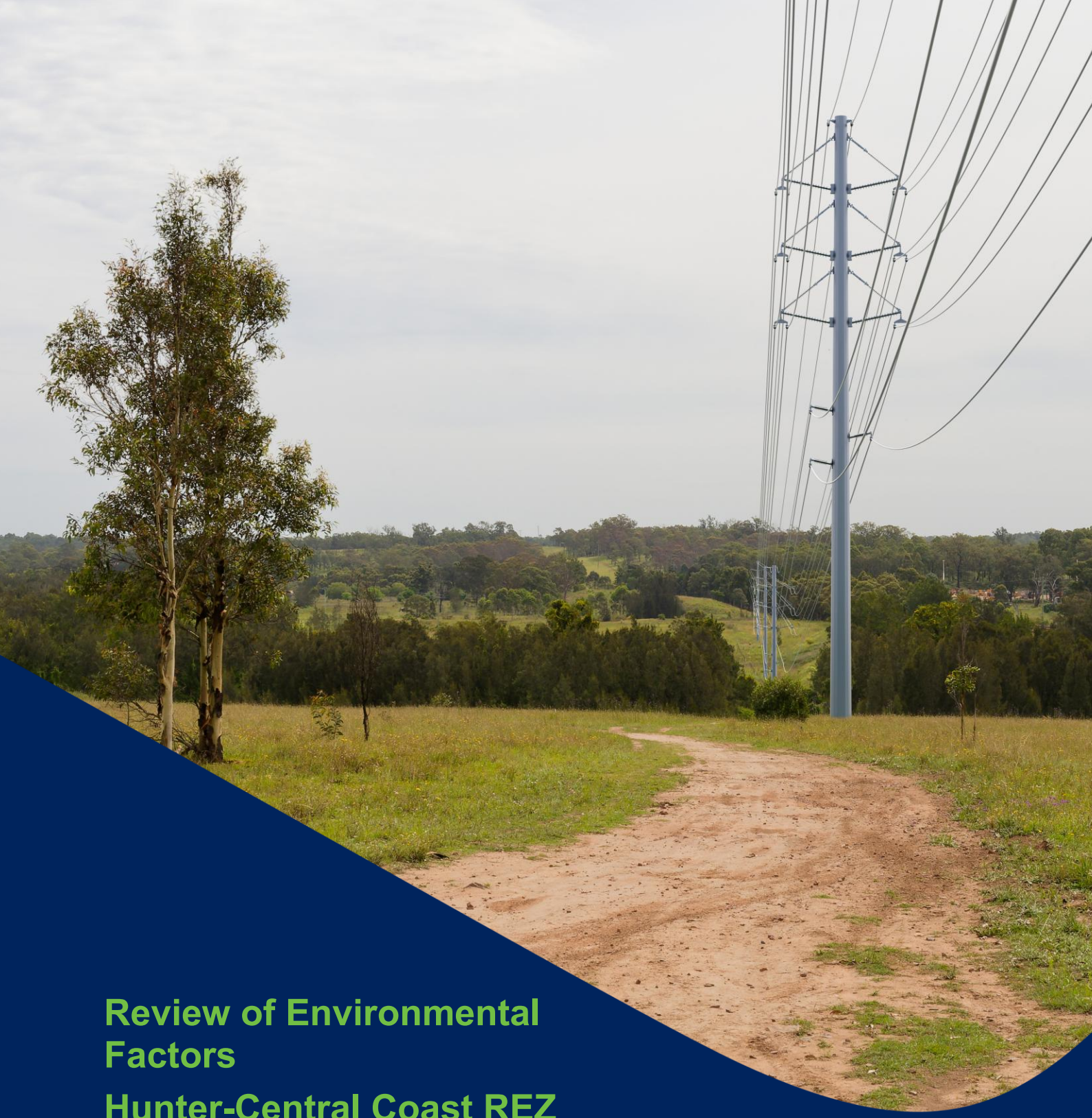

Review of Environmental Factors

Hunter-Central Coast REZ Network Infrastructure

Appendix D – Noise Impact Assessment

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Environmental Noise Impact Assessment

Hunter Renewable Energy Zone (REZ) Project
Kurri Kurri STSS, Sandy Creek STSS & Antiene STSS

REPORT No
8002-1.1R

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Prepared For:
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Report	Date	Prepared	Checked	Comment
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TABLE OF CONTENTS

TABLES

FIGURES

1.0 EXECUTIVE SUMMARY

Ausgrid has engaged Day Design to prepare an acoustic report that assesses the environmental noise impact of the proposed construction and operation of the Hunter Renewable Energy Zone (REZ) project on the surrounding areas.

Ausgrid supplies electricity to the greater part of The Hunter, Central Coast and Newcastle regions. To sustain this service they have a number of substations to convert high voltage electricity to lower voltages.

The Hunter REZ project will include the following:

- Stage 1 - Singleton to Kurri Kurri 132kV Link & fibre optic underground cable from Antiene sub-transmission switching station (STSS) to Muswellbrook BSP;
- Stage 2 - Antiene 132kV STSS, Antiene STSS to Singleton 132kV Link and Sandy Creek STSS network rearrangement.

The project brief provided to Day Design by Ausgrid outlines three STSS's that will require a noise impact assessment, being:

- Kurri Kurri STSS - 123 Main Road, Heddon Greta;
- Sandy Creek STSS - 20-24 Sandy Creek Road, Muswellbrook; and
- Antiene STSS - Hebdan Road, Muswellbrook.

The environmental noise impact from the construction and operation of each STSS listed been assessed in this report;

- Kurri Kurri STSS – Section 4;
- Sandy Creek STSS – Section 5; and
- Antiene STSS – Section 6.

A construction noise and vibration management plan is provided in Section 7 for the construction of the feeder line throughout the Hunter REZ project.

Acceptable noise limits for the operation of the Hunter REZ project are derived from the NSW Environment Protection Authority's (EPA) *NSW Noise Policy for Industry* (NPI) at the nearest noise sensitive receivers.

Acceptable noise and vibration limits for the construction of the Hunter REZ project are derived from the NSW EPA's *Interim Construction Noise Guideline* and *Assessing Vibration: a technical guideline* at the nearest noise and vibration sensitive receivers.

Noise and vibration levels from the construction and operation of the Hunter REZ project have been assessed at the nearest noise sensitive receivers and, provided the noise controls in Sections 4.3.2.5, 5.3.2.5, 6.3.2.5 and 7 are implemented and adhered to, will comply with EPA's guidelines.

2.0 CONSULTING BRIEF

Day Design Pty Ltd has been engaged by Ausgrid to prepare an acoustic report that assesses the environmental noise impact of the construction and operation of the Hunter REZ project. This commission involves the following:

Scope of Work:

- Inspect the sites and environs
- Measure the background noise levels at critical locations and times for each STS
- Establish acceptable noise level criteria
- Quantify noise emissions from the construction and operation of the Hunter REZ project
- Calculate the level of noise emissions, taking into account screen walls and distance attenuation
- Calculate the level of vibration emissions from the construction of the STS's
- Prepare a site plan identifying the development and nearby noise sensitive locations
- Provide recommendations for noise and vibration control (if necessary)
- Prepare an Environmental Noise Impact Assessment Report.

3.0 NOISE CRITERIA

The relevant policies and guidelines for assessing noise and vibration emissions from each of the STS's are outlined in this Section.

3.1 Operational Noise Emission Criteria – NSW Environment Protection Authority

3.1.1 Protection of the Environment Operations Act 1997 No 156

Schedule 1 of the Protection of the Environment Operations Act 1997 (POEO Act) No 156 provides a list of industrial type developments required to hold a licence under that Act for the operations at the site. Clause 17 of Schedule 1 relates to electricity generation, as follows:

17 Electricity generation

(1) This clause applies to the following activities:

***general electricity works**, meaning the generation of electricity by means of electricity plant that, wherever situated, is based on, or uses, any energy source other than wind power or solar power.*

***metropolitan electricity works (gas turbines)**, meaning the generation of electricity by means of electricity plant:*

(a) that is based on, or uses, a gas turbine, and

(b) that is situated in the metropolitan area or in the local government area of Port Stephens, Maitland, Cessnock, Singleton, Wollondilly or Kiama.

***metropolitan electricity works (internal combustion engines)**, meaning the generation of electricity by means of electricity plant:*

(a) that is based on, or uses, an internal combustion engine, and

(b) that is situated in the metropolitan area or in the local government area of Port Stephens, Maitland, Cessnock, Singleton, Wollondilly or Kiama.

(1A) However, this clause does not apply to the generation of electricity by means of electricity plant that is emergency stand-by plant operating for less than 200 hours per year.

(2) Each activity referred to in Column 1 of the Table to this clause is declared to be a scheduled activity if it meets the criteria set out in Column 2 of that Table.

Table

Column 1	***Column 2***
Activity	***Criteria***
general electricity works	*capacity to generate more than 30 megawatts of electrical power*
metropolitan electricity works (gas turbines)	*capacity to burn more 20 megajoules of fuel per second*
metropolitan electricity works (internal combustion engines)	*capacity to burn more than 3 megajoules of fuel per second*

The Hunter REZ project is not an electricity generation project, it is an electricity transmission project, therefore Clause 17 of the POEO Act does not apply.

3.1.2 NSW Noise Policy for Industry

The NSW Environment Protection Authority (EPA) published the *Noise Policy for Industry* (NPI) in October 2017. The *NPI* is specifically aimed at assessing noise from industrial noise sources listed in Schedule 1 of the Protection of the Environment Operations Act 1997 (POEO, 1997).

As detailed in Section 3.1 of this Report, the Hunter REZ project is not a 'scheduled premises' under the Protection of the Environment Operations Act 1997, and is not required to hold a licence under that Act for operations at the site.

Notwithstanding, the *NPI* provides the framework to assess noise emission from a non-scheduled premises, and whether that premises produces intrusive or non-intrusive noise.

Section 2.1 of the *NPI* states the following:

"Intrusive noise levels are only applied to residential receivers (residences). For other receiver types identified in Table 2.2, only the amenity levels apply."

3.2 Construction Noise & Vibration Emission Criteria

3.2.1 Australian Standard AS2436

The Australian Standard AS2436:2010 *"Guide to noise and vibration control on construction, demolition and maintenance sites"* provides guidance on noise control in respect to construction, demolition and maintenance sites. The Standard also provides guidance for the preparation of noise and vibration management plans.

Section 1.5 'Regulatory Requirements' of the Standard states:

"Legislation associated with the control of noise and vibration on and from construction, demolition and maintenance sites in Australia is generally the responsibility of the relevant State or Territory government, local council or a designated statutory authority."

Consequently the Standard does not provide specific noise criteria rather sets out practical methods for determining the potential for noise and vibration impact on the community from construction, demolition and maintenance sites.

A qualitative method is described in Section 3.3 of the standard, which is designed to avoid the need for complex noise predictions by following a series of questions relating to, for example, whether the noise is likely to be loud, have annoying characteristics or affect sleep.

In the event that any of these outcomes are likely, a more detailed and quantitative approach should be adopted.

In relation to carrying out detailed noise impact assessments, Section 4 'General' of the standard states:

"Regulatory authorities may have relevant polices and/or guidelines for the control of noise and vibration on construction sites. These should also be referred to when developing noise and vibration management plans for such projects."

In NSW this is the NSW Environment Protection Authority's *Interim Construction Noise Guideline 2009* as outlined in Section 3.2.2.

The Standard further states, in Section 4.6.1, that if noisy processes cannot be avoided, then the amount of noise reaching the receiver should be minimised and goes on to provide advice and recommendations to reduce noise and vibration impacts as far as reasonably practicable.

This report has been prepared in accordance with the guidance provided in AS2436:2010.

3.2.2 NSW Environment Protection Authority

3.2.2.1 General – EPA Construction Noise Guideline

The NSW Environment Protection Authority published the *Interim Construction Noise Guideline* in July 2009. While some noise from construction sites is inevitable, the aim of the Guideline is to protect the majority of residences and other sensitive land uses from noise pollution most of the time.

The Guideline presents two ways of assessing construction noise impacts; the quantitative method and the qualitative method.

The quantitative method is generally suited to longer term construction projects and involves predicting noise levels from the construction phase and comparing them with noise management levels given in the guideline.

The qualitative method for assessing construction noise is a simplified way to identify the cause of potential noise impacts and may be used for short-term works, such as repair and maintenance projects of short duration.

In this instance, the quantitative method is the most appropriate and has been used in this assessment. Details of the quantitative method are given in Section 4 of the Guideline.

Normal construction hours are defined by the EPA as follows:

- 7.00 am to 6.00 pm Monday to Friday;
- 8.00 am to 1.00 pm Saturday; and
- No work on Sunday or Public Holiday.

Table 2 in Section 4 of the Guideline sets out noise management levels at affected residences and how they are to be applied during normal construction hours. The noise management level is derived from the rating background level (RBL) plus 10 dB in accordance with the Guideline. This level is considered to be the 'noise affected level' which represents the point above which there may be some community reaction to noise.

The 'highly noise affected' level of 75 dBA represents the point above which there may be strong community reaction to noise. This level is provided in the Guideline and is not based on the RBL. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

3.2.2.2 EPA Vibration Guideline

The NSW EPA published the *Assessing Vibration: a technical guideline* in February 2006. This guideline is based on the British Standard BS6472:1992 *"Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)."*

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. The guideline considers vibration from construction activities as Intermittent Vibration. Table 2.4 of the guideline sets out limits for Vibration Dose Values to assess intermittent vibration and is replicated below in Table 1 for residential, commercial and industrial receptor locations.

Table 1 Hunter REZ – Vibration Dose Values (VDV) from Construction Activities

Receptor Location	Daytime	
	Preferred value ($m/s^{1.75}$)	Maximum value ($m/s^{1.75}$)
All Residences	0.20	0.40
Workshops	0.80	1.60

The British Standard BS7385-2:1993 *"Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration"* provides guide values for transient vibration relating to cosmetic damage, replicated below in Table 2 for residential, commercial and industrial buildings.

Table 2 Hunter REZ – Transient Vibration Guide Values for Cosmetic Damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Unreinforced or light framed structures - residential buildings and light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Industrial buildings	50 mm/s at 4 Hz and above	

In our opinion, an overall peak particle velocity of **15 mm/s** at the residential receptors and **50 mm/s** at the boundaries of commercial/industrial receptors will comply with the recommended values in Table 2, and is an acceptable criteria for intermittent vibration to prevent cosmetic damage to the adjacent residential, commercial and industrial buildings.

4.0 KURRI STSS – NOISE & VIBRATION EMISSION ASSESSMENT

4.1 Kurri STSS – Site & Project Description

4.1.1 Kurri STSS – Site Description

The Kurri Kurri STSS (Kurri STSs) is located at 123 Main Road, Heddon Greta, NSW.

The Kurri STSS is situated on and adjacent to the north and south of land zoned *R2: Rural Landscape* under Cessnock Local Environmental Plan (LEP) 2011. The land adjacent to east is zoned *C2: Environment Conservation*, with the land adjacent to the west zoned *SP2: Classified Road*. The Kurri STSS and the surrounding land is shown on Figure 1 below.

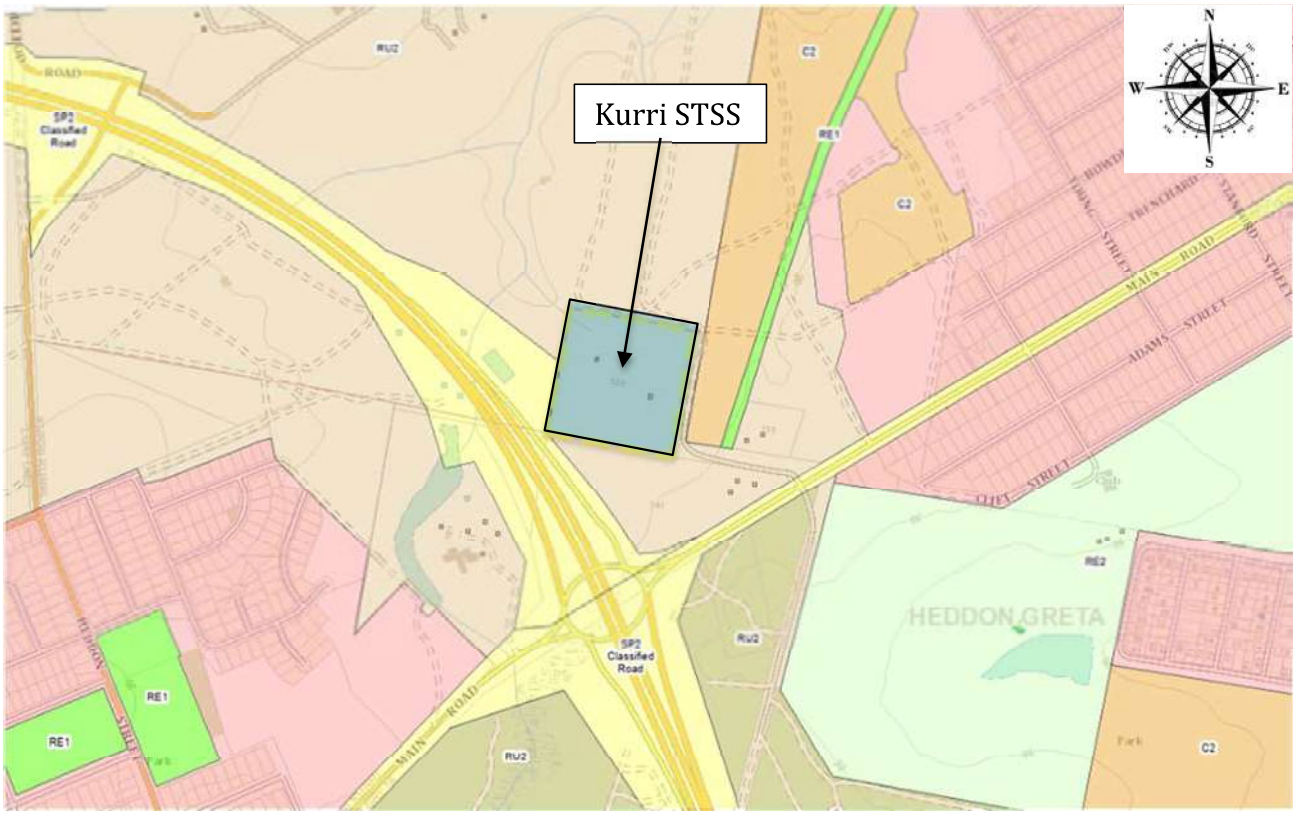


Figure 1 Land Zoning, Kurri STSS, NSW

The Kurri STSS is bounded by undeveloped rural land to the north, east, south and west.

The nearest noise sensitive receptors to the Kurri STSS, in various directions, are shown in Figure 2 and as follows in Table 3.

Table 3 Kurri STSS – Noise Sensitive Receptors

Receptor and Type	Address[1] & Location	Direction from site
R1 – Residential Zone	Main Road, Trenchard Street & Earp Street, Heddon Great	East
R2 – Industrial	115 Main Road, Heddon Great	East
R3 – Commercial	112 Main Road, Heddon Great	South - East
R4 – Industrial	181 Main Road, Kurri Kurri	South - West
R5 – Residential Zone	Acacia Street & Brown Crescent	South - West

[1] *Where multiple receiver locations exist in a given direction, and to ensure a worst-case scenario is considered, the noise impact from a noise source is assessed at the potentially most affected receiver location – compliance at the potentially most affected receiver location will ensure compliance at all other locations.*

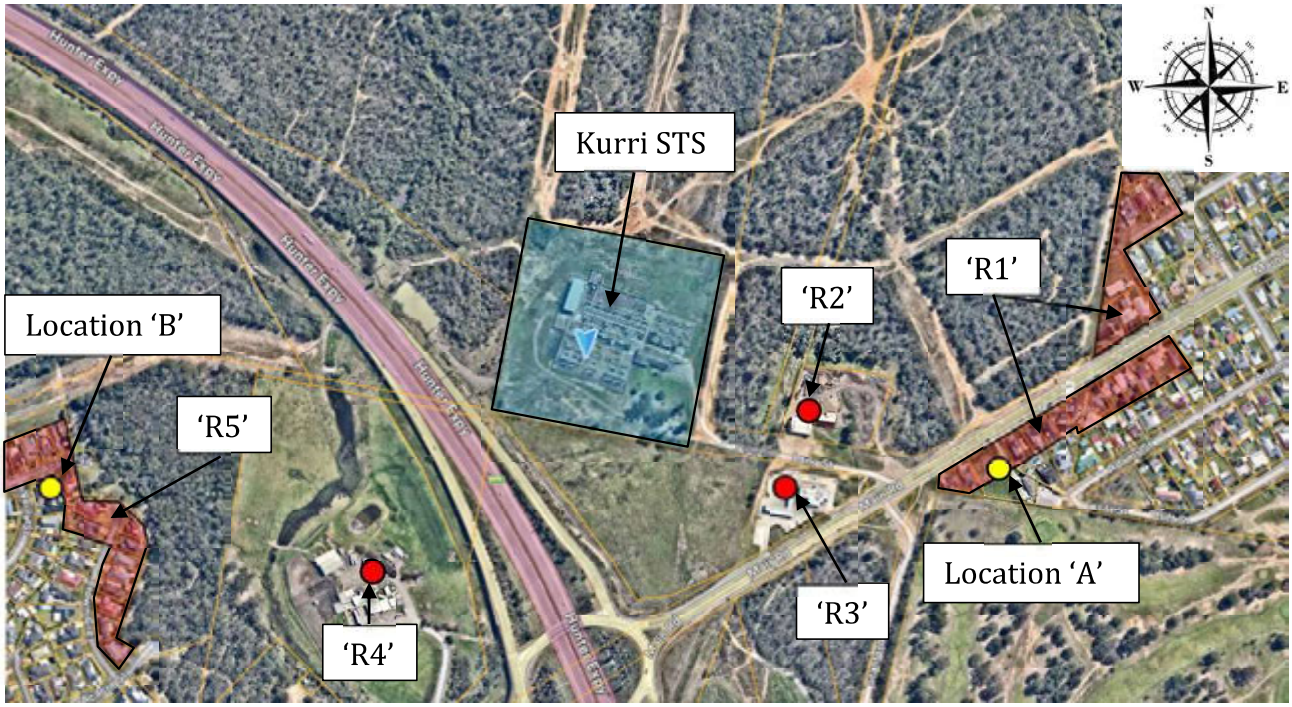


Figure 2 Location Plan, Kurri STSS, 123 Main Road, Heddon Greta, NSW.

4.1.2 Kurri STSS – Development Description

The existing Kurri STSS operates 24 hours a day, 7 days a week.

Ausgrid is proposing alterations and additions to the Kurri STSS which will comprise of the installation of three new 132 kV outdoor dead-tank switchgears (3-pole – SF6 3150A), nine outdoor disconnectors and earth switches (3150A), nine 132kV/110V MVT's, six 132kV surge arresters and three 132kV/110V CVTs.

Generally the main noise producing equipment at a STSS are the transformers, we note that no additional transformers are proposed to be installed at the Kurri STSS.

The location(s) of the equipment outlined above can be seen in the Site Plan prepared by Ausgrid, attached in Appendix C1.

The construction of the Kurri STSS alterations and additions is broken down into two stages:

Stage 1- Expected timeframe of 32 weeks

- Stage 1 – site preparation and establishment:
    - Activities include use of a rock breaker, crane, piling rig, excavators, bobcat, vacuum truck, light and heavy vehicles.

Stage 2 - Expected timeframe of 28 weeks

- Stage 2 – forming the concrete foundations, general construction of infrastructure and installation of additional equipment at the Kurri STSS:
    - Activities include use of a rock breaker, excavator, bobcat, concrete trucks, crane, hand tools (electric), hand tools (pneumatic), and light and heavy vehicles.

The proposed hours of construction are, as follows:

High Impact Noise (rock/concrete breaking, piling, etc):

- Monday to Friday: 7 am to 6 pm;
- Saturdays: 8 am to 1 pm; and
- Sundays and public holidays: No work proposed.

Low Impact Noise:

- Monday to Friday: 7 am to 6 pm;
- Saturdays: 7 am to 6 pm; and
- Sundays and public holidays: No work proposed.

4.2 Kurri STSS – Existing Ambient Noise Level & Project Noise Trigger Levels

4.2.1 Kurri STSS – Description of Existing Acoustic Environment

Site inspections of the residential areas surrounding Locations 'A' and 'B' were conducted by Day Design staff during the placement of the noise loggers with the following observations made:

Location 'A' -

- the area is defined by the natural environment and constant local road traffic noise from Main Road during the day and evening;
- the area is defined by the natural environment and intermittent local road traffic noise from Main Road during the night;
- the area is in close proximity to existing industrial and commercial premises – 115 (industrial) and 112 (commercial) Main Road, Heddon Great.

Location 'B' -

- the area is defined by the natural environment and constant, distant local road traffic noise from The Hunter Expressway during the day and evening;
- the area is defined by the natural environment and intermittent, distant local road local road traffic noise from Main Road during the night;
- the area is in close proximity to an existing industrial premises – 181 Main Road, Kurri Kurri.

4.2.2 Kurri STSS – Measured Ambient Noise Levels

In order to assess the severity of a possible environmental noise problem in a residential area it is necessary to measure the ambient background noise level at the times and locations of worst possible annoyance. The lower the background noise level, the more perceptible the intrusive noise becomes and the more potentially annoying.

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

The Rating Background Level (RBL) is defined by the Environment Protection Authority (NSW) 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 places of worst possible annoyance are the nearby residential dwellings. These locations are shown in the Location Plan on Figure 2 as 'R1' and 'R5'. The times of worst possible annoyance will be during the night when the Kurri STSS is operating.

Ambient noise levels were measured in two locations shown as Location 'A' and Location 'B' on Figure 2, during the following period:

- Locations 'A' & 'B'
  - Friday 5 to Thursday 18 July 2024.

The day, evening and night time ambient noise levels are presented in the attached Appendix B1 and also below in Table 4.

Table 4 Kurri STSS – Ambient Noise Levels

Noise Measurement Location	Date & Time Period	L_{90} Rating Background Level	Existing L_{eq} Noise Level
	5/7 to 18/7/2024		
Location 'A' – 96 Main Rd, Heddon Greta	Day (7 am to 6 pm)	**53 dBA**	**61 dBA**
	Evening (6 pm to 10 pm)	**47 dBA**	**58 dBA**
	Night (10 pm to 7 am)	**39 dBA**	**56 dBA**
Location 'B' – 22 Neilly Street, Kurri Kurri	Day (7 am to 6 pm)	**40 dBA**	**49 dBA**
	Evening (6 pm to 10 pm)	**42 dBA**	**47 dBA**
	Night (10 pm to 7 am)	**35 dBA**	**45 dBA**

Meteorological conditions during the monitoring typically consisted of clear skies with temperatures ranging from 5 to 19°C. Where applicable, weather affected (ie rain or wind [speed > 5 m/s]) data has been removed from the assessment period. Atmospheric conditions were generally ideal for noise monitoring. Noise measurements were therefore considered reliable and typical for the receptor areas. Meteorological data was gathered from weather station ID 061430 Singleton Defence AWS NSW circa 35 kms away.

Fact Sheet A: Determining existing noise levels, Section A1 of the NPI states the following in relation to determining background noise levels:

Background noise levels need to be determined before intrusive noise can be assessed. The background noise levels to be measured are those that are present at the time of the noise assessment and without the subject development operating. For the assessment of modifications to existing premises, the noise from the existing premises should be excluded from background noise measurements. The exception is where the premises has been operating for a significant period of time and is considered a normal part of the acoustic environment; it may be included in the background noise assessment under the following circumstances:

- *the development must have been operating for a period in excess of 10 years in the assessment period/s being considered and is considered a normal part of the acoustic environment; and*
- *the development must be operating in accordance with noise limits and requirements imposed in a consent or licence and/or be applying best practice.*

Day Design has been advised that the existing Kurri STSS was commissioned well over 10 years ago, and has been generally operating under the same conditions to the current day. Day Design has also been advised that the operators are applying best practices for day to day operations.

Therefore, considering the above, any ambient noise measurements must also take into consideration the noise contribution to the surrounding area from the operation of the existing Kurri STSS and local (road) traffic noise, as it forms part of the existing acoustic environment – the noise from the operation of Kurri STSS and local (road) traffic noise is typical/expected in this area.

Section B1.1 'Instrument requirements and siting', paragraph 2 of the *NPI* requires monitoring to take place at a 'site that is truly representative of the noise environment at the residence'.

Section B1.2 'Measurement procedure', point 2, of the *NPI* specifies that monitoring should take place for 'each day of the week the proposed development will be operating and over the proposed operating hours'.

In addition to the long-term unattended ambient noise level measurements, and in accordance with Fact Sheet A: Determining existing noise levels, Table A1 of the NSW Environment Protection Authority's *NSW Noise Policy for Industry,* short-term attended ambient noise level measurements were also conducted at Location 'A' from 5.00 to 05.15 pm and at Location 'B' from 02.45 to 03.00 pm on Friday 5 July 2024, with a Type 1 or 2, respectively, environmental noise logger (see Appendix A) to verify the acoustic environment.

The attended $L_{90,\ 15\ minute}$ noise level at Location 'A' was 59 dBA, with the attended $L_{90,\ 15\ minute}$ noise level at Location 'B' being 48 dBA.

During the attended measurements it was confirmed that the acoustic environment, per the observations in Section 4.2.1, is dominated by the natural environment and constant local road traffic noise from Main Road at Location 'A' and the natural environment and constant, distant local road traffic noise from The Hunter Expressway at Location 'B'.

In accordance with Fact Sheet A and Section B1.1, Day Design is of the opinion the measured ambient noise levels in Location 'A' are representative of the noise environment at residential receivers 'R1' and the measured ambient noise levels in Location 'B' are representative of the noise environment at residential receivers 'R5' – see Figure 2.

4.2.3 Kurri STSS – Operational Noise – Noise Emission Criteria

4.2.3.1 Kurri STSS – EPA NPI – Project Intrusiveness Noise Level

The EPA states in Section 2.3 of its *NPI* (October 2017) that the intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the rating background noise level by more than 5 dB when beyond a minimum threshold (EPA *NPI*, 2017, Section 2.3).

The RBL at Location 'A' was 53 dBA in the day, 47 dBA the evening and 39 dBA at night (see Table 4).

Therefore the acceptable L_{eq} noise intrusiveness criteria in this area is:

- (53 + 5 =) 58 dBA during the day;
- (47 + 5 =) 52 in the evening; and
- (39 + 5 =) 44 dBA at night.

The RBL at Location 'B' was 40 dBA in the day, 42 dBA the evening and 35 dBA at night (see Table 4).

The NSW EPA in their *Noise Policy for Industry* (2017), Section 2.3, state the following:

"The objective of carrying out long-term background noise monitoring at a location is to determine existing background noise levels that are indicative of levels during the entire year. However, the RBL for evening or night periods calculated from long-term unattended background noise monitoring can sometimes be higher than the RBL for the daytime period. This situation can arise due to increased noise from, for example, insects or frogs during the evening and night in the warmer months, or due to temperature inversion conditions during winter.

In determining project noise trigger levels from RBLs, the community's expectations also need to be considered. The community generally expects greater control of noise during the more sensitive evening and night-time periods than during the less sensitive daytime period. Therefore, in determining project noise trigger levels for a particular development, it is generally recommended that the project intrusiveness noise level for evening be set at no greater than the project intrusiveness noise level for daytime. The project intrusiveness noise level for night-time should be no greater than the project intrusiveness noise level for day or evening. Alternative approaches to these recommendations may be adopted if appropriately justified."

Therefore the acceptable L_{eq} noise intrusiveness criteria in this area is:

- (40 + 5 =) 45 dBA during the day and in the evening; and
- (35 + 5 =) 40 dBA at night.

4.2.3.2 Kurri STSS – EPA NPI – Project Amenity Noise Level

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. The NSW *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.

Section 2.4, Table 2.3 of the *NPI* provides guidance on assigning residential receiver noise categories. A site inspection of the residential areas surrounding residential receivers 'R1' and 'R5' was conducted by Day Design staff during the placement and retrieval of the environmental noise loggers, see Section 4.2.1 for observations.

The observations in Section 4.2.1 indicate the residential area around residential receivers 'R1' and 'R5' is considered 'Suburban', as per Table 2.3 of the *NPI*. The 'Suburban' amenity noise levels as per Table 2.3 of the *NPI* will be used to assess residential receivers in the area.

The recommended L_{eq} noise levels below in Table 5 are taken from Section 2.4, Table 2.2 of the NPI. Compliance with the Noise Amenity levels in Table 2.2 will limit ambient noise creep.

Table 5 Kurri STSS – Amenity Noise Levels (NPI - Table 2.2)

Receiver	Noise Amenity Area	Time of Day	Recommended L_{eq}, dBA Amenity Noise Level
Residential	Suburban	Day	55
		Evening	45
		Night	40
Commercial premises	All	When in use	65
Industrial premises	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)** (Section 2.2 NPI).

Compliance with the amenity criteria will limit ambient noise creep. **Section 2.4** of the *NPI* states the following:

*'To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a **project amenity noise level** applies for each new source of industrial noise as follows:*

- ***Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB (A).***

The following exceptions to the above method to derive the project amenity noise level apply:

3. *Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.'*

As described in Section 4.2.1, other industrial and commercial premises are present in the area with the noise levels unlikely to reduce in the future.

