	5	111	650	36	3696
Light vehicle	106	5	101	650	26	370

R2 Residence to the south **700** **35**

Noise Source	Power level	Shielding correction	SWL	Distance m	SPL	Iw
Hand tools	116	5	111	700	35	3071
Light vehicle	106	5	101	700	25	307

R5 Residence to the west **800** **39**

Noise Source	Power level	Shielding correction	SWL	Distance m	SPL	Iw
Hand tools	116		116	800	38	6955
Light vehicle	106		106	800	28	695

R3 Residence to the southwest **830** **33**

Noise Source	Power level	Shielding correction	SWL	Distance m	SPL	Iw
Hand tools	116	5	111	830	33	2006
Light vehicle	106	5	101	830	23	201

R4 Residence to the southeast **910** **32**

Noise Source	Power level	Shielding correction	SWL	Distance m	SPL	Iw
Hand tools	116	5	111	910	32	1594
Light vehicle	106	5	101	910	22.0	159

AE1184.1 Armidale BESS (NSW)

Plant	Units	SPL (dBA)
HVT	2	84
BC	104	83
MVT	52	79
PCU/Inverter	52	93

R2 Residence to the south	
Nearest boundary	730

Residence to:	+ Dist	HVT	MVT	PCU/Inverter	BC
HVT	300	2			
1st row	70		16	16	32
Middle rows	130		22	22	44
End rows	190		14	14	28

+ Distances measured using Google Earth

Plant	SWL	Shielding correction	SWL	Distance m	SPL	No. of units	Quantity correction	Contribution SPL	Contribution lw
HVT	84	5	79	1030	0	2	3	3	2
1st row									
BC	83	5	78	800	1	32	15	16	44
MVT	79	5	74	800	-3	16	12	9	9
PCU/Inverter	93	5	88	800	11	16	12	23	222
Middle rows									
BC	83	5	78	860	1	44	16	17	51
MVT	79	5	74	860	-3	22	13	10	10
PCU/Inverter	93	5	88	860	11	22	13	24	255
End rows									
BC	83	5	78	920	0	28	14	14	27
MVT	79	5	74	920	-4	14	11	7	5
PCU/Inverter	93	5	88	920	10	14	11	21	137

Total SPL	lw
29	763

Penalty

Tonal	5
Adverse	5
	10

Neutral	**34**
Adverse	**39**

AE1184.1 Armidale BESS (NSW)

Plant	Units	SPL (dBA)
HVT	2	84
BC	104	83
MVT	52	79
PCU/Inverter	52	93

R3 Residence to the southwest	
Nearest boundary	820

Residence to:	+ Dist	HVT	MVT	PCU/Inverter	BC
HVT	300	2			
1st row	70		14	14	28
Middle rows	130		22	22	44
End rows	190		16	16	32

+ Distances measured using Google Earth

Plant	SWL	Shielding correction	SWL	Distance m	SPL	No. of units	Quantity correction	Contribution SPL	Contribution lw
HVT	84	5	79	1120	-1	2	3	2	2
1st row									
BC	83	5	78	890	0	28	14	15	30
MVT	79	5	74	890	-4	14	11	8	6
PCU/Inverter	93	5	88	890	10	14	11	22	149
Middle rows									
BC	83	5	78	950	0	44	16	16	40
MVT	79	5	74	950	-4	22	13	9	8
PCU/Inverter	93	5	88	950	10	22	13	23	199
End rows									
BC	83	5	78	1010	-1	32	15	14	25
MVT	79	5	74	1010	-5	16	12	7	5
PCU/Inverter	93	5	88	1010	9	16	12	21	124

Total SPL	lw
28	586

Penalty

Tonal	5
Adverse	5
	10

Neutral	**33**
Adverse	**38**

AE1184.1 Armidale BESS (NSW)

Plant	Units	SPL (dBA)
HVT	2	84
BC	104	83
MVT	52	79
PCU/Inverter	52	93

R4 Residence to the southeast	
Nearest boundary	930

Residence to:	+ Dist	HVT	MVT	PCU/Inverter	BC
HVT	300	2			
1st row	70		14	14	28
Middle rows	130		22	22	44
End rows	190		16	16	32

