APPENDIX I

ACOUSTIC REPORT

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Murrumbateman Distribution BESS

3 Turton Place, Murrumbateman, NSW

Acoustic Report – Environmental Noise Emission Assessment

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Table of Contents

1. Introduction

The proposal includes the construction and operation of a new 4.95MW battery energy storage system (BESS) facility at the site described as 3 Turton Place, Murrumbateman, New South Wales.

The subject site is currently occupied by farmland, a residential dwelling and rural infrastructure including fencing, roadways and outbuildings. The area designated for the proposed BESS is currently used for agricultural activities.

The new facility will include electrical infrastructure which will generate noise emissions with the potential to impact on the acoustic amenity of the surrounding environment including at residential receptors.

In consideration of the above, Watson Moss Growcott Acoustics (WMG) has been engaged to undertake an assessment of noise emissions from the proposal to consider the following:

- Noise and vibration associated with electrical infrastructure and vehicle activity at the subject site during general operations associated with the proposed facility.
- Noise and vibration emissions associated with the construction phase of the proposal.

This report presents the findings of the assessment, and where appropriate, includes indicative noise mitigation strategies to minimise the potential for adverse impacts at nearby noise sensitive receptor locations.

2. Noise Assessment Terminology

Noise assessment terminology used within this report is defined within Table 1 below.

Table 1: Noise Assessment Terminology

Terminology	Definition
dB(A)	Decibels recorded on a sound level meter, which has had its frequency response modified electronically to an international standard, to quantify the average human loudness response to sounds of different character
L_{eq} / L_{Aeq}	The equivalent continuous level that would have the same total acoustic energy over the measurement period as the actual varying noise level under consideration. It is the noise measure defined by the EPA as the measure of the noise to use in assessing compliance with noise limits.
L_{90} / L_{A90}	The level exceeded for 90% of the measurement period, which is representative of the typical lower levels in a varying noise environment. It is the noise measure defined by the EPA as the measure of the background noise level to use in determining noise limits.
Sound Power Level (Lw)	The sound power level of a source is a measure of the amount of energy in the form of sound emitted from the source. The sound power level of a source is an inherent characteristic of that source and does not vary with distance from the source or with a different acoustic environment. The sound power level equals the sound pressure level at a distance from the source plus 10 times the logarithm (to base 10) of the measurement surface area (m^2), and is relative to a reference sound power of 1pW, (10-12 Watts).
Sound Pressure Level (Lp)	Sound that we can hear with our ears or measure with a sound level meter is actually small variations in the pressure of the air around us. The magnitude of the pressure fluctuations vary over a very wide range from the very lowest levels we can just hear to the very high levels we need to be protected from, and for that reason sound is measured on a logarithmic scale. The sound pressure level equals 10 times the logarithm (to base 10) of the sound pressure divided by a reference pressure, which is 20 µPa. The sound pressure level reduces with increasing distance from a source and is influenced by the surroundings.

3. Site and Surrounding Environment

The land under consideration is located at 3 Turton Place, Murrumbateman, New South Wales.

The subject site boundary adjoins Turton Place to the south and is adjacent to RU4 zoned land to the east, west and north. The area of land under consideration is located in the northwest corner of the subject site and is rectangular in shape.

The land in immediate proximity of the proposal is generally vacant and would not be expected to be noise sensitive in accordance with legislative or guideline criteria.

The closest and therefore most critical sensitive uses located within proximity of the site will include:

- **R01** – 3 Turton Place, Murrumbateman.
- **R02** – 4 Turton Place, Murrumbateman.
- **R03** – 5 Turton Place, Murrumbateman.
- **R04** – 270 Murrumbateman Road, Murrumbateman.
- **R05** – 1A Turton Place, Murrumbateman.
- **R06** – 1 Turton Place, Murrumbateman.

Information regarding the location and the use at the sensitive receptors has been provided by the client.

It is noted that the site is also in proximity to the 'Dionysus Winery and Woo Chocolate' premises which is located at 1 Patemans Lane to the northeast of the site. This site is identified as **R07** below.

Figure 1 below provides an aerial photo of the site and surrounds including the sensitive receptors which have been considered as part of the noise emission assessment.