In addition, the level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the L_{Aeq} noise level from that industrial noise source may exceed the project amenity noise level, ie where the existing traffic noise level is 10 dB or more above the recommended amenity noise level for the area. In such cases the project amenity noise level may be derived from the $L_{Aeq,\ period\ (traffic)}$ minus 15 dBA (refer Section 2.4.1 of the NPI).

The existing L_{eq} noise level at Location 'A' was 61 dBA during the day, 58 dBA in the evening and 56 dBA at night (see Table 4).

Ambient L_{eq} noise levels at Location 'A' were affected by existing industrial, commercial and local road traffic noise during the day, evening and night. From observations made at Location 'A', the local road traffic is the dominant noise at the receiver, therefore Section 2.4.1 of the NPI is applicable.

The existing industrial and commercial noise is not more than 10 dB above the project amenity noise level during the day, evening or night, therefore corrections for industrial and commercial noise are not applicable.

The existing local road traffic during the day is not more than 10 dB above the recommended amenity noise level for the area, therefore section 2.4.1 of the NPI is not applicable. However, the existing local road traffic during the evening and night is more than 10 dB above the recommended amenity noise level for the area and it is highly unlikely the road traffic noise will decrease in the future.

Therefore, the acceptable amenity noise levels at Location 'A' are:

- (55 – 5 + 3 =) 53 dBA $L_{eq,\ 15\ minute}$ during the day;
- (58 – 15 + 3 =) 46 dBA $L_{eq,\ 15\ minute}$ in the evening; and
- (56 – 15 + 3 =) 44 dBA $L_{eq,\ 15\ minute}$ at night.

The existing L_{eq} noise level at Location 'B' was 49 dBA during the day, 47 dBA in the evening and 45 dBA at night (see Table 4).

Ambient L_{eq} noise levels at Location 'B' were affected by existing industrial and distant local road traffic noise during the day, evening and night. The existing commercial and local road traffic noise are not more than 10 dB above the project amenity noise level or recommended amenity noise level, respectively, during the day, evening or night at Location 'B'.

Therefore, the acceptable amenity noise levels at Location 'B' are:

- (55 – 5 + 3 =) 53 dBA $L_{eq,\ 15\ minute}$ during the day;
- (45 – 5 + 3 =) 43 dBA $L_{eq,\ 15\ minute}$ in the evening; and
- (40 – 5 + 3 =) 38 dBA $L_{eq,\ 15\ minute}$ at night.

The acceptable amenity noise levels at the commercial receivers is as follows:

- (65 – 5 + 3 =) 63 dBA $L_{eq,\ 15\ minute}$ when in use.

The acceptable amenity noise levels at the industrial receivers is as follows:

- (70 – 5 + 3 =) 68 dBA $L_{eq,\ 15\ minute}$ when in use.

4.2.3.3 Kurri STSS – EPA NPI – Project Sleep Disturbance Noise Trigger Levels

The EPA's *NPI* states in Section 2.5 that the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Sleep may be disturbed if the subject development night-time noise levels at a residential location exceed the following:

- $L_{Aeq,\ 15min}$ 40 dBA or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

Where either of the above criteria are triggered, a detailed maximum noise level event assessment should be undertaken.

The RBL at Location 'A' is 39 dBA at night (see Table 4). Therefore, the acceptable $L_{eq,\ 15\ minute}$ and L_{AFmax} noise sleep disturbance criteria in these areas are:

Location 'A'

- 44 dBA $L_{eq,\ 15\ minute}$ at night; and/or
- 54 dBA L_{AFmax} at night.

The RBL at Location 'B' is 35 dBA at night (see Table 4). Therefore, the acceptable $L_{eq,\ 15\ minute}$ and L_{AFmax} noise sleep disturbance criteria in these areas are:

Location 'B'

- 40 dBA $L_{eq,\ 15\ minute}$ at night; and/or
- 52 dBA L_{AFmax} at night.

4.2.3.4 Kurri STSS – EPA NPI – Modifying Factors Corrections

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. On the other hand, some sources may cause less annoyance where only a single event occurs for a limited duration. Correction factors are to be applied to the noise from the source measured or predicted at the receiver before comparison with the criteria. AC500-10 in the Appendices is extracted from Table C.1 of the *NPI*.

4.2.3.5 Kurri STSS – Operational Noise – Project Noise Trigger Levels

Based on the measured background noise levels and the relevant planning instruments and legislation, the Project Noise Trigger Levels at each receptor location are as follows:

4.2.3.5.1 Kurri STSS – Residential Receptor Project Noise Trigger Levels

For Residential Receptors 'R1' – based on the measured background noise levels at Location 'A':

- **53 dBA** $L_{Aeq,\ 15\ minute}$ during the day;
- **46 dBA** $L_{Aeq,\ 15\ minute}$ in the evening; and
- **44 dBA** $L_{Aeq,\ 15\ minute}$ at night.

For Residential Receptors 'R5' – based on the measured background noise levels at Location 'B':

- **45 dBA** $L_{Aeq,\ 15\ minute}$ during the day;
- **43 dBA** $L_{Aeq,\ 15\ minute}$ in the evening; and
- **38 dBA** $L_{Aeq,\ 15\ minute}$ at night.

These criteria apply at the most-affected point on or within the residential property boundary – or, if that is more than 30 metres from the residence, at the most-affected point within 30 metres of the residence.

The following criteria will be applied at 1 metre from the potentially most affected residential façades of, 'R1' and 'R5' for potential sleep disturbance caused by switching of the outdoor dead-tank switchgears (see Section 4.3.1 for detail) during the night (10 pm to 7 am).

'For Residential Receptors 'R1' – based on the measured background noise levels at Location 'A':

- **44 dBA** $L_{eq,\ 15\ minute}$; and/or
- **54 dBA** L_{AFmax} at night time.

'For Residential Receptors 'R5' – based on the measured background noise levels at Location 'B':

- **40 dBA** $L_{eq,\ 15\ minute}$; and/or
- **52 dBA** L_{AFmax} at night time.

4.2.3.5.2 Kurri STSS – Commercial & Industrial Receptor Project Noise Trigger Levels

For commercial receptor 'R3':

- **63 dBA** $L_{Aeq,\ 15\ minute}$ when in use.

For industrial receptors 'R2'& 'R4':

- **68 dBA** $L_{Aeq,\ 15\ minute}$ when in use.

These criteria apply at the reasonably most-affected point on or within the property boundary.

4.2.4 Kurri STSS – Construction Noise – Noise & Vibration Emission Criteria

4.2.4.1 Kurri STSS – EPA Construction Noise Guideline

Based on the RBLs at all sensitive residential receiver locations in the daytime, the recommended noise management level during all aspects of the construction program are summarised in Table 6.

Table 6 Kurri STSS – L_{eq} Noise Management Levels from Construction Activities

Receptor Location	Noise Management Level	How to Apply
All Residential Receptors	**'R1' (53 + 10 =) 63 dBA** **'R5' (40 + 10 =) 50 dBA**	The noise affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured $L_{Aeq\ (15\ min)}$ noise level is greater than the noise affected level, the proponent should apply all feasible and reasonable* work practices to meet the noise affected level. ▪ The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. ▪ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 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.

*Section 6, 'work practices' of The *Interim Construction Noise Guideline*, states: *"there are no prescribed noise controls for construction works. Instead, all feasible and reasonable work practices should be implemented to minimise noise impacts. This approach gives construction site managers and construction workers the greatest flexibility to manage noise"*.

Definitions of the terms feasible and reasonable are given in Section 1.4 of the Guideline.

Section 4.1.3 of the guideline sets out noise management levels at the nearby affected commercial and industrial premises. It states that 'the external noise levels should be assessed at the most-affected occupied point of the premises', as follows:

- industrial premises: external $L_{Aeq,\ 15\ minute}$ 75 dBA;
- offices, retail outlets: external $L_{Aeq,\ 15\ minute}$ 70 dBA.

During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work.

4.2.4.2 Kurri STSS – EPA Vibration Guideline

Per Section 3.2.2.2 of this report, an overall peak particle velocity of **15 mm/s** at the boundaries of residential receptors and **50 mm/s** at the boundaries of commercial/industrial receptors will comply with the recommended values in Table 2, and is an acceptable criteria for intermittent vibration to prevent cosmetic damage to the nearby residential, commercial and industrial buildings.

4.2.4.3 Kurri STSS – Construction Noise & Vibration – Project Noise & Vibration Trigger Levels

4.2.4.3.1 Kurri STSS – Construction Noise Management Levels

- Noise management level of **63 dBA** $L_{Aeq,\ 15\ minute}$ for all residential receptors 'R1';
- Noise management level of **50 dBA** $L_{Aeq,\ 15\ minute}$ for all residential receptors 'R5';
- Noise management level of **70 dBA** $L_{eq,\ 15\ minute}$ for all commercial receptors; and
- Noise management level of **75 dBA** $L_{eq,\ 15\ minute}$ for all industrial receptors.

4.2.4.3.2 Kurri STSS – Construction Vibration Management Levels

- A Vibration Dose Value (VDV) between **0.2 – 0.4 m/s$^{1.75}$** for human annoyance in residential buildings;
- A Vibration Dose Value (VDV) between **0.8 – 1.6 m/s$^{1.75}$** for human annoyance in commercial/industrial buildings;
- A Peak Particle Velocity no greater than **15 mm/s** for cosmetic damage at the residential buildings; and
- A Peak Particle Velocity no greater than **50 mm/s** for cosmetic damage at the commercial/industrial buildings.

4.3 Kurri STSS – Noise & Vibration Emission Assessment

4.3.1 Kurri STSS – Operational Noise Emission Assessment

The main sources of noise from the proposed alterations and addition at the Kurri STSS are the three new 132 kV outdoor dead-tank switchgears (3-pole – SF6 3150A).

All other proposed equipment emits negligible levels of noise.

Additionally, as detailed in Section 4.2.2, the existing Kurri STSS was commissioned well over 10 years ago, and has been generally operating under the same conditions to the current day. Therefore, the noise contribution to the surrounding area from the operation of existing Kurri STSS is deemed acceptable and it forms part of the existing noise environment – no consideration or assessment is given or required for noise emissions associated with existing items of plant or equipment at the Kurri STSS in this report.

We have been advised that the three new 132 kV outdoor dead-tank switchgears (3-pole – SF6 3150A) are required to operate 1 to 2 times per year during switching. Switching takes place over a short period, ie up to 3 seconds (1 second per outdoor dead-tank switchgear). Noise emissions associated with switching are advised to be ≤ 90 dBA $L_{eq,\ 1\ second}$ (sound power level).

Considering the above, and excluding maintenance and emergencies, the maximum run time for the outdoor dead-tank switchgears would be (2 x 3 =) 6 seconds per year, or 3 seconds on up to 2 days of the year.

We have considered noise emissions based on the typical operation of the Kurri STSS following the alterations and additions, ie noise emissions during the day, evening and night include the operation of the three new 132 kV outdoor dead-tank switchgears.

Calculations are based on plans prepared by Ausgrid as shown in Appendix C1. Calculations include reductions for the acoustic shielding provided by the existing building structures on the Site and in the surrounding areas were required.

Using the information gathered above, a schedule of sound power levels for an outdoor dead-tank switchgears is given in Table 7 below.

Table 7 Kurri STSS – L_{eq} Sound Power Levels

Description	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)							
	dBA	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**
Outdoor Dead-Tank Switchgear	**90[1]**	*74*	*86*	*88*	*86*	*87*	*82*	*75*

**Numbers in italics are estimated*

[1]For the assessment of potential sleep disturbance we have adopted an $L_{AF,max}$ sound power level of 93 dBA.

4.3.1.1 Kurri STSS – Applicable NPI Modifying Factor Corrections

The Sound Power Level spectrum of the outdoor dead-tank switchgears above does not contain tonal or dominant low frequency noise characteristics. Noise associated with the operation of the outdoor dead-tank switchgears is considered to contain intermittent noise characteristics. Therefore, corrections to the predicted noise levels for intermittent noise at the receiver locations are required for the assessment of noise associated with the operation of the outdoor dead-tank switchgears in accordance with Fact Sheet C: Correction for annoying noise characteristics of the NPI during the night time period only.

4.3.1.2 Kurri STSS – Predicted Noise Emissions

Knowing the sound power level of a noise source (see Table 7), the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for time corrections, distance losses, sound barriers, etc.

Calculations have been carried out using *iNoise V2024.1* industrial noise prediction modelling software which incorporates the methods specified in *ISO 9613.1/2* [1] to calculate noise emissions. The noise emissions have been calculated to determine the noise level at each receptor location due to the future operation of the Kurri STSS. Noise-enhancing meteorological conditions (see Fact Sheet D of the NPI) have been adopted for all calculations.

[1] *ISO6913-1 - Acoustics – Attenuation of sound during propagation outdoors, Parts 1 - Calculation of the absorption of sound by the atmosphere and Part 2 - General method of calculation.*

4.3.1.2.1 Kurri STSS – Predicted $L_{eq,\ 15\ minute}$ Noise Emissions

Table 8 shows the predicted $L_{eq,\ 15\ minute}$ sound pressure levels at the nearest receptor locations during the operation of the Kurri STSS.

Noise contour maps for the future operation scenarios shown in Table 8 are attached in Appendix D1.

Table 8 Kurri STSS – Predicted $L_{eq,\ 15\ minute}$ Noise Levels at the Receivers

Description	Predicted L_{eq} Noise Level (dBA) at Receptor Locations				
	R1	**R2**	**R3**	**R4**	**R5**
Day – 7 am to 6 pm					
Predicted Noise Level	4	12	10	10	3
Acceptable Noise Limit	**53**	**68**	**63**	**68**	**45**
Complies	Yes	Yes	Yes	Yes	Yes
Evening – 6 pm to 10 pm					
Predicted Noise Level	4	12	10	10	3
Acceptable Noise Limit	**45**	**68**	**63**	**68**	**45**
Complies	Yes	Yes	Yes	Yes	Yes
Night – 10 pm to 7 am					
Predicted Noise Level	9[1]	17[1]	15[1]	15[1]	8[1]
Acceptable Noise Limit	**44**	**68**	**63**	**68**	**38**
Complies	Yes	Yes	Yes	Yes	Yes

[1]5 dB added to the Predicted Noise Level in accordance with Fact Sheet C, Table C1 of the NPI.

The predicted $L_{eq,\ 15\ minute}$ level of noise associated with the use of the Kurri STSS following the alterations and additions comply the day, evening and night period project noise trigger levels at receivers R1 to R5, and are acceptable.

4.3.1.2.2 Kurri STSS – Predicted $L_{AF, max}$ Noise Emissions

Table 9 shows the predicted $L_{AF, max}$ sound pressure levels at the nearest receptor locations during the operation of the Kurri STSS.

Noise contour maps for the future operation scenarios shown in Table 9 are attached in Appendix D1.

Table 9 Kurri STSS – Predicted $L_{AF, max}$ Noise Levels at the Receivers

Description	Predicted $L_{AF, max}$ Noise Level (dBA) at Receptor Locations				
	R1	**R2**	**R3**	**R4**	**R5**
Night – 10 pm to 7 am					
Predicted Noise Level	28	n/a	n/a	n/a	26
Acceptable Noise Limit	**54**	**n/a**	**n/a**	**n/a**	**52**

The predicted $L_{AF, max}$ level of noise associated with the use of the Kurri STSS following the alterations and additions comply the day, evening and night period project noise trigger levels at receivers R1 to R5, and are acceptable.

4.3.2 Kurri STSS – Construction Noise & Vibration Emissions

The main sources of noise on the site during the two phases of excavation and construction will be from heavy machinery such as excavators, trucks, cranes, cement agitators, concrete/rock breakers, etc.

Unless otherwise noted, the predicted noise levels in the following Sections assume that all equipment and plant listed are operating at the same time within the same general area along the nearest or furthest point of the work area. This constitutes a worst-case scenario, however, due to the nature of the works, it is more likely that equipment will be dispersed over a wider area of the construction site and will not be continuously operating simultaneously. Typically, therefore, lower average levels can be expected.

A schedule of the sound power levels for the main excavation and construction equipment was extracted from the Day Design database of Sound Power Levels and the Australian Standard AS2436:1981 *"Guide to Noise Control on Construction, Maintenance and Demolition Sites".*

Knowing the sound power level of a noise source, 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, barrier effects, etc.

Calculations consider distance attenuation only and the range of levels are based on the closest potential distance and furthest potential distance at which each item of plant may operate from each respective receiver location.

The calculated noise levels at nearby residential receptors are presented in Tables 10, 12 and 13.

4.3.2.1 Kurri STSS – Stage 1 Works

The Stage 1 works are estimated to take 32 weeks and will involve the use of an excavator, vacuum truck, light vehicles and heavy vehicles, hand tools (electric), hand tools (pneumatic) a crane (mobile), piling rig and a concrete/rock breaker. The equipment likely to be used and their corresponding sound power levels are presented below in Table 10.

Table 10 Kurri STSS – Typical Stage 1 Works - Sound Power Levels

Description	Sound Power Level, dBA
Excavator	107
Vacuum Truck	109
Light Vehicles	106
Heavy Vehicles	107
Crane (Mobile)	104
Piling (Bored)	111
Concrete/Rock Breaker	117

Given the intensity of work involved with concrete/rock breaking/sawing, it is unlikely that this activity will take place at the same time as any other activity. Notwithstanding, to ensure a conservative assessment, we have assessed the noise impact of concrete/rock breaker cumulatively. The calculated noise levels at nearby receptors are presented below in Table 11 as a worst case scenario.

Table 11 Kurri STSS – Calculated Receptor Sound Pressure Levels from Stage 1 Works

Receptor Location	Calculated Sound Pressure Levels (dBA)
R1 – Main Road, Trenchard Street & Earp Street, Heddon Great	52 – 52
R2 – 115 Main Road, Heddon Great	59 – 61
R3 – 112 Main Road, Heddon Great	59 – 59
R4 – 181 Main Road, Kurri Kurri	59 – 59
R5 – Acacia Street & Brown Crescent	51 – 51

4.3.2.2 Kurri STSS – Stage 2 Works

The Stage 2 works are estimated to take 28 weeks and will involve the use of an excavator, light vehicles and heavy vehicles, hand tools (electric) and hand tools (pneumatic), concrete agitator truck, concrete pump truck, a crane (mobile) and a concrete/rock breaker. The equipment likely to be used and their corresponding sound power levels are presented below in Table 12.

Table 12 Kurri STSS – Typical Stage 2 Works - Sound Power Levels

Description	Sound Power Level, dBA
Excavator	107
Light Vehicles	106
Heavy Vehicles	107
Hand Tools (Electric)	102
Hand Tools (Pneumatic)	116
Concrete Agitator Truck	109
Concrete Pump Truck	108
Crane (Mobile)	104
Concrete/Rock Breaker	117

Note: (All sound power levels are based on previous noise measurements at various sites)

Given the intensity of work involved with concrete/rock breaking/sawing, it is unlikely that this activity will take place at the same time as any other activity. Notwithstanding, to ensure a conservative assessment, we have assessed the noise impact of concrete/rock breaker cumulatively. The calculated noise levels at nearby receptors are presented below in Table 13 as a worst case scenario.

Table 13 Kurri STSS – Calculated Receptor Sound Pressure Levels from Stage 2 Works

Receptor Location	Calculated Sound Pressure Levels (dBA)
R1 – Main Road, Trenchard Street & Earp Street, Heddon Great	52 – 56
R2 – 115 Main Road, Heddon Great	65 – 65
R3 – 112 Main Road, Heddon Great	65 – 65
R4 – 181 Main Road, Kurri Kurri	65 – 66
R5 – Acacia Street & Brown Crescent	59 – 59

4.3.2.3 Kurri STSS – Noise Emission Summary

From the calculated noise levels in Sections 4.3.2.1 to 4.3.2.2, the level of noise exceedance are presented below in Table 14.

Table 14 Kurri STSS – Calculated $L_{eq\ 15\ minute}$ Noise Levels (Without Noise Controls) – R1 to R5

Description	Calculated Noise Levels (dBA)				
	R1	R2	R3	R4	R5
Stage 1 Works					
Typical Works	52 – 52	59 – 61	59 – 59	59 – 59	51 – 51
Noise Management Level	63	75	70	75	50
Exceedance	**nil**	**nil**	**nil**	**nil**	**Yes (+ 1 dB)**
Stage 2 Works					
Typical Works	52 – 56	65 – 65	65 – 65	65 – 66	59 – 59
Noise Management Level	63	75	70	75	50
Exceedance	**nil**	**nil**	**nil**	**nil**	**Yes (+ 9 dB)**

It can be seen from Table 14 above, that the predicted levels of noise from construction activities may at times be in excess of the noise management levels of 50 dBA at residential receptor locations 'R5'.

To minimise the noise impact from the construction activities we recommend that the noise controls and the management plan detailed in Section 4.3.2.5 of this report be implemented.

Concrete/rock breaking is not considered cumulatively, and including it in the cumulative noise predictions potentially over-states the predicted impact. As a precaution, it is recommended in the noise management controls (Section 4.3.2.5.2) that where concrete/rock breaking is required near to receptors, it is conducted in the absence of any other plant operations to avoid a cumulative noise impact.

4.3.2.4 Kurri STSS – Vibration Emission

It is difficult to accurately predict levels of ground borne vibration at remote locations as there are many variables to consider including the surrounding terrain, strata, rock density, etc.

Previous measurements of ground borne vibration from concrete/rock breaking/sawing show that vibration levels can vary significantly at different distances and receptor locations. Given the distances from neighbouring developments to any potential concrete/rock breaking/ sawing on site, if warranted (a substantiated complaint is received regarding vibration levels, cosmetic damage to a structure, etc), we recommend that compliance monitoring of ground borne vibration is carried out at the critical receptor.

Recommendations are made in Section 4.3.2.5 of this report should complaints arise from nearby premises regarding vibration from the site.

4.3.2.5 Kurri STSS – Construction Noise & Vibration Control Recommendations

The predicted level of noise emission from the two stages of construction activities for the alterations and additions at the existing Kurri STSS, NSW may at times be in excess of the noise management levels established in Section 4.2.4.3 of this report at residential receiver 'R5'.

In order to minimise the noise impact from all excavation and construction activities, we recommend the following engineering and management noise controls be implemented.

4.3.2.5.1 Kurri STSS – Engineering and Practical Noise Controls

Australian Standard AS2436:2010, Appendix C, Table C3 provides the relative effectiveness of various forms of noise control that may be applicable and implemented on various construction sites and projects. Table C3 is replicated below in Table 15.

Table 15 Kurri STSS – Relative Effectiveness of Various Forms of Noise Control

Control by	Nominal Noise Reduction Possible
Enclosure	Normally 5 dB to 25 dB maximum 50 dB
Silencing	Normally 5 dB to 10 dB maximum 20 dB

Enclosure

Constructing acoustical enclosures around items of mobile plant such as generators is recommended where extended use for long periods of time is expected.

Silencing

Consideration should be given to any mobile plant already acoustically treated when assessing tenders. All plant and machinery should be selected with consideration to low noise options where practicable and available.

Care should be taken to ensure that no more than one item of plant is operating simultaneously within close proximity of any given residence as far as reasonably practicable, to minimise cumulative noise impacts.

4.3.2.5.2 Kurri STSS – Noise Management Controls

The following noise management controls are derived from, or are in accordance with recommendations given in Australian Standard AS2436:2010 and the EPA's *Interim Construction Noise Guideline*.

Periods of Respite

We recommend that noisy construction activities such as concrete/rock breaking/sawing or the like only operate for 2 to 3 hours at a time.

Ensure activities in any one location are staggered, for instance, if concrete/rock breaking/sawing is occurring near to a residential receptor, all other construction activities will cease in the same location so as to minimise cumulative noise impacts.

Work Practices

We recommend that workers and contractors be trained in work practices to minimise noise emission such as the following:

- Avoid dropping materials from a height.
- Avoid shouting and talking loudly outdoors.
- Avoid the use of radios outdoors that can be heard at the boundary of residences.
- Turn off equipment when not being used.
- Carry out high impact noise work only within normal construction hours (see Sections 3.2.2.1 and 4.1.2).

Heavy Vehicles and Staff Vehicles

- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- Locate site vehicle entrances away from residences where practicable.
- Optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Staff parking areas should be located as far from residential receiver locations as practicable.
- No motor vehicles should access the site via, or park within residential areas prior to 7 am on any occasion, in order avoid sleep disturbance.

Community Relations

- A Community Liaison Officer (Project Manager or Site Manager) is to be appointed by the contractor prior to the commencement of any works.
- The Community Liaison Officer will approach all potentially affected residents prior to the commencement of any works as an initial introduction and provide his or her contact details.
- The Community Liaison Officer will explain the project, duration of works, potentially noisy periods as well as determine any particularly sensitive receivers or sensitive time periods and schedule works accordingly, as far as reasonably practical.
- A contact number will be provided for any residents to call with complaints or queries.

Once works commence, communication with the community should be maintained by the Community Liaison Officer. Communication should be maintained via a range of media including, for example, continued individual contact, letter box drops or a clearly visible notice board at the site office or on construction site boundaries.

Consultation and cooperation between the contractor and the neighbours and the removal of uncertainty and rumour can help to reduce adverse reaction to noise.

Managing a Noise Complaint

The Community Liaison Officer should receive and manage noise complaints.

All complaints should be treated promptly and with courtesy.

Should a justified noise complaint not be resolved, noise monitoring may be carried out at the affected receptor location and appropriate measures be taken to reduce the noise emission as far as reasonably practicable.

Where it is not practicable to stop the noise, or reduce the noise, a full explanation of the event taking place, the reason for the noise and times when it will stop should be given to the complainant.

The following guidelines are recommended in Section 6 of the *Interim Construction Noise Guideline* to manage a noise complaint:

- Provide a readily accessible contact point.
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.

- Implement all feasible and reasonable measures to address the source of complaint.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area, time of verbal response and timeframe for written response where appropriate.

4.3.2.5.3 Kurri STSS – Noise Monitoring

We recommend that noise emissions from the development be measured during the construction periods in the event that complaints arise from nearby receivers, regarding noise.

The noise measurements should be carried out using an attended noise monitor at the location (or as close as practically possible) of the noise complaint. Noise level measurements should be carried out by an appropriately qualified acoustical consultant/engineer, using Type 1 (see AS1259) noise measuring equipment.

The measured noise level are to be compared against the Project Noise Trigger Levels shown in Section 4.2.4.3 of this report. The outcomes of the noise monitoring should be submitted to the relevant authority for review.

4.3.2.5.4 Kurri STSS – Vibration Monitoring

We recommend that the level of vibration be measured during any concrete/rock breaking/ sawing in the event complaints arise from any nearby receivers/premises regarding vibration.

The vibration measurements can be carried out using either an attended or an unattended vibration monitor. An unattended vibration monitor should be fitted with an alarm in the form of a strobe light, siren or digital (mobile/computer) alert system to make the plant operator aware immediately when the vibration limit is exceeded. The vibration monitor should be set to trigger the alarm when the overall Peak Particle Velocity (PPV) exceeds **15 mm/s** at the affected residential building or **50 mm/s** at the affected commercial/industrial building.

Dilapidation reports should be commissioned for potentially affected nearby premises prior to any works being undertaken. This may be reassessed once the extent of required work is known.

In the event that levels of ground-borne vibration exceed the recommended acceptable levels for cosmetic damage, vibration causing works should cease immediately and alternative methods be considered.

4.3.2.5.5 Kurri STSS – Construction Disclaimer

Recommendations made in this report are intended to resolve acoustical problems only. We make no claims of expertise in other areas of building construction and therefore the recommended noise controls should be implements into the building design in consultation with other specialists to ensure they meet the structural, fire, thermal or other aspects of building construction.

We encourage clients to check with us before using materials or equipment that are alternative to those specified in our Acoustical Report.

5.0 SANDY CREEK STSS – NOISE & VIBRATION EMISSION ASSESSMENT

5.1 Sandy Creek STSS – Site & Project Description

5.1.1 Sandy Creek STSS – Site Description

The Sandy Creek STSS is located at 20-24 Sandy Creek Road, Muswellbrook, NSW.

The Sandy Creek STSS is situated on and adjacent to the east and south of land zoned *C3: Environment Management* and on and adjacent to the west of land zoned *SP2: Classified Road* under Muswellbrook Local Environmental Plan (LEP) 2009. The land adjacent to north is zoned *RU1: Primary Production.* The Sandy Creek STSS and the surrounding land is shown on Figure 3 below.

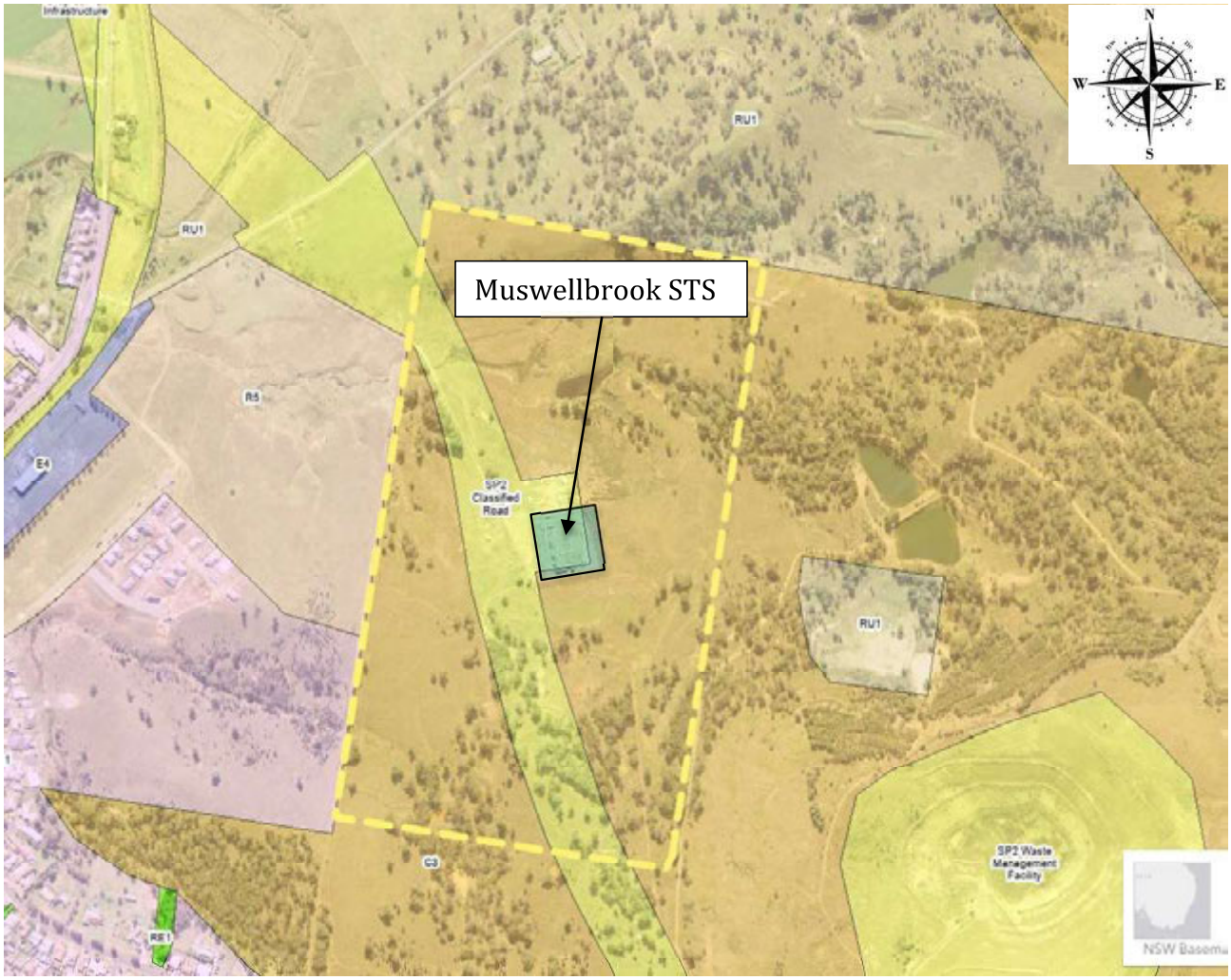


Figure 3 Land Zoning, Sandy Creek STSS, NSW

The Sandy Creek STSS is bounded by undeveloped rural land to the north, east, south and west.

The nearest noise sensitive receptors to the Sandy Creek STSS, in various directions, are shown in Figure 4 and in Table 16.

Table 16 Sandy Creek STSS – Noise Sensitive Receptors

Receptor and Type	Address[1] & Location	Direction from site
R1 – Residential Zone	Northview Circuit & Sunline Street	South-West
R2 – Residential Zone	Lonhro Place & Sepov Crescent	West

[1] Where multiple receiver locations exist in a given direction, and to ensure a worst-case scenario is considered, the noise impact from a noise source is assessed at the potentially most affected receiver location – compliance at the potentially most affected receiver location will ensure compliance at all other locations.