+ Distances measured using Google Earth

Plant	SWL	Shielding correction	SWL	Distance m	SPL	No. of units	Quantity correction	Contribution SPL	Contribution lw
HVT	84	5	79	1230	-2	2	3	1	1
1st row									
BC	83	5	78	1000	-1	28	14	13	22
MVT	79	5	74	1000	-5	14	11	6	4
PCU/Inverter	93	5	88	1000	9	14	11	20	111
Middle rows									
BC	83	5	78	1060	-2	44	16	15	30
MVT	79	5	74	1060	-6	22	13	8	6
PCU/Inverter	93	5	88	1060	8	22	13	22	151
End rows									
BC	83	5	78	1120	-2	32	15	13	19
MVT	79	5	74	1120	-6	16	12	6	4
PCU/Inverter	93	5	88	1120	8	16	12	20	96

Total SPL	lw
26	445

Penalty

Tonal	5
Adverse	5
	10

Neutral	**31**
Adverse	**36**

AE1184.1 Armidale BESS (NSW)

Plant	Units	SPL (dBA)
HVT	2	84
BC	104	83
MVT	52	79
PCU/Inverter	52	93

R5 Residence to the west	
Nearest boundary	820

Residence to:	+ Dist	HVT	MVT	PCU/Inverter	BC
HVT	25	2			
1st row	80		6	6	12
Middle rows	105		24	24	48
End rows	130		22	22	44

+ Distances measured using Google Earth

Plant	SWL	Shielding correction	SWL	Distance m	SPL	No. of units	Quantity correction	Contribution SPL	Contribution lw
HVT	84		84	845	7	2	3	10	10
1st row									
BC	83		83	900	5	12	11	16	39
MVT	79		79	900	1	6	8	9	8
PCU/Inverter	93		93	900	15	6	8	23	196
Middle rows									
BC	83	5	78	925	0	48	17	17	46
MVT	79	5	74	925	-4	24	14	10	9
PCU/Inverter	93	5	88	925	10	24	14	24	232
End rows									
BC	83	5	78	950	0	44	16	16	40
MVT	79	5	74	950	-4	22	13	9	8
PCU/Inverter	93	5	88	950	10	22	13	23	199

Total SPL	lw
29	786

Penalty

Tonal	5
Adverse	5
	10

Neutral	**34**
Adverse	**39**

AE1184.1 Armidale BESS (NSW)

Plant	Units	SPL (dBA)
HVT	2	84
BC	104	83
MVT	52	79
PCU/Inverter	52	93

R6 Residence to the northeast	
Nearest boundary	670

Residence to:	+ Dist	HVT	MVT	PCU/Inverter	BC
HVT	50	2			
1st row	100		14	14	28
Middle rows	160		22	22	44
End rows	220		16	16	32

+ Distances measured using Google Earth

Plant	SWL	Shielding correction	SWL	Distance m	SPL	No. of units	Quantity correction	Contribution SPL	Contribution lw
HVT	84	5	79	720	4	2	3	7	5
1st row									
BC	83	5	78	770	2	28	14	16	43
MVT	79	5	74	770	-2	14	11	9	9
PCU/Inverter	93	5	88	770	12	14	11	23	214
Middle rows									
BC	83	5	78	830	1	44	16	17	56
MVT	79	5	74	830	-3	22	13	10	11
PCU/Inverter	93	5	88	830	11	22	13	24	278
End rows									
BC	83	5	78	890	0	32	15	15	34
MVT	79	5	74	890	-4	16	12	8	7
PCU/Inverter	93	5	88	890	10	16	12	22	170