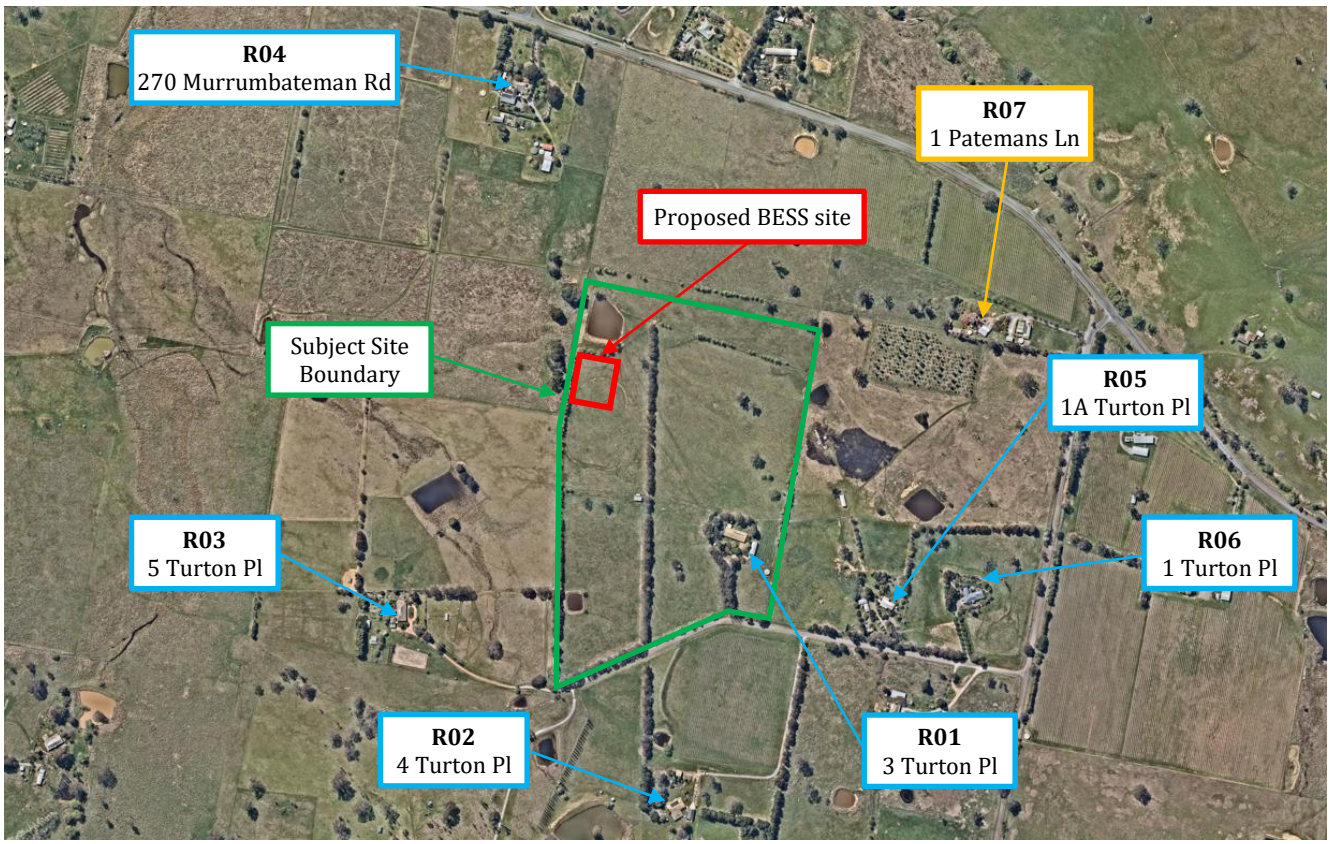


Figure 1: Proposed subject site and surrounding environment

4. Operational Phase Noise Assessment

4.1. Operational Noise Criteria

4.1.1. Overview

The NSW Environment Protection Authority (EPA) Noise Policy for Industry (NPfI) provides criterion for addressing operational noise emissions associated with the proposed use at sensitive receptors. The Policy was released in 2017 and includes relevant methodologies for assessment and management of typical operational noise emissions from industrial premises within NSW.

Within the NPfI, commercial noise emissions are considered during various assessment periods defined as the day, evening, and night to reflect the sensitivity associated within the impacts of noise. The assessment periods defined by the EPA are included within Table 2 below.

Table 2: EPA Defined Assessment Periods

EPA Assessment Period	Relevant Days	Relevant Time Periods
Day	Monday to Saturday	7:00am to 6:00pm
	Sunday	8:00am to 6:00pm
Evening	All Days	6:00pm to 10:00pm
Night	Monday to Saturday	10:00pm to 7:00am
	Sunday	10:00pm to 8:00am

When addressing noise emissions associated with commercial/industrial uses, the NPfi defines project trigger levels which are used to consider potential impacts at sensitive receptors. The levels are determined based on consideration of what the NPfI refers to as the 'Project Intrusiveness Noise Level', and the 'Project Amenity Noise Levels'.

In accordance with the NPfI methodologies, project trigger levels are adopted based on the lower and more stringent of the determined intrusiveness and amenity noise levels.

4.1.2. Project Intrusiveness Noise Criteria

The intent of the project intrusiveness noise level is to minimise the potential for change in the acoustic environment at relevant sensitive receptors by ensuring that impacts associated with a new source are controlled to values 5 dB above a minimum threshold noise level.

The attributable noise levels are defined as L_{Aeq} values assessed over a 15 minute period.

WMG has not undertaken any measurement of the ambient noise environment at or within the vicinity of the site for the preparation of this report.

The proposed development is situated in a rural residential environment characterised by RU4 zoned land consisting of agricultural production with scattered dwellings. The site is additionally located in proximity to two major arterial roadways, Murrumbateman Road and the Barton Highway. Given the surrounding land uses there is the potential that the subject site and adjacent land is already subjected to elevated noise levels, including those associated with vehicle movements and agricultural production.

Whilst no direct measurement of existing ambient noise levels has been completed, it is anticipated that, if necessary, further investigations could be conducted at a later stage of the project to determine the existing ambient noise levels at the surrounding sensitive receptors and the influence of existing traffic movements.

In consideration of the above and in the absence of site measured data, WMG has adopted a conservative approach to the assessment by adopting the minimum 'rating background levels' (RBLs) as the basis for determining the project intrusiveness noise levels.

The minimum RBLs adopted are nominated within the NPFI and are reproduced in Table 3.

Table 3: Minimum RBLs

Descriptor	NPfi Defined Assessment Period		
	Day	Evening	Night
Minimum RBLs	35 L_{A90}	30 L_{A90}	30 L_{A90}

The project intrusiveness noise levels have been determined based on the minimum RBLs in accordance with the methods provided in the NPFI. The adopted project intrusiveness noise levels are detailed in Table 4 and reflect the adopted minimum RBLs plus 5 dB.

Table 4: Project Intrusiveness Noise Levels

Descriptor	NPfi Defined Assessment Period		
	Day	Evening	Night
Project Intrusiveness Noise Levels	40 $L_{Aeq\ 15min}$	35 $L_{Aeq\ 15min}$	35 $L_{Aeq\ 15min}$

4.1.3. Project Amenity Noise Criteria

Project Amenity Noise levels, as detailed by the NPfI, are provided to address the ambient noise levels within an area from all industrial noise sources combined.

The intent of amenity noise levels is to allow for a consideration of noise impacts accumulated from the addition of surrounding commercial/industrial operations. Project amenity noise levels therefore limit the sole independent consideration of intrusiveness levels and the potential for continual increases to noise levels through the addition of separate commercial/industrial operations.

Derivation of the project amenity noise levels is based on the 'recommended amenity noise levels' contained within **Table 2.2: Amenity noise levels** of the NPfI. The values presented in the Table represent the total industrial noise which may impact on a receptor location over an assessment period.

In order to compare the amenity values with the **project intrusiveness level**, the values are adjusted from a $L_{Aeq\ period}$ to $L_{Aeq\ 15min}$, by adding a 3dB correction to the amenity noise level.

When determining the relevant amenity noise levels, WMG has considered the site as 'rural' as the surrounding land is generally comprised of agricultural land uses on RU4 land with scattered residential receptors. The amenity noise levels for 'rural' areas are summarised below.

Table 5: NPfI Amenity Noise Levels

Receiver	Noise Amenity Area	Time of Day	Recommended Amenity Noise Level	
			Raw NPfI Values	Adjusted for 15min
Residential	Rural	Day	50 $L_{Aeq\ period}$	53 $L_{Aeq\ 15min}$
		Evening	45 $L_{Aeq\ period}$	48 $L_{Aeq\ 15min}$
		Night	40 $L_{Aeq\ period}$	43 $L_{Aeq\ 15min}$

New industrial noise sources are then subject to the **project amenity noise level** which is determined to represent an objective for any single commercial/industrial noise source at a receptor location.

Where the surrounds include other commercial/industrial uses which may impact on receptors, the project amenity noise level implements a negative adjustment to account for cumulative contributions.

