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Environmental Noise Impact Assessment

Proposed Gas Power Generator Plant & Battery Energy Storage System 30 Douglas Road, Moss Vale, NSW

REPORT No

7303-7.1R Rev A

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Prepared For:
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TABLES

1.0 EXECUTIVE SUMMARY

Development consent is sought for the construction of a new power plant, designated SQE2, at 30 Douglas Road, Moss Vale, NSW. The proposal includes the operation of gas engine powered generators which will be housed within a dedicated generator hall. These generators will supply power to an approved and proposed data centre. Excess power will be stored at the proposed Battery Energy Storage System (BESS) compound.

The generator hall will have capacity to house a total of 7 generators, however, only 5 generators will be in operation at any one time to supply the data centre as part of this application. To assess a worst case scenario, noise has been assessed from the operation of all 7 generators and associated plant.

Other items of associated plant will also be in operation such as ventilation fans and air cooled radiators.

The BESS compound will comprise of up to 40 Battery Energy Storage Systems and 8 Power Conversion Unit (PCU) systems for efficient energy storage.

Wingecarribee Shire Council requires an acoustic assessment to demonstrate that the noise impact from the operation of the generators will not affect the acoustic amenity of nearby residential and industrial premises. Acceptable noise levels at the nearest residential and industrial premises have been derived from the NSW Noise Policy for Industry (NPI).

The subject site is located on land zoned E4 – *General Industrial* under Wingecarribee Local Environment Plan 2010. The nearest residential dwellings are located to the south, west and north of the subject site within the E4 zoning. Additional residential dwellings are located sparsely throughout the surrounding area on large rural lots with the nearest of these 1.6km to the north of the subject site on land zoned C3 – *Environmental Management*.

Recommendations for noise controls are specified in Section 7 of this report.

Noise levels from the operation of these generators and associated plant been modelled to the nearest residential and industrial premises. Measurements and calculations indicate that, provided the noise control recommendations are satisfactorily implemented, the most stringent noise criterion established in accordance with the NSW Noise Policy for Industry is met at all residential and industrial receptors.

2.0 CONSULTING BRIEF

Day Design Pty Ltd was engaged by Nakar Property Pty Ltd to assess the environmental noise impact from the operation of up to 7 gas engine power generators and associated plant and a BESS compound which will serve the approved and proposed data centre. This commission involves the following:

Scope of Work:

- Inspect the site and environs
- Measure the background noise levels at critical locations and times
- Establish acceptable noise level criterion
- Prepare a site plan identifying the development and nearby noise sensitive locations
- Quantify noise emissions from the subject site
- Calculate the level of noise emission, taking into account building envelope transmission loss, screen walls and distance attenuation
- Provide recommendations for noise control
- Prepare an Environmental Noise Impact Report.

3.0 SITE AND DEVELOPMENT DESCRIPTION

3.1 Site Description

The subject site is located on land zoned E4 – *General Industrial* under Wingecarribee Local Environment Plan 2010. The nearest residential dwellings are located to the south, west and north of the subject site within the E4 zoning. Additional residential dwellings are located sparsely throughout the surrounding area on large rural lots with the nearest of these located approximately 1.6 km to the north of the subject site (designated 'R5' in Table 1) on land zoned C3 – *Environmental Management*.

The nearest residential and industrial receptors in all directions are shown in Figures 1 and 2 and in Table 1. These receptors are the closest and most exposed to noise generated by the use of the generators and associated plant. As such, compliance with the noise criteria applicable at these locations will ensure compliance at all other residential and industrial receptor locations within the E4 zoning.

Additionally, compliance with the noise criteria for residential dwellings in the C3 zoning (designated 'R5' - 'R7') will also ensure compliance for other residential premises outside of the E4 zoning surrounding the subject site.

Table 1 Noise Sensitive Receptors

Receptor	Address	Direction From Site	Zoning
R1 – Residential	64 Brookdale Road, Moss Vale	South	E4 – General Industrial
R2 – Residential	15 Carribee Road, Moss Vale	West	E4 – General Industrial
R3 – Residential	50 Carribee Road, Moss Vale	North	E4 – General Industrial
R4 – Industrial	1 Douglas Road, Moss Vale	East	E4 – General Industrial
R5 – Residential	40 Railway Road, Moss Vale	North	C3 – Environmental Management
R6 – Residential	25 McCourt Road, Moss Vale	East	C3 – Environmental Management
R7 – Residential	37 Elizabeth Street, Burradoo	East	C3 – Environmental Management

3.2 Development Description

Wingecarribee Shire Council has granted approval (Development Application DA21/1042) for the construction of a data centre at 30 Douglas Road, Moss Vale. It is proposed to generate and store power onsite to serve the present and proposed data centres.

Power is to be supplied to the data centres by 5 (of 7 total) gas powered generators with excess power sent to a proposed Battery Energy Storage System (BESS) compound. The generators will be housed inside a dedicated generator hall building located approximately 100 metres southwest of the previously approved generator hall.

The generator hall has capacity to house up to 7 gas generators. We are advised that 7 generators will be installed, with 5 generators in operation and 2 generators on standby for maintenance and service purposes.

The generators will operate continuously 24 hours a day.

The BESS compound will be comprised of up to 40 Battery Energy Storage Systems and 8 Power Conversion Unit (PCU) systems for efficient energy storage.