Total SPL	lw
29	826

Penalty

Tonal	5
Adverse	5
	10

Neutral	**34**
Adverse	**39**

AE1184.1 Armidale BESS Traffic Flow Waterfall Way

year	cardinal_direction_seq	classification_seq	hour_00	hour_01	hour_02	hour_03	hour_04	hour_05	hour_06	hour_07	hour_08	hour_09	hour_10	hour_11	hour_12	hour_13	hour_14	hour_15	hour_16	hour_17	hour_18	hour_19	hour_20	hour_21	hour_22	hour_23	daily_total
2015	Eastbound	Heavy Vehicles	2	2	2	2	2	3	5	8	8	9	9	9	8	9	9	10	8	6	5	4	3	3	3	2	131
2015	Eastbound	Light Vehicles	4	2	2	2	3	5	16	30	39	42	43	43	45	47	45	48	48	39	20	12	8	7	5	4	559
2015	Eastbound	All Vehicles	5	3	2	2	4	7	21	38	46	50	51	52	53	55	53	57	56	44	24	15	10	9	6	5	668
2015	Westbound	Light Vehicles	3	2	2	2	4	5	13	21	45	44	45	42	39	40	42	44	41	38	24	14	9	8	5	4	536
2015	Westbound	Heavy Vehicles	2	2	2	2	3	3	5	8	10	10	11	10	11	9	11	11	11	8	6	5	4	4	4	3	155
2015	Westbound	All Vehicles	4	3	2	3	6	7	18	28	54	53	55	52	49	49	52	54	51	45	30	18	13	11	8	6	671
2016	Westbound	Heavy Vehicles	2	2	2	2	2	3	4	8	10	10	10	11	10	10	11	11	10	8	6	5	4	4	4	3	152
2016	Westbound	Light Vehicles	3	2	2	3	4	5	11	22	42	44	44	42	40	41	44	44	42	37	27	15	10	7	5	4	540
2016	Westbound	All Vehicles	3	3	2	4	5	7	14	30	51	53	54	52	49	51	54	54	52	44	32	19	14	10	8	6	671
2017	Eastbound	Heavy Vehicles	2	2	2	2	3	6	11	12	12	12	14	15	13	13	12	13	10	8	5	4	3	3	3	2	182
2017	Eastbound	Light Vehicles	3	2	2	2	9	28	29	29	40	43	44	45	46	46	45	47	46	36	19	12	8	7	5	3	596
2017	Eastbound	All Vehicles	3	2	2	2	11	33	39	40	51	55	57	59	58	59	56	60	55	44	24	16	10	9	6	4	755
2017	Westbound	Light Vehicles	3	2	2	3	4	5	12	23	40	44	45	45	42	43	46	46	47	47	39	17	11	8	5	4	583
2017	Westbound	Heavy Vehicles	2	2	2	2	2	3	6	9	13	12	14	14	13	13	14	14	14	12	9	6	5	4	4	3	192
2017	Westbound	All Vehicles	3	3	3	4	5	7	17	31	52	56	58	58	54	56	59	60	61	59	48	22	15	11	8	5	755
2018	Eastbound	Heavy Vehicles	2	2	2	2	2	4	9	11	12	12	13	14	12	12	12	13	12	8	6	5	3	3	3	2	176
2018	Eastbound	Light Vehicles	3	2	2	2	3	14	30	29	38	42	42	44	43	45	44	44	44	33	17	11	8	6	4	3	553
2018	Eastbound	All Vehicles	5	3	2	2	4	17	37	40	50	53	54	57	55	56	56	57	56	41	22	15	11	8	6	4	711
2018	Westbound	Heavy Vehicles	2	2	2	2	3	4	7	8	13	11	12	12	12	12	13	13	13	11	8	5	5	4	3	3	180
2018	Westbound	Light Vehicles	3	2	2	2	4	5	12	20	42	44	43	42	41	44	44	46	45	44	30	15	10	7	4	3	554
2018	Westbound	All Vehicles	3	2	3	3	6	8	18	27	54	54	55	54	52	56	56	59	57	55	37	19	14	11	7	5	715
2019	Westbound	Light Vehicles	3	2	2	2	4	6	12	20	43	41	42	39	39	41	43	44	41	37	23	13	8	6	4	3	518
2019	Westbound	Heavy Vehicles	2	2	2	2	2	3	6	8	11	12	12	12	12	12	12	13	13	11	7	5	4	4	4	3	174
2019	Westbound	All Vehicles	3	3	3	3	6	8	18	27	54	52	54	51	51	53	54	56	54	48	30	17	12	10	7	5	679
2019	Eastbound	Light Vehicles	3	2	2	2	3	6	19	30	38	41	41	43	44	43	43	44	44	31	17	11	8	6	4	3	528
2019	Eastbound	Heavy Vehicles	2	2	2	2	2	4	8	12	12	11	12	13	11	11	10	12	11	8	6	4	4	3	3	2	167
2019	Eastbound	All Vehicles	4	3	2	2	4	9	27	41	49	52	52	56	54	53	53	55	54	38	23	15	11	8	5	4	674
2020	Eastbound	Light Vehicles	3	2	2	2	3	7	19	28	33	38	39	42	43	43	39	42	41	30	16	9	7	5	4	3	500
2020	Eastbound	Heavy Vehicles	2	2	2	2	2	4	7	11	10	10	11	12	10	11	10	11	10	7	5	4	3	3	2	2	153
2020	Eastbound	All Vehicles	4	3	2	2	4	10	25	38	43	48	50	54	52	53	49	53	50	37	21	12	9	6	5	4	634
2020	Westbound	Light Vehicles	2	2	2	2	4	6	11	20	38	38	40	39	39	40	40	40	40	33	20	11	7	6	4	3	487
2020	Westbound	Heavy Vehicles	2	2	2	2	2	3	5	8	11	12	12	12	11	12	11	12	12	9	6	4	4	4	3	3	164
2020	Westbound	All Vehicles	3	3	3	3	5	8	16	27	49	49	52	50	49	52	51	51	52	41	25	15	10	8	6	5	633
2021	Westbound	Heavy Vehicles	2	2	2	2	2	3	4	8	12	13	13	13	12	12	13	12	14	11	6	4	4	3	3	3	173
2021	Westbound	Light Vehicles	3	2	2	2	4	4	12	24	43	42	45	44	44	46	45	44	44	40	24	13	9	7	4	3	550
2021	Westbound	All Vehicles	3	3	3	3	5	7	15	31	54	55	58	56	55	58	57	56	58	50	30	17	12	9	7	5	707
2021	Eastbound	Heavy Vehicles	2	2	2	2	2	4	8	11	11	10	11	12	12	12	10	11	9	7	5	4	3	3	2	2	157
2021	Eastbound	Light Vehicles	3	2	2	2	3	8	19	29	41	43	44	47	49	48	46	49	48	35	18	11	8	6	4	3	568
2021	Eastbound	All Vehicles	4	3	3	3	4	11	26	39	51	53	55	58	60	59	55	60	56	42	22	14	10	8	5	4	705