It is noted that there are two existing wineries located to the northeast of the site identified as 'Dionysus Winery & Woo Chocolate', and 'Found Winds Vineyard'. Based on a review of each of the venue websites, the premises are open 11:00am-4:00pm which will align with the NPfI 'day' period and will avoid the night period which is critical for the proposed BESS site operations.

In consideration of the above, WMG has allowed for potential cumulative contributions due to the wineries during the day period, but not during the more critical evening and night periods at the sensitive receptor locations. The adopted values are therefore as shown below in Table 6.

Table 6: Project Amenity Noise Levels

Descriptor	NPfi Defined Assessment Period		
	Day	Evening	Night
Recommended Amenity Noise Level	50 $L_{Aeq\ period}$	45 $L_{Aeq\ period}$	40 $L_{Aeq\ period}$
Adjustment to allow for additional contributions	minus 5 dB	-	-
Adjustment to reflect 15min assessment period	plus 3 dB	plus 3 dB	plus 3 dB
Project Amenity Noise Levels	48 $L_{Aeq\ 15min}$	48 $L_{Aeq\ 15min}$	43 $L_{Aeq\ 15min}$

4.1.4. Adopted Project Trigger Noise Criteria

4.1.4.1. Residential Receptors

In accordance with the assessment methodologies contained within the NPfI, the project noise trigger levels will be determined based on whichever of the project intrusiveness level and the project amenity level is the lower or more stringent. In consideration of the above, the project trigger noise levels will be as shown in Table 7.

Table 7: Project Trigger Noise Levels

Descriptor	NPfi Defined Assessment Period		
	Day	Evening	Night
Project Intrusiveness Noise Levels	40 $L_{Aeq\ 15min}$	35 $L_{Aeq\ 15min}$	35 $L_{Aeq\ 15min}$
Project Amenity Noise Levels	48 $L_{Aeq\ 15min}$	48 $L_{Aeq\ 15min}$	43 $L_{Aeq\ 15min}$
Project Trigger Noise Levels	**40 $L_{Aeq\ 15min}$**	**35 $L_{Aeq\ 15min}$**	**35 $L_{Aeq\ 15min}$**

For sensitive residential receptors, and in accordance with the NPfI, the project noise trigger levels are to be assessed at the reasonably most-affected point on or within the residential property boundary or, if that is more than 30 metres from the residence, at the reasonably most affected point within 30 metres of the residence, but not closer than 3 metres to a reflective surface and at a height of between 1.2–1.5 metres above ground level.

For multi-storey residential buildings (greater than two storeys) where a ground floor assessment location is deemed to be unrepresentative of the exposure of upper stories, the assessment may be undertaken at a representative elevation and closer than 3 metres to a reflective surface, as agreed with the regulator.

However, the assessed/measured noise level is to be suitably adjusted to reflect a 'free field' (that is, nominally no reflective signals) assessment/measurement location.

Due to the continuous operation of the subject site and new equipment, the critical criteria will be based on the night period when the lowest criteria will be applicable.

4.1.4.2. Commercial Premises

Due to the proximity of the 'Dionysus Winery & Woo Chocolate' commercial premises to the subject site, it would also be considered reasonable to assess potential noise impacts at this receptor.

When considering potential noise impacts on independent commercial premises, the NPfI nominates amenity levels of 65 $L_{Aeq\ period}$ during times when the premises are in use.

When converted to a 15-minute assessment period, this objective will be 68 $L_{Aeq\ 15min}$.

4.1.5. Modifying Factor Corrections

When considering noise impacts on sensitive receptors, NPfI methodology includes relevant adjustment factors which account for the potential for the noise source under consideration to impact on the acoustic amenity of the noise sensitive receptor.

The relevant factors are included within Fact Sheet C of the NPfI and include:

- Tonal noise.
- Low frequency noise.
- Intermittent noise.

Clarification regarding each of the adjustments is shown below in Table 8.

Table 8: NPfI Modifying Factor Corrections

Relevant Factor	Assessment / Measurement	When to Apply	Correction
Tonal Noise	One-third octave band analysis.	Level of one-third octave band exceeds the level of the adjacent bands level on both sides by in the order of 5dB – 15dB as defined in the NPfI.	5 dB
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 defined in Table C2 of the NPfI is exceeded.	2 or 5 dB
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(A) and the intermittent nature of the noise is clearly audible.	5 dB

The adjustments are applied to the measured/predicted values at sensitive receptors for consideration relative to the project noise trigger levels. A maximum of 10dB correction will be applied to the measured/predicted noise levels at the sensitive receptor, with a maximum of 5dB applicable when the tonal character is in the low frequency range below 160Hz.

4.2. Noise Modelling Results

4.2.1. Noise Prediction Methodology

Modelling of operational noise emissions from the site has been conducted using DataKustik CadnaA environmental noise modelling software.

Relevant information regarding site elevations, site buildings and the surrounding environment has been provided by the client and sourced from online databases including Nearmaps, NSW Planning Portal, and topography from the ANZLIC Committee on Surveying and Mapping.

With the utilisation of the above, the model has been developed and configured with sufficient detail for appropriate noise emission calculations to be undertaken.

For this assessment, the modelling software has implemented the calculation procedures defined within International Standard ISO 9613-2: 1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation (ISO 9613).

The described standard has been considered and approved as part of many previous projects requiring noise emission assessment works. Through implementation of the Standard using CadnaA, the noise emission modelling considers the following attenuation measures:

- Geometrical spreading.
- Atmospheric absorption.
- Ground attenuation.
- Meteorological effects.
- Source / Receiver height effects.
- Attenuation due to the surrounding environment including existing buildings / structures.

In addition to the above, and in accordance with the methodologies contained within the NPfI, noise predictions must account for noise enhancing weather conditions in the direction of sensitive receptors.

This can be addressed via two options:

- **Option 1**
  Adopt the **noise-enhancing meteorological conditions** for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur – a conservative approach that considers source-to-receiver wind vectors for all receivers and F class temperature inversions with wind speeds up to 2 m/s at night.

- **Option 2**
  Determine the **significance** of noise-enhancing conditions.

Option 1 has been adopted as the basis for predicting noise emissions from the proposed use and is often considered conservative as it represents a worst case operation scenario.

The critical receptors located in proximity of the subject site are understood to be single level dwellings, therefore an assessment height of 1.5m has been adopted as the basis for the noise model.

Predicted values at receptor locations have been calculated in the 'free-field', which do not include reflections from localised surfaces other than the ground.

4.2.2. Source Sound Power Levels

When considering noise emissions associated with the proposal, the client has advised that the relevant noise sources will include the following:

- 1no. MVPS including 2no. inverters and 1no. 5MVA transformer.
- 10no. liquid cooling battery containers.