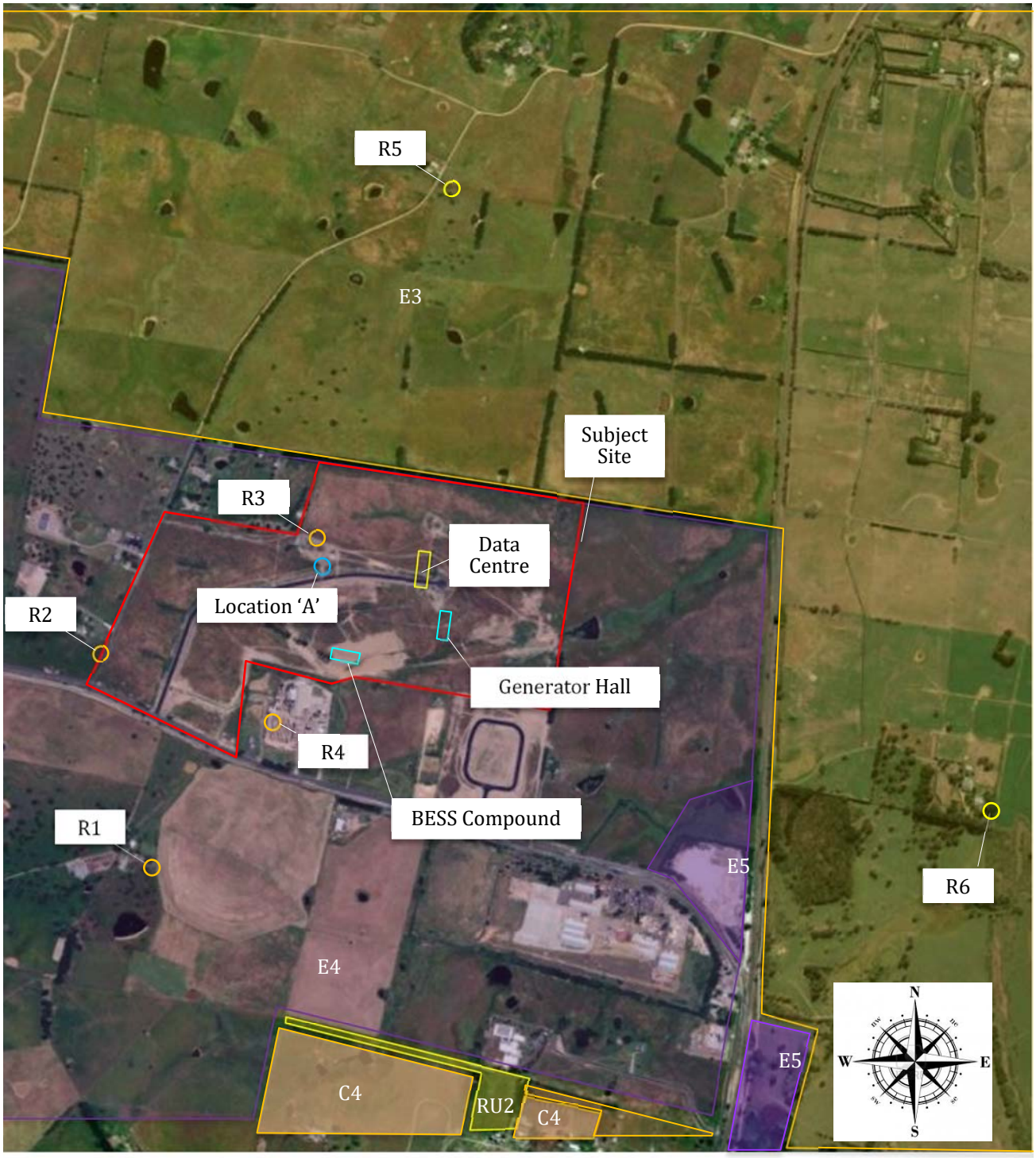


Figure 1 Location Plan: Lot 40 - DP 1189246, Douglas Road, Moss Vale, NSW.

Figure 2 Location Plan: Lot 40 - DP 1189246, Douglas Road, Moss Vale, NSW.

4.0 MEASURED NOISE LEVELS

4.1 Long Term Noise Monitoring

The L_{90} background noise level is a statistical measure of the sound pressure level that is exceeded for 90% of the measurement period (typically 15 minutes).

The Rating Background Level (RBL) is defined by the NSW EPA as the median value of the (lower) tenth percentile of L_{90} ambient background noise levels for day, evening or night periods, measured over a number of days during the proposed days and times of operation.

The background noise level should be measured at a location representative of the potentially affected receptors, in the absence of any noise sources that may be associated with the development.

An environmental noise logger was placed on the north side of the site at ground level approximately 60 metres from 'R3'. The logger acquired ambient noise data between Tuesday 10 August and Tuesday 17 April 2021. The logger location is designated as Location 'A', as shown in Figures 1 and 2.

Details of instrumentation used during the noise surveys can be seen in the attached Appendix A.

The results of the background noise survey at the logger position are shown in the attached Appendix B and Table 2.

Table 2 Ambient Background Levels – Lot 40, Douglas Road, Moss Vale

Location	Time Period	L_{90} Rating Background Level	Existing L_{eq} Noise Levels
Location A – Lot 40, Douglas Rd Moss Vale	Day (7 am – 6 pm)	31 dBA	42 dBA
	Evening (6 pm – 10 pm)	31 dBA	37 dBA
	Night (10 pm – 7 am)	32 dBA	39 dBA

Meteorological conditions during the measurement surveys typically consisted of clear skies with temperatures ranging from 8°C to 28°C. Atmospheric conditions were considered ideal for noise monitoring. No significant rainfall was recorded during the measurement period however, periods of high winds (above 5 m/s) were recorded at the Moss Vale meteorological station approximately 5km east of the subject site. Noise data affected by high winds was removed from the data set. Therefore, noise level measurements were considered reliable and typical for the receptor area.

5.0 NOISE CRITERIA

5.1 NSW Industrial Noise Policy

The Environment Protection Authority (EPA) published their NSW Noise Policy for Industry (NPI) in October 2017. The NPI is specifically aimed at assessing noise from industrial noise sources scheduled under the Protection of the Environment Operations Act 1997 (POEO, 1997).

The NPI provides a useful framework to assess noise emission from an industrial premises to determine whether that premises produces intrusive or non-intrusive noise.

The noise limits set out in the NPI will be used as a guide in determining whether the level of noise is considered intrusive or not.

5.1.1 Amenity Criteria

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. The NPI provides a schedule of recommended L_{eq} industrial noise levels that under normal circumstances should not be exceeded. If successive developments occur near a residential area, each one allowing a criterion of background noise level plus 5 dB, the ambient noise level will gradually creep higher.

The recommended L_{eq} noise levels shown in Table 3 are taken from Section 2.4, Table 2.2 of the NPI.

Table 3 Amenity Criteria

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{eq} Noise Level, dBA
			Acceptable
Residential	Rural	Day	50
		Evening	45
		Night	40
Industrial & Isolated Residences within E4 and E5 Industrial Zonings	All	When in use	70

The L_{Aeq} is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the project amenity noise level. This leads to the situation where, because of the different averaging periods, the same numerical value does not necessarily represent the same amount of noise heard by a person for different time periods. To standardise the time periods for the intrusiveness and amenity noise levels, the NPI assumes that the **$L_{Aeq, 15min}$** will be taken to be equal to the **$L_{Aeq, period}$ + 3 decibels (dB)**.

Compliance with the amenity criteria will limit ambient noise creep. Wherever the existing L_{eq} noise level from industrial noise sources approaches or exceeds the amenity criteria at a critical receptor location, the intrusive L_{eq} noise from the noise source in question must be reduced to a level that may be as much as 10 dB below the existing L_{eq} industrial noise level.

The acceptable L_{Aeq} amenity criteria for industrial receptors and isolated residences within land zoned industrial (eg 'R1' - 'R4') is:

- (70 – 5 + 3 dB =) 68 dBA when in use.

The acceptable $L_{Aeq,\ 15\ min}$ amenity criteria for residential areas outside of industrial zonings (eg 'R5' - 'R7') is:

- (50 – 5 + 3 dB =) 48 dBA during the day; and
- (45 – 5 + 3 dB =) 43 dBA during the evening; and
- (40 – 5 + 3 dB =) 38 dBA during the night.

5.1.2 Intrusiveness Criteria

The EPA states in Section 2.3 of the NPI that the L_{eq} level of noise intrusion from broad-band industrial noise sources may be up to 5 dB above the L_{90} background noise level at a residential receptor without being considered intrusive.

The $L_{90,\ 15\ minute}$ Rating Background Level at Location 'A' was 31 dBA during the day, 31 dBA during the evening and 32 dBA during the night.