Source:

Transport for NSW

https://roads-waterways.transport.nsw.gov.au/about/corporate-publications/statistics/traffic-volumes/aadt-map/index.html#/?z=8&lat=-30.7738472882512478lon=152.15838362961134&id=6133

Accessed: 4-Aug-21

Summary of traffic flow (2021)

Type		Day (7am-10pm)	%	Night (10pm-7am)	%	Total
Heavy Vehicles		281	21.3%	49	37%	330
Light Vehicles		1036	79%	82	63%	1118
Total		1317	91%	131	9%	1448

Breakdown of traffic flow

Type	Direction	Day (7am-10pm)	%	Night (10pm-7am)	%	Total
Heavy Vehicles	Westbound	150	22.6%	23	39%	173
Light Vehicles	Westbound	514	77%	36	61%	550
						723
Heavy Vehicles	Eastbound	131	20%	26	36%	157
Light Vehicles	Eastbound	522	80%	46	64%	568
						725
						1448

Estimated traffic flow (Waterfall Way)

	Estimate No.	Day (7am-10pm)	%	Night (10pm-7am)	%	Total
Total	1330	1210	91%	120	9%	1330

Breakdown of Estimated traffic flow

Type	Direction	Day (7am-10pm)	%	Night (10pm-7am)	%	Total
Heavy Vehicles	Westbound	133	22%	23	39%	156
Light Vehicles	Westbound	472	78%	37	61%	509
						665
Heavy Vehicles	Eastbound	133	22%	22	36%	155
Light Vehicles	Eastbound	472	78%	38	64%	510
						665
						1330

AE1184.1 Armidale BESS Traffic Noise Earthorpe Road 9Nov2021

Road Traffic Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Ground type	Undeveloped green fields (rural areas with isolated dwellings)
Road surface	DGA
Road type	Local road

Note that a road is new if a road's functional class changes during construction. For example, rerouting traffic from an arterial road temporarily to a collector road changes the functional class of the collector road for the duration of the temporary reroute.

	Day	Night
Noise criteria (residences)	55	50
Existing speed	100	100
Speed during construction	70	70

	Day (7am to 10pm)		Night (10pm to 7am)		Worst Case 1-hour Day		Worst Case 1-hour Night	
Existing traffic	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**
Direction (1)	10000	800	3420	380	5	1	5	1
Direction (2)	8000	700	3420	380	5	1	5	1
Additional traffic								
Direction (1)	12	5	0	0	80	11	1	0
Direction (2)	12	5	3125	235	0	0	1	0

	Day	Night
Change in noise levels (dBA)	6.4	-2.0
Mitigation level (dBA)	55	50
Is the change in noise level greater than 2.0 dBA?	Yes	No
Require consideration of additional mitigation measures?	Yes	No
Mitigation distance (m)	39	

To assess noise impacts from construction traffic or a temporary reroute due to a road closure or both an initial screening test should be undertaken by evaluating whether noise levels will increase by more than 2dB(A). Where increases are 2dBA or less then no further assessment is required. Where noise levels increase by more than 2dBA (2.1dBA) and noise levels exceed the controlling criterion then the receiver qualifies for consideration of noise mitigation under the Noise Mitigation Guideline. [note: the assessment methodology is similar to minor works so in any instance the only trigger for noise mitigation under the NMG shall be due to noise level increase]