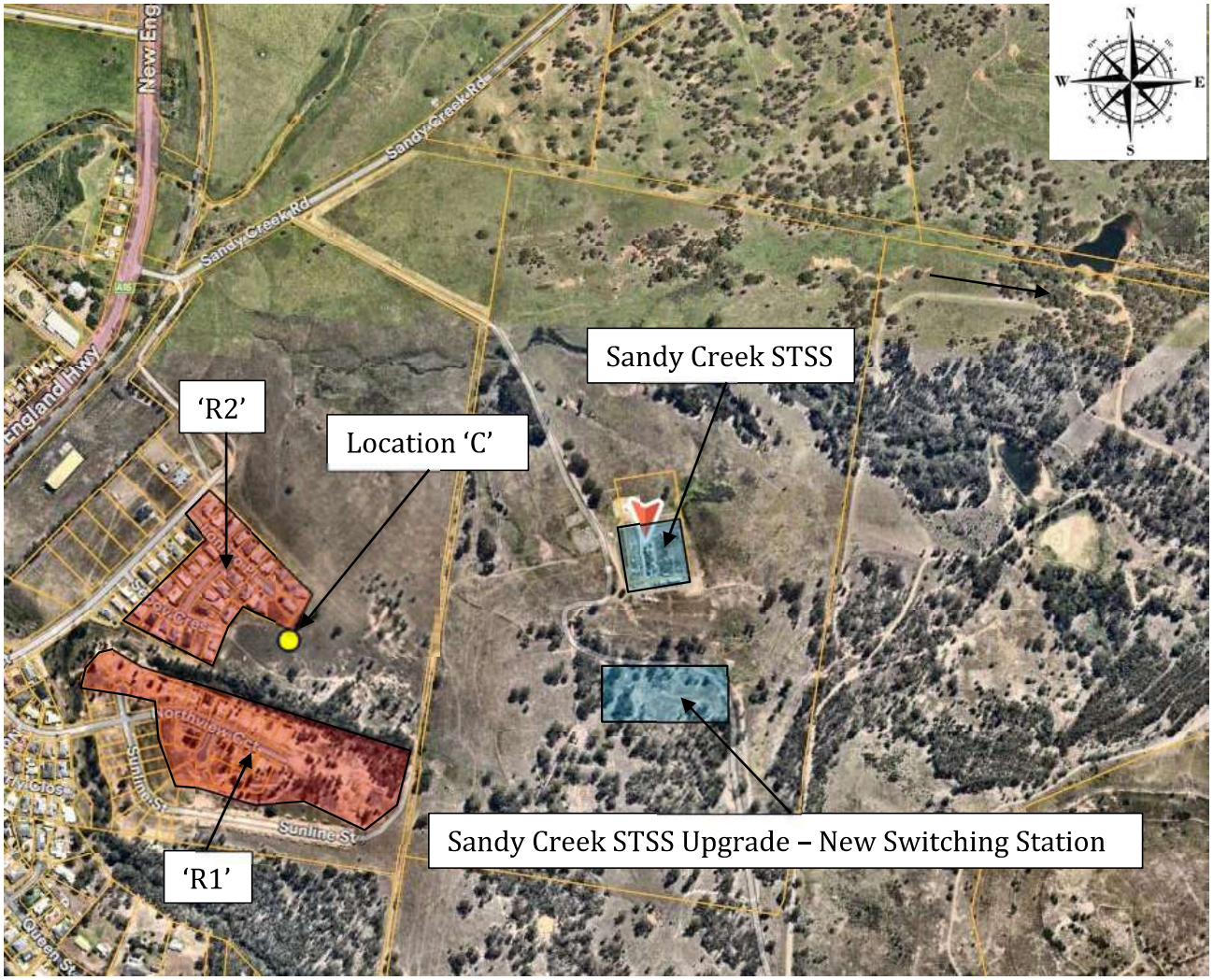


Figure 4 Location Plan, Sandy Creek STSS, 20 – 24 Sandy Creek Road, Muswellbrook.

5.1.2 Sandy Creek STSS– Development Description

The existing Sandy Creek STSS operates 24 hours a day, 7 days a week.

Ausgrid is proposing an upgrade to the Sandy Creek STSS which will comprise of the installation 12 new 132 kV outdoor dead-tank switchgears (3-pole – SF6 2500A), 27 outdoor disconnectors and earth switches (2500A), 24 132kV/110V MVT's, six 132kV surge arresters, two 54 cell batteries, battery chargers and monitoring equipment, one fibre MUX/FOX panel smart hardware and nine 132kV/110V CVTs.

The new equipment will be located in a new designated area approximately 150 metres to the south of the existing Sandy Creek STSS, see Figure 4 for detail.

Generally, the main noise producing equipment at a STSS is a transformer, we note that no additional transformers are proposed to be installed at the Sandy Creek STSS.

The location of the equipment outlined above can be seen in the Site Plan prepared by Ausgrid, attached in Appendix C2.

The construction of the Sandy Creek STSS upgrade is broken down into two stages:

Stage 1- Expected timeframe of 40 weeks

- Stage 1 – site preparation and establishment:
    - Activities include use of a rock breaker, crane, piling rig, excavators, bobcat, vacuum truck, light and heavy vehicles.

Stage 2 - Expected timeframe of 40 weeks

- Stage 2 – forming the concrete foundations, general construction of infrastructure and installation of additional equipment at the Sandy Creek STSS:
    - Activities include use of a rock breaker, excavator, bobcat, concrete trucks, crane, hand tools (electric), hand tools (pneumatic), and light and heavy vehicles.

The proposed hours of construction are, as follows:

High Impact Noise (rock/concrete breaking, piling, etc):

- Monday to Friday: 7 am to 6 pm;
- Saturdays: 8 am to 1 pm; and
- Sundays and public holidays: No work proposed.

Low Impact Noise:

- Monday to Friday: 7 am to 6 pm;
- Saturdays: 7 am to 6 pm; and
- Sundays and public holidays: No work proposed.

5.2 Sandy Creek STSS – Existing Ambient Noise Level & Project Noise Trigger Levels

5.2.1 Sandy Creek STSS – Description of Existing Acoustic Environment

Site inspections of the residential area surrounding Location 'C' was conducted by Day Design staff during the placement of the noise logger with the following observations made:

Location 'C' -

- the area is defined by the natural environment and constant, distant local road traffic noise from the New England Highway during the day;
- the area is defined by the natural environment and intermittent, distant local road traffic noise from New England Highway during the evening and night;
- the area is exposed to intermittent rail traffic noise from the Hunter and North West NSW rail line to the east;
- the nearest existing industrial premises is located circa 1.8 kilometers to the west (*Muswellbrook Coal Co. Ltd*).

5.2.2 Sandy Creek STSS – Measured Ambient Noise Levels

In order to assess the severity of a possible environmental noise problem in a residential area it is necessary to measure the ambient background noise level at the times and locations of worst possible annoyance. The lower the background noise level, the more perceptible the intrusive noise becomes and the more potentially annoying.

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

The Rating Background Level (RBL) is defined by the Environment Protection Authority (NSW) 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 places of worst possible annoyance are the nearby residential dwellings. These locations are shown in the Location Plan on Figure 4 as 'R1' and 'R2'. The times of worst possible annoyance will be during the night when the Sandy Creek STSS is operating.

Ambient noise levels were measured in one location shown as Location 'C' on Figure 4, during the following period:

- Location 'C'
  - Friday 5 to Tuesday 23 July 2024.

The day, evening and night time ambient noise levels are presented in the attached Appendix B2 and in Table 17.

Table 17 Sandy Creek STSS – Ambient Noise Levels – Sandy Creek STS

Noise Measurement Location	Date & Time Period	L_{90} Rating Background Level	Existing L_{eq} Noise Level
	5/7 to 23/7/2024		
Location 'C' – 11 Lonhro Place, Muswellbrook	Day (7 am to 6 pm)	**41 dBA**	**61 dBA**
	Evening (6 pm to 10 pm)	**39 dBA**	**52 dBA**
	Night (10 pm to 7 am)	**35 dBA**	**50 dBA**

Meteorological conditions during the monitoring typically consisted of clear skies with temperatures ranging from 0 to 19°C. Where applicable, weather affected (ie rain or wind [speed > 5 m/s]) data has been removed from the assessment period. Atmospheric conditions were generally ideal for noise monitoring. Noise measurements were therefore considered reliable and typical for the receptor areas. Meteorological data was gathered from weather station ID 061363 Scone Airport AWS NSW circa 24 kms away.

Fact Sheet A: Determining existing noise levels, Section A1 of the NPI states the following in relation to determining background noise levels:

Background noise levels need to be determined before intrusive noise can be assessed. The background noise levels to be measured are those that are present at the time of the noise assessment and without the subject development operating. For the assessment of modifications to existing premises, the noise from the existing premises should be excluded from background noise measurements. The exception is where the premises has been operating for a significant period of time and is considered a normal part of the acoustic environment; it may be included in the background noise assessment under the following circumstances:

- *the development must have been operating for a period in excess of 10 years in the assessment period/s being considered and is considered a normal part of the acoustic environment; and*
- *the development must be operating in accordance with noise limits and requirements imposed in a consent or licence and/or be applying best practice.*

Day Design has been advised that the existing Sandy Creek STSS was commissioned well over 10 years ago, and has been generally operating under the same conditions to the current day. Day Design has also been advised that the operators are applying best practices for day to day operations, with any equipment replacements being upgraded to units with lower sound outputs.

Therefore, considering the above, any ambient noise measurements must also take into consideration the noise contribution to the surrounding area from the operation of existing Sandy Creek STSS and local (road) traffic noise, as it forms part of the existing acoustic environment – the noise from the operation of Sandy Creek STSS and local (road) traffic noise is typical/expected in this area.

Section B1.1 'Instrument requirements and siting', paragraph 2 of the *NPI* requires monitoring to take place at a 'site that is truly representative of the noise environment at the residence'.

Section B1.2 'Measurement procedure', point 2, of the *NPI* specifies that monitoring should take place for 'each day of the week the proposed development will be operating and over the proposed operating hours'.

In addition to the long-term unattended ambient noise level measurements, and in accordance with Fact Sheet A: Determining existing noise levels, Table A1 of the NSW Environment Protection Authority's *NSW Noise Policy for Industry,* short-term attended ambient noise level measurements were also conducted at Location 'C' from 07.30 to 07.45 pm on Friday 5 July 2024, with a Type 2, environmental noise logger (see Appendix A) to verify the acoustic environment.

The attended $L_{90,\ 15\ minute}$ noise level at Location 'C' was 40 dBA.

During the attended measurements it was confirmed that the acoustic environment, per the observations in Section 5.2.1, is dominated by the natural environment and constant, distant local road traffic noise from the New England Highway.

In accordance with Fact Sheet A and Section B1.1, Day Design is of the opinion the measured ambient noise levels in Location 'C' are representative of the noise environment at residential receivers 'R1' and 'R2' – see Figure 4.

5.2.3 Sandy Creek STSS – Operational Noise – Noise Emission Criteria

5.2.3.1 Sandy Creek STSS – EPA NPI – Project Intrusiveness Noise Level

The EPA states in Section 2.3 of its *NPI* (October 2017) that the intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the rating background noise level by more than 5 dB when beyond a minimum threshold (EPA *NPI*, 2017, Section 2.3).

The RBL at Location 'C' was 41 dBA in the day, 39 dBA the evening and 35 dBA at night (see Table 17).

Therefore the acceptable L_{eq} noise intrusiveness criteria in this area is:

- (41 + 5 =) 46 dBA during the day;
- (39 + 5 =) 44 in the evening; and
- (35 + 5 =) 40 dBA at night.

5.2.3.2 Sandy Creek STSS – EPA NPI – Project Amenity Noise Level

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. The NSW *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.

Section 2.4, Table 2.3 of the *NPI* provides guidance on assigning residential receiver noise categories. A site inspection of the residential areas surrounding residential receivers 'R1' and 'R2' was conducted by Day Design staff during the placement and retrieval of the environmental noise loggers, see Section 5.2.1 for observations.

The observations in Section 5.2.1 indicate the residential area around residential receivers 'R1' and 'R2' is considered 'Suburban', as per Table 2.3 of the *NPI*. The 'Suburban' amenity noise levels as per Table 2.3 of the *NPI* will be used to assess residential receivers in the area.

The recommended L_{eq} noise levels below in Table 18 are taken from Section 2.4, Table 2.2 of the NPI. Compliance with the Noise Amenity levels in Table 2.2 will limit ambient noise creep.

Table 18 Sandy Creek STSS – Amenity Noise Levels (NPI - Table 2.2)

Receiver	Noise Amenity Area	Time of Day	Recommended L_{eq}, dBA Amenity Noise Level
Residential	Suburban	Day	55
		Evening	45
		Night	40

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 $\mathbf{L_{Aeq,15min}}$ will be taken to be equal to the $\mathbf{L_{Aeq,\ period}}$ **+ 3 decibels (dB)** (Section 2.2 NPI).

Compliance with the amenity criteria will limit ambient noise creep. **Section 2.4** of the *NPI* states the following:

'To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a ***project amenity noise level*** *applies for each new source of industrial noise as follows:*

- ***Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB (A).***

The following exceptions to the above method to derive the project amenity noise level apply:

3. *Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.'*

As described in Section 5.2.1, other industrial premises are present in the area with the noise levels unlikely to reduce in the near future.

In addition, the level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the L_{Aeq} noise level from that industrial noise source may exceed the project amenity noise level, ie where the existing traffic noise level is 10 dB or more above the recommended amenity noise level for the area. In such cases the project amenity noise level may be derived from the $L_{Aeq,\ period\ (traffic)}$ minus 15 dBA (refer Section 2.4.1 of the NPI).

The existing L_{eq} noise level at Location 'C' was 61 dBA during the day, 52 dBA in the evening and 50 dBA at night (see Table 17).

Ambient L_{eq} noise levels at Location 'C' were affected by existing industrial and local road traffic noise during the day, evening and night. From observations made at Location 'C', the local road traffic is the dominant noise at the receiver during the day, therefore Section 2.4.1 of the NPI is applicable.

The existing industrial noise is not more than 10 dB above the project amenity noise level during the day, evening or night, therefore corrections for industrial and commercial noise are not applicable.

The existing local road traffic during the day, evening and night is not more than 10 dB above the recommended amenity noise level for the area, therefore section 2.4.1 of the NPI is not applicable.

Therefore, the acceptable amenity noise levels at Location 'C' are:

- (55 – 5 + 3 =) 53 dBA $L_{eq,\ 15\ minute}$ during the day;
- (45 – 5 + 3 =) 43 dBA $L_{eq,\ 15\ minute}$ in the evening; and
- (40 – 5 + 3 =) 38 dBA $L_{eq,\ 15\ minute}$ at night.

5.2.3.3 Sandy Creek STSS – EPA NPI – Project Sleep Disturbance Noise Trigger Levels

The EPA's *NPI* states in Section 2.5 that the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Sleep may be disturbed if the subject development night-time noise levels at a residential location exceed the following:

- $L_{Aeq,\ 15min}$ 40 dBA or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

Where either of the above criteria are triggered, a detailed maximum noise level event assessment should be undertaken.

The RBL at Location 'C' is 35 dBA at night (see Table 17). Therefore, the acceptable $L_{eq,\ 15\ minute}$ and L_{AFmax} noise sleep disturbance criteria in these areas are:

Location 'C'

- 40 dBA $L_{eq,\ 15\ minute}$ at night; and/or
- 52 dBA L_{AFmax} at night.

5.2.3.4 Sandy Creek STSS – EPA NPI – Modifying Factors Corrections

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. On the other hand, some sources may cause less annoyance where only a single event occurs for a limited duration. Correction factors are to be applied to the noise from the source measured or predicted at the receiver before comparison with the criteria. AC500-10 in the Appendices is extracted from Table C.1 of the *NPI*.

5.2.3.5 Sandy Creek STSS – Operational Noise – Project Noise Trigger Levels

Based on the measured background noise levels and the relevant planning instruments and legislation, the Project Noise Trigger Levels at each receptor location are as follows:

For Residential Receptors 'R1' & 'R2' – based on the measured background noise levels at Location 'C':

- **46 dBA** during the day;
- **43 dBA** in the evening; and
- **38 dBA** at night.

These criteria apply at the most-affected point on or within the residential property boundary – or, if that is more than 30 metres from the residence, at the most-affected point within 30 metres of the residence.

The following criteria will be applied at 1 metre from the potentially most affected residential façades of, 'R1' and 'R2' for potential sleep disturbance caused by switching of the outdoor dead-tank switchgears (see Section 5.3.1 for detail) during the night (10 pm to 7 am).

'For Residential Receptors 'R1' & 'R2'– based on the measured background noise levels at Location 'C':

- **40 dBA** $L_{eq,\ 15\ minute}$; and/or
- **52 dBA** L_{AFmax} at night time.

5.2.4 Sandy Creek STSS – Construction Noise – Noise & Vibration Emission Criteria

5.2.4.1 Sandy Creek STSS – EPA Construction Noise Guideline

Based on the RBLs at all sensitive residential receiver locations in the daytime, the recommended noise management level during all aspects of the construction program are summarised in Table 19.

Table 19 Sandy Creek STSS – L_{eq} Noise Management Levels from Construction Activities

Receptor Location	Noise Management Level	How to Apply
All Residential Receptors	**'R1' & 'R2' (41 + 10 =) 51 dBA**	The noise affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured $L_{Aeq\ (15\ min)}$ noise level is greater than the noise affected level, the proponent should apply all feasible and reasonable* work practices to meet the noise affected level. ▪ The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. ▪ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 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.

*Section 6, 'work practices' of The *Interim Construction Noise Guideline*, states: *"there are no prescribed noise controls for construction works. Instead, all feasible and reasonable work practices should be implemented to minimise noise impacts. This approach gives construction site managers and construction workers the greatest flexibility to manage noise"*.

Definitions of the terms feasible and reasonable are given in Section 1.4 of the Guideline.

5.2.4.2 Sandy Creek STSS – EPA Vibration Guideline

Per Section 3.2.2.2 of this report, an overall peak particle velocity of **15 mm/s** at the boundaries of residential receptors will comply with the recommended values in Table 2, and is an acceptable criterion for intermittent vibration to prevent cosmetic damage to the nearby residential buildings.

5.2.4.3 Sandy Creek STSS – Construction Noise & Vibration – Project Noise & Vibration Trigger Levels

5.2.4.3.1 Sandy Creek STSS – Noise Management Levels

- Noise management level of **51 dBA** $L_{Aeq,\ 15\ minute}$ for all residential receptors 'R1' & 'R2'.

5.2.4.3.2 Sandy Creek STSS – Vibration Management Levels

- A Vibration Dose Value (VDV) between **0.2 – 0.4 m/s$^{1.75}$** for human annoyance in residential buildings;
- A Peak Particle Velocity no greater than **15 mm/s** for cosmetic damage at the residential buildings.

5.3 Sandy Creek STSS – Noise & Vibration Emission Assessment

5.3.1 Sandy Creek STSS – Operational Noise Emission Assessment

The main sources of noise from the proposed upgrades at the Sandy Creek STSS are the 12 new 132 kV outdoor dead-tank switchgears (3-pole – SF6 2500A).

All other proposed equipment emits negligible levels of noise.

Additionally, as detailed in Section 5.2.2, the existing Sandy Creek STSS was commissioned well over 10 years ago, and has been generally operating under the same conditions to the current day. Therefore, the noise contribution to the surrounding area from the operation of existing Sandy Creek STSS is deemed acceptable and it forms part of the existing noise environment – no consideration or assessment is given or required for noise emissions associated with existing items of plant or equipment at the Sandy Creek STSS in this report.

We have been advised that the 12 new 132 kV outdoor dead-tank switchgears (3-pole – SF6 2500A) are required to operate 1 to 2 times per year during switching. Switching takes place over a short period, ie up to 12 seconds (1 second per outdoor dead-tank switchgear). Noise emissions associated with switching are advised to be ≤ 90 dBA $L_{eq,\ 1\ second}$ (sound power level).

Considering the above, and excluding maintenance and emergencies, the maximum run time for the outdoor dead-tank switchgears would be (2 x 12 =) 24 seconds per year, or 12 seconds on up to 2 days of the year.

We have considered noise emissions based on the typical operation of the Sandy Creek STSS following the upgrade, ie noise emissions during the day, evening and night include the operation of the 12 new 132 kV outdoor dead-tank switchgears.

Calculations are based on plans prepared by Ausgrid as shown in Appendix C2. Calculations include reductions for the acoustic shielding provided by the existing/proposed building structures on the Site and in the surrounding areas were required.

Using the information gathered above, a schedule of sound power levels for an outdoor dead-tank switchgears is given in Table 20 below.

Table 20 Sandy Creek STSS – L_{eq} Sound Power Levels

Description	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)							
	dBA	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**
Outdoor Dead-Tank Switchgear	**90[1]**	*74*	*86*	*88*	*86*	*87*	*82*	*75*

**Numbers in italics are estimated*

[1]For the assessment of potential sleep disturbance we have adopted an $L_{AF,max}$ sound power level of 93 dBA.

5.3.1.1 Sandy Creek STSS – Applicable NPI Modifying Factor Corrections

The Sound Power Level spectrum of the outdoor dead-tank switchgears above does not contain tonal or dominant low frequency noise characteristics. Noise associated with the operation of the outdoor dead-tank switchgears is considered to contain intermittent noise characteristics. Therefore, corrections to the predicted noise levels for intermittent noise at the receivers locations are required for the assessment of noise associated with the operation of the outdoor dead-tank switchgears in accordance with Fact Sheet C: Correction for annoying noise characteristics of the NPI during the night time period only.

5.3.1.2 Sandy Creek STSS – Predicted Noise Emissions

Knowing the sound power level of a noise source (see Table 20), the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for time corrections, distance losses, sound barriers, etc.

Calculations have been carried out using *iNoise V2024.1* industrial noise prediction modelling software which incorporates the methods specified in *ISO 9613.1/2* [2] to calculate noise emissions. The noise emissions have been calculated to determine the noise level at each receptor location due to the future operation of the Sandy Creek STSS. Noise-enhancing meteorological conditions (see Fact Sheet D of the NPI) have been adopted for all calculations.

[2] *ISO6913-1 - Acoustics – Attenuation of sound during propagation outdoors, Parts 1 - Calculation of the absorption of sound by the atmosphere and Part 2 - General method of calculation.*

5.3.1.2.1 Sandy Creek STSS – Predicted $L_{eq,\ 15\ minute}$ Noise Emissions

Table 21 shows the predicted $L_{eq,\ 15\ minute}$ sound pressure levels at the nearest receptor locations during the operation of the Sandy Creek STSS.

Noise contour maps for the future operation scenarios shown in Table 21 are attached in Appendix D2.

Table 21 Sandy Creek STSS – Predicted $L_{eq,\ 15\ minute}$ Noise Levels at the Receivers

Description	Predicted L_{eq} Noise Level (dBA) at Receptor Locations	
	R1	**R2**
Day – 7 am to 6 pm		
Predicted Noise Level	6	7
Acceptable Noise Limit	**46**	**46**
Complies	Yes	Yes
Evening – 6 pm to 10 pm		
Predicted Noise Level	6	7
Acceptable Noise Limit	**43**	**43**
Complies	Yes	Yes
Night – 10 pm to 7 am		
Predicted Noise Level	11[1]	12[1]
Acceptable Noise Limit	**38**	**38**
Complies	Yes	Yes

[1]5 dB added to the Predicted Noise Level in accordance with Fact Sheet C, Table C1 of the NPI.

The predicted $L_{eq,\ 15\ minute}$ level of noise associated with the use of the Sandy Creek STSS following the alterations and additions comply the day, evening and night period project noise trigger levels at receivers R1 and R2, and are acceptable.

5.3.1.2.2 Sandy Creek STSS – Predicted $L_{AF, max}$ Noise Emissions

Table 22 shows the predicted $L_{AF, max}$ sound pressure levels at the nearest receptor locations during the operation of the Sandy Creek STSS.

Noise contour maps for the future operation scenarios shown in Table 22 are attached in Appendix D2.

Table 22 Sandy Creek STSS – Predicted $L_{AF, max}$ Noise Levels at the Receivers

Description	Predicted $L_{AF, max}$ Noise Level (dBA) at Receptor Locations	
	R1	**R2**
Night – 10 pm to 7 am		
Predicted Noise Level	29	33
Acceptable Noise Limit	**52**	**52**
Complies	Yes	Yes

The predicted $L_{AF, max}$ level of noise associated with the use of the Sandy Creek STSS following the alterations and additions comply the day, evening and night period project noise trigger levels at receivers R1 and R2, and are acceptable.

5.3.2 Sandy Creek STSS – Construction Noise & Vibration Emissions

The main sources of noise on the site during the two phases of excavation and construction will be from heavy machinery such as excavators, trucks, cranes, cement agitators, concrete/rock breakers, etc.

Unless otherwise noted, the predicted noise levels in the following Sections assume that all equipment and plant listed are operating at the same time within the same general area along the nearest or furthest point of the work area. This constitutes a worst-case scenario, however, due to the nature of the works, it is more likely that equipment will be dispersed over a wider area of the construction site and will not be continuously operating simultaneously. Typically, therefore, lower average levels can be expected.

A schedule of the sound power levels for the main excavation and construction equipment was extracted from the Day Design database of Sound Power Levels and the Australian Standard AS2436:1981 *"Guide to Noise Control on Construction, Maintenance and Demolition Sites".*

Knowing the sound power level of a noise source, 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, barrier effects, etc.

Calculations consider distance attenuation only and the range of levels are based on the closest potential distance and furthest potential distance at which each item of plant may operate from each respective receiver location.

The calculated noise levels at nearby residential receptors are presented in Tables 24, 26 and 27.

5.3.2.1 Sandy Creek STSS – Stage 1 Works

The Stage 1 works are estimated to take 40 weeks and will involve the use of an excavator, vacuum truck, light vehicles and heavy vehicles, hand tools (electric), hand tools (pneumatic) a crane (mobile), piling rig and a concrete/rock breaker. The equipment likely to be used and their corresponding sound power levels are presented below in Table 23.

Table 23 Sandy Creek STSS – Typical Stage 1 Works - Sound Power Levels

Description	Sound Power Level, dBA
Excavator	107
Vacuum Truck	109
Light Vehicles	106
Heavy Vehicles	107
Crane (Mobile)	104
Piling (Bored)	111
Concrete/Rock Breaker	117

Given the intensity of work involved with concrete/rock breaking/sawing, it is unlikely that this activity will take place at the same time as any other activity. Notwithstanding, to ensure a conservative assessment, we have assessed the noise impact of concrete/rock breaker cumulatively. The calculated noise levels at nearby receptors are presented below in Table 24 as a worst case scenario.

Table 24 Sandy Creek STSS – Calculated Receptor Sound Pressure Levels from Stage 1 Works

Receptor Location	Calculated Sound Pressure Levels (dBA)
R1 – Northview Circuit & Sunline Street	44 – 49
R2 – Lonhro place & Sepov Crescent	46 – 49

5.3.2.2 Sandy Creek STSS – Stage 2 Works

The Stage 2 works are estimated to take 40 weeks and will involve the use of an excavator, light vehicles and heavy vehicles, hand tools (electric) and hand tools (pneumatic), concrete agitator truck, concrete pump truck, a crane (mobile) and a concrete/rock breaker. The equipment likely to be used and their corresponding sound power levels are presented below in Table 25.

Table 25 Sandy Creek STSS – Typical Stage 2 Works - Sound Power Levels

Description	Sound Power Level, dBA
Excavator	107
Light Vehicles	106
Heavy Vehicles	107
Hand Tools (Electric)	102
Hand Tools (Pneumatic)	116
Concrete Agitator Truck	109
Concrete Pump Truck	108
Crane (Mobile)	104
Concrete/Rock Breaker	117

Note: (All sound power levels are based on previous noise measurements at various sites)

Given the intensity of work involved with concrete/rock breaking/sawing, it is unlikely that this activity will take place at the same time as any other activity. Notwithstanding, to ensure a conservative assessment, we have assessed the noise impact of concrete/rock breaker cumulatively. The calculated noise levels at nearby receptors are presented below in Table 26 as a worst case scenario.

Table 26 Sandy Creek STSS – Calculated Receptor Sound Pressure Levels from Stage 2 Works

Receptor Location	Calculated Sound Pressure Levels (dBA)
R1 – Northview Circuit & Sunline Street	45 – 50
R2 – Lonhro place & Sepov Crescent	48 – 50

5.3.2.3 Sandy Creek STSS – Noise Emission Summary

From the calculated noise levels in Sections 5.3.2.1 to 5.3.2.2, the level of noise exceedance are presented below in Table 27.

Table 27 Sandy Creek STSS – Calculated $L_{eq\ 15\ minute}$ Noise Levels (Without Noise Controls) – R1 to R2

Description	Calculated Noise Levels (dBA)	
	R1	R2
Stage 1 Works		
Typical Works	44 – 49	46 – 49
Noise Management Level	51	51
Exceedance	**Nil**	**Nil**
Stage 2 Works		
Typical Works	45 – 50	48 – 50
Noise Management Level	51	51
Exceedance	**Nil**	**Nil**

It can be seen from Table 27 above, that the predicted levels of noise from construction activities are not likely to be in excess of the noise management levels of 51 dBA at residential receptor locations 'R1' and 'R2'.

Notwithstanding, to minimise the noise impact from the construction activities we recommend that the noise controls and the management plan detailed in Section 5.3.2.5 of this report be implemented.

Concrete/rock breaking is not considered cumulatively, and including it in the cumulative noise predictions potentially over-states the predicted impact. As a precaution, it is recommended in the noise management controls (Section 5.3.2.5.2) that where concrete/rock breaking is required near to receptors, it is conducted in the absence of any other plant operations to avoid a cumulative noise impact.

5.3.2.4 Sandy Creek STSS – Vibration Emission

It is difficult to accurately predict levels of ground borne vibration at remote locations as there are many variables to consider including the surrounding terrain, strata, rock density, etc.

Previous measurements of ground borne vibration from concrete/rock breaking/sawing show that vibration levels can vary significantly at different distances and receptor locations. Given the distances from neighbouring developments to any potential concrete/rock breaking/ sawing on site, if warranted (a substantiated complaint is received regarding vibration levels, cosmetic damage to a structure, etc), we recommend that compliance monitoring of ground borne vibration is carried out at the critical receptor.

Recommendations are made in Section 5.3.2.5 of this report should complaints arise from nearby premises regarding vibration from the site.

5.3.2.5 Sandy Creek STSS – Construction Noise & Vibration Control Recommendations

The predicted level of noise emission from the two stages of construction activities for the alterations and additions at the existing Sandy Creek STSS, NSW may at times be in excess of the noise management levels established in Section 5.2.4.3 of this report at residential receiver 'R1' and 'R2'.

In order to minimise the noise impact from all excavation and construction activities, we recommend the following engineering and management noise controls be implemented.

5.3.2.5.1 Sandy Creek STSS - Engineering and Practical Noise Controls

Australian Standard AS2436:2010, Appendix C, Table C3 provides the relative effectiveness of various forms of noise control that may be applicable and implemented on various construction sites and projects. Table C3 is replicated below in Table 28.

Table 28 Sandy Creek STSS – Relative Effectiveness of Various Forms of Noise Control

Control by	Nominal Noise Reduction Possible
Silencing	Normally 5 dB to 10 dB maximum 20 dB

Silencing

Consideration should be given to any mobile plant already acoustically treated when assessing tenders. All plant and machinery should be selected with consideration to low noise options where practicable and available.

Care should be taken to ensure that no more than one item of plant is operating simultaneously within close proximity of any given residence as far as reasonably practicable, to minimise cumulative noise impacts.

5.3.2.5.2 Sandy Creek STSS – Noise Management Controls

The following noise management controls are derived from, or are in accordance with recommendations given in Australian Standard AS2436:2010 and the EPA's *Interim Construction Noise Guideline*.

Periods of Respite

We recommend that noisy construction activities such as concrete/rock breaking/sawing or the like only operate for 2 to 3 hours at a time.

Ensure activities in any one location are staggered, for instance, if concrete/rock breaking/sawing is occurring near to a residential receptor, all other construction activities will cease in the same location so as to minimise cumulative noise impacts.

Work Practices

We recommend that workers and contractors be trained in work practices to minimise noise emission such as the following:

- Avoid dropping materials from a height.
- Avoid shouting and talking loudly outdoors.
- Avoid the use of radios outdoors that can be heard at the boundary of residences.
- Turn off equipment when not being used.
- Carry out high impact noise work only within normal construction hours (see Sections 3.2.2.1 and 5.1.2).

Heavy Vehicles and Staff Vehicles

- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- Locate site vehicle entrances away from residences where practicable.
- Optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Staff parking areas should be located as far from residential receiver locations as practicable.
- No motor vehicles should access the site via, or park within residential areas prior to 7 am on any occasion, in order avoid sleep disturbance.

Community Relations

- A Community Liaison Officer (Project Manager or Site Manager) is to be appointed by the contractor prior to the commencement of any works.
- The Community Liaison Officer will approach all potentially affected residents prior to the commencement of any works as an initial introduction and provide his or her contact details.
- The Community Liaison Officer will explain the project, duration of works, potentially noisy periods as well as determine any particularly sensitive receivers or sensitive time periods and schedule works accordingly, as far as reasonably practical.
- A contact number will be provided for any residents to call with complaints or queries.

Once works commence, communication with the community should be maintained by the Community Liaison Officer. Communication should be maintained via a range of media including, for example, continued individual contact, letter box drops or a clearly visible notice board at the site office or on construction site boundaries.

Consultation and cooperation between the contractor and the neighbours and the removal of uncertainty and rumour can help to reduce adverse reaction to noise.

Managing a Noise Complaint

The Community Liaison Officer should receive and manage noise complaints.

All complaints should be treated promptly and with courtesy.

Should a justified noise complaint not be resolved, noise monitoring may be carried out at the affected receptor location and appropriate measures be taken to reduce the noise emission as far as reasonably practicable.