It is noted that the night time RBL is found to be 1 dB higher than the day and evening RBL. In these situations, the NPI recommends that the project intrusiveness noise level should be no greater than the project intrusiveness level for the day and evening periods.

Therefore, the acceptable L_{eq} noise intrusiveness criteria for the nearest residential areas (outside of the E4 and E5 industrial zonings) is:

- (31 + 5 dB =) 36 dBA during the day; and
- (31 + 5 dB =) 36 dBA during the evening; and
- (32 - 1 + 5 dB =) 36 dBA during the night.

5.2 Project Specific Noise Criteria

The measured background noise levels have been used to establish the most stringent noise criteria at each receptor location as follows:

For isolated residential dwellings on land zoned Industrial and Industrial premises:

- **68 dBA** $L_{eq,\ 15\ minute}$ for broadband noise emission for residential premises; and
- **68 dBA** $L_{eq,\ 15\ minute}$ for broadband noise emission during the day (7 am – 6 pm) for industrial premises.

For all other residential dwellings:

- (31 + 5 dB =) **36 dBA** $L_{eq,\ 15\ minute}$ during the day, evening and night.

For a residence, compliance with the established noise criteria is to be assessed at the reasonably most-affected point on or within the residential property boundary but not closer than 3 metres to a reflective surface and at a height of between 1.2 and 1.5 metres above ground level. For upper floors, noise is assessed outside the nearest affected window.

6.0 NOISE EMISSION

The generator hall has the capacity to house 7 gas generators, which is the number to be installed. Of the 7 generators, 5 will be in operation at any one time, with 2 on standby.

As a worst case scenario, the cumulative noise impact to the nearest residential and industrial areas ('R1' - 'R7') has been assessed from noise generated from the operation of all 7 generators and associated plant. The generators and associated plant will operate 24 hours a day, all year.

The main noise producing facets from the operation of each of the 7 generator units are the external generator exhaust ducts and from the engine enclosure. The exhaust ducts for each generator unit are located externally on the east side of the generator hall and will have muffler units fitted. The engine enclosures and generator air intakes will be housed within the generator hall building.

The generator hall building will be ventilated with fresh air by supply fans located at ground level installed within the south façade of the generator hall building. Three fans per generator are proposed to be installed for a total of 21 supply fans.

The north and south facades will have louvres located at low level for additional ventilation of waste heat. Steel roller door assemblies are located within the east facade.

Each generator will be cooled by external radiator units located on the north side of the generator hall building.

Specific items of plant and equipment are yet to be finalised. Noise calculations are based on representative items of plant and equipment similar in size and capacity to what will be installed on site. Representative sound power levels for the main noise generating facets outlined above are derived from manufacturers data and are shown in Table 4 and Table 6 with tonal components shown in **bold**.

Table 4 L_{eq} Sound Power Levels Generator Hall

Description	L_{eq} Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)								
	dBA	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Generators – Based on *Jenbacher JGS 620 GS-N.L*									
Engine Enclosure (1 of 7)	**111**	106	112	110	105	104	93	105	106
Exhaust Discharge (Unsilenced – 1 of 7)	**136**	130	143	133	131	129	128	125	121
Cooling Units – Based on *BAC TVFC 1484*									
Flatbed Radiator (1 of 7)	**98**	81	89	85	92	93	80	88	91
Ventilation Fans – Based on *Fantech SQB1254FP12/10*									
Ventilation Fan (1 of 21)	**88**	94	86	83	81	81	78	82	80

Insertion loss values for representative generator exhaust mufflers are shown in Table 5, as supplied by the manufacturer.

Table 5 Generator Muffler – Insertion Loss

Description	Insertion Loss (dB) at Octave Band Centre Frequencies (Hz)							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Generator Exhaust Muffler – Based on *CAT SCE/A-LP*								
Exhaust Muffler (1 of 7)	40	43	46	49	49	45	39	33

Sound power levels for the BESS and PCU area based on manufacturers data. Tonal components are shown in bold.

Table 6 L_{eq} Sound Power Levels BESS Compound

Description	dBA	Sound Power Levels (dB) at Third Octave Band Centre Frequencies (Hz)						
		50	**100**	**200**	**400**	**800**	**1k6**	**3k15**
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**
		80	**160**	**315**	**630**	**1k25**	**2k5**	**5k**
BESS – Based on *Sungrow ST2236UX* (1 of 40)	**91**	86	82	84	80	82	79	75
		88	85	82	81	82	78	72
		81	**95**	85	81	82	77	70
Power Conversion Unit – Based on *Sungrow SC3450UD* (1 of 8)	**97**	87	89	84	94	84	81	82
		86	83	86	88	81	82	74
		84	82	87	85	80	83	**91**

Noise modeling is based on survey drawings of the subject site prepared by Keatley Surveyors, as shown in Appendix C. Additional topographical data of the area surrounding the subject site has been derived from LiDAR data sourced from ELVIS - Elevation and Depth.

6.1 Calculated Noise Level at Receptor Locations

Knowing the sound power level of a noise source (refer Table 4 & Table 6), the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for distance losses, sound barriers, etc.

The following noise level calculations are shown for the nearest residential and industrial premises surrounding the subject site in all directions, 'R1' - 'R7'. The calculated $L_{eq,\ 15\ min}$ noise levels at each receptor location from the operation of the generators are shown in Table 7 and 8.

Calculations assume a worst case 15 minute assessment scenario from the simultaneous operation of 7 generators, ventilation fans and radiator units and the BESS compound all operating at full capacity. We have also assumed noise enhancing, adverse meteorological conditions for all receptors.

Noise calculations assume the noise control recommendations have been implemented into the design of the generator hall building.

All distances used in noise calculations are approximate and are based on the general location of the generators and associated plant on the subject site to the assessment location at each receptor. All residential and industrial receptor locations listed in Table 1, at which noise levels have been assessed, are representative of all receptors in the immediate area. Compliance with the established noise criterion at 'R1' - 'R7' ensures compliance at all other residential/ industrial receptor locations.

Table 7 $L_{eq,\ 15\ minute}$ Noise Levels – SQE2 Generator Hall and BESS Compound Noise Levels (R1 – R4)

Description	Noise Source	Calculated Noise Level - $L_{eq,\ 15\ min}$	Noise Criterion - $L_{eq,\ 15\ min}$	Compliance (Yes/No)
Receptors within the E4: General Industrial Zoning				
R1 - 64 Brookdale Rd, Moss Vale	SQE2	23 dBA	68 dBA	Yes
	BESS & PCU	37 dBA		
	Proposal Total	37 dBA		
R2 - 15 Carribee Rd, Moss Vale	SQE2	21 dBA	68 dBA	Yes
	BESS & PCU	35 dBA		
	Proposal Total	35 dBA		
R3 - 50 Carribee Rd, Moss Vale	SQE2	30 dBA	68 dBA	Yes
	BESS & PCU	30 dBA		
	Proposal Total	33 dBA		
R4 - 1 Douglas Rd, Moss Vale	SQE2	31 dBA	68 dBA	Yes
	BESS & PCU	57 dBA		
	Proposal Total	57 dBA		