Mitigation Measures
Management of construction related traffic or traffic reroutes noise should as a minimum include the following controls:
- Scheduling and routing of vehicle movements
- Speed of vehicles
- Driver behaviour and avoidance of the use of engine compression brakes
- Ensuring vehicles are adequately silenced before allowing them to access the site

Where noise impacts are greater than one year then consideration should be given to the following measures where feasible and reasonable:
- temporary noise barriers
- at-receiver noise mitigation

Feasible and reasonable considerations should also include:
- time of day of the noise increase and exceedance of criteria
- time of use of affected receivers
- how many decibels the noise levels are to increase
- how long the mitigation will provide benefit to the receiver during the project

Calculating noise level at the receiver

Distance to receiver (m)	
Direction (1)	650
Direction (2)	650

	Day	Night
Predicted noise levels (dBA) @ 1m from the façade	37.5	30.8

Note:
(1) Noise reports present noise levels rounded to the nearest integer and differences between two noise levels rounded to a single decimal place.
(2) noise barriers more than 3 metres high, if designed using Roads and Maritime guidelines, would generally provide an insertion loss of around 5 dB(A) at the most affected residence.
(3) noise barriers more than 5 metres high, if designed using Roads and Maritime guidelines, would generally provide an insertion loss of around 10 dB(A) at the most affected residence.

AE1184.1 Armidale BESS Traffic Noise Waterfall Way 9Nov2021

Road Traffic Noise Estimator

Please input information into yellow cells
Please pick from drop-down list in orange cells

Ground type	Undeveloped green fields (rural areas with isolated dwellings)
Road surface	14mm Chipseal
Road type	Freeway/arterial/sub-arterial road

Note that a road is new if a road's functional class changes during construction. For example, rerouting traffic from an arterial road temporarily to a collector road changes the functional class of the collector road for the duration of the temporary reroute.

	Day	Night
Noise criteria (residences)	60	55
Existing speed	100	100
Speed during construction	100	100

	Day (7am to 10pm)		Night (10pm to 7am)		Worst Case 1-hour Day		Worst Case 1-hour Night	
Existing traffic	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**	**Light vehicles**	**Heavy vehicles**
Direction (1)	472	133	37	23	4	1	0	0
Direction (2)	472	133	38	22	4	1	5	0
Additional traffic								
Direction (1)	80	11	1	0	53	2	1	0
Direction (2)	80	11	1	0	0	2	1	0

	Day	Night
Change in noise levels (dBA)	0.5	0.0
Mitigation level (dBA)	60	55
Is the change in noise level greater than 2.0 dBA?	No	No
Require consideration of additional mitigation measures?	No	No
Mitigation distance (m)		

To assess noise impacts from construction traffic or a temporary reroute due to a road closure or both an initial screening test should be undertaken by evaluating whether noise levels will increase by more than 2dB(A). Where increases are 2dBA or less then no further assessment is required. Where noise levels increase by more than 2dBA (2.1dBA) and noise levels exceed the controlling criterion then the receiver qualifies for consideration of noise mitigation under the Noise Mitigation Guideline. [note: the assessment methodology is similar to minor works so in any instance the only trigger for noise mitigation under the NMG shall be due to noise level increase]

Mitigation Measures
Management of construction related traffic or traffic reroutes noise should as a minimum include the following controls:
- Scheduling and routing of vehicle movements
- Speed of vehicles
- Driver behaviour and avoidance of the use of engine compression brakes
- Ensuring vehicles are adequately silenced before allowing them to access the site

Where noise impacts are greater than one year then consideration should be given to the following measures where feasible and reasonable:
- temporary noise barriers
- at-receiver noise mitigation

Feasible and reasonable considerations should also include:
- time of day of the noise increase and exceedance of criteria
- time of use of affected receivers
- how many decibels the noise levels are to increase
- how long the mitigation will provide benefit to the receiver during the project

Calculating noise level at the receiver

Distance to receiver (m)	
Direction (1)	50
Direction (2)	50

	Day	Night
Predicted noise levels (dBA) @ 1m from the façade	59.9	54.7

Note:
(1) Noise reports present noise levels rounded to the nearest integer and differences between two noise levels rounded to a single decimal place.
(2) noise barriers more than 3 metres high, if designed using Roads and Maritime guidelines, would generally provide an insertion loss of around 5 dB(A) at the most affected residence.
(3) noise barriers more than 5 metres high, if designed using Roads and Maritime guidelines, would generally provide an insertion loss of around 10 dB(A) at the most affected residence.