Where it is not practicable to stop the noise, or reduce the noise, a full explanation of the event taking place, the reason for the noise and times when it will stop should be given to the complainant.

The following guidelines are recommended in Section 6 of the *Interim Construction Noise Guideline* to manage a noise complaint:

- Provide a readily accessible contact point.
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.

- Implement all feasible and reasonable measures to address the source of complaint.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area, time of verbal response and timeframe for written response where appropriate.

5.3.2.5.3 Sandy Creek STSS – Noise Monitoring

We recommend that noise emissions from the development be measured during the construction periods in the event that complaints arise from nearby receivers, regarding noise.

The noise measurements should be carried out using an attended noise monitor at the location (or as close as practically possible) of the noise complaint. Noise level measurements should be carried out by an appropriately qualified acoustical consultant/engineer, using Type 1 (see AS1259) noise measuring equipment.

The measured noise level are to be compared against the Project Noise Trigger Levels shown in Section 5.2.4.3 of this report. The outcomes of the noise monitoring should be submitted to the relevant authority for review.

5.3.2.5.4 Sandy Creek STSS – Vibration Monitoring

We recommend that the level of vibration be measured during any concrete/rock breaking/ sawing in the event complaints arise from any nearby receivers/premises regarding vibration.

The vibration measurements can be carried out using either an attended or an unattended vibration monitor. An unattended vibration monitor should be fitted with an alarm in the form of a strobe light, siren or digital (mobile/computer) alert system to make the plant operator aware immediately when the vibration limit is exceeded. The vibration monitor should be set to trigger the alarm when the overall Peak Particle Velocity (PPV) exceeds **15 mm/s** at the affected residential building.

Dilapidation reports should be commissioned for potentially affected nearby premises prior to any works being undertaken. This may be reassessed once the extent of required work is known.

In the event that levels of ground-borne vibration exceed the recommended acceptable levels for cosmetic damage, vibration causing works should cease immediately and alternative methods be considered.

5.3.2.5.5 Sandy Creek STSS – Construction Disclaimer

Recommendations made in this report are intended to resolve acoustical problems only. We make no claims of expertise in other areas of building construction and therefore the recommended noise controls should be implements into the building design in consultation with other specialists to ensure they meet the structural, fire, thermal or other aspects of building construction.

We encourage clients to check with us before using materials or equipment that are alternative to those specified in our Acoustical Report.

6.0 ANTIENE STSS – NOISE & VIBRATION EMISSION ASSESSMENT

6.1 Antiene STSS – Site & Project Description

6.1.1 Antiene STSS – Site Description

The Antiene STSS is proposed to be located at Lot 9 in DP250890 and Lots 30, 32, 33, 34 and 36 in DP1193430, Hebden Road, Muswellbrook, NSW.

The proposed Site is located on land zoned *RE1: Public Recreation* under Muswellbrook Local Environment Plan (LEP) 2009. The land adjacent to north is zoned *SP2: Rail Infrastructure,* and to the east, south and west *SP2: power Station.* The Antiene STSS and the surrounding land is shown on Figure 5 below.

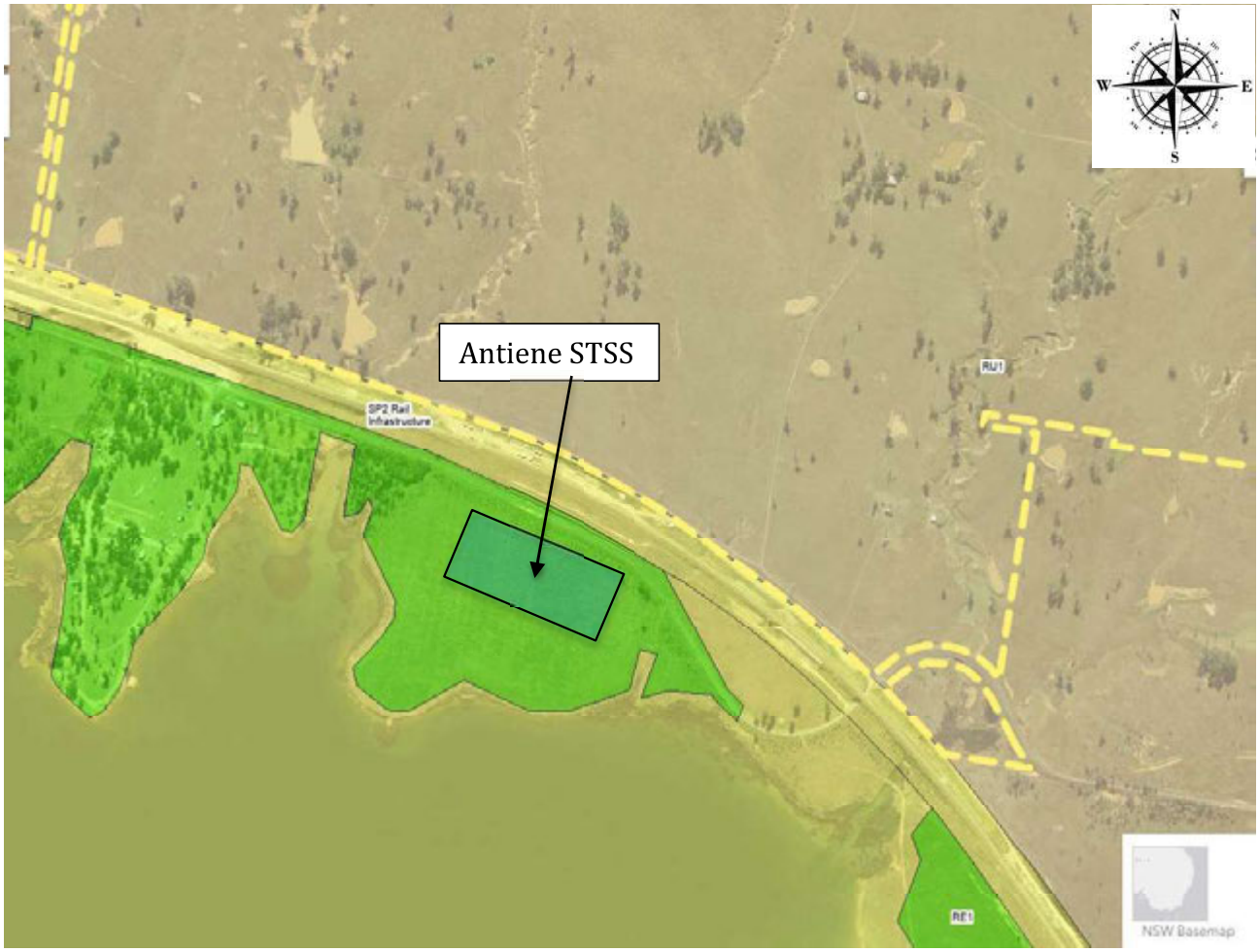


Figure 5 Land Zoning, Antiene STSS, NSW

The Antiene STSS is bounded by Hebden Road to the north and east, Lake Liddell to the south and south-west and *Lake Liddell Recreation Area* to the west. On the opposite side of Hebden Road is the *'Main Northern Railway'*, with two residential dwellings located on large rural lots (*RU1: Primary Production*) located further away on the opposite side of the railway to the north-west of the Site.

Lake Liddell Recreation Area consists of a combination of permanent residences (dwelling houses) and holiday accommodation (caravan lots).

The nearest noise sensitive receptors to the proposed Antiene STSS, in various directions, are shown in Figure 6 and as follows in Table 29.

Table 29 Antiene STSS – Noise Sensitive Receptors

Receptor and Type	Address	Direction from site
R1 – Residence	Lot 3 in DP233020	North West
R2 – Residence	Lot 311 in DP549456	North West
R3 – Residence	400 Hebden Road	West
R4 – Holiday Accommodation	400 Hebden Road	West
R5 – Residence	400 Hebden Road	West

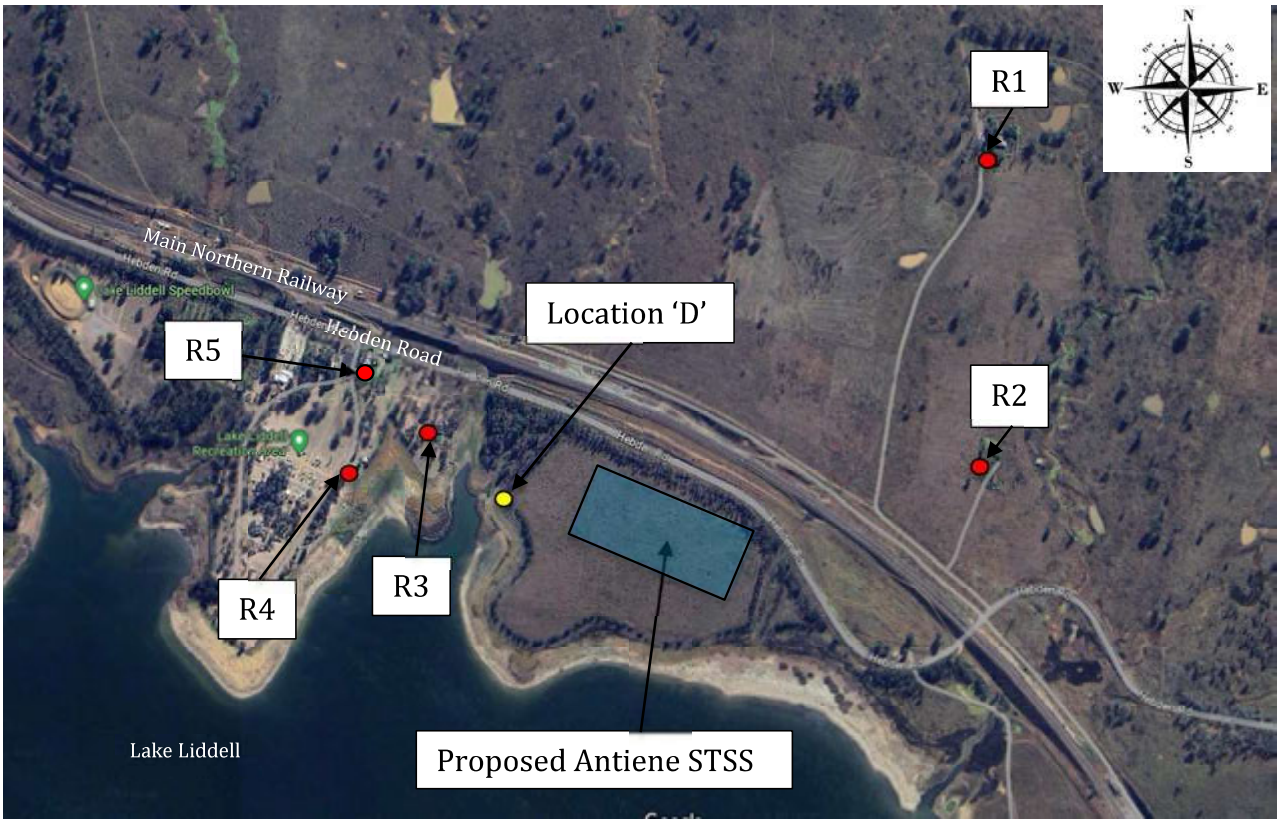


Figure 6 Proposed Antiene STSS Location Plan, Lot 9 in DP250890 and Lots 30, 32, 33, 34 and 36 in DP1193430, Hebden Road, Muswellbrook

6.1.2 Antiene STSS – Development Description

The Antiene STSS is proposed to operate 24 hours a day, 7 days a week.

Ausgrid is proposing to construct the Antiene STSS which will comprise of the installation six 132 kV outdoor dead-tank switchgears (3-pole – SF6 2500A), three 132 kV outdoor dead-tank switchgears (3-pole – SF6 3150A), 15 outdoor disconnectors and earth switches (2500A), six outdoor disconnectors and earth switches (3150A), three power VT's for auxiliary supply (100kVA), 24 132kV/110V MVT's, six 132kV/110V CVTs, 30 132kV surge arresters, two 54 cell batteries, battery chargers and monitoring equipment, one 11 kV 400kVA Kiosk L-type, one substation control room, and one amenities building.

The location(s) of the equipment outlined above can be seen in the Site Plan prepared by Ausgrid, attached in Appendix C3.

The construction process for the Antiene STSS is broken down into two stages:

Stage 1 - Expected timeframe of 46 weeks

- Stage 1 – site preparation and establishment:
    - Activities include use of a rock breaker, crane, piling rig, excavators, bobcat, vacuum truck, light and heavy vehicles.

Stage 2 - Expected timeframe of 46 weeks

- Stage 2 – forming the concrete foundations, general construction of infrastructure and installation of equipment at the Antiene STSS:
    - Activities include use of a rock breaker, excavator, bobcat, concrete trucks, crane, hand tools (electric), hand tools (pneumatic), and light and heavy vehicles.

The proposed hours of construction are, as follows:

High Impact Noise (rock/concrete breaking, piling, etc):

- Monday to Friday: 7 am to 6 pm;
- Saturdays: 8 am to 1 pm; and
- Sundays and public holidays: No work proposed.

Low Impact Noise:

- Monday to Friday: 7 am to 6 pm;
- Saturdays: 7 am to 6 pm; and
- Sundays and public holidays: No work proposed.

6.2 Antiene STSS – Existing Ambient Noise Level & Project Noise Trigger Levels

6.2.1 Antiene STSS – Description of Existing Acoustic Environment

Site inspections of the residential areas surrounding Location 'D' were conducted by the Day Design staff during the placement of the noise logger with the following observations made:

Location 'D' -

- the area is dominated by 'natural sounds', ie amphibians, insects and birds;
- through traffic on Hebden Road is clearly audible, but traffic flow is low;
- rail traffic on the Main Northern Railway is clearly audible, but traffic flow is low; and
- the area is in not in close proximity to significant noise producing industrial or commercial premises.

6.2.2 Antiene STSS – Measured Ambient Noise Levels

In order to assess the severity of a possible environmental noise problem in a residential area it is necessary to measure the ambient background noise level at the times and locations of worst possible annoyance. The lower the background noise level, the more perceptible the intrusive noise becomes and the more potentially annoying.

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

The Rating Background Level (RBL) is defined by the Environment Protection Authority (NSW) 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 places of worst possible annoyance are the nearby residential dwellings. These locations are shown in the Location Plan on Figure 6 as 'R1' to 'R3' and 'R5'. The times of worst possible annoyance will be during the night when the Antiene STSS is operating.

Ambient noise levels were measured in one locations shown as Location 'D' on Figure 6, during the following period:

- Location 'D'
  - Tuesday 29 August to Friday 8 September 2023.

The day, evening and night time ambient noise levels are presented in the attached Appendix B3 and also below in Table 30.

Table 30 Antiene STSS – Ambient Noise Levels

Noise Measurement Location	Date & Time Period	L_{90} Rating Background Level	Existing L_{eq} Noise Level
	29/8 to 8/9/2023		
Location 'D' – *Lot 30 in DP1193430, Hebden Road, Muswellbrook*	Day (7 am to 6 pm)	**27 dBA**	**49 dBA**
	Evening (6 pm to 10 pm)	**33 dBA**	**51 dBA**
	Night (10 pm to 7 am)	**32 dBA**	**52 dBA**

Meteorological conditions during the monitoring typically consisted of clear skies with temperatures ranging from 6 to 31°C. Where applicable, weather affected (ie rain or wind [speed > 5 m/s]) data has been removed from the assessment period. Atmospheric conditions were generally ideal for noise monitoring. Noise measurements were therefore considered reliable and typical for the receptor areas. Meteorological data was gathered from weather station ID 061428 Maitland Airport AWS NSW circa 35 kms away.

Section B1.1 'Instrument requirements and siting', paragraph 2 of the *NPI* requires monitoring to take place at a 'site that is truly representative of the noise environment at the residence'.

Section B1.2 'Measurement procedure', point 2, of the *NPI* specifies that monitoring should take place for 'each day of the week the proposed development will be operating and over the proposed operating hours'.

In addition to the long-term ambient noise level measurements, and in accordance with Fact Sheet A: Determining existing noise levels, Table A1 of the NSW EPA's NPI, a short-term ambient noise level measurements was also conducted at Location 'D' from 10:45 to 11:00 am on Tuesday 29 August 2023, with a Type 1 hand held real-time precision integrating sound level meter (SLM) (see Appendix A) to verify the acoustic environment..

The attended $L_{90,\ 15\ minute}$ noise level at Location 'D' was 36 dBA.

During the attended measurements it was confirmed that the acoustic environment, per the observations in Section 6.2.1, in the area is mainly influenced by local fauna (insects, amphibians and birds), distant road traffic noise on Hebden Road and rail traffic noise from the *Main Northern Railway* at Location 'D'. We note that the increase to the ambient noise levels in the evening and night was likely caused by insects/amphibians in close proximity to Location 'D'.

In accordance with Fact Sheet A and Section B1.1, Day Design is of the opinion the measured ambient noise levels at Location 'D' are representative of the noise environment at residential receivers 'R1' to 'R3' and 'R5' – see Figure 6.

6.2.3 Antiene STSS – Operational Noise – Noise Emission Criteria

6.2.3.1 Antiene STSS – EPA NPI – Project Intrusiveness Noise Level

The EPA states in Section 2.3 of its *NPI* (October 2017) that the intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the rating background noise level by more than 5 dB when beyond a minimum threshold (EPA *NPI*, 2017, Section 2.3).

The RBL at Location 'D' was 27 dBA in the day, 33 dBA the evening and 32 dBA at night (see Table 30).

Fact Sheet A1, Section A1.2, of the NPI states the following:

"Where the rating background noise level is found to be less than 30 dB(A) for the evening and night periods, then it is set to 30 dB(A); where it is found to be less than 35 dB(A) for the daytime period, then it is set to 35 dB(A)."

Therefore the acceptable L_{eq} noise intrusiveness criteria in this area is:

- (35* + 5 =) 40 dBA $L_{eq,\ 15\ minute}$ during the day
- (33 + 5 =) 38 dBA $L_{eq,\ 15\ minute}$ in the evening; and
- (32 + 5 =) 37 dBA $L_{eq,\ 15\ minute}$ at night.

**As per Fact Sheet A1, Section A1.2, of the NPI the RBL is set to a minimum of 35 dBA, see Section 5.1 above.*

6.2.3.2 Antiene STSS – EPA NPI – Project Amenity Noise Level

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. The NSW *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.

Section 2.4, Table 2.3 of the *NPI* provides guidance on assigning residential receiver noise categories. A site inspection of the residential areas surrounding residential receivers 'R1' to 'R3' and 'R5' was conducted by Day Design staff during the placement and retrieval of the environmental noise logger, see Section 6.2.1 for observations.

The observations in Section 6.2.1 indicate the residential area around residential receivers 'R1' to 'R3' and 'R5' is considered 'Rural', as per Table 2.3 of the *NPI*. The 'Rural' amenity noise levels as per Table 2.3 of the *NPI* will be used to assess residential receivers in the area.

The recommended L_{eq} noise levels below in Table 31 are taken from Section 2.4, Table 2.2 of the NPI. Compliance with the Noise Amenity levels in Table 2.2 will limit ambient noise creep.

Table 31 Antiene STSS – Amenity Noise Levels (NPI - Table 2.2)

Receiver	Noise Amenity Area	Time of Day	Recommended L_{eq}, dBA Amenity Noise Level
Residential	Rural	Day	50
		Evening	45
		Night	40
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	-	-	5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day

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)** (Section 2.2 NPI).

Compliance with the amenity criteria will limit ambient noise creep. **Section 2.4** of the *NPI* states the following:

*'To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a **project amenity noise level** applies for each new source of industrial noise as follows:*

- ***Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB (A).***

The following exceptions to the above method to derive the project amenity noise level apply:

3. *Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.'*
4. *Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for the development.*

As described in Section 6.2.1, no other industries are present in the area, or likely to be introduced into the area in the future.

In addition, the level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the L_{Aeq} noise level from that industrial noise source may exceed the project amenity noise level, ie where the existing traffic noise level is 10 dB or more above the recommended amenity noise level for the area. In such cases the project amenity noise level may be derived from the $L_{Aeq,\ period\ (traffic)}$ minus 15 dBA (refer Section 2.4.1 of the NPI).

The existing L_{eq} noise level at Location 'D' was 49 dBA during the day, 51 dBA in the evening and 52 dBA at night (see Table 30).

Ambient L_{eq} noise levels at Location 'D' were not affected by existing industrial, commercial or local road traffic noise during the day, evening and night, therefore Section 2.4.1 of the NPI is not applicable.

Therefore, the acceptable amenity noise levels at Location 'D' are:

Residential Receivers

- (50 + 3 =) 53 dBA $L_{eq,\ 15\ minute}$ during the day;
- (45 + 3 =) 48 dBA $L_{eq,\ 15\ minute}$ in the evening; and
- (40 + 3 =) 43 dBA $L_{eq,\ 15\ minute}$ at night.

Holiday Accommodation

- (55 + 3 =) 58 dBA $L_{eq,\ 15\ minute}$ during the day;
- (50 + 3 =) 53 dBA $L_{eq,\ 15\ minute}$ in the evening; and
- (45 + 3 =) 48 dBA $L_{eq,\ 15\ minute}$ at night.

6.2.3.3 Antiene STSS – EPA NPI – Project Sleep Disturbance Noise Trigger Levels

The EPA's *NPI* states in Section 2.5 that the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Sleep may be disturbed if the subject development night-time noise levels at a residential location exceed the following:

- $L_{Aeq,\ 15min}$ 40 dBA or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

Where either of the above criteria are triggered, a detailed maximum noise level event assessment should be undertaken.

The RBL at Location 'D' is 32 dBA at night (see Table 30). Therefore, the acceptable $L_{eq,\ 15\ minute}$ and L_{AFmax} noise sleep disturbance criteria in these areas are:

Location 'D'

- 40 dBA $L_{eq,\ 15\ minute}$ at night; and/or
- 52 dBA L_{AFmax} at night.

6.2.3.4 Antiene STSS – EPA NPI – Modifying Factors Corrections

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. On the other hand, some sources may cause less annoyance where only a single event occurs for a limited duration. Correction factors are to be applied to the noise from the source measured or predicted at the receiver before comparison with the criteria. AC500-10 in the Appendices is extracted from Table C.1 of the *NPI*.

6.2.3.5 Antiene STSS – Operational Noise – Project Noise Trigger Levels

Based on the measured background noise levels and the relevant planning instruments and legislation, the Project Noise Trigger Levels at each receptor location are as follows:

6.2.3.5.1 Antiene STSS – Residential Receptor Project Noise Trigger Levels

For Residential Receptors 'R1' to 'R3' & 'R5' – based on the measured background noise levels at Location 'D':

- **40 dBA** during the day;
- **38 dBA** in the evening; and
- **37 dBA** at night.

These criteria apply at the most-affected point on or within the residential property boundary – or, if that is more than 30 metres from the residence, at the most-affected point within 30 metres of the residence.

The following criteria will be applied at 1 metre from the potentially most affected residential façades of, R1' to 'R3' & 'R5' for potential sleep disturbance caused by switching of the outdoor dead-tank switchgears (see Section 6.3.1 for detail) during the night (10 pm to 7 am).

'For Residential Receptors 'R1' to 'R3' & 'R5' – based on the measured background noise levels at Location 'D':

- **40 dBA** $L_{eq,\ 15\ minute}$; and/or
- **52 dBA** L_{AFmax} at night time.

6.2.3.5.2 Antiene STSS – Holiday Accommodation Receptor Project Noise Trigger Levels

Noise emissions from the use of the proposed Antiene STSS are assessed against the NSW *NPI* at the holiday accommodation receiver, 'R4', as follows:

- **58 dBA** during the day;
- **53 dBA** during the evening;
- **48 dBA** at night.

These criteria apply at the reasonably most–affected point on or within the property boundary.

6.2.4 Antiene STSS – Construction Noise – Noise & Vibration Emission Criteria

6.2.4.1 Antiene STSS – EPA Construction Noise Guideline

Based on the RBLs at all sensitive residential receiver locations in the daytime, the recommended noise management level during all aspects of the construction program are summarised in Table 32.

Table 32 Antiene STSS – L_{eq} Noise Management Levels from Construction Activities

Receptor Location	Noise Management Level	How to Apply
All Residential Receptors	**'R1' (35[1] + 10 =) 45 dBA**	The noise affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured $L_{Aeq\ (15\ min)}$ noise level is greater than the noise affected level, the proponent should apply all feasible and reasonable* work practices to meet the noise affected level. ▪ The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. ▪ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 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.

[1]*As per Fact Sheet A1, Section A1.2, of the NPI the RBL is set to a minimum of 35 dBA, see Section 5.1 above.*

*Section 6, 'work practices' of The *Interim Construction Noise Guideline*, states: *"there are no prescribed noise controls for construction works. Instead, all feasible and reasonable work practices should be implemented to minimise noise impacts. This approach gives construction site managers and construction workers the greatest flexibility to manage noise"*.

Definitions of the terms feasible and reasonable are given in Section 1.4 of the Guideline.

Section 4.1.2 of the guideline sets out noise management levels at the nearby affected passive recreation (holiday accommodation) premises. It states that 'the external noise levels should be assessed at the most-affected occupied point of the premises', as follows:

- passive recreation areas: external $L_{Aeq,\ 15\ minute}$ 60 dBA.

During construction, the proponent should regularly update the occupants of the passive recreation (holiday accommodation) premises regarding noise levels and hours of work.

6.2.4.2 Antiene STSS – EPA Vibration Guideline

Per Section 3.2.2.2 of this report, an overall peak particle velocity of **15 mm/s** at the boundaries of residential receptors will comply with the recommended values in Table 2, and is an acceptable criteria for intermittent vibration to prevent cosmetic damage to the nearby residential buildings.

6.2.4.3 Antiene STSS – Construction Noise & Vibration – Project Noise & Vibration Trigger Levels

6.2.4.3.1 Antiene STSS – Construction Noise Management Levels

- Noise management level of **45 dBA** $L_{Aeq,\ 15\ minute}$ for all residential receptors 'R1' to 'R3' and 'R5'; and
- Noise management level of **60 dBA** $L_{eq,\ 15\ minute}$ for all holiday accommodation receptors.

6.2.4.3.2 Antiene STSS – Construction Vibration Management Levels

- A Vibration Dose Value (VDV) between **0.2 – 0.4 m/s$^{1.75}$** for human annoyance in residential buildings;
- A Peak Particle Velocity no greater than **15 mm/s** for cosmetic damage at the residential buildings.

6.3 Antiene STSS – Noise & Vibration Emission Assessment

6.3.1 Antiene STSS – Operational Noise Emission Assessment

The main sources of noise from the proposed Antiene STSS are the six 132 kV outdoor dead-tank switchgears (3-pole – SF6 2500A), three 132 kV outdoor dead-tank switchgears (3-pole – SF6 3150A) and one 11 kV 400kVA Kiosk L-type.

All other proposed equipment emits negligible levels of noise.

We have been advised that the six 132 kV outdoor dead-tank switchgears (3-pole – SF6 2500A), three 132 kV outdoor dead-tank switchgears (3-pole – SF6 3150A) and MV switchgear are required to operate 1 to 2 times per year during switching. Switching takes place over a short period, ie up to 9 seconds (1 second per outdoor dead-tank switchgear/MV switchgear). Noise emissions associated with switching are advised to be ≤ 90 dBA $L_{eq,\ 1\ second}$ (sound power level).

Considering the above, and excluding maintenance and emergencies, the maximum run time for the outdoor dead-tank switchgears/MV switchgear would be (2 x 9 =) 18 seconds per year, or 9 seconds on up to 2 days of the year.

We have considered noise emissions based on the typical operation of the Antiene STSS following its construction, ie noise emissions during the day, evening and night include the operation of the six 132 kV outdoor dead-tank switchgears (3-pole – SF6 2500A), three 132 kV outdoor dead-tank switchgears (3-pole – SF6 3150A) and one 11 kV 400kVA Kiosk L-type.

Calculations are based on plans prepared by Ausgrid as shown in Appendix C3. Calculations include reductions for the acoustic shielding provided by the proposed building structures on the Site.

Using the information gathered above and provided by Ausgrid, a schedule of sound power levels for all significant noise producing equipment is given in Table 33 below.

Table 33 Antiene STSS – L_{eq} Sound Power Levels

Description	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)							
	dBA	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**
Outdoor Dead-Tank Switchgear	**90[1]**	*74*	*86*	*88*	*86*	*87*	*82*	*75*
11 kV 400kVA Kiosk L-type	**57**	*55*	*62*	*59*	*55*	*53*	*44*	*33*

**Numbers in italics are estimated*

[1]For the assessment of potential sleep disturbance we have adopted an $L_{AF,max}$ sound power level of 93 dBA.

6.3.1.1 Antiene STSS – Applicable NPI Modifying Factor Corrections

The Sound Power Level spectrum of the outdoor dead-tank switchgears above does not contain tonal or dominant low frequency noise characteristics. Noise associated with the operation of the outdoor dead-tank switchgears is considered to contain intermittent noise characteristics. Therefore, corrections to the predicted noise levels for intermittent noise at the receivers locations are required for the assessment of noise associated with the operation of the outdoor dead-tank switchgears in accordance with Fact Sheet C: Correction for annoying noise characteristics of the NPI during the night time period only.

6.3.1.2 Antiene STSS – Predicted Noise Emissions

Knowing the sound power level of a noise source (see Table 33), the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for time corrections, distance losses, sound barriers, etc.

Calculations have been carried out using *iNoise V2024.1* industrial noise prediction modelling software which incorporates the methods specified in *ISO 9613.1/2* [3] to calculate noise emissions. The noise emissions have been calculated to determine the noise level at each receptor location due to the future operation of the Antiene STSS. Noise-enhancing meteorological conditions (see Fact Sheet D of the NPI) have been adopted for all calculations.

[3] *ISO6913-1 - Acoustics – Attenuation of sound during propagation outdoors, Parts 1 - Calculation of the absorption of sound by the atmosphere and Part 2 - General method of calculation.*

6.3.1.2.1 Antiene STSS – Predicted $L_{eq,\ 15\ minute}$ Noise Emissions

Table 34 shows the predicted $L_{eq,\ 15\ minute}$ sound pressure levels at the nearest receptor locations during the operation of the Antiene STSS.

Noise contour maps for the future operation scenarios shown in Table 34 are attached in Appendix D3.

Table 34 Antiene STSS – Predicted $L_{eq,\ 15\ minute}$ Noise Levels at the Receivers

Description	Predicted L_{eq} Noise Level (dBA) at Receptor Locations				
	R1	**R2**	**R3**	**R4**	**R5**
Day – 7 am to 6 pm					
Predicted Noise Level	7	12	17	15	14
Acceptable Noise Limit	**40**	**40**	**40**	**58**	**40**
Complies	Yes	Yes	Yes	Yes	Yes
Evening – 6 pm to 10 pm					
Predicted Noise Level	7	12	17	15	14
Acceptable Noise Limit	**38**	**38**	**38**	**53**	**38**
Complies	Yes	Yes	Yes	Yes	Yes
Night – 10 pm to 7 am					
Predicted Noise Level	12[1]	17[1]	22[1]	20[1]	19[1]
Acceptable Noise Limit	**37**	**37**	**37**	**48**	**37**
Complies	Yes	Yes	Yes	Yes	Yes

[1]5 dB added to the Predicted Noise Level in accordance with Fact Sheet C, Table C1 of the NPI.

The predicted $L_{eq,\ 15\ minute}$ level of noise associated with the use of the Antiene STSS comply with the day, evening and night period project noise trigger levels at receivers R1 to R5, and are acceptable.

6.3.1.2.2 Antiene STSS – Predicted $L_{AF, max}$ Noise Emissions

Table 35 shows the predicted $L_{AF, max}$ sound pressure levels at the nearest receptor locations during the operation of the Antiene STSS.

Noise contour maps for the future operation scenarios shown in Table 35 are attached in Appendix D3.

Table 35 Antiene STSS – Predicted $L_{AF, max}$ Noise Levels at the Receivers

Description	Predicted $L_{AF, max}$ Noise Level (dBA) at Receptor Locations				
	R1	R2	R3	R4	R5
Night – 10 pm to 7 am					
Predicted Noise Level	19	24	31	n/a	28
Acceptable Noise Limit	**52**	**52**	**52**	**n/a**	**52**
Complies	Yes	Yes	Yes	Yes	Yes

The predicted $L_{AF, max}$ level of noise associated with the use of the Antiene STSS following the alterations and additions comply the day, evening and night period project noise trigger levels at receivers R1 to R5, and are acceptable.

6.3.2 Antiene STSS – Construction Noise & Vibration Emissions

The main sources of noise on the site during the two phases of excavation and construction will be from heavy machinery such as excavators, trucks, cranes, cement agitators, concrete/rock breakers, etc.

Unless otherwise noted, the predicted noise levels in the following Sections assume that all equipment and plant listed are operating at the same time within the same general area along the nearest or furthest point of the work area. This constitutes a worst-case scenario, however, due to the nature of the works, it is more likely that equipment will be dispersed over a wider area of the construction site and will not be continuously operating simultaneously. Typically, therefore, lower average levels can be expected.

A schedule of the sound power levels for the main excavation and construction equipment was extracted from the Day Design database of Sound Power Levels and the Australian Standard AS2436:1981 *"Guide to Noise Control on Construction, Maintenance and Demolition Sites".*

Knowing the sound power level of a noise source, 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, barrier effects, etc.

Calculations consider distance attenuation only and the range of levels are based on the closest potential distance and furthest potential distance at which each item of plant may operate from each respective receiver location.