Table 8 $L_{eq,\ 15\ minute}$ Noise Levels – SQE2 Generator Hall and BESS Compound Noise Levels (R5 – R7)

Description	Noise Source	Calculated Noise Level - $L_{eq,\ 15\ min}$	Noise Criterion - $L_{eq,\ 15\ min}$	Compliance (Yes/No)
Receptors within the C3: Environmental Management Zoning				
R5 - 40 Railway Rd, Moss Vale	SQE2	19 dBA	36 dBA	Yes
	BESS & PCU	23 dBA		
	Proposal Total	25 dBA		
R6 - 25 McCourt Rd, Moss Vale	SQE2	19 dBA	36 dBA	Yes
	BESS & PCU	23 dBA		
	Proposal Total	24 dBA		
R7 - 37 Elizabeth St, Burradoo	SQE2	15 dBA	36 dBA	Yes
	BESS & PCU	18 dBA		
	Proposal Total	19 dBA		

The total cumulative $L_{eq,\ 15\ min}$ noise levels emitted from the site, inclusive of existing and approved developments, have been calculated at each receptor location to be as shown in Table 9. Where low frequency noise or tonality is present, a 5 dB penalty has been applied.

Table 9 $L_{eq,\ 15\ minute}$ Noise Levels – Site Cumulative Noise Levels (R1 – R7)

Description	Calculated Noise Level $L_{eq\ (15\ min)}$	Noise Criterion $L_{eq,\ 15\ min}$	Compliance (Yes/No)
R1 - 64 Brookdale Road, Moss Vale	45 dBA[1]	68 dBA	Yes
R2 - 15 Carribee Road, Moss Vale	43 dBA[1]	68 dBA	Yes
R3 - 50 Carribee Road, Moss Vale	49 dBA[1]	68 dBA	Yes
R4 - 1 Douglas Road, Moss Vale	63 dBA[2]	68 dBA	Yes
R5 - 40 Railway Road, Moss Vale	32 dBA	36 dBA	Yes
R6 - 25 McCourt Road, Moss Vale	31 dBA	36 dBA	Yes
R7 - 37 Elizabeth Street, Burradoo	26 dBA	36 dBA	Yes

It can be seen that, with the aforementioned assumptions, the $L_{eq,\ 15\ min}$ levels of noise at all receptor locations are calculated to be at or below the noise criterion established for residential and industrial receptors and is therefore acceptable.

Receptor locations 'R1' - 'R7' are marked up on the Noise Contour Map (attached as Appendix D) with the calculated noise level for each location. Additional noise levels are also shown at other points of interest across the map for comparative purposes.

[1] Inclusive of 5 dB penalty for Low Frequency noise

[2] Inclusive of 5 dB penalty for tonality (5 kHz).

7.0 NOISE CONTROL RECOMMENDATIONS

7.1 Generator Hall Building

In order to reduce the level of noise emission from the site, we recommend that the generator hall roof and façade is constructed to include the following components.

7.1.1 External Walls and Roof

External walls and roof construction to achieve a minimum weighted sound reduction index R_w40.

An example facade construction that will achieve R_w40 may comprise:

- External metal or insulated panel cladding such as Colorbond, Kingspan or similar external cladding material with min. surface density of 5kg/m^2 fixed to the external side of the wall/roof structural beams;
- Internal lining such as 9 mm fibre cement sheet or equivalent product with min. surface density of 14kg/m^2 fixed to the internal side of the wall/roof structural beams with a minimum cavity depth of 90 mm;
- Min 50 mm thick glasswool or mineral wool insulation installed within the wall cavity.

There are numerous proprietary wall/roof products and systems that can achieve R_w40 for industrial noise control applications. Any wall or roof system may be utilised in the construction of the generator hall provided it achieves the minimum R_w rating.

We recommend that confirmation of acoustic performance of any wall or roof system is obtained from Day Design prior to finalising product selections.

7.1.2 Louvred Facade Openings

All louvred openings should comprise acoustic louvres with minimum insertion loss values as shown in Table 10. Louvred openings should not exceed a maximum of 250 m^2.

Table 10 Generator Hall Louvres – Insertion Loss

Description	Insertion Loss (dB) at Octave Band Centre Frequencies (Hz)							
	63	125	250	500	1k	2k	4k	8k
Façade Acoustic Louvres – Based on *Flexshield SL4-20C*[3]								
Acoustic Louvre	4*	6	15	21	24	25	24	17*

*Expected insertion loss values.

[3] https://flexshield.com.au/product/acoustic-louvres/

7.1.3 Generator Hall Entry Doors

Standard solid core fire doors and steel roller doors on the east facade are sufficient to attenuate noise, however we recommend that any door openings are kept closed when entryways are not in use.

7.1.4 Internal Reverberation Control

The internal surfaces of the generator hall are predominantly hard and reflective which will result in long reverberation times. Reducing the level of reverberant noise will lower the overall noise level within the generator hall and lower noise emission at receptor locations. We recommend that acoustic linings are installed on the walls and/or the ceiling surfaces covering a minimum internal surface area of 1,200m^2.

The linings should comprise minimum 100 mm thick mineral wool (min. density 24kg/m^3) and may be faced with perforated metal sheet.

Proprietary products such as Flexshield 'Sonic System V100'[4] or IAC Acoustics 4" thick 'Noise Foil'[5] products are acceptable and their respective R_w ratings can be included in external wall and roof systems to achieve the recommended minimum R_w40 rating for the generator hall façades.

Alternatively, any absorptive lining may be used in conjunction with the external walls and roof (min R_w40), provided the linings themselves achieve minimum NRC 0.9.

7.2 Plant and Equipment

In order to reduce the level of noise emission from items of plant and equipment operating on or within the site, the following recommendations should be implemented when finalising selections.

Plant Selection

We recommend that each generator exhaust has a muffler/silencer fitted such that the sound pressure level, when measured at 1 metre from the discharge, is no greater than 86 dBA.

This can be achieved by installing a muffler/silencer arrangement that achieves or exceeds the insertion loss values specified in Table 5, such as the Jenbacher JGS 620 GS-N.L or an equivalent system.

We recommend that ventilation fans installed on the south façade of the generator hall should be selected and/or attenuated such that the sound pressure level, when measured 1 metre from each fan, is no greater than 80 dBA.

We recommend that the external dry cooler units installed outside the north façade of the generator hall should be selected and/or attenuated such that the sound pressure level, when measured 1 metre from each unit, is no greater than 90 dBA.

[4] https://flexshield.com.au/product/acoustic-modular-panels/
[5] https://www.iacacoustics.com/noise-foil-absorption-panels

We recommend that each BESS unit installed should be selected and/or attenuated such that the sound pressure level, when measured 1 metre from each unit, is no greater than 83 dBA.

We recommend that each Power Conversion Unit installed should be selected and/or attenuated such that the sound pressure level, when measured 1 metre from each unit, is no greater than 89 dBA.

Provided the sound power level for each of the 7 the gas generator sets are limited to 111 dBA, up to 7 generators may be installed, and operated, in the SQE2 Generator Hall.