Figure 2 below provides a site plan for the proposal including the relevant equipment locations.

Figure 2: Site plan including relevant noise sources

For the purposes of this assessment, WMG has considered source noise data provided by the inverter and battery unit manufacturers in combination with input from the client. A summary of the sound power/pressure levels adopted for each item of equipment is included within Table 9.

Table 9: Adopted source sound power levels

Noise Source	Adopted Noise Level
MVPS inverter – per unit	88 dB(A) – sound power
MVPS Transformer – 5MVA unit	65 dB(A) – sound power
Battery cabinet liquid cooling – per unit	81 dB(A) – sound power

Once commissioned, the electrical infrastructure which forms part of the facility will operate continuously 24 hours per day, 7 days per week. The assessment will therefore consider potential noise emissions during the day, evening, and night assessment periods.

4.2.3. Predicted Noise Levels

The noise sources forming part of the proposal have been modelled based on the following assumptions:

- The MVPS unit inverters and transformers have been assessed as omnidirectional noise sources. There may be the potential for the MVPS to include directivity which may reduce noise emissions in some directions pending their orientation.
- The battery units have been assessed with their noise source directivity facing north away from the nearest noise sensitive residential receptors.

The results of the noise model are presented below in Table 10.

Table 10: Noise modelling results compared with Project Trigger Noise Levels

Assessment Location	Predicted Noise Level (15_{min})	Project Trigger Noise Levels L_{Aeq}		
		Day	Evening	Night
R01	36 dB(A) L_{eq}	40	35	35
R02	26 dB(A) L_{eq}	40	35	35
R03	32 dB(A) L_{eq}	40	35	35
R04	30 dB(A) L_{eq}	40	35	35
R05	23 dB(A) L_{eq}	40	35	35
R06	<20 dB(A) L_{eq}	40	35	35
R07	22 dB(A) L_{eq}	68		

The outcomes of the noise model indicate that in the absence of noise control, and without consideration of any NPfI modifying factors, predicted noise levels at the R02-R07 receptors are compliant with the project trigger noise levels.

When considered at R01 however, the predicted values indicate the potential for marginal exceedances of the project trigger levels by 1 dB(A) during the evening and night periods.

As part of previous assessments, WMG has identified that electrical infrastructure has the potential to include a tonal character which may be audible at nearby receptors and warrant an adjustment in accordance with the NPfI.

Due to the distance separation between the electrical infrastructure and nearby sensitive receptors however, WMG would expect that residual tonal noise may not be present and therefore not require an adjustment for this project.

The noise modelling software utilised as part of the assessment includes the capability to predict the one-third octave band noise levels at the sensitive receptors. The predicted one-third octave band noise levels are summarised below.

Table 11: Predicted one-third octave band noise levels - dB

Rec	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
R01	24	21	25	23	23	23	29	33	26	25	32	25	22	25	24	26	25	26	25	22	23	29	14	<10	<10	<10	<10
R02	19	17	21	19	18	19	21	24	20	16	22	15	15	17	16	18	16	17	16	12	11	16	<10	<10	<10	<10	<10
R03	23	21	25	23	23	23	27	31	24	22	29	21	20	22	21	22	22	22	21	18	18	24	<10	<10	<10	<10	<10

Rec	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz
R04	18	16	20	18	17	19	20	24	21	16	22	15	14	16	17	19	17	17	16	13	11	16	<10	<10	<10	<10	<10
R05	17	15	19	17	16	17	19	23	17	14	20	13	12	14	13	14	13	14	12	<10	<10	14	<10	<10	<10	<10	<10
R06	16	13	17	15	14	15	16	20	15	11	17	10	9	11	10	11	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
R07	17	15	18	17	16	18	18	21	19	14	19	12	12	13	14	15	13	12	11	<10	<10	<10	<10	<10	<10	<10	<10

To provide a basis for understanding the presence of any modifying factors, WMG has compared the predicted values with the criteria nominated in the NPfI which relates to tonal noise and low frequency noise.

Tonal noise
When considered at R02, R04, R06 and R07, the predicted values do not exceed the level of the adjacent one-third octave bands on both sides by the 5dB, 8dB and 15dB thresholds nominated in the NPfI. A tonal adjustment will not be applicable for the assessment at these receptors. For the R01, R03 and R05 receptors, the acoustic energy at 3150Hz is sufficiently elevated that a tonal adjustment of +5dB(A) will be applicable.

Low frequency noise
The predicted values do not exceed the low-frequency noise threshold values, and hence an adjustment will not be applicable for the assessment.

The results of the updated assessment including the +5dB(A) tonal adjustment at the R01, R03 and R05 receptors is summarised below.

Table 12: Noise modelling results compared with Project Trigger Noise Levels (including tonal adjustment)

Assessment Location	Predicted Noise Level (15_{min})	Project Trigger Noise Levels L_{Aeq}		
		Day	Evening	Night
R01	41 dB(A) L_{eq}	40	35	35
R02	26 dB(A) L_{eq}	40	35	35
R03	37 dB(A) L_{eq}	40	35	35
R04	30 dB(A) L_{eq}	40	35	35
R05	28 dB(A) L_{eq}	40	35	35
R06	<20 dB(A) L_{eq}	40	35	35
R07	22 dB(A) L_{eq}	68		

As shown above, with the inclusion of the +5dB(A) tonal adjustment, WMG has determined that residual noise impacts at the R01 and R03 receptors have the potential to exceed the project trigger levels, and hence additional noise control should be considered at the subject site.

4.2.4. Noise Control Discussion

The findings of the assessment identify potential exceedances of the project trigger levels by up to 6 dB(A) at the R01 receptor and 2 dB(A) at the R02 receptor.

Due to the predicted non-compliances, WMG has amended the noise model to include a 3.0m high acoustic barrier to the east and south of the electrical infrastructure which will provide noise shielding in the direction of these receptors.

The barrier will effectively block line of sight between the receptors and the electrical infrastructure forming part of the site operations, and hence will reduce the noise impacts. The barrier construction requirements are discussed in Section 4.2.5.

The proposed barrier alignment is included below.