The calculated noise levels at nearby residential receptors are presented in Tables 37, 39 and 40.

6.3.2.1 Antiene STSS – Stage 1 Works

The Stage 1 works are estimated to take 46 weeks and will involve the use of an excavator, vacuum truck, light vehicles and heavy vehicles, hand tools (electric), hand tools (pneumatic) a crane (mobile), piling rig and a concrete/rock breaker. The equipment likely to be used and their corresponding sound power levels are presented below in Table 36.

Table 36 Antiene STSS – Typical Stage 1 Works - Sound Power Levels

Description	Sound Power Level, dBA
Excavator	107
Vacuum Truck	109
Light Vehicles	106
Heavy Vehicles	107
Concrete/Rock Breaker	117
Crane (Mobile)	104
Piling (Bored)	111

Given the intensity of work involved with concrete/rock breaking/sawing, it is unlikely that this activity will take place at the same time as any other activity. Notwithstanding, to ensure a conservative assessment, we have assessed the noise impact of concrete/rock breaker cumulatively. The calculated noise levels at nearby receptors are presented below in Table 37 as a worst case scenario.

Table 37 Antiene STSS – Calculated Receptor Sound Pressure Levels from Stage 1 Works

Receptor Location	Calculated Sound Pressure Levels (dBA)
R1 – Lot 3 in DP233020	44 – 45
R2 – Lot 311 in DP549456	48 – 52
R3 – 400 Hebden Road	48 – 57
R4 – 400 Hebden Road	46 – 54
R5 – 400 Hebden Road	45 – 53

6.3.2.2 Antiene STSS – Stage 2 Works

The Stage 2 works are estimated to take 46 weeks and will involve the use of an excavator, light vehicles and heavy vehicles, hand tools (electric) and hand tools (pneumatic), concrete agitator truck, concrete pump truck, a crane (mobile) and a concrete/rock breaker. The equipment likely to be used and their corresponding sound power levels are presented below in Table 38.

Table 38 Antiene STSS – Typical Stage 2 Works - Sound Power Levels

Description	Sound Power Level, dBA
Excavator	107
Light Vehicles	106
Heavy Vehicles	107
Hand Tools (Electric)	102
Hand Tools (Pneumatic)	116
Concrete Agitator Truck	109
Concrete Pump Truck	108
Crane (Mobile)	104
Concrete/Rock Breaker	117

Note: (All sound power levels are based on previous noise measurements at various sites)

Given the intensity of work involved with concrete/rock breaking/sawing, it is unlikely that this activity will take place at the same time as any other activity. Notwithstanding, to ensure a conservative assessment, we have assessed the noise impact of concrete/rock breaker cumulatively. The calculated noise levels at nearby receptors are presented below in Table 39 as a worst case scenario.

Table 39 Antiene STSS – Calculated Receptor Sound Pressure Levels from Stage 2 Works

Receptor Location	Calculated Sound Pressure Levels (dBA)
R1 – Lot 3 in DP233020	46 – 47
R2 – Lot 311 in DP549456	49 – 54
R3 – 400 Hebden Road	50 – 59
R4 – 400 Hebden Road	47 – 56
R5 – 400 Hebden Road	46 – 55

6.3.2.3 Antiene STSS – Noise Emission Summary

From the calculated noise levels in Sections 6.3.2.1 to 6.3.2.2, the level of noise exceedance are presented below in Table 40.

Table 40 Antiene STSS – Calculated $L_{eq\ 15\ minute}$ Noise Levels (Without Noise Controls) – R1 to R5

Description	Calculated Noise Levels (dBA)				
	R1	R2	R3	R4	R5
Stage 1 Works					
Typical Works	44 – 45	48 – 52	48 – 57	46 – 54	45 – 53
Noise Management Level	45	45	45	60	45
Exceedance	**Nil**	**Yes (+ 7 dB)**	**Yes (+ 12 dB)**	**Nil**	**Yes (+ 8 dB)**
Stage 2 Works					
Typical Works	46 – 47	49 – 54	50 – 59	47 – 56	46 – 55
Noise Management Level	45	45	45	60	45
Exceedance	**Yes (+ 2 dB)**	**Yes (+ 9 dB)**	**Yes (+ 14 dB)**	**Nil**	**Yes (+ 10 dB)**

It can be seen from Table 40 above, that the predicted levels of noise from construction activities may at times be in excess of the noise management levels of 45 dBA at residential receptor locations 'R1', 'R2', 'R3' and 'R5'.

To minimise the noise impact from the construction activities we recommend that the noise controls and the management plan detailed in Section 6.3.2.5 of this report be implemented.

Concrete/rock breaking is not considered cumulatively, and including it in the cumulative noise predictions potentially over-states the predicted impact. As a precaution, it is recommended in the noise management controls (Section 6.3.2.5.2) that where concrete/rock breaking is required near to receptors, it is conducted in the absence of any other plant operations to avoid a cumulative noise impact.

6.3.2.4 Antiene STSS – Vibration Emission

It is difficult to accurately predict levels of ground borne vibration at remote locations as there are many variables to consider including the surrounding terrain, strata, rock density, etc.

Previous measurements of ground borne vibration from concrete/rock breaking/sawing show that vibration levels can vary significantly at different distances and receptor locations. Given the distances from neighbouring developments to any potential concrete/rock breaking/ sawing on site, if warranted (a substantiated complaint is received regarding vibration levels, cosmetic damage to a structure, etc), we recommend that compliance monitoring of ground borne vibration is carried out at the critical receptor.

Recommendations are made in Section 6.3.2.5 of this report should complaints arise from nearby premises regarding vibration from the site.

6.3.2.5 Antiene STSS – Construction Noise & Vibration Control Recommendations

The predicted level of noise emission from the two stages of construction activities for the alterations and additions at the existing Antiene STSS, NSW may at times be in excess of the noise management levels established in Section 6.2.4.3 of this report at residential receivers 'R1', 'R2', 'R3' and 'R5'.

In order to minimise the noise impact from all excavation and construction activities, we recommend the following engineering and management noise controls be implemented.

6.3.2.5.1 Antiene STSS – Engineering and Practical Noise Controls

Australian Standard AS2436:2010, Appendix C, Table C3 provides the relative effectiveness of various forms of noise control that may be applicable and implemented on various construction sites and projects. Table C3 is replicated below in Table 41.

Table 41 Antiene STSS – Relative Effectiveness of Various Forms of Noise Control

Control by	Nominal Noise Reduction Possible
Distance	Approximately 6 dB for each doubling of distance
Enclosure	Normally 5 dB to 25 dB maximum 50 dB
Silencing	Normally 5 dB to 10 dB maximum 20 dB

Distance

Where applicable, we recommend locating mechanical plant near the centre of the construction area such that it is as far as practically possible from the residences to the north-west and west.

Enclosure

Constructing acoustical enclosures around items of mobile plant such as generators is recommended where extended use for long periods of time is expected.

Silencing

Consideration should be given to any mobile plant already acoustically treated when assessing tenders. All plant and machinery should be selected with consideration to low noise options where practicable and available.

Care should be taken to ensure that no more than one item of plant is operating simultaneously within close proximity of any given residence as far as reasonably practicable, to minimise cumulative noise impacts.

6.3.2.5.2 Antiene STSS – Noise Management Controls

The following noise management controls are derived from, or are in accordance with recommendations given in Australian Standard AS2436:2010 and the EPA's *Interim Construction Noise Guideline*.

Periods of Respite

We recommend that noisy construction activities such as concrete/rock breaking/sawing or the like only operate for 2 to 3 hours at a time.

Ensure activities in any one location are staggered, for instance, if concrete/rock breaking/sawing is occurring near to a residential receptor, all other construction activities will cease in the same location so as to minimise cumulative noise impacts.

Work Practices

We recommend that workers and contractors be trained in work practices to minimise noise emission such as the following:

- Avoid dropping materials from a height.
- Avoid shouting and talking loudly outdoors.
- Avoid the use of radios outdoors that can be heard at the boundary of residences.
- Turn off equipment when not being used.
- Carry out high impact noise work only within normal construction hours (see Sections 3.2.2.1 and 6.1.2).

Heavy Vehicles and Staff Vehicles

- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- Locate site vehicle entrances away from residences where practicable.
- Optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Staff parking areas should be located as far from residential receiver locations as practicable.

- No motor vehicles should access the site via, or park within residential areas prior to 7 am on any occasion, in order avoid sleep disturbance.

Community Relations

- A Community Liaison Officer (Project Manager or Site Manager) is to be appointed by the contractor prior to the commencement of any works.
- The Community Liaison Officer will approach all potentially affected residents prior to the commencement of any works as an initial introduction and provide his or her contact details.
- The Community Liaison Officer will explain the project, duration of works, potentially noisy periods as well as determine any particularly sensitive receivers or sensitive time periods and schedule works accordingly, as far as reasonably practical.
- A contact number will be provided for any residents to call with complaints or queries.

Once works commence, communication with the community should be maintained by the Community Liaison Officer. Communication should be maintained via a range of media including, for example, continued individual contact, letter box drops or a clearly visible notice board at the site office or on construction site boundaries.

Consultation and cooperation between the contractor and the neighbours and the removal of uncertainty and rumour can help to reduce adverse reaction to noise.

Managing a Noise Complaint

The Community Liaison Officer should receive and manage noise complaints.

All complaints should be treated promptly and with courtesy.

Should a justified noise complaint not be resolved, noise monitoring may be carried out at the affected receptor location and appropriate measures be taken to reduce the noise emission as far as reasonably practicable.

Where it is not practicable to stop the noise, or reduce the noise, a full explanation of the event taking place, the reason for the noise and times when it will stop should be given to the complainant.

The following guidelines are recommended in Section 6 of the *Interim Construction Noise Guideline* to manage a noise complaint:

- Provide a readily accessible contact point.
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.

- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of complaint.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area, time of verbal response and timeframe for written response where appropriate.

6.3.2.5.3 Antiene STSS – Noise Monitoring

We recommend that noise emissions from the development be measured during the construction periods in the event that complaints arise from nearby receivers, regarding noise.

The noise measurements should be carried out using an attended noise monitor at the location (or as close as practically possible) of the noise complaint. Noise level measurements should be carried out by an appropriately qualified acoustical consultant/engineer, using Type 1 (see AS1259) noise measuring equipment.

The measured noise level are to be compared against the Project Noise Trigger Levels shown in Section 6.2.4.3 of this report. The outcomes of the noise monitoring should be submitted to the relevant authority for review.

6.3.2.5.4 Antiene STSS – Vibration Monitoring

We recommend that the level of vibration be measured during any concrete/rock breaking/ sawing in the event complaints arise from any nearby receivers/premises regarding vibration.

The vibration measurements can be carried out using either an attended or an unattended vibration monitor. An unattended vibration monitor should be fitted with an alarm in the form of a strobe light, siren or digital (mobile/computer) alert system to make the plant operator aware immediately when the vibration limit is exceeded. The vibration monitor should be set to trigger the alarm when the overall Peak Particle Velocity (PPV) exceeds **15 mm/s** at the affected residential building.

Dilapidation reports should be commissioned for potentially affected nearby premises prior to any works being undertaken. This may be reassessed once the extent of required work is known.

In the event that levels of ground-borne vibration exceed the recommended acceptable levels for cosmetic damage, vibration causing works should cease immediately and alternative methods be considered.

6.3.2.5.5 Antiene STSS – Construction Disclaimer

Recommendations made in this report are intended to resolve acoustical problems only. We make no claims of expertise in other areas of building construction and therefore the recommended noise controls should be implements into the building design in consultation with other specialists to ensure they meet the structural, fire, thermal or other aspects of building construction.

We encourage clients to check with us before using materials or equipment that are alternative to those specified in our Acoustical Report.

7.0 HUNTER REZ FEEDER LINE – CONSTRUCTION NOISE & VIBRATION MANAGEMENT PLAN

The Hunter REZ project will include the installation of a new feeder line between the STSS's, as follows:

- Stage 1 - Singleton to Kurri Kurri 132kV Link & fibre optic underground cable from Antiene STSS to Muswellbrook BSP;
- Stage 2 - Antiene 132kV STSS, Antiene STSS to Singleton 132kV Link and Sandy Creek STSS network rearrangement.

As detailed above, both overhead and underground cables are proposed for the feeder line. The routes of the feeder lines are shown in Figures 7, 8 and 9.

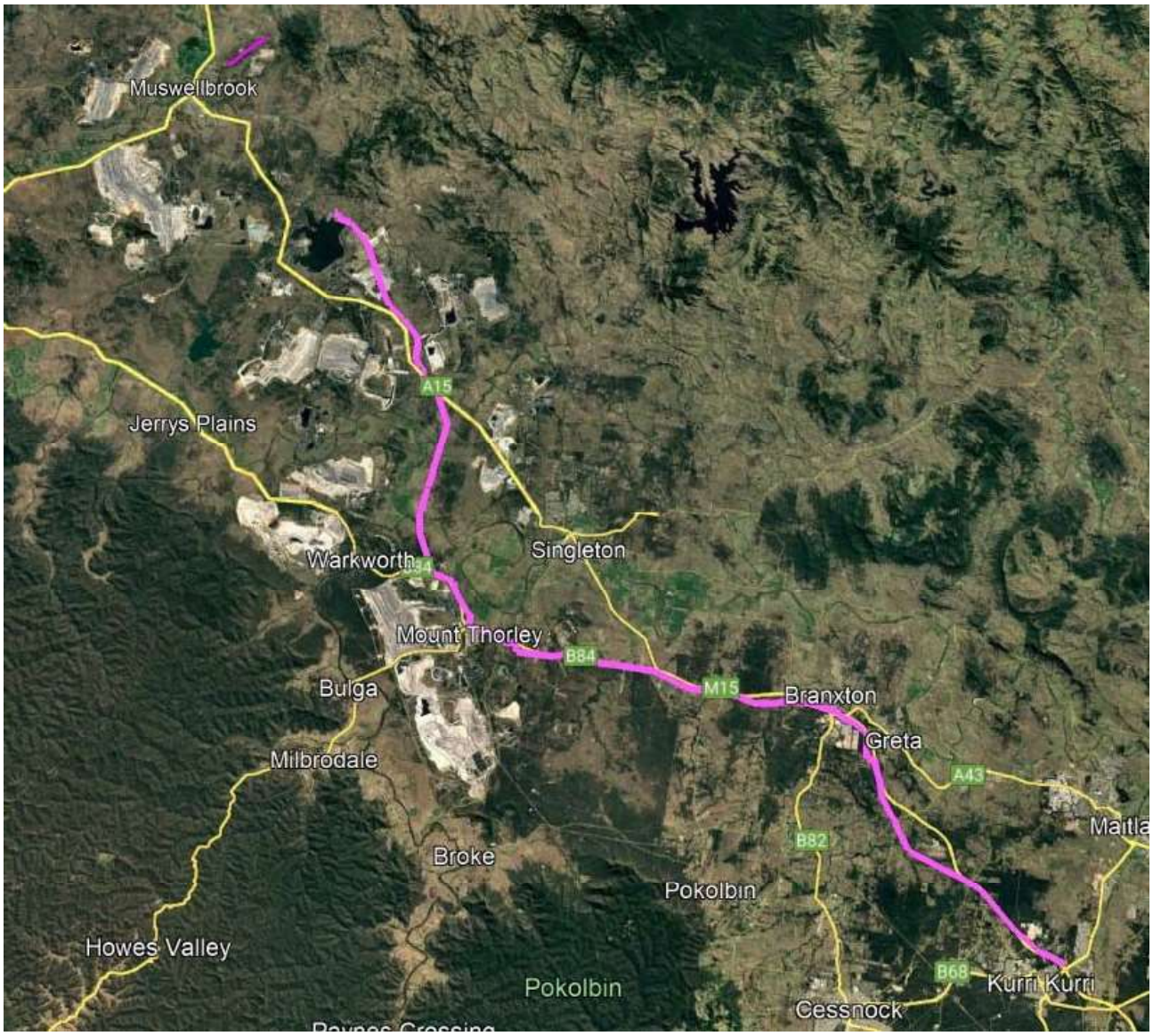


Figure 7 Antiene STSS to Kurri STSS 132kV Link (Overhead)

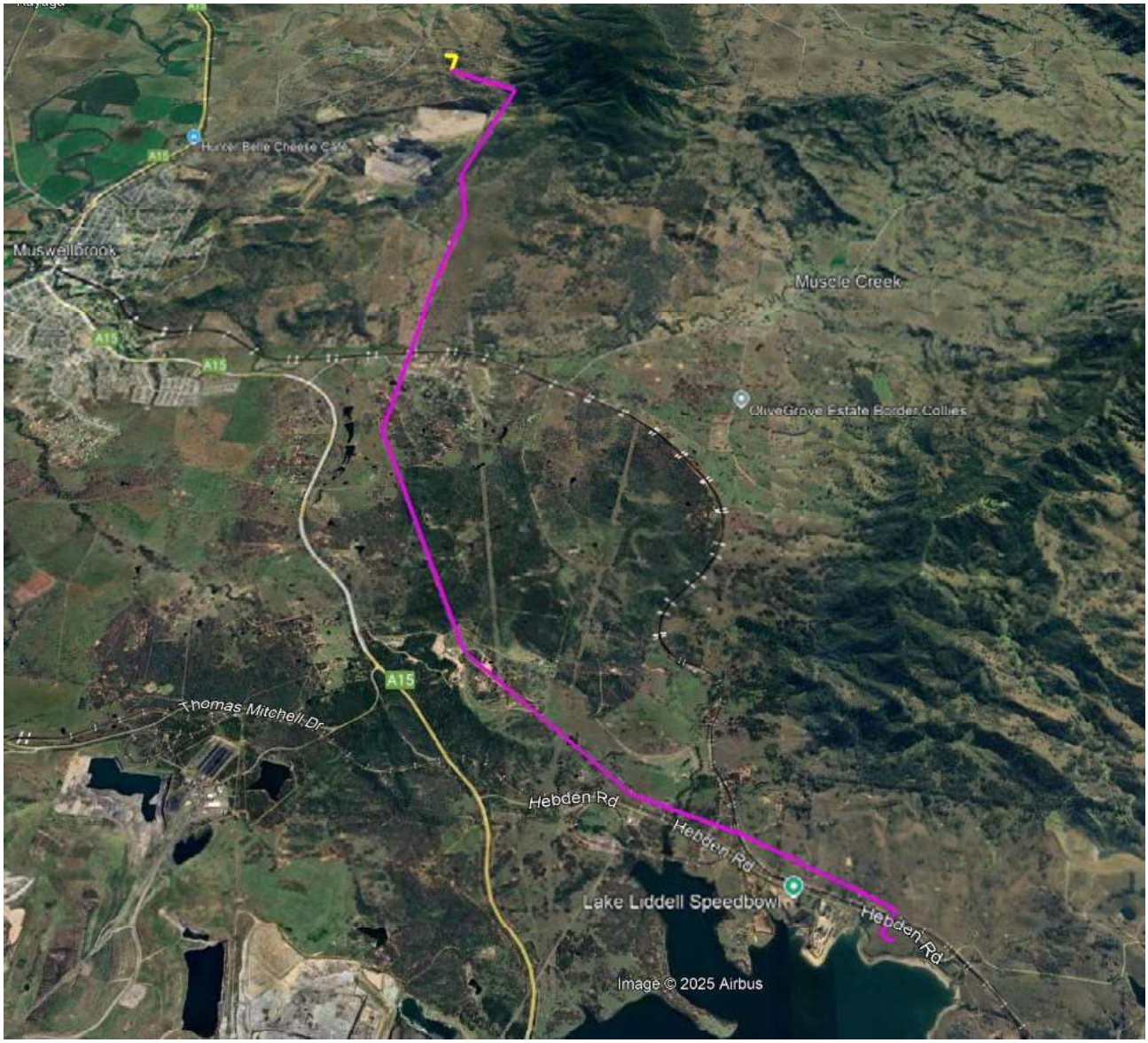


Figure 8 Fibre optic underground cable from Antiene STSS to Muswellbrook BSP

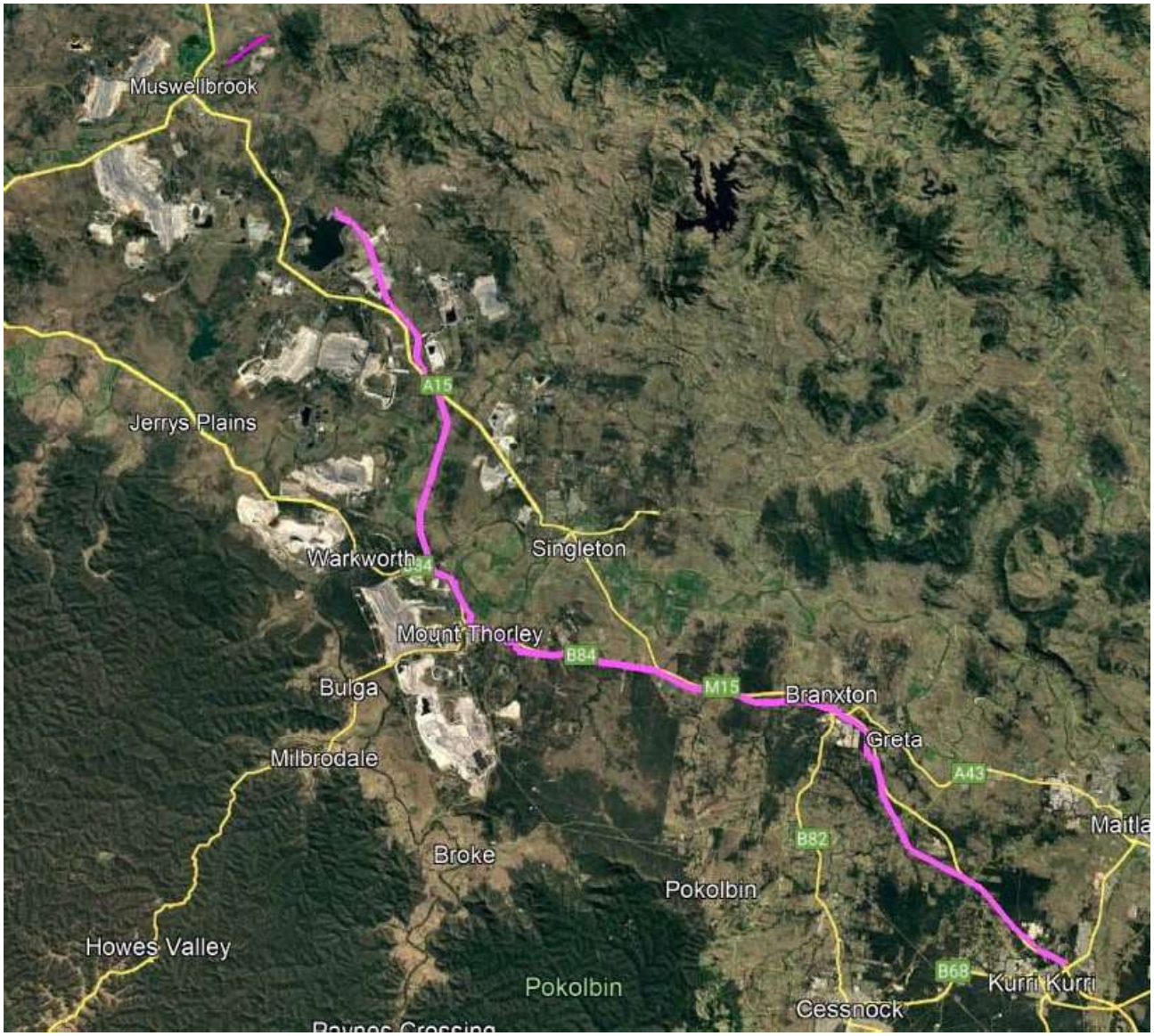


Figure 9 Antiene STSS to Singleton STSS 132kV Link (Overhead)

The route of the feeder line passes in close proximity to several residential premises.

It is proposed to construct sections of the feeder line outside of the normal construction hours defined by the EPA, as detailed in Section 3.2.2.1 of this report.

Equipment likely to be used for during the construction of the feeder line are as follows:

1. General

- Light 4x4 vehicles;
- 4 x 4 Quad Axle Full Widening Low Loader;
- Tipper truck;
- Dump truck.

2. Access tracks/veg

- Positrac/forester;
- Excavator;

- Bulldozer;
- Bobcat / skid steer;
- Grader;
- Tipper;
- Roller compactor.

3. Pole boring:

- Piling rig;
- Pepper drill – confirmed.

4. Pole erection, dressing and stringing

- 60T and 100T mobile cranes;
- 50 m EWP;
- Concrete trucks;
- Concrete pump;
- Eurocopter AS350 Squirrel;
- Drone;
- Winches (Pullers);
- Tensioners;
- Robotic spacer.

5. Laydowns

- Generators;
- Franner crane;
- Forklift;
- Manitou.

6. Handheld/small plant

- Power tools (Hydraulic & Electric);
- Grinder;
- Oxy welder;
- Chainsaw;
- Portable pumps;
- Compactor;
- Jackhammer;
- Portable Petrol Winch;
- Demolition Saw.

In order to minimise the noise impact from all excavation and construction activities, we recommend the following engineering and management noise controls be implemented by Ausgrid during the construction of the Hunter REZ project's feeder line.

Commissioning of the Hunter REZ project's feeder line will be continue through to August 2028.

7.1 Hunter REZ Feeder Line – Engineering and Practical Noise Controls

Australian Standard AS2436:2010, Appendix C, Table C3 provides the relative effectiveness of various forms of noise control that may be applicable and implemented on various construction sites and projects. Table C3 is replicated below in Table 42.

Table 42 Hunter REZ Feeder Line – Relative Effectiveness of Various Forms of Noise Control

Control by	Nominal Noise Reduction Possible
Distance	Approximately 6 dB for each doubling of distance
Enclosure	Normally 5 dB to 25 dB maximum 50 dB
Silencing	Normally 5 dB to 10 dB maximum 20 dB

Distance

Where applicable, we recommend locating mechanical plant and equipment near the centre of the construction area such that it is as far as practically possible from the residences.

Enclosure

Constructing acoustical enclosures around items of mobile plant such as generators and compressors is recommended where extended use for long periods of time is expected.

Silencing

Consideration should be given to any mobile plant already acoustically treated when assessing tenders. All plant and machinery should be selected with consideration to low noise options where practicable and available.

Care should be taken to ensure that no more than one item of plant is operating simultaneously within close proximity of any given residence as far as reasonably practicable, to minimise cumulative noise impacts.

7.2 Hunter REZ Feeder Line – Noise Management Controls

The following noise management controls are derived from, or are in accordance with recommendations given in Australian Standard AS2436:2010 and the EPA's *Interim Construction Noise Guideline*.

Periods of Respite

When in close proximity to residential premises (ie ≤ 500 metres), we recommend that noisy construction activities such as rock breaking/sawing, piling, helicopter use or the like only operate for 2 to 3 hours at a time, and during the normal construction hours defined by the EPA, as detailed below.

- 7.00 am to 6.00 pm Monday to Friday;
- 8.00 am to 1.00 pm Saturday; and
- No work on Sunday or Public Holiday.

Ensure activities in any one location are staggered, for instance, if rock breaking/sawing is occurring near to a residential receptor, all other construction activities will cease in the same location so as to minimise cumulative noise impacts.

Work Practices

We recommend that workers and contractors be trained in work practices to minimise noise emission such as the following:

- Avoid dropping materials from a height.
- Avoid shouting and talking loudly outdoors.
- Avoid the use of radios outdoors that can be heard at the boundary of residences.
- Turn off equipment when not being used.
- When in close proximity to residential premises (ie ≤ 500 metres), carry out work only within normal construction hours (see Sections 3.2.2.1 and above).

Heavy Vehicles and Staff Vehicles

- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- Locate site vehicle entrances away from residences where practicable.
- Optimise the number of vehicle trips to and from the site – movements can be organised to amalgamate loads rather than using a number of vehicles with smaller loads.
- Staff parking areas should be located as far from residential receiver locations as practicable.
- No motor vehicles should access the site via, or park within residential areas prior to 7 am on any occasion, in order avoid sleep disturbance.

Community Relations

- A Community Liaison Officer (Project Manager or Site Manager) is to be appointed by the contractor prior to the commencement of any works.
- The Community Liaison Officer will approach all potentially affected residents prior to the commencement of any works as an initial introduction and provide his or her contact details.

- The Community Liaison Officer will explain the project, duration of works, potentially noisy periods as well as determine any particularly sensitive receivers or sensitive time periods and schedule works accordingly, as far as reasonably practical.
- A contact number will be provided for any residents to call with complaints or queries.

Once works commence, communication with the community should be maintained by the Community Liaison Officer. Communication should be maintained via a range of media including, for example, continued individual contact, letter box drops or a clearly visible notice board at the site office or on construction site boundaries.

Consultation and cooperation between the contractor and the neighbours and the removal of uncertainty and rumour can help to reduce adverse reaction to noise.

Managing a Noise Complaint

The Community Liaison Officer should receive and manage noise complaints.

All complaints should be treated promptly and with courtesy.

Should a justified noise complaint not be resolved, noise monitoring may be carried out at the affected receptor location and appropriate measures be taken to reduce the noise emission as far as reasonably practicable.

Where it is not practicable to stop the noise, or reduce the noise, a full explanation of the event taking place, the reason for the noise and times when it will stop should be given to the complainant.

The following guidelines are recommended in Section 6 of the *Interim Construction Noise Guideline* to manage a noise complaint:

- Provide a readily accessible contact point.
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of complaint.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area, time of verbal response and timeframe for written response where appropriate.

7.3 Hunter REZ Feeder Line – Noise Monitoring

We recommend that noise emissions from the development be measured during the construction periods in the event that complaints arise from nearby receivers, regarding noise.

The noise measurements should be carried out using an attended noise monitor at the location (or as close as practically possible) of the noise complaint. Noise level measurements should be carried out by an appropriately qualified acoustical consultant/engineer, using Type 1 (see AS1259) noise measuring equipment.

The measured noise level are to be compared against the relevant noise management levels, as defined in the EPA's *Interim Construction Noise Guideline* (see Section 3.2.2.1). The outcomes of the noise monitoring should be submitted to the relevant authority for review.

7.4 Hunter REZ Feeder Line – Vibration Monitoring

We recommend that the level of vibration be measured during any rock breaking / sawing / piling in the event complaints arise from any nearby receivers/premises regarding vibration.

The vibration measurements can be carried out using either an attended or an unattended vibration monitor. An unattended vibration monitor should be fitted with an alarm in the form of a strobe light, siren or digital (mobile/computer) alert system to make the plant operator aware immediately when the vibration limit is exceeded. The vibration monitor should be set to trigger the alarm when the overall Peak Particle Velocity (PPV) exceeds **15 mm/s** at the affected residential building.

In the event that levels of ground-borne vibration exceed the recommended acceptable levels for cosmetic damage, vibration causing works should cease immediately and alternative methods be considered.

8.0 CONCLUSION

Day Design Pty Ltd has been engaged by Ausgrid to prepare an acoustic report that assesses the environmental noise impact of the construction and operation of the Hunter REZ project.

Measurements and calculations show that, provided the recommendations in Sections 4.3.2.5, 5.3.2.5, 6.3.2.5 and 7 of this report are implemented, the level of noise and vibration emitted by the proposed construction and operation of the Hunter REZ project will meet the acceptable noise and vibration level requirements of the NSW Environment Protection Authority's NSW *Noise Policy for Industry*, *Interim Construction Noise Guideline* and *Assessing Vibration: a technical guideline* as detailed in Section 3 of this report, and will be acceptable.