We recommend that an acoustic review is conducted at CC stage for final plant and equipment selections and mechanical services drawings to ensure the noise criteria can be met.

8.0 CONCLUSION

Day Design Pty Ltd was engaged by Nakar Property Pty Ltd to assess the environmental noise impact from a new BESS compound and the operation of up to 7 gas engine power generators and associated plant and equipment which will supply power to an approved and proposed data centre.

Measurements and calculations show that, provided the noise controls specified in Section 7 of this report are satisfactorily implemented into the design of the BESS compound, generator hall and plant selections, the cumulative level of noise emitted by the operation of the gas engine powered generators and associated plant and equipment, will meet the most stringent noise criteria at the nearest residential and industrial receptors, established in accordance with the NSW Noise Policy for Industry, as detailed in Section 5 of this report.

Alexander Mendoza, MDesSc (Audio & Acoustics), MAAS
Acoustic Consultant
for and on behalf of Day Design Pty Ltd

AAAC MEMBERSHIP

Day Design Pty Ltd is a member company of the Association of Australasian Acoustical Consultants, and the work herein reported has been performed in accordance with the terms of membership.

APPENDICES

Appendix A – Instrumentation
Appendix B – Ambient Noise Survey
Appendix C – Site Plan & Survey
Appendix D – Noise Emission Contour Map
AC108-1 to 4 – Glossary of Acoustical Terms

NOISE SURVEY INSTRUMENTATION

Noise level measurements and analysis in this report were made with instrumentation as follows:

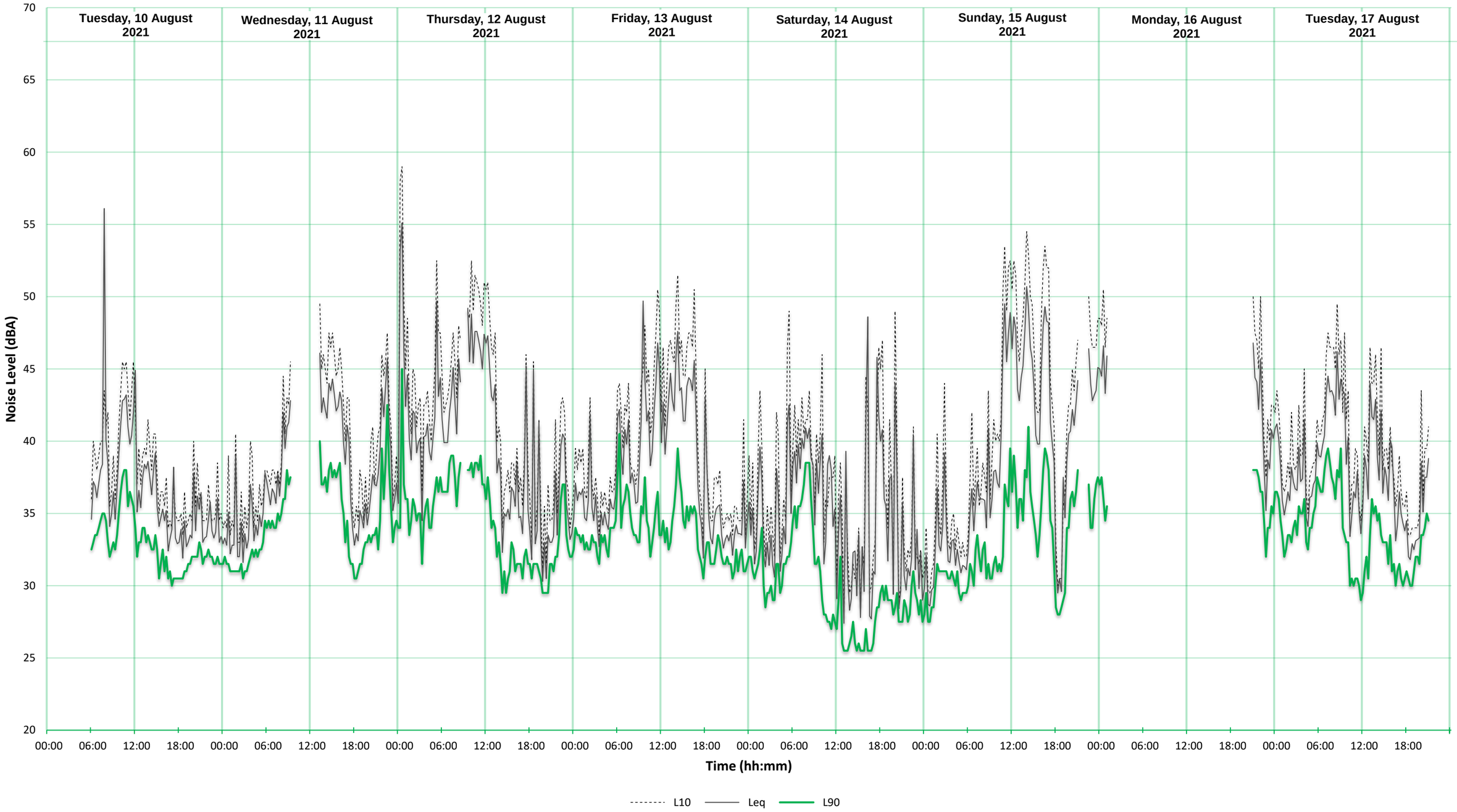
Table A1 Noise Survey Instrumentation

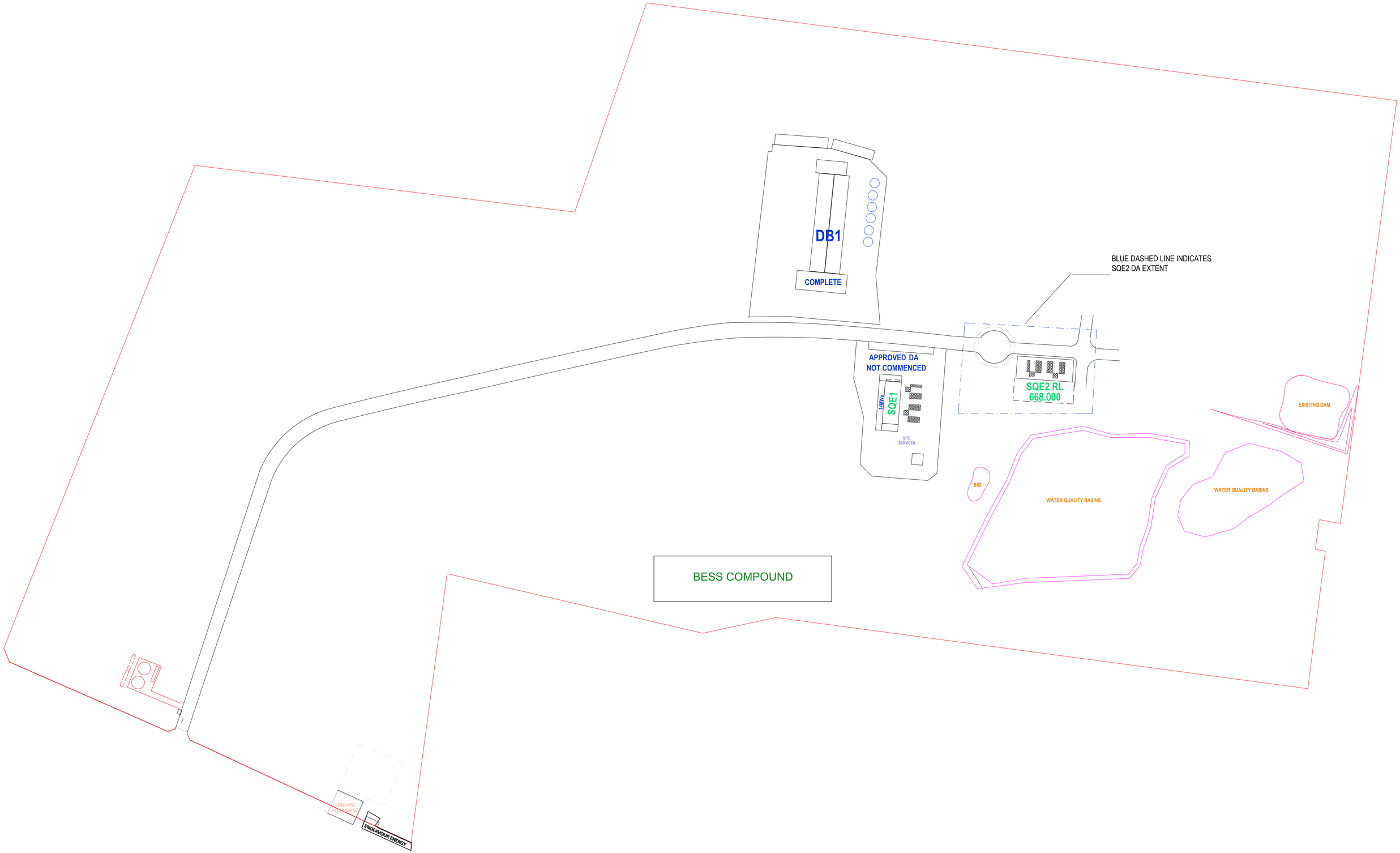
Description	Model No	Serial No
Infobyte Noise Logger (Type 2)	iM4	120
Condenser Microphone 0.5" diameter	MK 250	120

An environmental noise logger is used to continuously monitor ambient noise levels and provide information on the statistical distribution of noise during an extended period of time. The Infobyte Noise Monitor iM4 is a Type 2 (#120) precision environmental noise monitors meeting all the applicable requirements of AS1259 for an integrating-averaging sound level meter.

All instrument systems had been laboratory calibrated using instrumentation traceable to Australian National Standards and certified within the last two years thus conforming to Australian Standards. The measurement system was also field calibrated prior to and after noise surveys. Calibration drift was found to be less than 1 dB during unattended measurements. No adjustments for instrument drift during the measurement period were warranted.

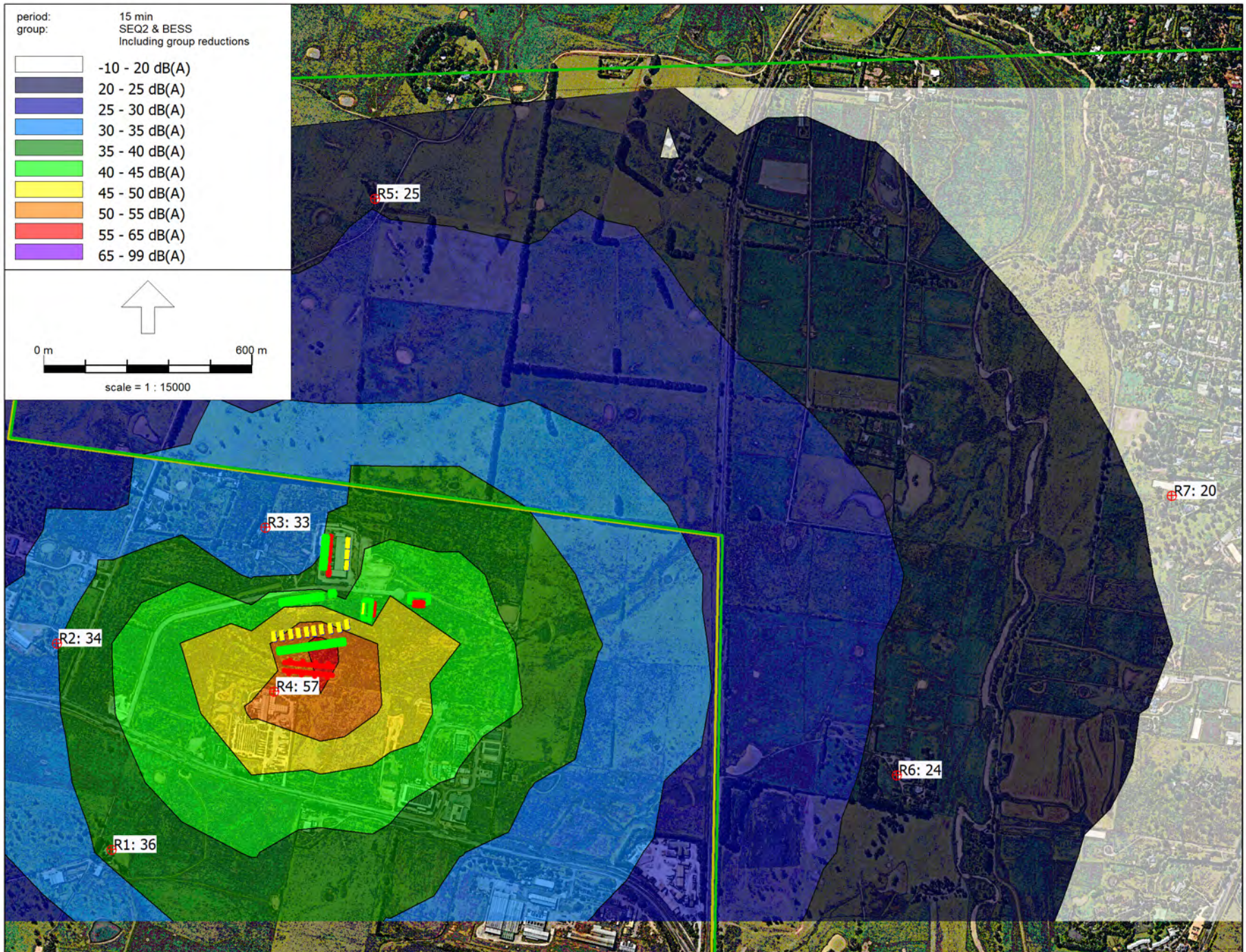
Located at Lot 40 Douglas Rd, Moss Vale, NSW