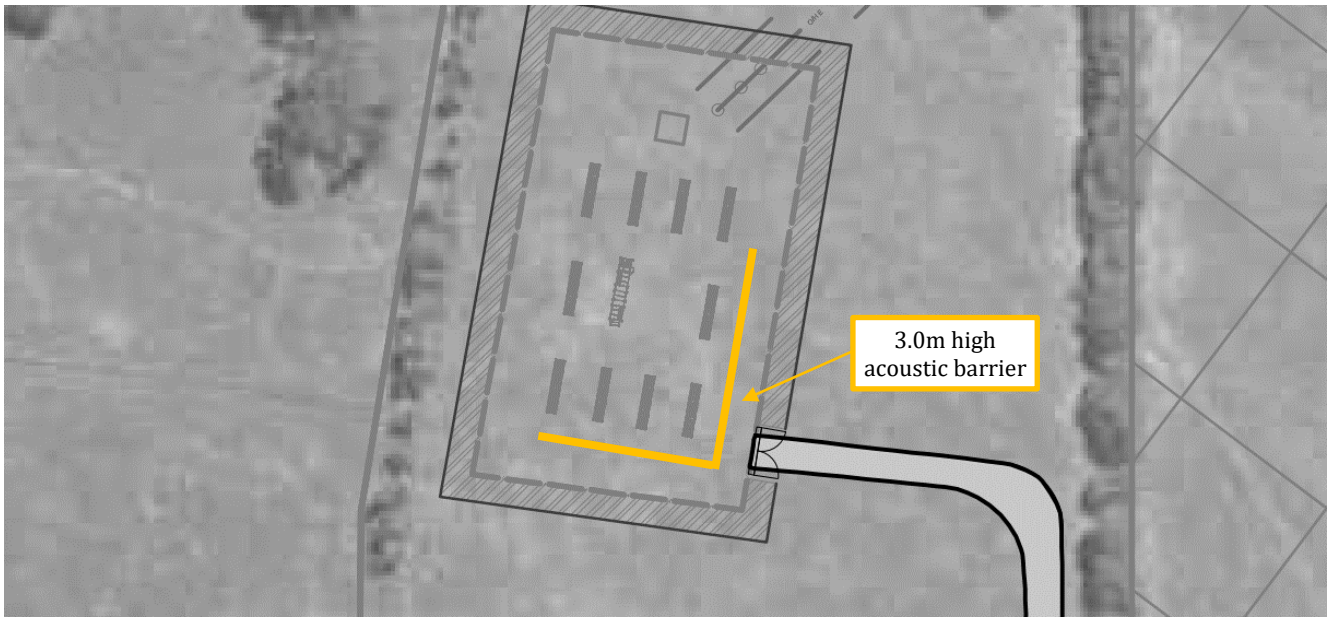


Figure 3: Proposed acoustic barrier arrangement

With the inclusion of the acoustic barrier, and the relevant tonal adjustment, WMG has determined that the predicted noise levels at each of the surrounding sensitive receptors will be compliant with the project trigger levels.

The results of the updated noise model are summarised below.

Table 13: Noise modelling results compared with Project Trigger Noise Levels (including tonal adjustment)

Assessment Location	Predicted Noise Level (15_{min})	Project Trigger Noise Levels L_{Aeq}		
		Day	Evening	Night
R01	35 dB(A) L_{eq}	40	35	35
R02	20 dB(A) L_{eq}	40	35	35
R03	34 dB(A) L_{eq}	40	35	35
R04	30 dB(A) L_{eq}	40	35	35
R05	28 dB(A) L_{eq}	40	35	35
R06	<20 dB(A) L_{eq}	40	35	35
R07	22 dB(A) L_{eq}	68		

The assessment outcomes indicate that there will be a practical solution available to reduce noise impacts at the R01 and R03 receptors so that they comply with the project trigger levels.

However, in the absence of the adopted tonal adjustment which may not be applicable in 'real world' conditions, the acoustic barrier may not be necessary to comply with the project trigger levels at the R03 receptor. This would result in only the R01 receptor being exposed to noise levels marginally higher than the project trigger levels.

It is understood that the R01 receptor is associated with the proposal, and hence is aware of the potential noise level impacts which may arise at their property. It is therefore expected that this receptor may be more tolerant of noise impacts from the subject site operations.

In consideration of the above, and with the understanding that there is a practical solution available for the project, it would be reasonable that the client makes provisions for the acoustic barriers within the subject site design, but only introduces the barriers if it was determined to be necessary after commissioning of the electrical infrastructure.

4.2.5. Acoustic Barrier Construction

Based on the results of the noise model the acoustic barrier will need to be constructed to be 3000mm high and located to the south and east of the equipment to provide sufficient noise shielding in the direction of the nearby receptors.

To provide noise reduction qualities, the barrier must be constructed of materials with a surface minimum weight of 12 kg/m^2 and be constructed with no gaps between panels and between the panels and the ground below.

Where practical, the acoustic barrier location should be selected to maximise its height on the land topography, hence maximising the noise shielding in the direction of the sensitive receptors.

In addition to the above, the acoustic barrier must be lined on the electrical infrastructure side of the barrier using 100mm thick sound absorbing materials which achieve a Noise Reduction Coefficient (NRC) of not less than 0.9.

Suitability of the materials for external applications, and for installation within proximity of the proposed equipment must be considered and approved by others. Suppliers of the materials can include Megasorber or an equivalent alternative. Fibrous insulation faced with perforated metal may also be a suitable alternative, however, would require a specific detail to ensure it was suitable for outdoor applications and could prevent rain ingress.

5. Construction Noise Assessment

5.1. Duration of Construction Works and Construction Program

The construction program for the proposed BESS facility is expected to have a duration of four weeks, during which various activities will be undertaken at the subject site.

The client has advised that the construction hours will be limited in accordance with the 'recommended standard hours' nominated by the EPA which include:

- Monday to Friday, 7:00am to 6:00pm.
- Saturday, 8:00am to 1:00pm.
- Sunday and Public Holidays, no construction works.

In consideration of the above, assessment of noise emissions due to construction activities at the site has been limited to the above 'recommended standard hours', as the client has advised that there is no need for works to be completed during other times.

For the purposes of this assessment, the client has provided a breakdown of the proposed construction program to assist with calculating residual noise levels at the critical sensitive receptors within proximity of the subject site.

The construction program is included below in Table 14 and indicates that the potentially 'noisy' activities including excavation, crane usage and heavy delivery vehicles will generally be limited to week 1 and week 2 of the program.

Table 14: Proposed construction program

Period	Site Works	No. of Vehicle Access per week
Week 1	• Drainage, road, and fencing works • Installation of concrete footings	Light – 10 (2 per day) Heavy – 2
Week 2	• Cable installation • Delivery of battery shipping containers and inverter station • Installation of battery shipping containers and inverter station	Light – 15 (3 per day) Heavy – 12
Week 3	• Electrical installation and cable termination • Electrical testing	Light – 15 (3 per day)
Week 4	• commissioning / demobilisation	Light – 10 (2 per day) Heavy – 1

5.2. Interim Construction Noise Guideline

5.2.1. General Assessment Methodologies

Construction noise and vibration associated with demolition, remediation, renewal, maintenance, and general building works has been identified as a major environmental issue within NSW. Construction activities can generate high levels of noise which can adversely impact on the surrounding acoustic environment including affecting sleep, concentration, mental and physical health.