Adam Shearer, BCT (Audio), MDesSc (Audio and Acoustics), MAAS
Senior Acoustical 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 Surveys
Appendix C – Site Plans
Appendix D – iNoise Noise Maps
AC108-1 to 4 – Glossary of Acoustical Terms
AC500-10 – NSW Noise Policy for Industry, Modifying Factor Corrections

NOISE SURVEY INSTRUMENTATION

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

Table A1 Noise Survey Instrumentation

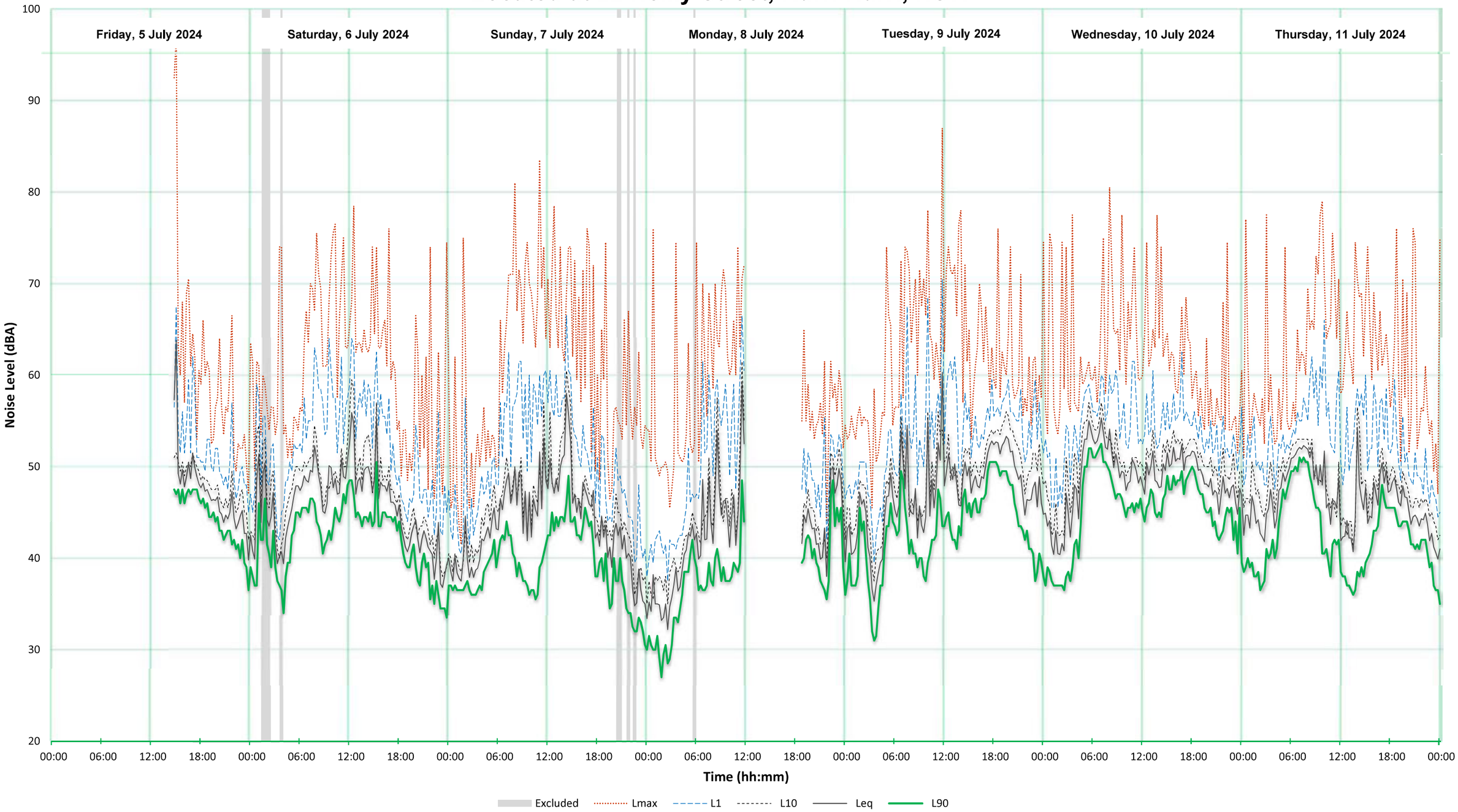
Description	Model No	Serial No
Kurri Kurri STSS		
Infobyte Noise Logger (Type 2) Condenser Microphone 0.5" diameter	iM4 MK 250	113 113
Infobyte Noise Logger (Type 1) Condenser Microphone 0.5" diameter	iM4 MK 250	115 3778
Acoustical Calibrator (Microphone)	B&K 4231	302 1796
Acoustical Calibrator (Microphone)	B&K 4231	301 1809
Sandy Creek STSS		
Infobyte Noise Logger (Type 2) Condenser Microphone 0.5" diameter	iM4 MK 250	119 119
Acoustical Calibrator (Microphone)	B&K 4231	302 1796
Antiene STSS		
Infobyte Noise Logger (Type 1) Condenser Microphone 0.5" diameter	iM4 MK 250	105 7112
Acoustical Calibrator (Microphone)	B&K 4231	302 1796
Acoustical Calibrator (Microphone)	B&K 4231	301 1809
Modular Precision Sound Analyser Condenser Microphone 0.5" diameter	B&K 2270 B&K 4189	301 1809 309 9836

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 1 precision environmental noise monitors meeting all the applicable requirements of AS1259 for an integrating-averaging sound level meter.

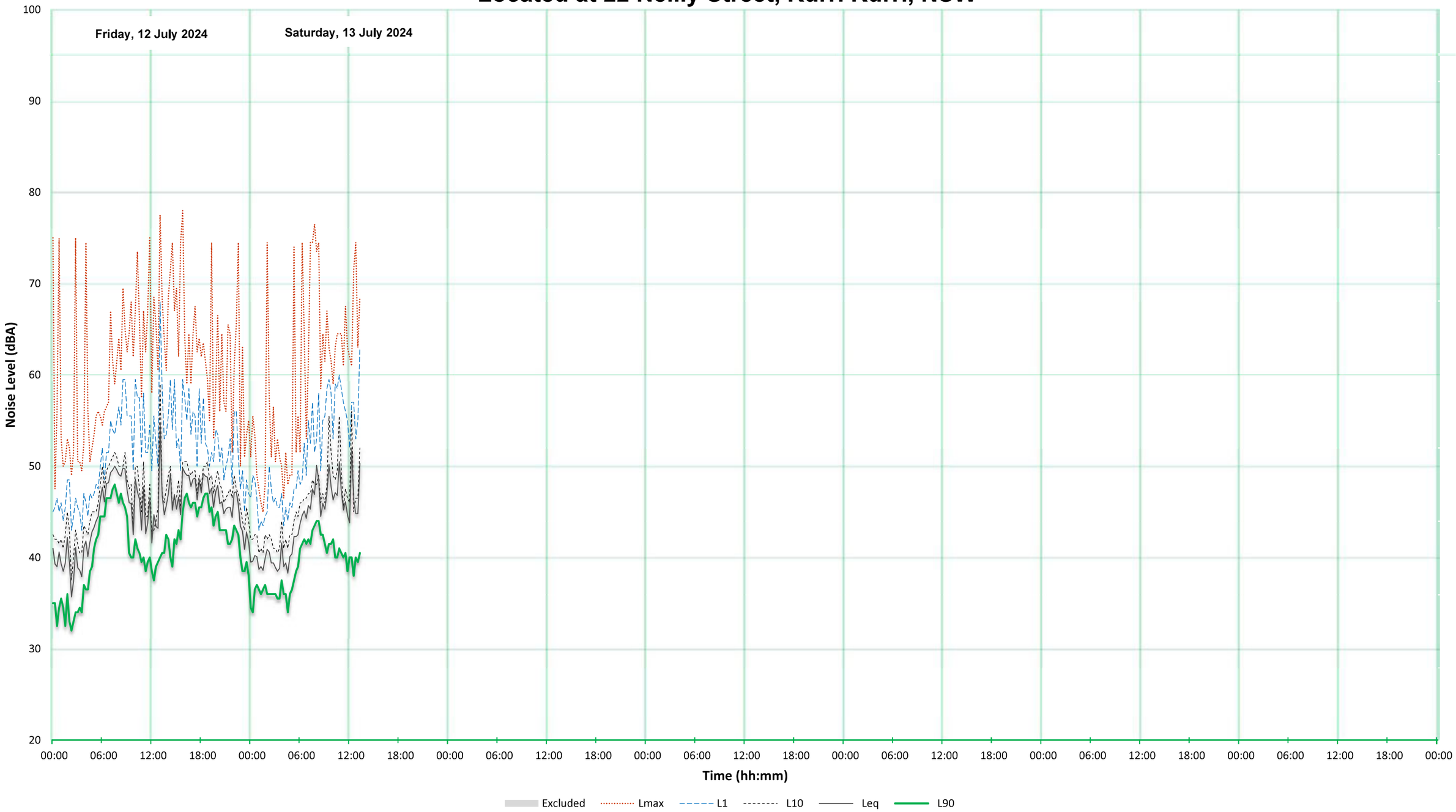
The B&K 2270 Sound Analyser is a real-time precision integrating sound level meters with octave and third octave filters, that sample noise at a rate of 10 samples per second and provides L_{eq} and L_{90}, L_{10} noise levels using both Fast and Slow response and L_{peak} noise levels on Impulse response time settings. The meters are frequency weighted to provide dBA, dBC or Linear sound pressure level readings as required.

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 and 0.5 dB during attended measurements. No adjustments for instrument drift during the measurement period were warranted.

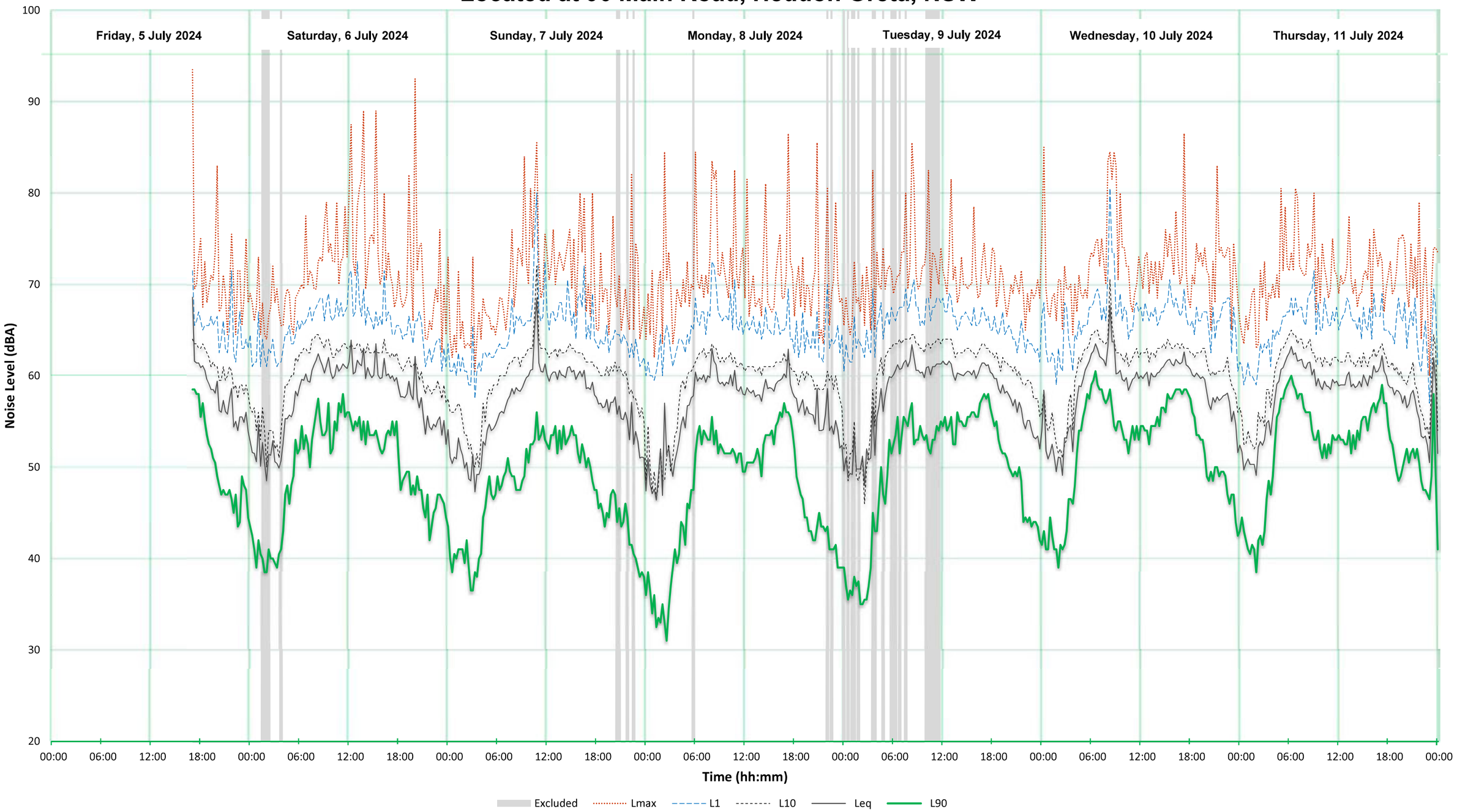
Located at 22 Neilly Street, Kurri Kurri, NSW



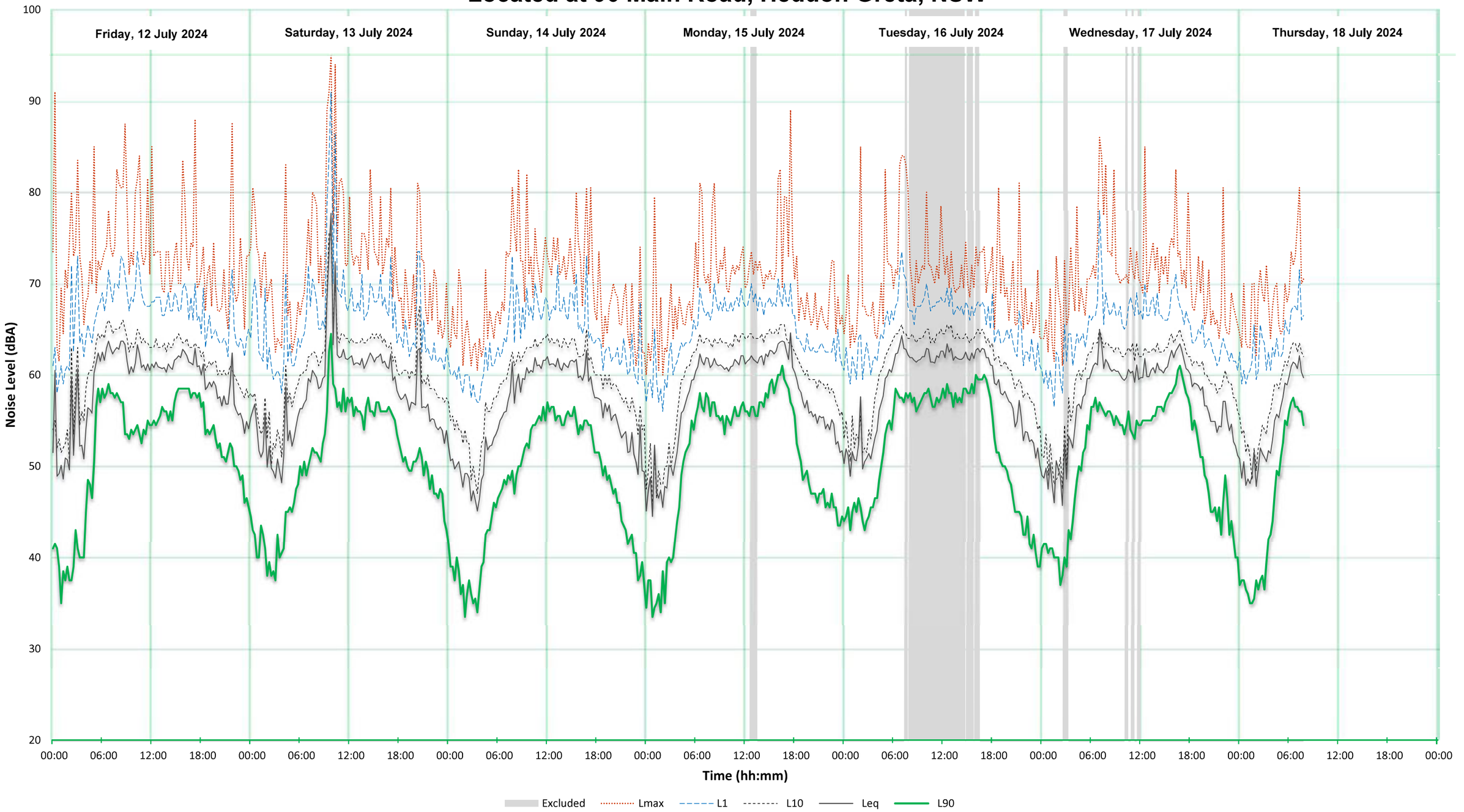
Located at 22 Neilly Street, Kurri Kurri, NSW



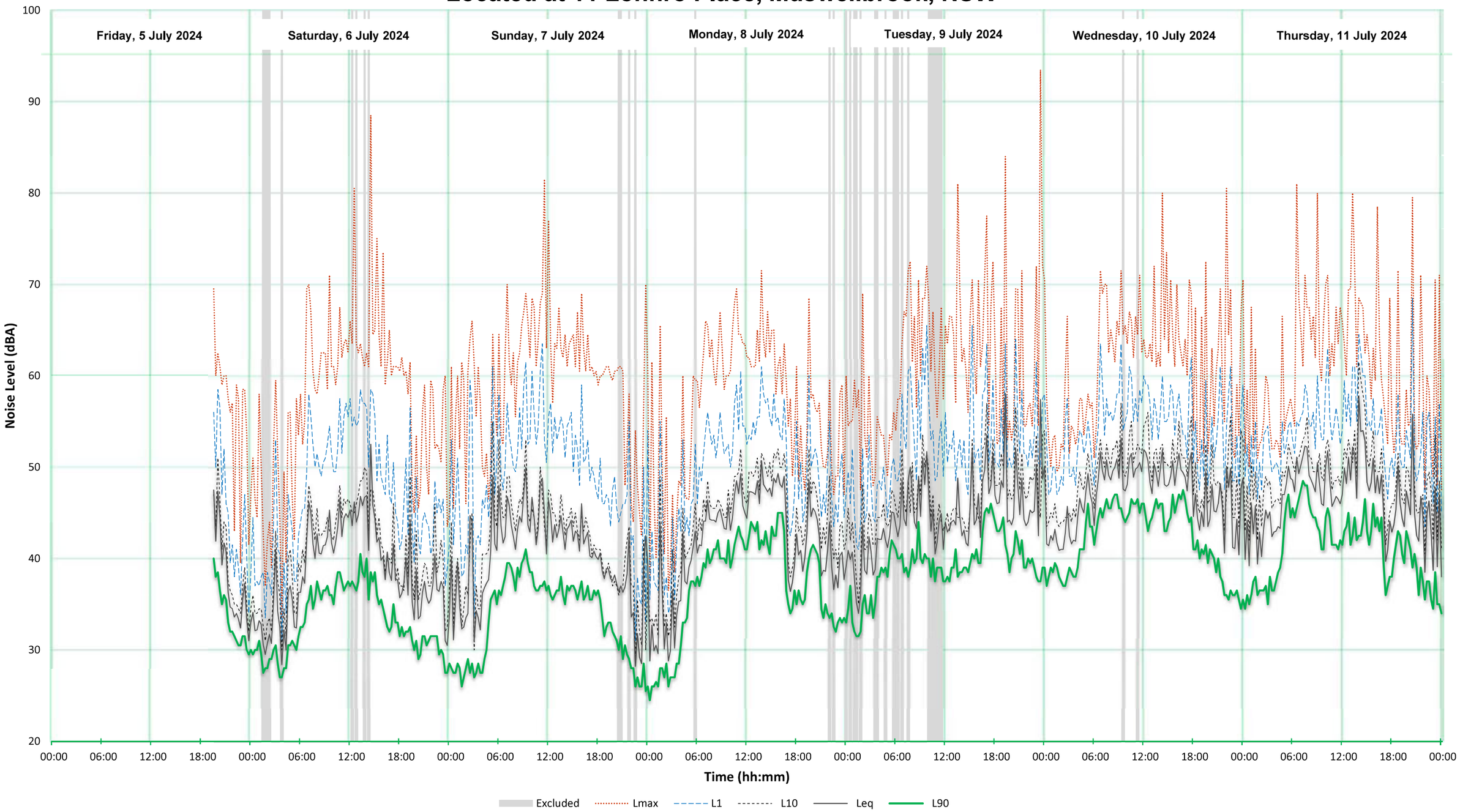
Located at 96 Main Road, Heddon Greta, NSW



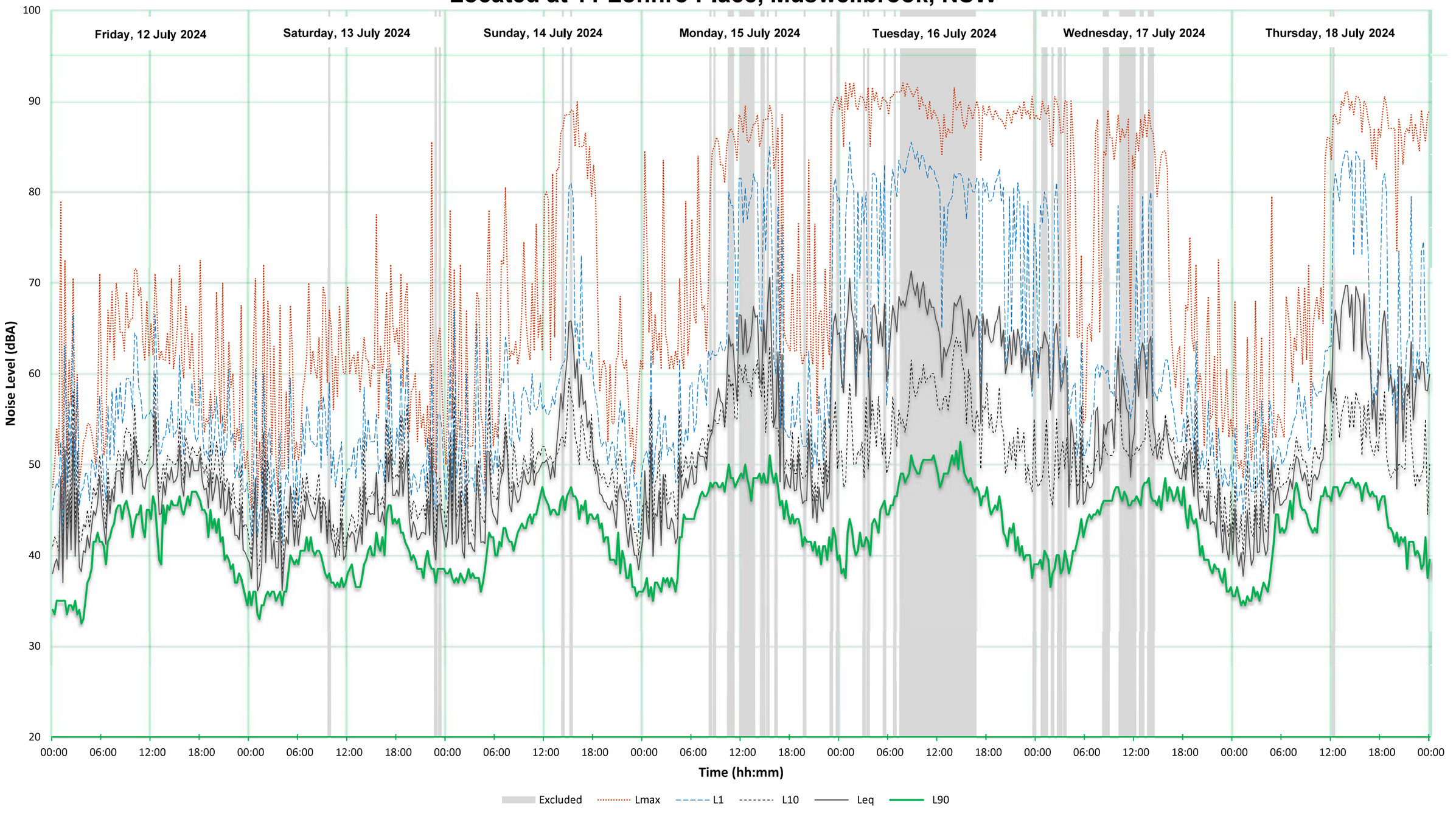
Located at 96 Main Road, Heddon Greta, NSW



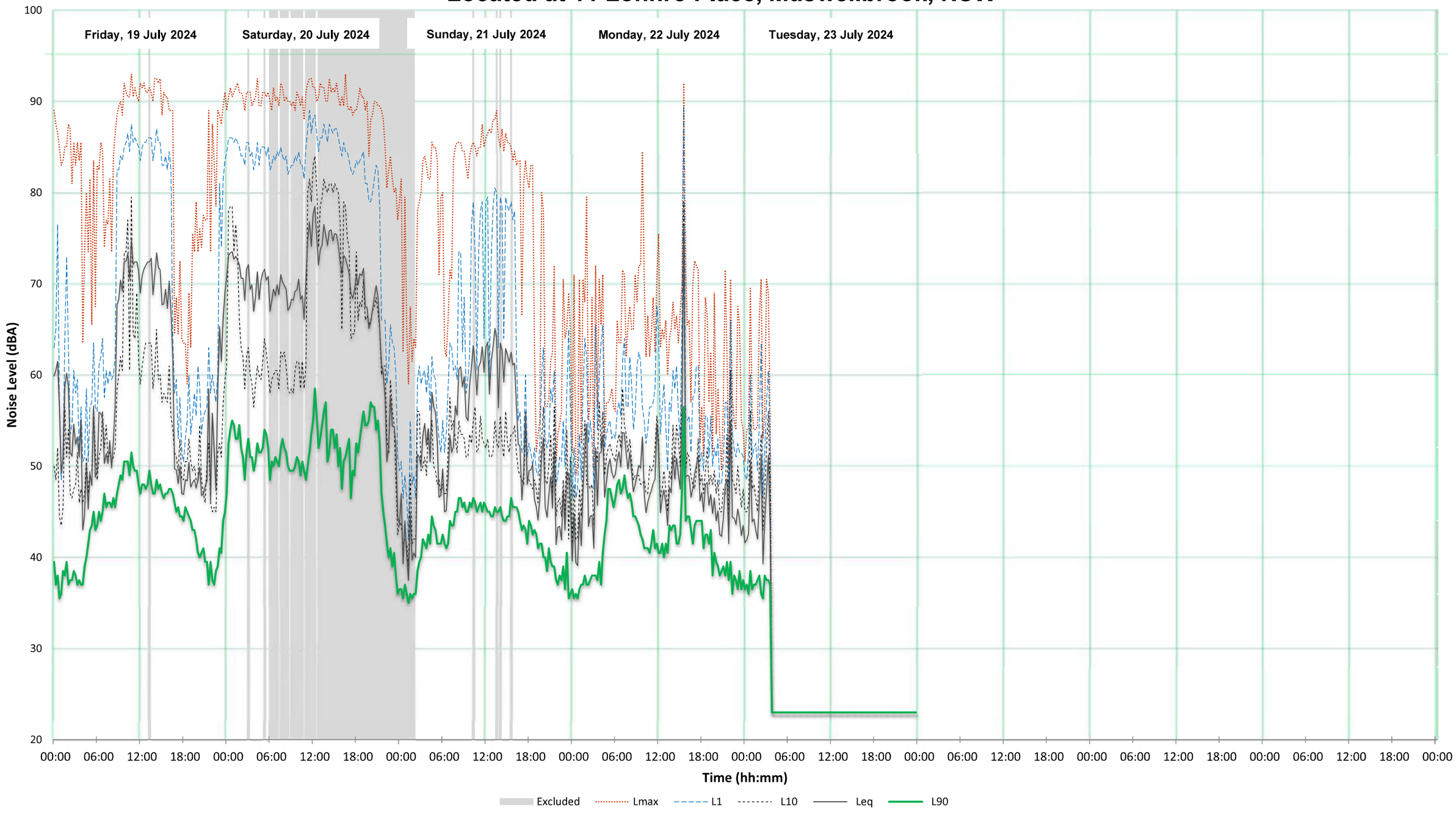
Located at 11 Lonhro Place, Muswellbrook, NSW



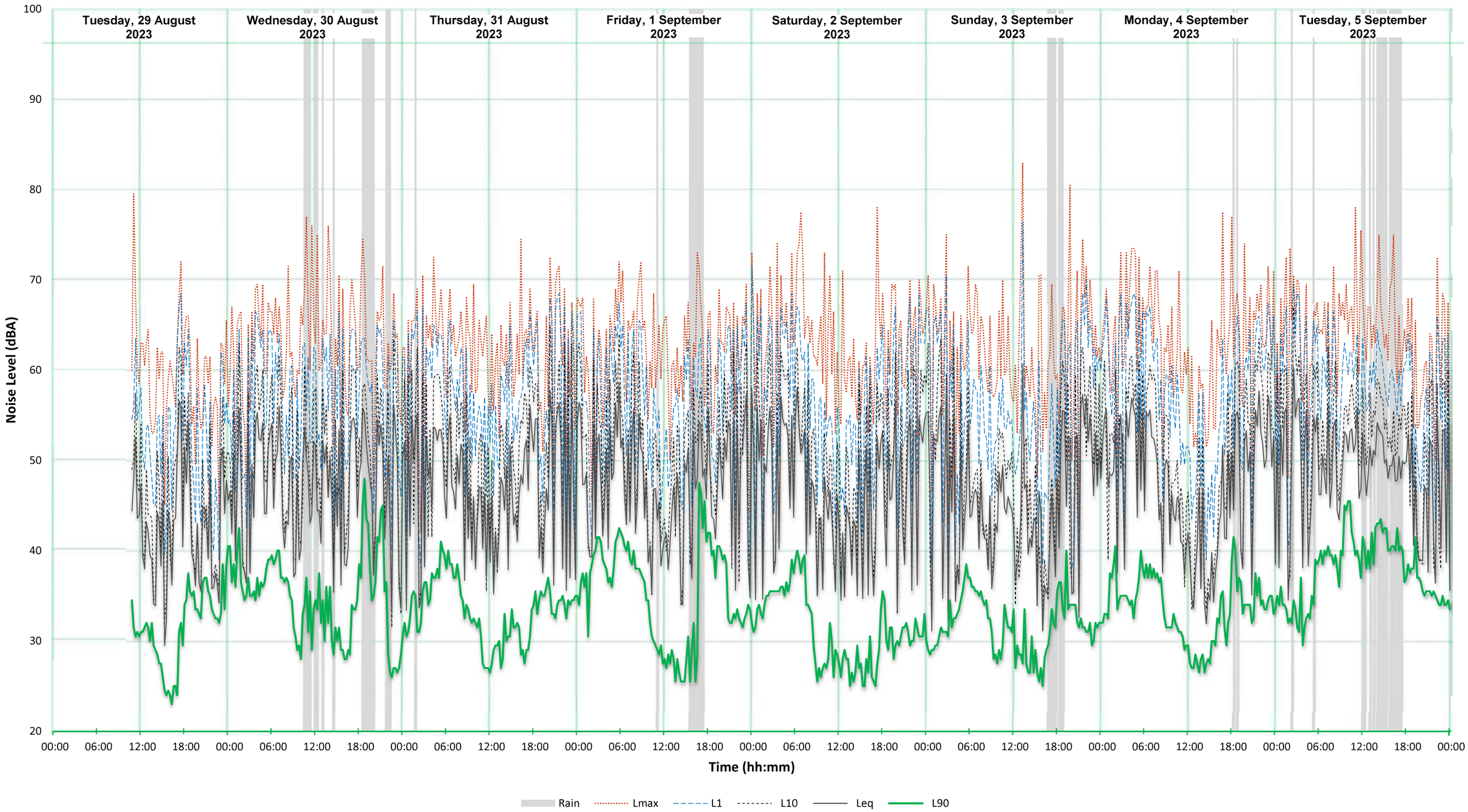
Located at 11 Lonhro Place, Muswellbrook, NSW



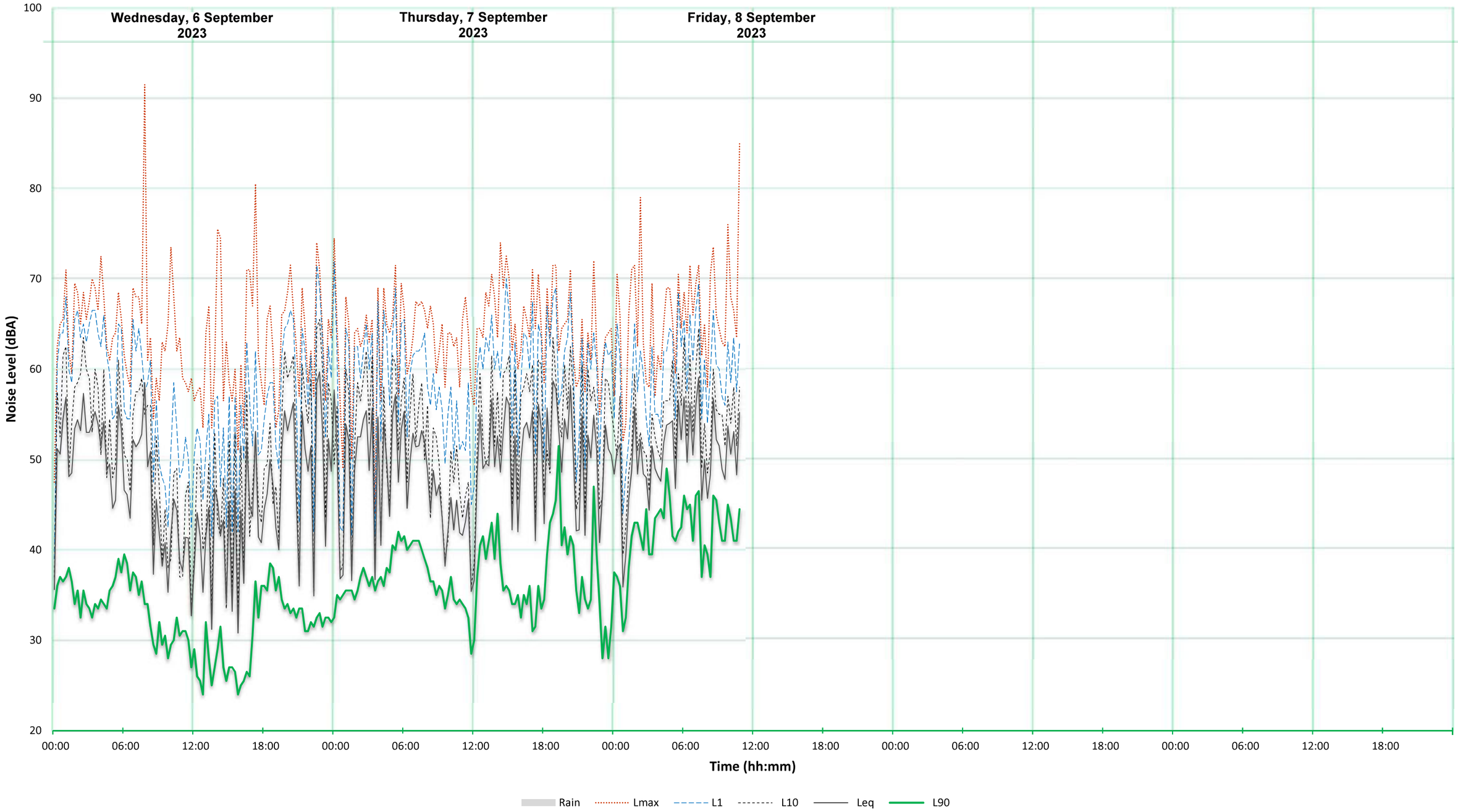
Located at 11 Lonhro Place, Muswellbrook, NSW



Located at Western Boundary, Lot 30 in DP1193430 - Hebden Road, Muswellbrook, NSW

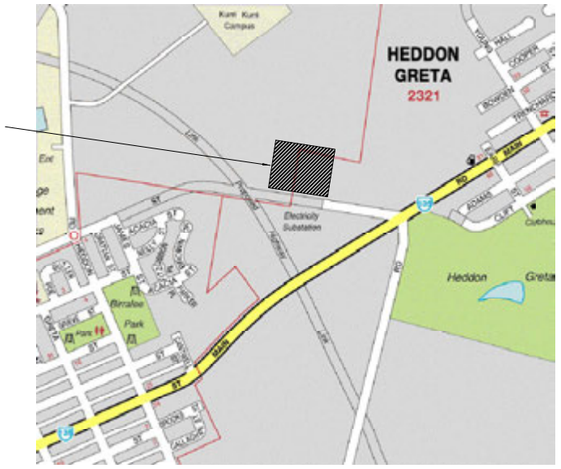


Located at Western Boundary, Lot 30 in DP1193430 - Hebden Road, Muswellbrook, NSW



NORTH

SUBSTATION SITE



LOCALITY PLAN
N.T.S.