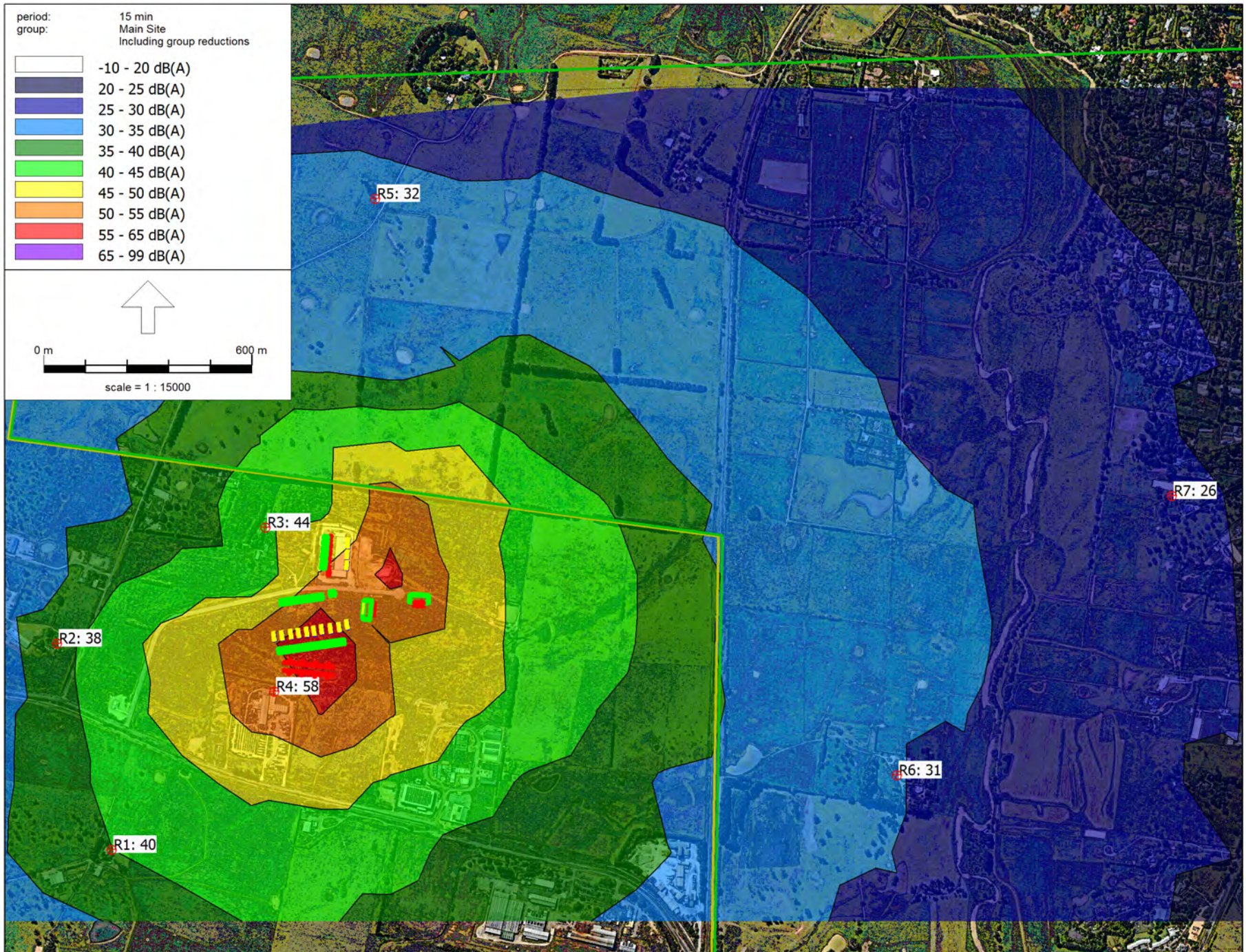


SQUARE ENERGY | **SOUTHERN HIGHLANDS DATA CAMPUS** | **SQE2 – SITE PLAN LOCATION** | **LOT 40 DP 1189246 30 DOUGLAS ROAD MOSS VALE NSW** | **REF:CC_FEE_SK_002_L11** | **REV. DATE: 25.06.2025**

Leq, 15 min - Proposed SEQ2, BESS & PCU operations. Adverse meteorological conditions.



Leq, 15 min - Total cumulative noise emission from entire site. Adverse meteorological conditions.



ACOUSTICAL – Pertaining to the science of sound, including the generation, propagation, effects and control of both noise and vibration.

AMBIENT NOISE – The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including road traffic, factories, wind in the trees, birds, insects, animals, etc.

AUDIBLE – means that a sound can be heard. However, there are a wide range of audibility grades, varying from "barely audible" to "just audible", "clearly audible" and "prominent". Chapter 83 of the NSW Environment Protection Authority – Environmental Noise Control Manual (1985) states:
"noise from a particular source might be offensive if it is clearly audible, distinct from the prevailing background noise and of a volume or character that a reasonable person would be conscious of the intrusion and find it annoying or disruptive".

It follows that the word "audible" in an environmental noise context means "clearly audible".

BACKGROUND NOISE LEVEL – Silence does not exist in the natural or the built-environment, only varying degrees of noise. The Background Noise Level is the average minimum dBA level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by cicadas, lawnmowers, etc. It is quantified by the L_{A90} or the dBA noise level that is exceeded for 90 % of the measurement period (usually 15 minutes).

- **Assessment Background Level (ABL)** is the single figure background level representing each assessment period – day, evening and night (ie three assessment background levels are determined for each 24hr period of the monitoring period). Determination of the assessment background level is by calculating the tenth percentile (the lowest tenth percent value) of the background levels (L_{A90}) for each period (refer: NSW Industrial Noise Policy, 2000).
- **Rating Background Level (RBL)** as specified by the Environment Protection Authority is the overall single figure (L_{A90}) background noise level representing an assessment period (day, evening or night) over a monitoring period of (normally) three to seven days.

  The RBL for an assessment period is the median of the daily lowest tenth percentile of L_{90} background noise levels.

  If the measured background noise level is less than 30 dBA, then the Rating Background Level (RBL) is considered to be 30 dBA.

DECIBEL – The human ear has a vast sound-sensitivity range of over a thousand billion to one. The decibel is a logarithmic unit that allows this same range to be compressed into a somewhat more comprehensible range of 0 to 120 dB. The decibel is ten times the logarithm of the ratio of a sound level to a reference sound level. See also Sound Pressure Level and Sound Power Level.

Decibel noise levels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dBA, and another similar machine is placed beside it, the level will increase to 53 dBA, not 100 dBA. Ten similar machines placed side by side increase the sound level by 10 dBA, and one hundred machines increase the sound level by 20 dBA.

dBA – The human ear is less sensitive to low frequency sound than high frequency sound. We are most sensitive to high frequency sounds, such as a child's scream. Sound level meters have an inbuilt weighting network, termed the dBA scale, that approximates the human loudness response at quiet sound levels (roughly approximates the 40 phon equal loudness contour).

However, the dBA sound level provides a poor indication of loudness for sounds that are dominated by low frequency components (below 250 Hz). If the difference between the "C" weighted and the "A" weighted sound level is 15 dB or more, then the NSW Industrial Noise Policy recommends a 5 dBA penalty be applied to the measured dBA level.

dBC – The dBC scale of a sound level meter is similar to the dBA scale defined above, except that at high sound intensity levels, the human ear frequency response is more linear. The dBC scale approximates the 100 phon equal loudness contour.