In consideration of the above, several agencies including the Department of Environment and Climate Change (DECC), NSW Department of Planning, Roads and Traffic Authority (RTA), WorkCover NSW, NSW Health together with the Local Government and Shires Association of NSW prepared the *Interim Construction Noise Guideline* (INCG) to assist with addressing construction noise and vibration impacts.

The guideline was released in 2009 and provides methodologies for assessing and managing the potential impacts of construction noise on residences and other sensitive land uses.

The INCG document is currently under review by the EPA with a new draft guideline having been issued for *public consultation purposes only*, however had not been superseded at this stage.

In consideration of the above, WMG has adopted the currently applicable INCG document as the basis for providing an assessment of construction noise and vibration emissions associated with the project.

The main objectives of the ICNG are to:

- Promote a clear understanding of ways to identify and minimise noise from construction works.
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise.
- Encourage construction activities to be undertaken only during the 'recommended standard hours' unless approval is given for works that cannot be undertaken during these hours.
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage.
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

When addressing construction noise and vibration, the guideline presents two alternative assessment methodologies expressed as either quantitative or qualitative and which vary based on the proposed construction project duration.

For shorter duration projects which are nominally defined as less than three weeks in total, the qualitative assessment procedures are commonly adopted which require the proponent to consider the guideline's checklist of work practices to minimise noise and implement appropriate strategies.

Where projects have a duration of greater than three weeks, the quantitative assessment procedure is recommended which includes derivation of 'noise management levels' (NML) and noise predictions to consider the potential noise impacts at sensitive receptor locations.

This BESS project will be undertaken for a period of four weeks and will therefore marginally exceed the timeframe which is nominated for a qualitative assessment. Furthermore, due to the proximity of the site to the nearest sensitive receptors, it is considered appropriate that a detailed investigation consistent with the quantitative assessment approach is undertaken for the proposal.

5.2.2. Determination of Project Noise Management Levels

The NMLs are determined based on an emergence of the construction noise impacts above the RBLs defined within the NPfI for the 'recommended standard hours' as shown within Table 15.

Table 15: Hours Nominated within ICNG

Period Designation	Relevant Hours
Recommended Standard Hours	Monday to Friday – 7:00am to 6:00pm Saturday – 8:00am to 1:00pm
Outside Recommended Standard Hours	All Days – 6:00pm to 7:00am Saturday – 1:00pm to 6:00pm Sunday / Public Holidays – All Day

A summary of the methodologies associated with determining the NMLs and the methods of application are included within Table 16 below.

Table 16: Noise impacts at residences using quantitative assessment procedure.

Time of Day	NML L_{Aeq} (15 min)	How to Apply
Recommended standard hours.	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 LAeq (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 residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	▪ A strong justification would typically be required for works outside the recommended standard hours. ▪ The proponent should apply all feasible and reasonable work practices to meet the noise affected level. ▪ Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

The NMLs are not mandatory limits, however where construction noise levels are predicted to exceed the NMLs, it is considered appropriate that the proponent implement feasible and reasonable work practices to minimise the potential impacts on noise sensitive receptors.

Guidance in relation to what is considered feasible and reasonable is included in the ICNG and generally relates to practical implementation and ongoing maintenance associated with the proposed treatment.

It also considers whether the overall noise benefits associated with the noise control approach outweigh the overall adverse social, economic, and environmental effects, including the cost of the measure.

When determining the noise management levels for the construction phase of the project, and in the absence of site measured data, WMG has adopted the minimum RBLs which form part of the NPfI.

The adopted NMLs for the project are therefore as shown below in Table 17.

Table 17: Residential Receptor Noise Management Levels for Construction

Descriptor	NPfi Defined Assessment Period		
	Day	Evening	Night
Recommended Standard Hours – Noise Affected	45 L_{Aeq}	N/A	N/A
Recommended Standard Hours – Highly Affected	75 L_{Aeq}	N/A	N/A

Where appropriate, the ICNG also requires consideration of ground borne noise impacts at residential receptors as well as the potential for noise emissions to cause sleep disturbance at residential receptors during the night periods.

Given the distance setback of the closest sensitive receptor to the site and the proposed construction hours which are limited to the day period, potential ground borne noise emissions, and the potential for sleep disturbance has not been considered further.

5.3. Proposed Construction Activities and Noise Assessment

Based on information provided by the client, equipment which will form part of the construction works associated with preparation and commissioning of the subject site will include:

- Excavator.
- Grader.
- Drum roller.
- Water dust suppression truck.
- Truck mounted crane (60 tonne) – lifting and positioning works expected to be completed in 1 day.
- Concrete truck and associated agitator.
- Power hand tools.

In addition to the above, a total of fifteen (15) heavy vehicles will attend the subject site throughout the four week construction program, with fourteen (14) expected within the first two weeks. The heavy vehicles will deliver the battery containers and inverter station. The final truck will likely be for waste collection.

An indicative breakdown of the construction stages during which each type of equipment will be utilised is included below within Table 18.

Table 18: Summary of Construction Activities.

Construction Stage	Equipment and Activity
Access road construction.	▪ Excavator. ▪ 10t smooth drum roller. ▪ Grader for gravel road construction. ▪ Water trucks for dust suppression.
Drainage and fencing works.	▪ Excavator for landscaping. ▪ Water trucks for dust suppression. ▪ Concrete truck and associated agitator for fence construction. ▪ Private vehicles.
Installation of concrete footings	▪ Concrete truck and associated agitator. ▪ Private vehicles.
Delivery of battery shipping containers and inverter station unit.	▪ Semi-trucks for good deliveries. ▪ Crane truck to move containers and place in position. ▪ Private vehicles.
Cable installation	▪ Excavator for cable trenching. ▪ Water trucks for dust suppression. ▪ Powered hand tools for connection. ▪ Private vehicles.
Electrical installation, cable termination and electrical testing.	▪ Powered hand tools for connection. ▪ Private vehicles.
Commissioning and demobilisation	▪ Private vehicles. ▪ Waste truck.

Private vehicles, although relevant, will have source sound power levels significantly lower than other potential noise sources forming part of the proposed construction activities and will not contribute to the calculated value at the sensitive receptors. In consideration of the above, WMG has not considered noise associated with private vehicles further within the construction noise assessment.