LEGEND

- EXISTING OVERHEAD
- PROPERTY BOUNDARY
- NEW SUBSTATION FENCE
- EXIST SUBSTATION FENCE
- EXIST POWER POLE

33kV SWITCHROOM SETOUT

DATUM - N/W CORNER OF Tx3 BUND - E359534.037
N6369238.319

POINT 1 - S/E CORNER OF SWITCHROOM - E359525.597
N6369251.515

POINT 2 - S/W CORNER OF SWITCHROOM - E359514.453
N6369255.177

TENDER ISSUE C

AMENDMENTS			
CAD DRAWING DO NOT MANUALLY AMEND			
DWN: amend_by			
CHKD: check_by			
APP'D: approve			
DATE: 27-10-2023	DWN: amend_by	DWN: amend_by	
TENDER ISSUE A	CHKD: check_by	CHKD: check_by	
A	APP'D: approve	APP'D: approve	
	DATE: 7/11/2023	DATE: 6/02/2024	
	TENDER ISSUE B	TENDER ISSUE C	
	B	C	

ASSOCIATED DRAWINGS	
EMERGENCY DRAINAGE PLAN	151037
DRAWING INDEX	203617
KURRI KURRI SUBSTATION GENERAL ARRANGEMENT	524352

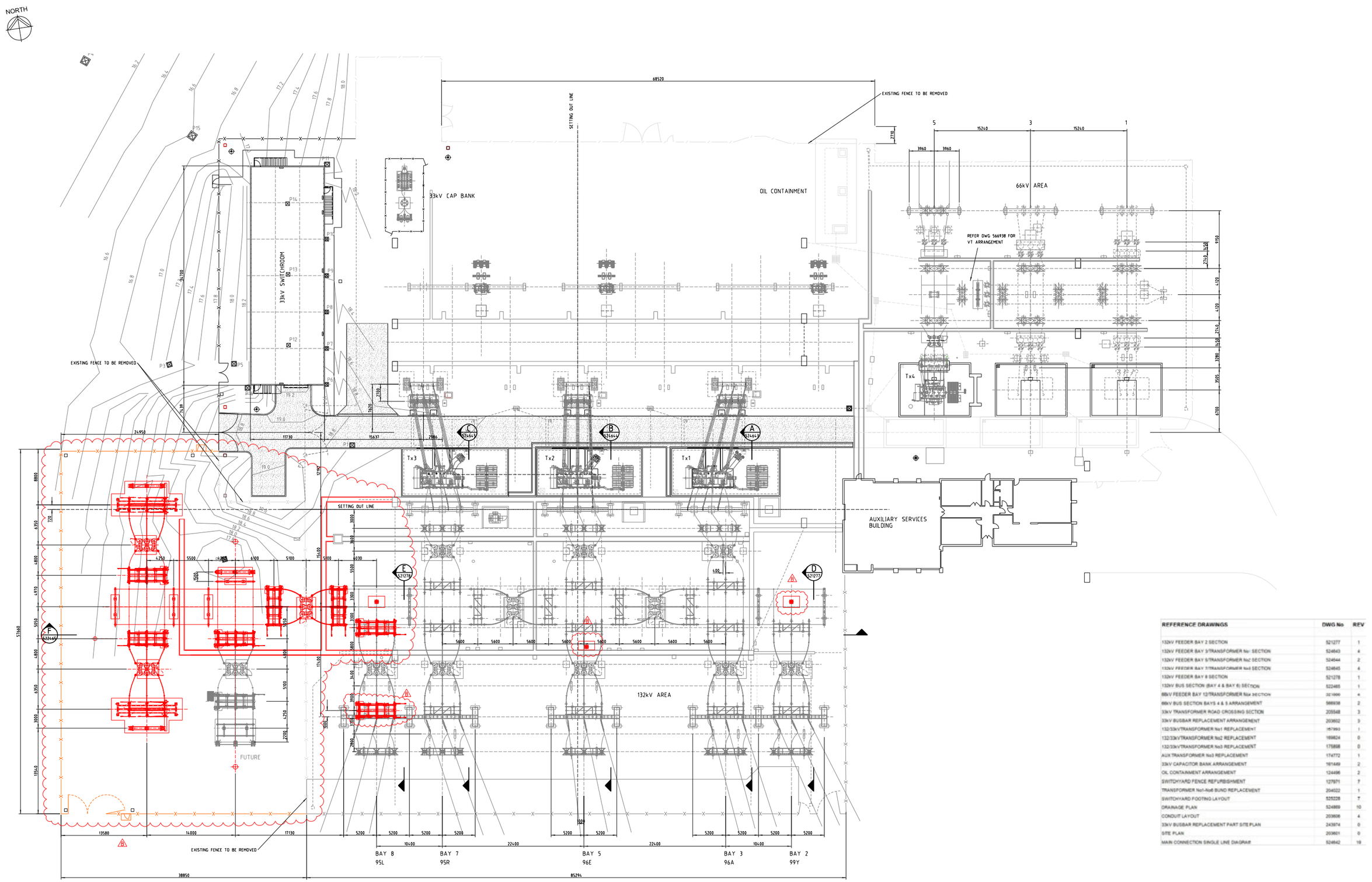
Ausgrid
145 NEWCASTLE RD WALLSEND, NSW 2287

SCALE	1:250
DESIGNED	DENNIS COURTNEY
DRAWN	RAY DEAL
CHECKED	DENNIS COURTNEY
APPROVED	ROSS HUGHES
DATE	17/09/09
PROJECT NUMBER	SJ-5559
PROJTRAK NUMBER	

TS 404 KURRI KURRI
132/33kV SUBSTATION
SITE PLAN

SIZE	DRAWING No	SHEET	AMD
B1	203601	1	C

20110923



REFERENCE DRAWINGS	DWG No	REV
132kV FEEDER BAY 2 SECTION	521277	1
132kV FEEDER BAY 3/TRANSFORMER No1 SECTION	524643	4
132kV FEEDER BAY 5/TRANSFORMER No2 SECTION	524644	2
132kV FEEDER BAY 7/TRANSFORMER No3 SECTION	524645	4
132kV FEEDER BAY 8 SECTION	521278	1
132kV BUS SECTION (BAY 4 & BAY 6) SECTION	522465	1
66kV FEEDER BAY 12/TRANSFORMER No4 SECTION	321000	4
66kV BUS SECTION BAYS 4 & 5 ARRANGEMENT	566938	2
33kV TRANSFORMER ROAD CROSSING SECTION	203548	3
33kV BUSBAR REPLACEMENT ARRANGEMENT	203602	3
132/33kVTRANSFORMER No1 REPLACEMENT	167993	1
132/33kVTRANSFORMER No2 REPLACEMENT	169824	0
132/33kVTRANSFORMER No3 REPLACEMENT	175858	0
AUX TRANSFORMER No3 REPLACEMENT	174772	1
33kV CAPACITOR BANK ARRANGEMENT	161449	2
OIL CONTAINMENT ARRANGEMENT	124496	2
SWITCHYARD FENCE REFURBISHMENT	127871	7
TRANSFORMER No1-No6 BUND REPLACEMENT	204022	1
SWITCHYARD FOOTING LAYOUT	525228	7
DRAINAGE PLAN	524869	10
CONDUIT LAYOUT	203606	4
33kV BUSBAR REPLACEMENT PART SITE PLAN	243974	0
SITE PLAN	203601	0
MAIN CONNECTION SINGLE LINE DIAGRAM	524642	19

TENDER ISSUE B

CAD DRAWING IS MASTER DRAWING

AMENDMENTS

A.	Draft. amend_by	DATE: 27/10/2023	TENDER ISSUE A
	CHKD. check_by		
	APPD. approve		
B	Draft. amend_by	DATE: 7/11/2023	TENDER ISSUE B
	CHKD. check_by		
	APPD. approve		

ASSOCIATED DRAWINGS

Ausgrid

145 NEWCASTLE RD WALLSEND, NSW 2287

SCALE	1:500
DESIGNED	EC
DRAWN	EC
CHECKED	EC
APPROVED	EC
DATE	01/01/61
PROJECT NUMBER	SM 034.97
PROJTRAK NUMBER	

TS 404 KURRI KURRI
132/66/33kV SUBSTATION
GENERAL ARRANGEMENT

SIZE	DRAWING No	SHEET	AMD
A0	524352	1	B

20110901

GENERAL NOTES:

1. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ACCOMPANYING AECOM REFERENCE DESIGN REPORT.
2. DO NOT SCALE DRAWINGS.
3. EXISTING FEATURES AND SURFACE CONTOURS SHOWN ON DRAWINGS AT MUSWELLBROOK SITE ARE BASED ON TOPOGRAPHICAL SURVEY PROVIDED BY AUSGRID. REFERENCE SURVEY PLAN 60199.DWG DATED 24/07/2023.
4. FOR SUBSTATION GENERAL ARRANGEMENT PLAN REFER TO DWG No. 265665.
5. DETAILED SURVEY OF EXISTING UNSEALED ACCESS TRACK REQUIRED TO CONFIRM EXTENT OF UPGRADE WORKS. PRELIMINARY ASSESSMENT OF DATA OBTAINED FROM GEOSCIENCE AUSTRALIA INDICATES VERTICAL ALIGNMENT IS LIKELY COMPLIANT TO AUSGRID STANDARDS.
6. IT IS ASSUMED THAT EXISTING POTABLE/FIRE WATER PROVISIONS INCLUDING TANKS BOOSTER AND PUMPHOUSE ARE ADEQUATE TO SERVE THE NEW SWITCHYARD IN ITS ELEVATED LOCATION. THIS NEEDS TO BE CONFIRMED PRIOR TO DETAILED DESIGN AND CONSIDERATION SHOULD BE GIVEN TO AN APPROPRIATE CONTINGENCY FOR THE PURPOSE OF TENDER.

N

SANDY CREEK

LOCAL SHOULDER WIDENING TO ALLOW FOR EARTHWORKS VEHICLES AND CONTROL ROOM DELIVERY

TO McCULLEYS GAP

OVERLAND FLOW PATH DIRECTION

ABERDEEN STREET

SANDY CREEK ROAD

INDICATIVE ALIGNMENT OF EXISTING UNSEALED PRIVATE ACCESS ROAD TO BE RETAINED & RESURFACED AS NECESSARY

INTERFACE WITH EXISTING PRIVATE PROPERTY ACCESS AND SUBSTATION ACCESS ROAD WITH GATE AND CATTLE GRID TO BE MAINTAINED

INDICATIVE SHOULDER WIDENING AT BEND TO ACCOMMODATE EARTHWORKS VEHICLES AND CONTROL ROOM DELIVERY

INDICATIVE PROPERTY BOUNDARIES (TYP.)

UPGRADE EXISTING PRIVATE ROAD ACCESS OFF SANDY CREEK ROAD. INTERSECTION TO BE IN ACCORDANCE WITH MUSWELLBROOK SHIRE COUNCIL STANDARD DRAWING 0041/1

TO MUSWELLBROOK

EXISTING GATE AND PRIVATE PROPERTY ACCESS TO BE MAINTAINED

EXISTING CULVERT BENEATH ACCESS ROAD TO BE RETAINED

EXISTING UNNAMED WATERCOURSE (TYP.)

OVERLAND FLOW PATH DIRECTION

PROPOSED MUSWELLBROOK BYPASS (BY OTHERS)

OVERLAND FLOW PATH DIRECTION

INDICATIVE ALIGNMENT OF EXISTING MUSWELLBROOK SUBSTATION RIGID ACCESS ROAD TO BE RETAINED

EXISTING MUSWELLBROOK SUBSTATION ACCESS ROAD AND TURNING AREA TO BE RETAINED

EXISTING MUSWELLBROOK 132/33kV SUBSTATION SITE

OVERLAND FLOW PATH DIRECTION

QUEEN STREET

LONHRO STREET

SEPOY CRESCENT

JEUNE STREET

POTABLE AND FIRE WATER CONNECTION TO EXISTING SERVICES- REFER NOTE 6

EXISTING UNSEALED ACCESS TRACK TO BE WIDENED TO 6m AND SEALED - REFER NOTE 5

VERTICAL ALIGNMENT AND TIE IN BETWEEN EXISTING ACCESS ROAD AND PROPOSED NEW SWITCHING STATION TO BE FURTHER DEVELOPED AT DETAILED DESIGN STAGE - REFER NOTE 5

INDICATIVE EASEMENT ALIGNMENT

PROPOSED CONTROL ROOM BUILDING

EXISTING 132kV OVERHEAD LINE (TYP.)

- INDICATIVE ASSET PROTECTION ZONE (APZ) EXISTING TREES AND SHRUBS TO BE CLEARED FROM WITHIN THIS AREA AND ALL VEGETATION TO BE MAINTAINED AT LESS THAN 100mm PER AS3959

EXISTING ACCESS ROAD TO BE REALIGNED CLEAR OF PROPOSED WORKS

PROPOSED INTERNAL ACCESS ROAD - REFER NOTE 4

PROPOSED MUSWELLBROOK 132kV SWITCHING STATION - REFER TO NOTE 4

SCALE 1 : 2000

0 50 150 METRES

100 200

THIS DRAWING MUST BE PRINTED IN COLOR

CIVIL LAYOUT

SCALE 1:2000

FOR TENDER ISSUE

CAD DRAWING DO NOT MANUALLY AMEND

AMENDMENTS

AMD	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
A	30.08.2023	FOR REVIEW	J.C	J.G	B.G	N.R
B	06.09.2023	REISSUED FOR REVIEW	D.C	J.G	B.G	N.R
C	13.10.2023	FOR TENDER ISSUE	L.D	J.G	B.G	N.R
D	27.10.2023	REISSUED TENDER ISSUE	L.D	J.G	B.G	N.R
E	02.02.2024	REISSUED TENDER ISSUE - OPTION 2	L.D	J.G	B.G	N.R

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CONSULTANT
AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com

ASSOCIATED DRAWINGS	
GENERAL ARRANGEMENT PLAN CIVIL	265665_01

Ausgrid
570 George Street
SYDNEY NSW 2000

SCALE	1:2000
DESIGNED	J.GRAY
DRAWN	J.CARVAJALINO
CHECKED	B.GRAFFEN
APPROVED	N.ROBINSON
DATE	27.10.2023
TRIM REF	-
ISSUED FOR	DRAFT
PROJECT NUMBER	-

TW 422 MUSWELLBROOK
132kV SWITCHING STATION
SITE LAYOUT
CIVIL

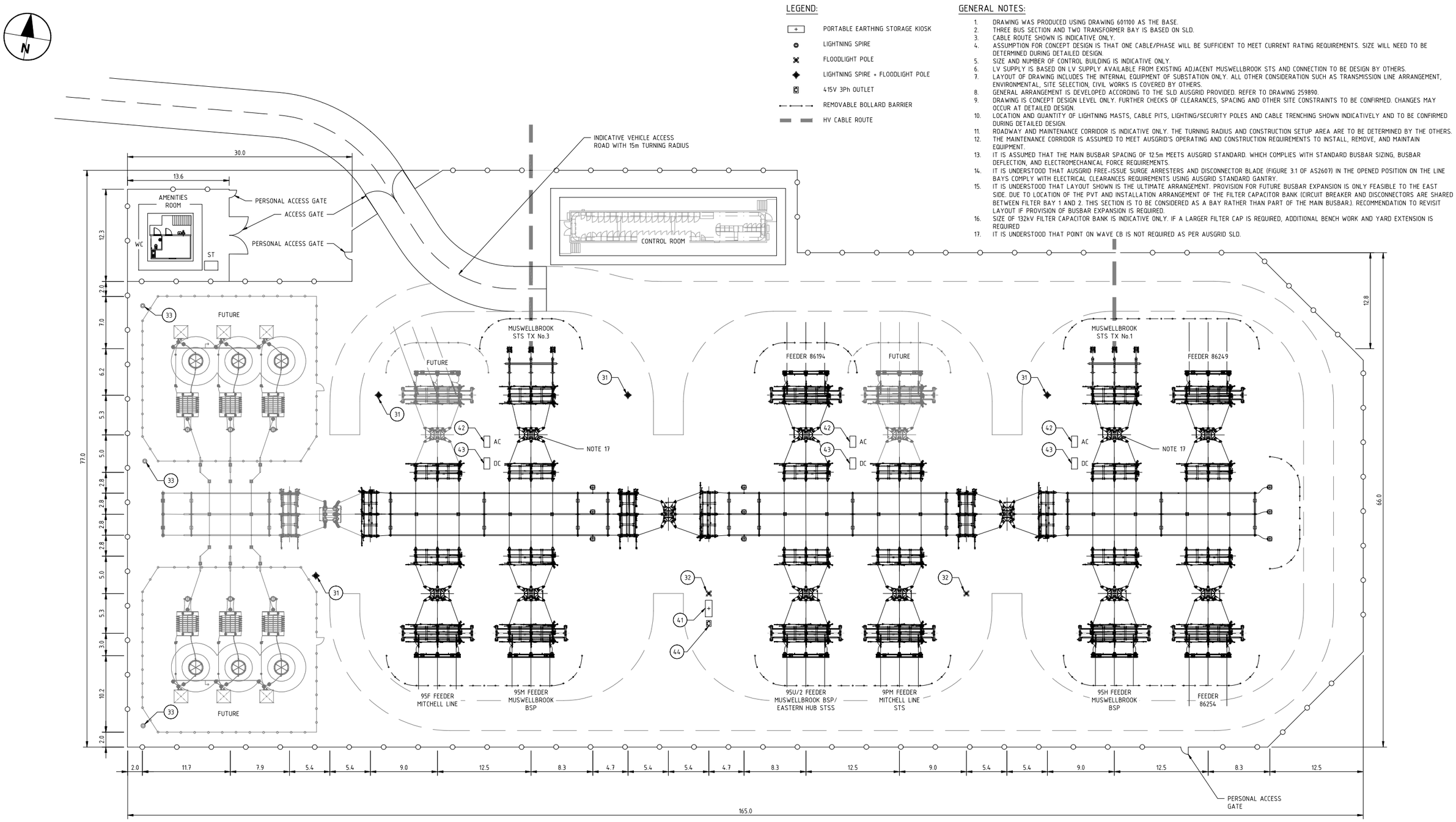
DRAWING No 265663 | SHEET 01 | AMD E | SIZE A1

LEGEND:

- PORTABLE EARTHING STORAGE KIOSK
- LIGHTNING SPIRE
- FLOODLIGHT POLE
- LIGHTNING SPIRE + FLOODLIGHT POLE
- 415V 3Ph OUTLET
- REMOVABLE BOLLARD BARRIER
- HV CABLE ROUTE

GENERAL NOTES:

1. DRAWING WAS PRODUCED USING DRAWING 601100 AS THE BASE.
2. THREE BUS SECTION AND TWO TRANSFORMER BAY IS BASED ON SLD.
3. CABLE ROUTE SHOWN IS INDICATIVE ONLY.
4. ASSUMPTION FOR CONCEPT DESIGN IS THAT ONE CABLE/PHASE WILL BE SUFFICIENT TO MEET CURRENT RATING REQUIREMENTS. SIZE WILL NEED TO BE DETERMINED DURING DETAILED DESIGN.
5. SIZE AND NUMBER OF CONTROL BUILDING IS INDICATIVE ONLY.
6. LV SUPPLY IS BASED ON LV SUPPLY AVAILABLE FROM EXISTING ADJACENT MUSWELLBROOK STS AND CONNECTION TO BE DESIGN BY OTHERS.
7. LAYOUT OF DRAWING INCLUDES THE INTERNAL EQUIPMENT OF SUBSTATION ONLY. ALL OTHER CONSIDERATION SUCH AS TRANSMISSION LINE ARRANGEMENT, ENVIRONMENTAL, SITE SELECTION, CIVIL WORKS IS COVERED BY OTHERS.
8. GENERAL ARRANGEMENT IS DEVELOPED ACCORDING TO THE SLD AUSGRID PROVIDED. REFER TO DRAWING 259890.
9. DRAWING IS CONCEPT DESIGN LEVEL ONLY. FURTHER CHECKS OF CLEARANCES, SPACING AND OTHER SITE CONSTRAINTS TO BE CONFIRMED. CHANGES MAY OCCUR AT DETAILED DESIGN.
10. LOCATION AND QUANTITY OF LIGHTNING MASTS, CABLE PITS, LIGHTING/SECURITY POLES AND CABLE TRENCHING SHOWN INDICATIVELY AND TO BE CONFIRMED DURING DETAILED DESIGN.
11. ROADWAY AND MAINTENANCE CORRIDOR IS INDICATIVE ONLY. THE TURNING RADIUS AND CONSTRUCTION SETUP AREA ARE TO BE DETERMINED BY THE OTHERS.
12. THE MAINTENANCE CORRIDOR IS ASSUMED TO MEET AUSGRID'S OPERATING AND CONSTRUCTION REQUIREMENTS TO INSTALL, REMOVE, AND MAINTAIN EQUIPMENT.
13. IT IS ASSUMED THAT THE MAIN BUSBAR SPACING OF 12.5m MEETS AUSGRID STANDARD. WHICH COMPLIES WITH STANDARD BUSBAR SIZING, BUSBAR DEFLECTION, AND ELECTROMECHANICAL FORCE REQUIREMENTS.
14. IT IS UNDERSTOOD THAT AUSGRID FREE-ISSUE SURGE ARRESTERS AND DISCONNECTOR BLADE (FIGURE 3.1 OF AS2607) IN THE OPENED POSITION ON THE LINE BAYS COMPLY WITH ELECTRICAL CLEARANCES REQUIREMENTS USING AUSGRID STANDARD GANTRY.
15. IT IS UNDERSTOOD THAT LAYOUT SHOWN IS THE ULTIMATE ARRANGEMENT. PROVISION FOR FUTURE BUSBAR EXPANSION IS ONLY FEASIBLE TO THE EAST SIDE. DUE TO LOCATION OF THE PVT AND INSTALLATION ARRANGEMENT OF THE FILTER CAPACITOR BANK (CIRCUIT BREAKER AND DISCONNECTORS ARE SHARED BETWEEN FILTER BAY 1 AND 2. THIS SECTION IS TO BE CONSIDERED AS A BAY RATHER THAN PART OF THE MAIN BUSBAR.). RECOMMENDATION TO REVISIT LAYOUT IF PROVISION OF BUSBAR EXPANSION IS REQUIRED.
16. SIZE OF 132kV FILTER CAPACITOR BANK IS INDICATIVE ONLY. IF A LARGER FILTER CAP IS REQUIRED, ADDITIONAL BENCH WORK AND YARD EXTENSION IS REQUIRED
17. IT IS UNDERSTOOD THAT POINT ON WAVE CB IS NOT REQUIRED AS PER AUSGRID SLD.



SCALE 1 : 250
0 5 15 METRES 25
10 20

SWITCHYARD LAYOUT

SCALE 1:250

BACKDRAFTING REQUIRED	CHECK PRINT	
READY FOR LEAD VERIFIER	INITIAL	DATE
DRAFTER CHECK:	Jose Carvajalin	19/01/24
DRAFTING CHECK:		
DESIGN ENGINEER CHECK:		
DESIGN REVIEWER CHECK:		
BACKDRAFTED/CORRECTED		

FOR TENDER ISSUE

CAD DRAWING DO NOT MANUALLY AMEND

AMENDMENTS

AMD	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
A	30.08.2023	FOR REVIEW	J.C	M.M	K.L	N.R
B	06.09.2023	REISSUED FOR REVIEW	L.D	M.M	K.L	N.R
C	08.09.2023	REISSUED FOR REVIEW	L.D	M.M	K.L	N.R
D	13.10.2023	FOR TENDER ISSUE	J.C	M.M	K.L	N.R
E	27.10.2023	REISSUED TENDER ISSUE	J.C	M.M	K.L	N.R
F	19.01.2024	REISSUED TENDER ISSUE - OPTION 2	J.C	M.M	K.L	N.R

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CONSULTANT
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A,B,N 20 093 846 925
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ASSOCIATED DRAWINGS	
MAIN CONNECTIONS SINGLE LINE DIAGRAMS	259890_01
CIVIL CABLE TRENCH AND SERVICE PLAN	265367
CONTROL BUILDING LAYOUT	265723_01
CONDUIT & TRENCH LAYOUT	265706_01
CONDUIT SCHEDULE	265707_01
EARTH GRID LAYOUT	265711_01
FOOTINGS LAYOUT	265477_01

Ausgrid
570 George Street
SYDNEY NSW 2000

ISSUED FOR DRAFT

SCALE	1:250
DESIGNED	M.MENG
DRAWN	J.CARVAJALINO
CHECKED	K.LIANG
APPROVED	N.ROBINSON
DATE	19.01.2024
TRIM REF	-
PROJECT NUMBER	-

TW 422 MUSWELLBROOK
132kV SWITCHING STATION
SWITCHYARD
GENERAL ARRANGEMENT
PRIMARY

DRAWING No 265703 | SHEET 01 | AMD F | SIZE A1

GENERAL NOTES:

1. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ACCOMPANYING AECOM REFERENCE DESIGN REPORT.
2. DO NOT SCALE DRAWINGS.
3. EXISTING FEATURES AND SURFACE CONTOURS SHOWN ON DRAWINGS AT EASTERN HUB SITE ARE BASED ON TOPOGRAPHICAL SURVEY PROVIDED BY AUSGRID. REFERENCE SURVEY PLAN 601125.DWG DATED 14/08/2023.
4. BOUNDARY FENCE TO BE POST AND WIRE TYPE FENCE AS SHOWN ON AUSGRID STANDARD DRAWING 252089.
5. BOUNDARY VEHICULAR GATE TO BE POST AND RAIL DOUBLE GATE AS SHOWN ON AUSGRID DRAWING 252089.

N

EXISTING CULVERT UNDER ROAD TO BE MAINTAINED

TO NEW ENGLAND HWY

LAKE LIDDEL SPORTS AND RECREATION PARK

HEBDEN ROAD

OVERLAND FLOW PATH DIRECTION

LOCAL SHOULDER WIDENING ON NORTHERN SIDE OF HEBDEN ROAD TO ACCOMMODATE EQUIPMENT DELIVERY

MAIN NORTH RAILWAY CORRIDOR

INDICATIVE PROPERTY BOUNDARIES (TYP.)

UNNAMED WATER COURSE DRAINING TOWARDS LAKE LIDDEL (TYP.)

PROPOSED SWITCHING STATION ACCESS ROAD TIE IN TO EXISTING HEBDEN ROAD - TO BE IN ACCORDANCE WITH MUSWELLBROOK SHIRE COUNCIL STANDARD DRAWING 0041/1

INDICATIVE CLEAR SIGHT LINE REQUIRED FOR VEHICLES APPROACHING PROPERTY ACCESS. VEGETATION IMPEDING ON THIS SIGHT LINE WILL NEED TO BE RELOCATED/REMOVED.

EXISTING CULVERT UNDER ROAD TO BE MAINTAINED

EXISTING 132kV OVERHEAD TRANSMISSION LINE

INDICATIVE SITE BOUNDARY FENCE ALIGNMENT TO BE SETOUT NOMINAL 1m INSIDE CADASTRAL BOUNDARY UNLESS SHOWN OTHERWISE (TYP.). ALLOW FOR PROVISION OF 4 VEHICULAR ACCESS GATES. - REFER NOTE 4 AND 5.

PROPOSED 84m SWITCHING STATION SEALED FLEXIBLE ACCESS ROAD TO HAVE APPROX. 6m WIDE ROAD WIDTH AND 1m WIDE SEALED SHOULDER

PROPOSED EASTERN HUB 132kV SWITCHING STATION

INDICATIVE ASSET PROTECTION ZONE (APZ). EXISTING TREES AND SHRUBS TO BE CLEARED FROM WITHIN THIS AREA AND ALL VEGETATION TO BE MAINTAINED AT LESS THAN 100mm PER AS3959.