EQUIVALENT CONTINUOUS NOISE LEVEL, L_{Aeq} – Many noises, such as road traffic or construction noise, vary continually in level over a period of time. More sophisticated sound level meters have an integrating electronic device inbuilt, which average the A weighted sound pressure levels over a period of time and then display the energy average or L_{Aeq} sound level. Because the decibel scale is a logarithmic ratio the higher noise levels have far more sound energy, and therefore the L_{Aeq} level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closely to the L_{Aeq} noise level.

FREE FIELD – This is a sound field not subject to significant reflection of acoustical energy. A free field over a reflecting plane is usually outdoors with the noise source resting on hard flat ground, and not closer than 6 metres to any large flat object such as a fence or wall; or inside an anechoic chamber.

FREQUENCY – The number of oscillations or cycles of a wave motion per unit time, the SI unit being the Hertz, or one cycle per second.

IMPACT ISOLATION CLASS (IIC) – The American Society for Testing and Materials (ASTM) has specified that the IIC of a floor/ceiling system shall be determined by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The IIC is a number found by fitting a reference curve to the measured octave band levels and then deducting the sound pressure level at 500 Hz from 110 decibels. Thus the higher the IIC, the better the impact sound isolation.

IMPACT SOUND INSULATION ($L_{nT,w}$) – Australian Standard AS ISO 717.2 – 2004 has specified that the Impact Sound Insulation of a floor/ceiling system be quantified by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The Weighted Standardised Impact Sound Pressure Level ($L_{nT,w}$) is the sound pressure level at 500 Hz for a reference curve fitted to the measured octave band levels. Thus the lower $L_{nT,w}$ the better the impact sound insulation.

IMPULSE NOISE – An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

INTRUSIVE NOISE LEVEL, L_{Aeq} – The level of noise from a factory, place of entertainment, etc. in NSW is assessed on the basis of the average maximum noise level, or the $L_{Aeq\ (15\ min)}$. This is the energy average A weighted noise level measured over any 15 minute period.

LOUDNESS – The degree to which a sound is audible to a listener is termed the loudness. The human ear perceives a 10 dBA noise level increase as a doubling of loudness and a 20 dBA noise increase as a quadrupling of the loudness.

MAXIMUM NOISE LEVEL, L_{Amax} – The rms maximum sound pressure level measured on the "A" scale of a sound level meter during a noise survey is the L_{Amax} noise level. It may be measured using either the Fast or Slow response time of the meter. This should be stated.

NOISE RATING NUMBERS – A set of empirically developed equal loudness curves has been adopted as Australian Standard AS1469-1983. These curves allow the loudness of a noise to be described with a single NR number. The Noise Rating number is that curve which touches the highest level on the measured spectrum of the subject noise. For broadband noise such as fans and engines, the NR number often equals the dBA level minus five.

NOISE – Noise is unwanted sound. Sound is wave motion within matter, be it gaseous, liquid or solid. "Noise includes sound and vibration".

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient".

OFFENSIVE NOISE - (Reference: Dictionary of the Protection of the Environment Operations Act 1997). *"Offensive Noise means noise:*

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

PINK NOISE – Pink noise is a broadband noise with an equal amount of energy in each octave or third octave band width. Because of this, Pink Noise has more energy at the lower frequencies than White Noise and is used widely for Sound Transmission Loss testing.

REVERBERATION TIME, T_{60} – The time in seconds, after a sound signal has ceased, for the sound level inside a room to decay by 60 dB. The first 5 dB decay is often ignored, because of fluctuations that occur while reverberant sound conditions are being established in the room. The decay time for the next 30 dB is measured and the result doubled to determine the T_{60}. The Early Decay Time (EDT) is the slope of the decay curve in the first 10 dB normalised to 60 dB.

SOUND ABSORPTION COEFFICIENT, α – α Sound is absorbed in porous materials by the viscous conversion of sound energy to heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, α. An absorption coefficient of 0.9 indicates that 90 % of the incident sound energy is absorbed. The average α from 250 to 2000 Hz is termed the Noise Reduction Coefficient (NRC).

SOUND ATTENUATION – If an enclosure is placed around a machine, or a silencer is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 30 dBA, reduces the sound energy by one thousand times.

SOUND EXPOSURE LEVEL (SEL) – The total sound energy of a single noise event condensed into a one second duration or in other words it is an L_{eq} (1 sec).

SOUND PRESSURE LEVEL, L_p – The level of sound measured on a sound level meter and expressed in decibels, dB, dBA, dBC, etc. $L_p = 20 \times \log (P/P_o)$ ... dB

where P is the rms sound pressure in Pascal and P_o is a reference sound pressure of 20 µPa. L_p varies with distance from a noise source.

SOUND POWER LEVEL, L_w – The Sound Power Level of a noise source is an absolute that does not vary with distance or with a different acoustic environment.

$L_w = L_p + 10 \log A$ ... dB, re: 1pW,
where A is the measurement noise-emission area in square metres in a free field.

SOUND TRANSMISSION CLASS (STC) – An internationally standardised method of rating the sound transmission loss of partition walls to indicate the decibels of noise reduction of a human voice from one side to the other. (Refer: Australian Standard AS1276 – 1979)

SOUND TRANSMISSION LOSS – The amount in decibels by which a random sound is reduced as it passes through a sound barrier. A method for the measurement of airborne Sound Transmission Loss of a building partition is given in Australian Standard AS1191 - 2002.

STATISTICAL EXCEEDENCE SOUND LEVELS, L_{A90}, L_{A10}, L_{A1}, etc – Noise which varies in level over a specific period of time (usually 15 minutes) may be quantified in terms of various statistical descriptors:

The L_{A90} is the dBA level exceeded for 90 % of the time. In NSW the L_{A90} is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

The L_{A10} is the dBA level that is exceeded for 10 % of the time. In NSW the L_{A10} measured over a period of 10 to 15 minutes. It was until recently used to describe the average maximum noise level, but has largely been replaced by the L_{Aeq} for describing level-varying noise.

The L_{A1} is the dBA level that is exceeded for 1 % of the time. In NSW the L_{A1} may be used for describing short-term noise levels such as could cause sleep arousal during the night.

STEADY NOISE – Noise, which varies in level by 6 dBA or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady". (Refer AS 1055.1 1997)

WEIGHTED SOUND REDUCTION INDEX, R_w – This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 to 3,150 Hertz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:1999).

Internal partition wall $R_w + C$ ratings are frequency weighted to simulate insulation from human voice noise. The $R_w + C$ is always similar in value to the STC rating value. External walls, doors and windows may be $R_w + C_{tr}$ rated to simulate insulation from road traffic noise. This is normally a lower number than the STC rating value.

WHITE NOISE – White noise is broadband random noise whose spectral density is constant across its entire frequency range. The sound power is the same for equal bandwidths from low to high frequencies. Because the higher frequency octave bands cover a wider spectrum, white noise has more energy at the higher frequencies and sounds like a hiss.