Transient sources such as trucks may travel within the site boundaries, however, for the purposes of this assessment, WMG has considered that the construction activities will generally occur where the electrical infrastructure will be located.

The exception to this will be that trucks will need to travel along the access road to enter the site, and hence will be in closer proximity to R01 at various times throughout the construction period. Furthermore, specific road preparation and construction works will also need to occur in proximity to R01, and hence have been considered at this location as part of the assessment.

When addressing source noise levels associated with the construction activities, WMG has considered the following:

- Maximum noise levels from plant and equipment nominated within Appendix C of the Construction Noise and Vibration Strategy document issued by Transport for NSW 2019.
- Noise level data provided by the manufacturer/equipment suppliers.
- Noise level data obtained by WMG as part of previous independent investigations.

Based on the above, and with input from the client, the equipment types and adopted sound power levels are included within Table 19 below.

Table 19: Summary of Equipment and Associated Sound Power Levels

Construction Stage	Equipment Type	No. of Units	Adopted Sound Power Level	Operating Time in 15min period	Adopted L_{WA} per Stage
Access road construction.	Excavator	1	95 dB(A)	100 %	111 dB(A)
	Roller	1	107 dB(A)	50 %	
	Grader	1	113 dB(A)	50 %	
	Water Cart	1	102 dB(A)	50 %	
Drainage and fencing works.	Excavator	1	95 dB(A)	100 %	111 dB(A)
	Water Cart	1	102 dB(A)	50 %	
	Concrete Truck	1	104 dB(A)	25 %	
	Concrete pouring	1	110 dB(A)	100 %	
Concrete footings install	Concrete Truck	1	104 dB(A)	25 %	110 dB(A)
	Concrete pouring	1	110 dB(A)	100 %	
Delivery of battery shipping containers and inverter station unit	Truck movements	1	101 dB(A)	25 %	102 dB(A)
	Crane truck	1	104 dB(A)	50 %	
Cable installation.	Excavator	1	95 dB(A)	100 %	102 dB(A)
	Water Cart	1	102 dB(A)	50 %	
	Hand Tools	3	96 dB(A)	50 %	
Electrical installation, cable termination and electrical testing	Hand Tools	3	96 dB(A)	50 %	98 dB(A)
Commissioning and demobilisation.	Waste Truck	1	101 dB(A)	50 %	98 dB(A)

The client has advised that each phase of the construction program will be undertaken progressively which will result in cumulative noise levels during each stage rather than due to multiple construction stages.

Using the adopted sound power levels and usage rates described in Table 19, the calculated resultant noise levels at the critical receptors are summarised within Table 20 below.

Table 20: Predicted Construction Noise Levels

Construction Phase	Predicted Noise Levels $L_{Aeq\ (15\ minute)}$						Predicted Noise Levels relative to Derived NMLs $L_{Aeq\ (15\ minute)}$					
	R01	R02	R03	R04	R05	R06	R01	R02	R03	R04	R05	R06
Access road construction.	59	49	49	42	45	42	45	45	45	45	45	45
Drainage and fencing works.	53	44	49	48	46	39	45	45	45	45	45	45
Concrete footings install	52	44	48	47	45	38	45	45	45	45	45	45
Battery containers and inverter station unit delivery and placement	45	37	40	39	37	30	45	45	45	45	45	45
Cable installation.	45	37	40	39	37	30	45	45	45	45	45	45
Electrical installation, cable termination and electrical testing	40	31	36	35	33	26	45	45	45	45	45	45
Commissioning and demobilisation.	40	31	36	35	33	26	45	45	45	45	45	45

The results of the noise model indicate that during the initial stages of the construction program, noise emissions associated with the construction of the access road, concrete truck use, and more particularly, the concrete pouring process have the potential to be higher than the 'Noise Affected' NMLs during the recommended standard hours.

The calculated values will continue to be well below the 'highly affected' NML of 75 dB(A).

Given the calculated NML exceedances, construction noise mitigation strategies have been included in Section 5.4.

It must be noted that the R01 receptor who is predicted to receive exposure to the higher levels of construction noise, is associated with the proposal, and hence has open communication with the client regarding the proposed works and construction methodology.

In consideration of the above, it is expected that this receptor will be more tolerant of the potential construction noise impacts that other nearby receptors.

5.4. Construction Noise Mitigation and Management

The NSW ICNG requires that noise emissions associated with construction are assessed against NMLs.

The NMLs are not mandatory noise limits, however where construction activity noise levels are predicted to exceed the NMLs, it is considered appropriate that the proponent implement feasible and reasonable work practices to minimise the potential impacts on noise sensitive receptors.

Guidance regarding minimisation of disturbance due to construction is included within *AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites'* as well as the ICNG and includes the reference to the following:

- Implementation of universal work practices relating to minimising noise.
- Selection of low noise plant and equipment.
- Consultation and transparency with the surrounding community.

In addition, due to the calculated exceedances of NMLs at the R01, R03 and R04 receptors, specific noise control for some activities should be considered by the client.

5.4.1. General Work Practices

Universal work practices which should form part of a construction management plan will include:

- Regular enforcement (ie toolbox talks) of the need to minimise noise and vibration. This will include educating heavy vehicle drivers regarding expectations of their vehicle use (eg. avoid engine brakes, sudden acceleration, minimising reversing etc).
- Regular identification of noisy activities and adoption of improvement techniques.
- Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents.
- Developing routes for the delivery of materials and parking of vehicles to minimise noise.
- Where possible avoiding the use of equipment that generates impulsive noise.
- Minimising the need for vehicles reversing at the site and within proximity of receptors.
- Use of broadband audible alarms on vehicles and elevating work platforms used on site.
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact.
- Minimising truck movements.
- Scheduling respite periods (eg. noisy periods limited to 3 hours).
- Prioritise ensuring that construction works, and heavy vehicle movements occur during standard work hours between 7am and 6pm Monday to Friday, and 7am to 1pm Saturday.

5.4.2. Plant and Equipment

General work practices which will minimise the potential for noise emissions to cause disturbance at sensitive receptors will include:

- Where possible, implementing quieter techniques for high noise activities.
- Choosing quieter mobile and fixed equipment based on the site requirements.
- Operating equipment in the quietest and most efficient manner.
- Regular inspection and maintenance of equipment to ensure it is in good working order.

5.4.3. Community Relations

Communication and transparency with the surrounding community will be critical in minimising the potential for adverse impacts on the acoustic amenity at sensitive receptors. In order to orchestrate the above, it is advised that the client implement the following:

- Appoint a relevant community relations manager prior to project commencement.
- The manager must approach and communicate with sensitive receptors information regarding the project timeline, construction methodologies, potentially noisy periods.
- Maintain contact with receptors throughout duration of project to ensure that they are up to date on when certain events will commence and finish.
- Provide a construction noise management plan to the sensitive receptors which includes site contact information for residents to call regarding complaints and other queries.

Where complaints are received, they must be recorded on a centralised system and handled in a prompt and responsive manner. This may involve noise monitoring or a review or processes.

5.4.4. Specific Construction Activity Noise Control

5.4.4.1. Concrete Truck Pouring

The noise emission assessment has identified the potential for exceedances of NMLs at the critical R01, R03 and R04 receptors due to the concrete pouring works which will occur during fencing and concrete footing installation.

Predicted values at all other identified receptor locations will be < 45 L_{Aeq} during the described works which is below the NML for the recommended standard hours at these locations.

Due to the calculated exceedances, it would be recommended that the client engage in consultation with the receptors and ensure that they are aware of the works proposed and the duration of the works.

It would be expected that the main source of noise associated with the pouring activity will be the truck engine revs, therefore the contractor should minimise this where possible to minimise noise emissions.

Furthermore, in accordance with information provided in AS2436-2010, where feasible, the contractor should:

- Locate static mixing activities as far as possible from sensitive receptors.
- Ensure that workers do not hammer the drum as part of cleaning.
- Fit more efficient silencers to diesel or petrol engines.

5.4.4.2. Reversing and Warning Alarms

Community concerns in relation to construction noise have often resulted from the use of tonal reversing beepers associated with mobile equipment at construction sites. In consideration of the above, WMG provide the following recommendations:

- Equipment which is based at site should be fitted with ‘new generation’ broadband reverse alarms which vary their noise output according to the ambient noise level in the surrounding environment.
- Encourage operators of commercial vehicles making deliveries / collection at site to replace any tonal revering beepers with the described ‘new generation’ broadband reverse alarms.
- Configure the site to minimise the requirement for non-site based vehicles to reverse.

Where possible, non-audible warning systems (eg. flashing lights, reversing cameras) should be used to reduce noise and must be approved by relevant safety authorities.

6. Vibration Assessment

The project construction and operational phase will not include any vibration intense activities such as piling and ramming and hence, have not been considered further.

7. Road Traffic Noise Assessment

During the operational phase of the BESS project, it is understood that there will be no permanent staff based at the site, and therefore no regular traffic movements.

Site inspections and maintenance works will be undertaken intermittently as required.

Given the infrequency of the operational vehicle movements, noise impacts during these times will be negligible and are not expected to impact adversely on the acoustic environment at sensitive receptors.

The focus of any vehicle movements will therefore be based on the project construction phase during which there will be weekly vehicle movements. It is understood that during this phase, vehicles will access the site via the internal access road from Turton Place.

When addressing the potential noise impacts associated with vehicle movements along public roads, commonly adopted criterion is provided within the NSW Department of Environment Climate Change and Water (DECCW) Road Noise Policy, March 2011.

The Policy includes assessment criteria to consider the potential noise impacts at residences affected by traffic on existing roadways generated by land use developments as shown in Table 21.

Table 21: Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Project / Land Use	Assessment Criteria L_{Aeq}	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway	Existing residences affected by additional traffic on described roadway generated by land use developments	60 (15 HOUR)	55 (9 HOUR)
Local Roads	Existing residences affected by additional traffic on described roadway generated by land use developments	55 (1 HOUR)	50 (1 HOUR)

Based on guidance provided by the client, it is understood that the following light and heavy vehicle movements will form part of the four week project construction program:

- **Week 1** – two light vehicles accessing the site per day, and a total of two heavy vehicles accessing the site across the week period. No more than one heavy vehicle in a one hour period.
- **Week 2** – three light vehicles accessing the site per day, and a total of twelve heavy vehicles accessing the site across the week period. No more than one heavy vehicle in a one hour period.
- **Week 3** – three light vehicles accessing the site per day, and no heavy vehicles.
- **Week 4** – two light vehicles accessing the site per day, and a total of one heavy vehicle accessing the site across the week period.

The heavy vehicles will be delivering materials to the site including the new battery storage containers and the MVPS containers. Light vehicles will be associated with construction staff and their personal vehicles.

Based on a review of aerial photography of the surrounding area, it is understood that dwellings will be setback from access roads which may carry site vehicles by 40-50m.

Based on calculations, the proposed construction program traffic movements will be below the assessment criteria values nominated in Table 20 above.

8. Conclusion

WMG has undertaken an acoustic assessment to address potential operational and construction noise and vibration impacts associated with the BESS facility proposed at the site described as 3 Turton Place, Murrumbateman, New South Wales.

Assessment of noise emissions from the proposed site operations, and construction activities have been based on the methodologies described within the following documentation:

- NSW EPA Noise Policy for Industry.
- NSW Interim Construction Noise Guideline 2009.
- Department of Environment and Conservation's 'Assessing Vibration: a technical guideline'.
- NSW Department of Environment Climate Change and Water Road Noise Policy 2011.

The findings of the assessment have concluded that there is potential for residual operational noise levels at the R01 and R03 receptors to be higher than the project trigger levels.

The predicted exceedances at the R03 receptor are primarily due to the inclusion of a 5 dB(A) tonal adjustment at the receptor which has been adopted within the assessment based on source data provided by the equipment supplier.

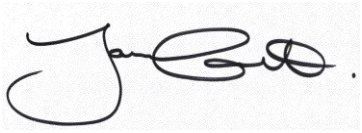
Without the adjustment the predicted noise levels would comply with the project trigger levels at R03 and would only marginally exceed the levels by 1 dB(A) at R01.

WMG has provided a practical solution to control noise emissions from the site if the 5dB(A) tonal adjustment is found to be applicable in 'real world' conditions. This would include a 3.0m high acoustic barrier installed to the south and east of the new electrical infrastructure.

Given that the R01 receptor is associated with the project, and with the understanding that there is a practical solution to reduce potential noise impacts at the critical receptors, it would be reasonable that the client makes provisions for the acoustic barriers within the site design, but only introduces the barriers if it was determined to be necessary after commissioning of the electrical infrastructure.

When addressing general construction noise and vibration as well as road traffic noise, the findings of the assessment concluded the following:

- Noise due to construction vehicle movements is predicted to be below noise level criteria nominated within the Road Noise Policy.
- Noise emissions due to some construction activities have been predicted to exceed NMLs at receptors. In these instances, WMG has provided suitable noise mitigation strategies to minimise the potential for adverse impacts on the relevant sensitive receptors.
- The project construction and operational phase will not include any vibration intense activities such as piling and ramming and hence, have not been considered further.



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Appendix 1 – Aerial Site Plan Layout