RAIL UNDERPASS

LAKE LIDDEL

EXISTING ELECTRICAL ASSET EASEMENT

TO HEBDEN

SCALE 1 : 2000
0 50 100 150 200 METRES

THIS DRAWING MUST BE PRINTED IN COLOR

CIVIL LAYOUT
SCALE 1:2000

FOR TENDER ISSUE

CAD DRAWING DO NOT MANUALLY AMEND

AMENDMENTS

AMD	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
A	30.08.2023	FOR REVIEW	J.C	J.G	B.G	N.R
B	06.09.2023	REISSUED FOR REVIEW	D.C	J.G	B.G	N.R
C	13.10.2023	FOR TENDER ISSUE	L.D	J.G	B.G	N.R
D	27.10.2023	REISSUED TENDER ISSUE	L.D	J.G	B.G	N.R
E	25.01.2024	REISSUED TENDER ISSUE - OPTION 2	L.D	J.G	B.G	N.R

AECOM
CONSULTANT
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A,B,N 20 093 846 925
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GENERAL ARRANGEMENT PLAN CIVIL	265364_01

ASSOCIATED DRAWINGS

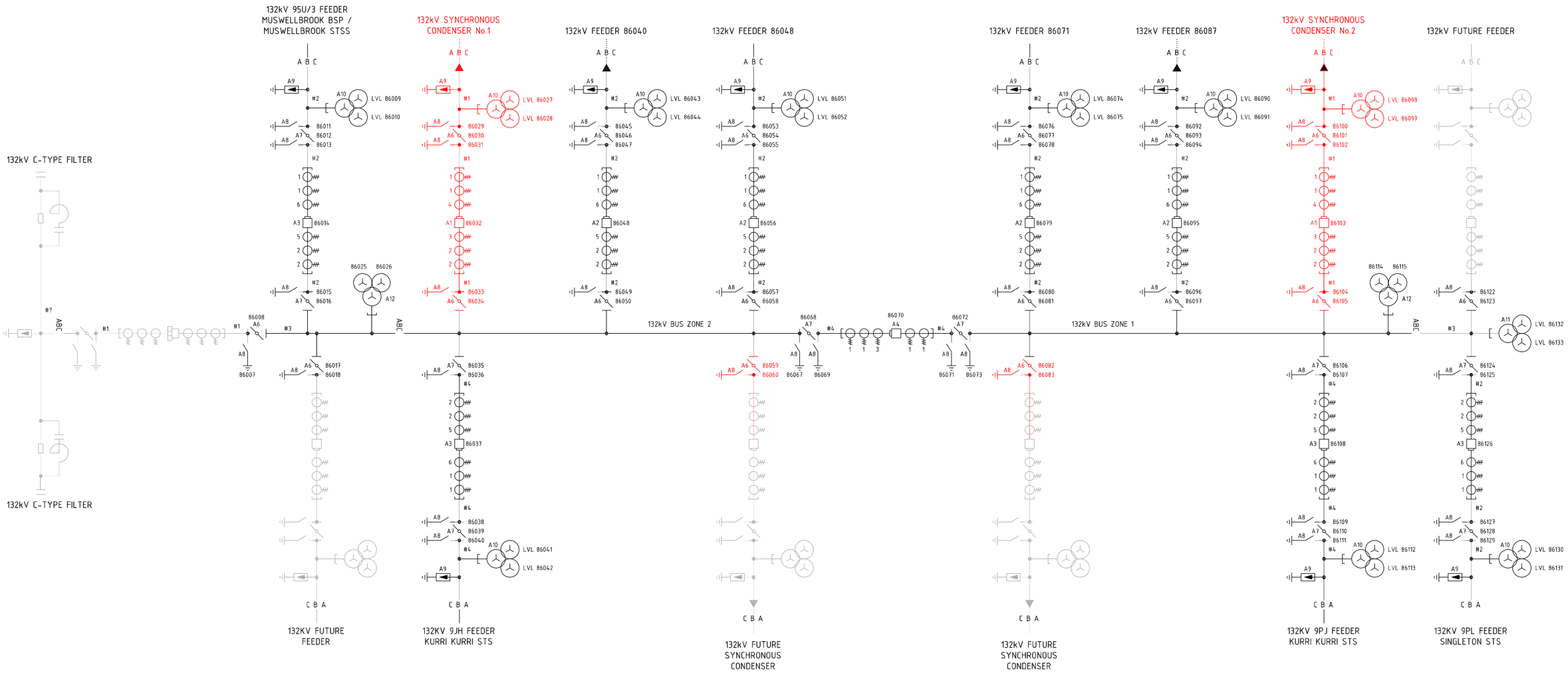
Ausgrid
570 George Street
SYDNEY NSW 2000

ISSUED FOR
DRAFT

SCALE	1:2000
DESIGNED	J.GRAY
DRAWN	J.CARVAJALINO
CHECKED	B.GRAFFEN
APPROVED	N.ROBINSON
DATE	27.10.2023
TRIM REF	-
PROJECT NUMBER	-

TW 420 EASTERN HUB
132kV SWITCHING STATION
SITE LAYOUT
CIVIL

DRAWING No 265363 | SHEET 01 | AMD E | SIZE A1



PRIMARY EQUIPMENT LEGEND			
ITEM	DESCRIPTION	ELECTRICAL SPECIFICATION	MANUFACTURER
A1	132kV FEEDER CB	145kV 1600A 40kA/1 SEC 650kV LIWL	TBA
A2	132kV FEEDER CB	145kV 2500A 40kA/1 SEC 650kV LIWL	TBA
A3	132kV FEEDER CB	145kV 3150A 40kA/1 SEC 650kV LIWL	TBA
A4	132kV BUS SECTION CB	145kV 3150A 40kA/1 SEC 650kV LIWL	TBA
A5			
A6	132kV DISCONNECTOR	145kV 2500A 40kA/1 SEC 650kV LIWL	TBA
A7	132kV DISCONNECTOR	145kV 3150A 40kA/1 SEC 650kV LIWL	TBA
A8	132kV MOTORISED EARTHING SWITCH	145KV 40kA/1 SEC 650KV LIWL	TBA
A9	132kV SURGE ARRESTER	120kV FOR EFFECTIVELY EARTHED SYSTEMS	TBA
A10	132kV VOLTAGE TRANSFORMER	132kV / √3 : 110V / √3 0.5/3P 50VA Vf=1.9 30 SEC	TBA
A11	132kV VOLTAGE TRANSFORMER (POWER)	132kV / √3 : 110V / √3 0.5/3P 50VA Vf=1.9 30 SEC POWER RATING 100kVA	TBA
A12	132kV VOLTAGE TRANSFORMER (SYNCHRONISING & PQ)	132kV / √3 : 110V / √3 0.5/3P 50VA Vf=1.9 30 SEC	TBA
	C-TYPE FILTER	C-TYPE FILTER	TBA

BAY THROUGHPUT RATINGS			
DESCRIPTION	CMR	STR	BIL
132kV FEEDER BAY (ITEM A1)	1600A	40kA 1SEC	650kV
132kV FEEDER BAY (ITEM A2)	2500A	40kA 1SEC	650kV
132kV FEEDER BAY (ITEM A3)	3150A	40kA 1SEC	650kV
132kV MAIN BUSBAR	3150A	40kA 1SEC	650kV

CABLE /BUSBAR LEGEND		
ITEM	DESCRIPTION	NOMINAL RATING
#1	STRANDED ALUMINUM - TBA	1600A
#2	STRANDED ALUMINUM - TBA	2500A
#3	BUSBAR - TBA	3150A
#4	STRANDED ALUMINUM - TBA	3150A
#5		
#6		
#7		

CURRENT TRANSFORMER LEGEND			
CORE No.	SCHEME	SPECIFICATION	STANDARD
1	132kV BUSBAR PROTECTION	2000/1 0.025PX1400R4.5 2A THERMAL	TO AS:61869.2
2	132kV FEEDER PROTECTION	2000/1000/1 0.15PXR2800R6.5 2A THERMAL ON ALL RATIOS, Kr<10%	TO AS:61869.2
3	132kV MEASUREMENT	2000/1200/800/200/1 0.5S 15VA (on 800/1) 2A THERMAL ON ALL RATIOS	TO AS:61869.2
4	132kV MEASUREMENT	2000/1200/800/200/1 0.2S 15VA (on 800/1) 2A THERMAL ON ALL RATIOS	TO AS:61869.2
5	132kV MEASUREMENT	3000/2000/1200/800/200/1 0.5S 15VA (on 800/1) 2A THERMAL ON ALL RATIOS	TO AS:61869.2
6	132kV MEASUREMENT	3000/2000/1200/800/200/1 0.2S 15VA (on 800/1) 2A THERMAL ON ALL RATIOS	TO AS:61869.2
7			
8			
9			
10			

NOTE:

1.HV CABLE NUMBERS SHOWN AS HVxx.

2.SYSTEM NUMBERS ISSUED: 86003 - 86144 INCLUSIVE.

3.SPARE SYSTEM NUMBERS: 86134 - 86144 INCLUSIVE.

4.MINIMUM RATINGS SHOWN. SUBJECT TO DETAILED DESIGN

CAD DRAWING
DO NOT MANUALLY AMEND

AMENDMENTS

AMD	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
D-1	04.10.2024	SYNCHRONOUS CONDENSER SCOPE DELETED. SHOWN IN RED	R.D.			

ASSOCIATED DRAWINGS

Ausgrid
145 Newcastle Road
WALLSEND NSW 2287
P: 4951 9388

ISSUED FOR
PRELIMINARY

SCALE	-
DESIGNED	B.JEAYES
DRAWN	B.WITTS
CHECKED	-
APPROVED	-
DATE	-
TRIM REF	-
PROJECT NUMBER	-

TW 420 EASTERN HUB
132kV SWITCHING STATION
MAIN CONNECTION
SINGLE LINE DIAGRAM

DRAWING No 259889 | SHEET 1 | AMD D-1 | SIZE A1

HEBDEN ROAD

PROPERTY BOUNDARY (TYP.)

PROPOSED PRIVATE PROPERTY ACCESS OFF HEBDEN ROAD - REFER NOTE 5

PROPOSED EXTERNAL SWITCHING STATION ACCESS ROAD - FLEXIBLE WITH TWO COAT SEAL - REFER NOTE 6

EXTERNAL VEGETATED DIVERSION DRAIN - REFER DRG No. 265368 FOR EXTENT (TYP.)

6m WIDE VEHICULAR ACCESS GATE (TYP.) - REFER NOTES 8 AND 10

MAIN TRANSFORMER ROAD - FLEXIBLE WITH TWO COAT SEAL (REFER NOTE 6)

NOMINAL SWITCHYARD MAINTENANCE ACCESS CORRIDOR (TYP.)

PROPOSED TRANSFORMER ENCLOSURE (TYP.) - REFER NOTE 4

FUTURE 2.4m HIGH H.V. CHAINLINK FENCE FIXED TO TOP OF SLAB WITH PEDESTRIAN GATE (TYP.)

SINGLE CABLE TRENCH - REFER NOTE 11

PROPOSED ENERGY HUB PAVEMENT - FLEXIBLE WITH AGGREGATE SURFACING (TYP.) - REFER NOTE 6

FUTURE HARMONIC FILTER (TYP.) (BY OTHERS) - REFER NOTE 4

PROPOSED TOPSOIL AND HYDROSEED TREATMENT TO EARTHWORKS BATTER AND EXTERNAL DRAIN SURFACES (TYP.) - REFER NOTE 6

EXISTING ELECTRICAL ASSET EASEMENT

PERSONNEL GATE (TYP.) - REFER NOTE 9

PROPOSED EASTERN HUB 132kV SWITCHING STATION - REFER NOTE 14

SEPTIC TANK - REFER NOTE 11

AMENITIES ROOM WITH CONCRETE FOOTPATH SURROUND - REFER NOTES 6 AND 11

MODULAR CONTROL ROOM BUILDING WITH CONCRETE FOOTPATH SURROUND - REFER NOTES 6 AND 11

PROPOSED PARKING FOR 2 No. PASSENGER VEHICLES

PROPOSED EARTHWORKS BENCH FOR NEW ENERGY HUB

POTABLE/FIRE WATER TANKS AND SLAB HANDSTAND AREA - REFER NOTE 11

INDICATIVE SYNCHRONOUS CONDENSER DELIVERY DRIVEWAY ACCESS REQUIREMENTS. TO BE CONFIRMED UPON RECEIPT OF SYNCON BUILDING LAYOUT AND DELIVERY VEHICLE SPECIFICATION - REFER NOTE 13

PROPOSED SYNCHRONOUS CONDENSER (TYP.) - REFER NOTE 4

HIGH SECURITY PERIMETER FENCE (TYP.) - REFER NOTE 7 AND 9

ENERGY HUB INTERNAL ROAD PAVEMENT - FLEXIBLE WITH TWO COAT SEAL (TYP.) - REFER NOTE 6

B 265365

C 265365

D 265365

A 265365

SCALE 1 : 500

0 10 20 30 40 50 METRES

THIS DRAWING MUST BE PRINTED IN COLOR

GENERAL NOTES:

1. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ACCOMPANYING AECOM REFERENCE DESIGN REPORT.
2. DO NOT SCALE DRAWINGS.
3. EXISTING FEATURES AND SURFACE CONTOURS SHOWN ON DRAWINGS AT EASTERN HUB SITE ARE BASED ON TOPOGRAPHICAL SURVEY PROVIDED BY AUSGRID. REFERENCE SURVEY PLAN 601125.DWG DATED 14/08/2023.
4. DETAILED EARTHWORKS GRADING AROUND MAJOR EQUIPMENT FOUNDATIONS TO BE FURTHER DEVELOPED AT SUBSEQUENT DESIGN STAGE.
5. ACCESS OFF HEBDEN ROAD TO BE IN ACCORDANCE WITH MUSWELLBROOK COUNCIL STANDARD DRAWING 0041/1.
6. FOR TYPICAL PAVEMENT PROFILES REFER TO DRAWING No. 265370/01.
7. HIGH SECURITY PERIMETER FENCE TO BE 3.0m HIGH WELDMESH FENCE AS DETAILED ON AUSGRID STANDARD DRAWINGS 127863 TO 127866.
8. FOR DOUBLE GATE DETAILS REFER TO AUSGRID STANDARD DRAWINGS 127867 AND 127868.
9. FOR TYPICAL PERSONNEL GATE DETAILS REFER TO AUSGRID STANDARD DRAWING 127927.
10. SIGNAGE TO BE MOUNTED ON EXTERNAL FACE OF SWITCHYARD AND BOUNDARY FENCES/GATES IN ACCORDANCE WITH AUSGRID STANDARD DRAWING 127950.
11. FOR SITE SERVICES PLAN REFER TO DRG No. 265367.
12. FOR SITE DRAINAGE PLAN REFER TO DRG No. 265368.
13. ALLOW PROVISION FOR ADDITIONAL FLEXIBLE PAVEMENT AND BENCHING TO ALLOW FOR SYNCON DELIVERY/ACCESS.
14. FOR PRIMARY EQUIPMENT DETAILS REFER TO DRG No. 265403

GENERAL ARRANGEMENT SITE PLAN

SCALE 1:500

FOR TENDER ISSUE

CAD DRAWING DO NOT MANUALLY AMEND

AMENDMENTS

AMD	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
A	13.10.2023	FOR TENDER ISSUE	L.D	J.G	B.G	N.R
B	27.10.2023	REISSUED TENDER ISSUE	L.D	J.G	B.G	N.R
C	25.01.2024	REISSUED TENDER ISSUE - OPTION 2	L.D	J.G	B.G	N.R
C-1	04.10.2024	SYNCHRONOUS CONDENSER SCOPE DELETED, SHOWN IN RED	R.D.			

AECOM
CONSULTANT
AECOM Australia Pty Ltd
AJLN 20 093 846 925
www.aecom.com

ASSOCIATED DRAWINGS	
PAVEMENT DETAILS - SHEET 1	265371-1
PAVEMENT DETAILS - SHEET 2	265371-2

Ausgrid
570 George Street
SYDNEY NSW 2000

ISSUED FOR DRAFT

SCALE	1:500
DESIGNED	J.GRAY
DRAWN	S.XIE
CHECKED	B.GRAFFEN
APPROVED	N.ROBINSON
DATE	27.10.2023
TRIM REF	-
PROJECT NUMBER	-

TW 420 EASTERN HUB
132kV SWITCHING STATION
GENERAL ARRANGEMENT PLAN
CIVIL

DRAWING No 265364 | SHEET 01 | AMD C-1 | SIZE A1

LEGEND:

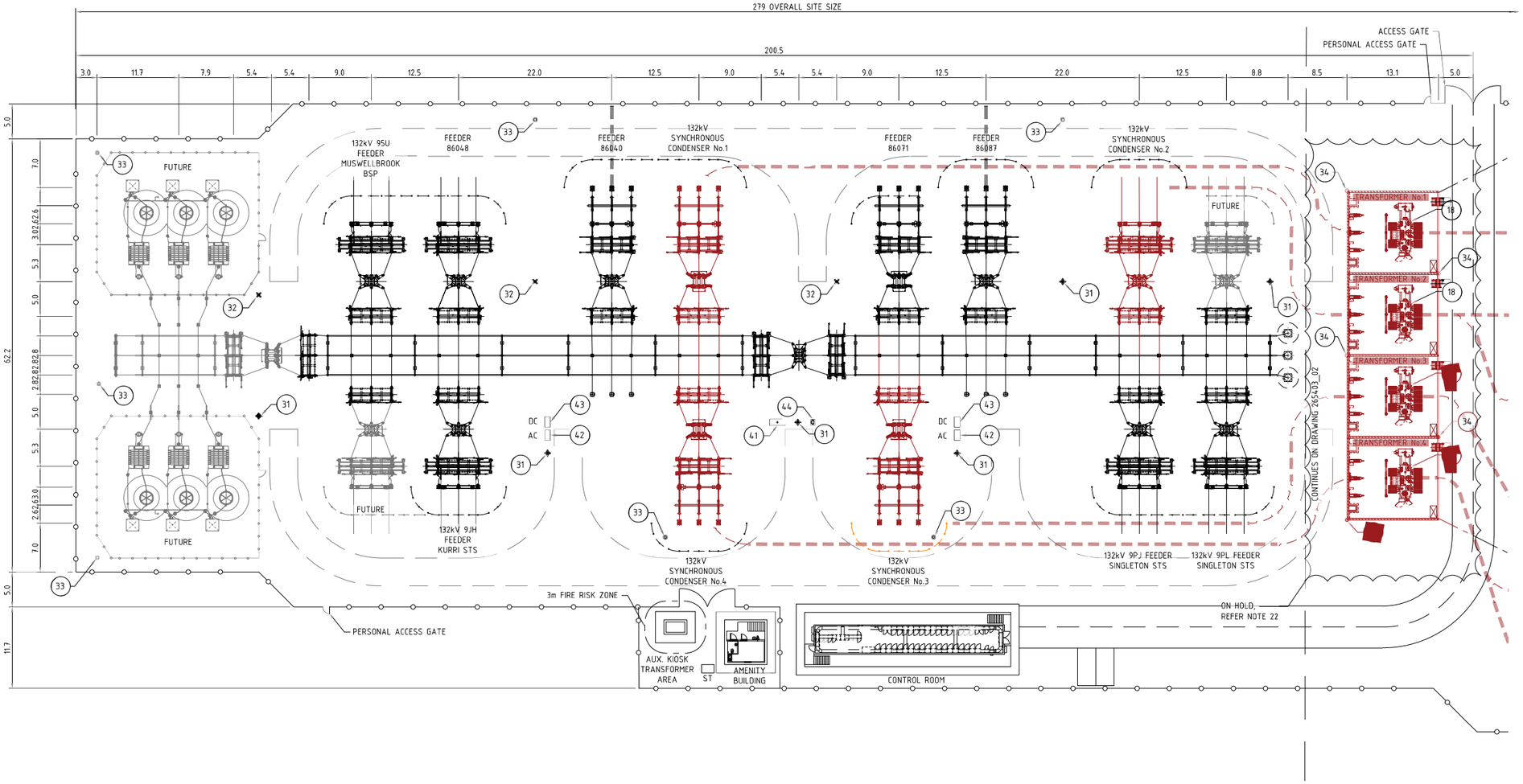
- PORTABLE EARTHING CABLE CABINET FLAT PACK
- LIGHTNING SPIRE
- LIGHTNING MAST WALL MOUNTED
- FLOODLIGHT POLE
- LIGHTNING SPIRE + FLOODLIGHT POLE
- 415V 3Ph OUTLET
- REMOVABLE BOLLARD BARRIER
- PARALLEL PLATE SEPARATOR
- FIRE RISK ZONE
- FIREWALL
- HV CABLE ROUTE

COLOUR LEGEND:

- FUTURE OPTION 1
- FUTURE OPTION 2

GENERAL NOTES:

1. DRAWING WAS PRODUCED USING DRAWING 601125 AS THE BASE.
2. CABLE ROUTE SHOWN IS INDICATIVE ONLY.
3. PVT BAY CONFIGURATION IS INDICATIVE. SA, DISCONNECTOR MAY BE REQUIRED AND TO BE DETERMINED DURING DETAILED DESIGN.
3. ASSUMPTION FOR CONCEPT DESIGN IS THAT ONE CABLE PER PHASE FOR 132kV AND THREE CABLE PER PHASE FOR 15kV TRANSFORMER CONNECTION. WILL BE SUFFICIENT TO MEET CURRENT RATING REQUIREMENTS. SIZE WILL NEED TO BE DETERMINED DURING DETAILED DESIGN.
4. SIZE OF THE 132kV TRANSFORMER AND SYNCHRONOUS CONDENSER IS BASED ON A 42.5MVAr. LARGER TRANSFORMER COMPOUND AND SYNCHRONOUS CONDENSERS BUILDING LIKELY REQUIRED TO MEET 185MWA SYSTEM AS PER TECHNICAL SPECIFICATION.
5. SIZE AND NUMBER OF CONTROL BUILDING IS INDICATIVE ONLY. CONTROL BUILDING IS TBC.
6. LV SUPPLY IS BASED ON ONE SET OF PVT AND LOCAL SUPPLY VIA AUX TRANSFORMER KIOSK.
7. LAYOUT OF DRAWING INCLUDES THE INTERNAL EQUIPMENT OF SUBSTATION ONLY. ALL OTHER CONSIDERATION SUCH AS TRANSMISSION LINE ARRANGEMENT, ENVIRONMENTAL, SITE SELECTION, CIVIL WORKS IS COVERED BY OTHERS.
8. FIRE SEPARATION DISTANCE ASSUMED TO BE 15m. FIRE WALL INCLUDED FOR PROTECTION TO BUILDING LAYOUT AND REQUIREMENTS TO BE DETERMINED IN DETAILED DESIGN. ASSUMPTION THAT FENCE AND ANY EQUIPMENT OUTSIDE THE FENCE-LINE ARE NON COMBUSTIBLE SURFACES AS PER TABLE 6.1 OF AS2067. IF AUSGRID NETWORK REQUIREMENTS TO KEEP FIRE CLEARANCE WITHIN THE FENCE LINE. ADDITIONAL FOOTPRINT OR FIREWALL IS REQUIRED.
9. GENERAL ARRANGEMENT IS DEVELOPED ACCORDING TO THE SLD AUSGRID PROVIDED. REFER TO DRAWING 259889.
10. DRAWING IS CONCEPT DESIGN LEVEL ONLY. FURTHER CHECKS OF CLEARANCES, SPACING AND OTHER SITE CONSTRAINTS TO BE CONFIRMED. CHANGES MAY OCCUR AT DETAILED DESIGN.
11. LOCATION AND QUANTITY OF LIGHTNING MASTS, CABLE PITS, LIGHTING/SECURITY POLES AND CABLE TRENCHING SHOWN INDICATIVELY AND TO BE CONFIRMED DURING DETAILED DESIGN.
12. DESIGN ASSUMES NO FUTURE SWITCHYARD EXPANSION IS REQUIRED.
13. ROADWAY AND MAINTENANCE CORRIDOR IS INDICATIVE ONLY. THE TURNING RADIUS AND CONSTRUCTION SETUP AREA ARE TO BE DETERMINED BY THE OTHERS.
14. THE MAINTENANCE CORRIDOR IS ASSUMED TO MEET AUSGRID'S OPERATING AND CONSTRUCTION REQUIREMENTS TO INSTALL, REMOVE, AND MAINTAIN EQUIPMENT.
15. IT IS ASSUMED THAT THE MAIN BUSBAR SPACING OF 12.5m MEETS AUSGRID STANDARD. WHICH COMPLIES WITH STANDARD BUSBAR SIZING, BUSBAR DEFLECTION, AND ELECTROMECHANICAL FORCE REQUIREMENTS.
16. IT IS UNDERSTOOD THAT AUSGRID FREE-ISSUE SURGE ARRESTERS AND DISCONNECTOR BLADE (FIGURE 3.1 OF AS2607) IN THE OPENED POSITION ON THE LINE BAYS COMPLY WITH ELECTRICAL CLEARANCES REQUIREMENTS USING AUSGRID STANDARD GANTRY.
17. IT IS UNDERSTOOD THAT LAYOUT SHOWN IS THE ULTIMATE ARRANGEMENT. PROVISION FOR FUTURE BUSBAR EXPANSION IS NOT FEASIBLE. DUE TO LOCATION OF THE TRANSFORMER AND INSTALLATION ARRANGEMENT OF THE FILTER CAPACITOR BANK (CIRCUIT BREAKER AND DISCONNECTORS ARE SHARED BETWEEN FILTER BAY 1 AND 2. THIS SECTION IS TO BE CONSIDERED AS A BAY RATHER THAN PART OF THE MAIN BUSBAR.). RECOMMENDATION TO REVISIT LAYOUT IF PROVISION OF BUSBAR EXPANSION IS REQUIRED.
18. TRANSFORMER COMPOUND SIZE AND SYNCHRONOUS CONDENSER LAYOUT ARE INDICATIVE ONLY. THE LAYOUT OF THE SYNCHRONOUS CONDENSER AREA WILL BE UPDATED BASED ON THE SUPPLIER'S DESIGN.
19. FIREWALL BETWEEN TRANSFORMER IS INDICATIVE ONLY. HEAT FLUX STUDY (IF REQUIRED) AND A DETAILED STUDY OF FIREWALL REQUIREMENTS ARE TO BE DETERMINED IN THE DETAILED DESIGN STAGE.
20. SYNCHRONOUS CONDENSER, GCB AND TRANSFORMERS CABLE CONNECTION SHOWN IS INDICATIVE ONLY SUBJECT TO CABLE NUMBER AND TERMINATION DESIGN IN DETAILED DESIGN STAGE. SYNCHRONOUS CONDENSER SUPPLIER SHALL PROVIDE CABLE TERMINATION CONNECTION POINT DETAILS FOR FURTHER ASSESSMENT.
21. IT IS ASSUMED THAT THE FIREWALL ON ALL 3 SIDES IS ACCEPTABLE TO MEET TRANSFORMER COOLING, ACCESS, AND INSTALLATION REQUIREMENTS.
22. TRANSFORMER COMPOUND & FIRE WALL LAYOUT BASED ON AUSGRID PROPOSAL REQUIRES FURTHER CONFIRMATION. RECOMMENDATION FOR THE TRANSFORMER TO BE SEPARATED AFTER EVERY TWO (2) TRANSFORMER TO REDUCE LONG OUTAGES TO ADJACENT TRANSFORMER DURING RECTIFICATION OF FIREWALL AFTER POSSIBLE FIRE INCIDENT.
23. IT IS ASSUMED THAT THE 132kV/15kV TRANSFORMER PROVIDED WILL BE FIT FOR PURPOSE. SUCH AS TRANSFORMER WILL HAVE ENOUGH CABLE TERMINATION CONNECTION POINT ON BOTH THE PRIMARY AND SECONDARY SIDE OF THE TRANSFORMER TO MEET RATING REQUIREMENTS.
24. SIZE OF 132kV FILTER CAPACITOR BANK IS INDICATIVE ONLY. IF A LARGER FILTER CAP IS REQUIRED, ADDITIONAL BENCH WORK AND YARD EXTENSION IS REQUIRED.
25. SAFETY RISKS REGARDING RESTRICTED ACCESS FROM MAIN GATE TO CONTROL BUILDING FOR EMERGENCY SWITCHING OPERATIONS DURING TRANSFORMER FIRE TO BE DISCUSSED IN SAFETY IN DESIGN WORKSHOP, OR RECOMMENDATION TO CONNECT THE ACCESS WAY BETWEEN MAIN ACCESS GATE AND SYNCON ACCESS GATE. BENCH EXTENSION WOULD BE REQUIRED FOR THIS OPTION.



SWITCHYARD LAYOUT

SCALE 1:250

THIS DRAWING MUST BE PRINTED IN COLOR

SCALE 1 : 250
0 5 10 15 20 METRES 25

FOR TENDER ISSUE

AMENDMENTS						
AMD	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
B	06.09.2023	REISSUED FOR REVIEW	L.D	M.M	K.L	N.R
C	08.09.2023	REISSUED FOR REVIEW	L.D	M.M	K.L	N.R
D	13.10.2023	FOR TENDER ISSUE	J.C	M.M	K.L	N.R
E	27.10.2023	REISSUED TENDER ISSUE	J.C	M.M	K.L	N.R
F	21.12.2023	REISSUED TENDER ISSUE - OPTION 2	J.C	M.M	K.L	N.R
G	19.01.2024	REISSUED TENDER ISSUE - OPTION 2	J.C	M.M	K.L	N.R
G-1	04.10.2024	SYNCHRONOUS CONDENSER SCOPE DELETED. SHOWN IN RED	R.D.	-	-	-

CAD DRAWING DO NOT MANUALLY AMEND

AECOM
CONSULTANT
AECOM Australia Pty Ltd
A,B,N 20 093 846 925
www.aecom.com

ASSOCIATED DRAWINGS	
MAIN CONNECTIONS SINGLE LINE DIAGRAMS	259899_01
CIVIL CABLE TRENCH AND SERVICE PLAN	265367
CONTROL BUILDING LAYOUT	265423_01
CONDUIT & TRENCH LAYOUT	265406_01
CONDUIT SCHEDULE	265407_01
EARTH GRID LAYOUT	265411_01
FOOTINGS LAYOUT	265496_01

Ausgrid
570 George Street
SYDNEY NSW 2000

ISSUED FOR: DRAFT

SCALE	1:250
DESIGNED	M.MENG
DRAWN	J.CARVAJALINO
CHECKED	K.LIANG
APPROVED	N.ROBINSON
DATE	19.01.2024
TRIM REF	-
PROJECT NUMBER	-

TW 420 EASTERN HUB
132kV SWITCHING STATION
SWITCHYARD
GENERAL ARRANGEMENT
PRIMARY

DRAWING No 265403 | SHEET 01 | AMD G-1 | SIZE A0

LEGEND:

- PORTABLE EARTHING CABLE CABINET FLAT PACK
- LIGHTNING SPIRE
- LIGHTNING MAST WALL MOUNTED
- FLOODLIGHT POLE
- LIGHTNING SPIRE + FLOODLIGHT POLE
- 415V 3Ph OUTLET
- REMOVABLE BOLLARD BARRIER
- PARALLEL PLATE SEPARATOR
- FIRE RISK ZONE
- FIREWALL
- HV CABLE ROUTE

COLOUR LEGEND:

- FUTURE OPTION 1
- FUTURE OPTION 2

GENERAL NOTES:

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3. PVT BAY CONFIGURATION IS INDICATIVE. SA, DISCONNECTOR MAY BE REQUIRED AND TO BE DETERMINED DURING DETAILED DESIGN.
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4. SIZE OF THE 132kV TRANSFORMER AND SYNCHRONOUS CONDENSER IS BASED ON A 42.5MVAr. LARGER TRANSFORMER COMPOUND AND SYNCHRONOUS CONDENSERS BUILDING LIKELY REQUIRED TO MEET 185MWA SYSTEM AS PER TECHNICAL SPECIFICATION.
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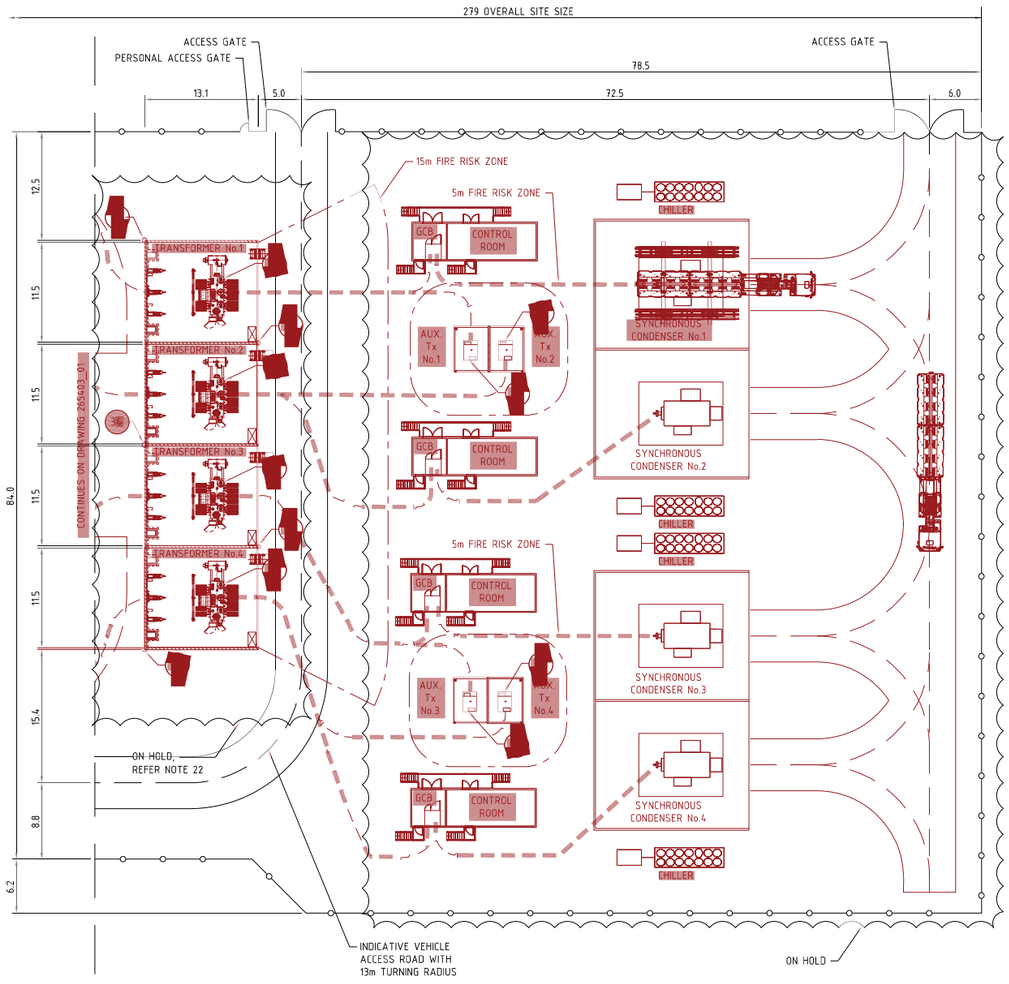
24. SIZE OF 132kV FILTER CAPACITOR BANK IS INDICATIVE ONLY. IF A LARGER FILTER CAP IS REQUIRED, ADDITIONAL BENCH WORK AND YARD EXTENSION IS REQUIRED.
25. SAFETY RISKS REGARDING RESTRICTED ACCESS FROM MAIN GATE TO CONTROL BUILDING FOR EMERGENCY SWITCHING OPERATIONS DURING TRANSFORMER FIRE TO BE DISCUSSED IN SAFETY IN DESIGN WORKSHOP, OR RECOMMENDATION TO CONNECT THE ACCESS WAY BETWEEN MAIN ACCESS GATE AND SYNCON ACCESS GATE. BENCH EXTENSION WOULD BE REQUIRED FOR THIS OPTION.



SWITCHYARD LAYOUT

SCALE 1:250

THIS DRAWING MUST BE PRINTED IN COLOR

SCALE 1 : 250
0 5 10 15 20 METRES 25

FOR TENDER ISSUE

AMENDMENTS

AMD	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
A	30.08.2023	FOR REVIEW	J.C	M.M	K.L	N.R
B	27.10.2023	REISSUED TENDER ISSUE	J.C	M.M	K.L	N.R
C	21.12.2023	REISSUED TENDER ISSUE - OPTION 2	J.C	M.M	K.L	N.R
D	19.01.2024	REISSUED TENDER ISSUE - OPTION 2	J.C	M.M	K.L	N.R
D-1	04.10.2024	SYNCHRONOUS CONDENSER SCOPE DELETED. SHOWN IN RED	R.D.			

CAD DRAWING SOLID MODEL AMENDMENTS

AECOM
CONSULTANT
AECOM Australia Pty Ltd
A.B.N. 20 093 846 925
www.aecom.com

ASSOCIATED DRAWINGS	
MAIN CONNECTIONS SINGLE LINE DIAGRAMS	259899_01
CIVIL CABLE TRENCH AND SERVICE PLAN	265367
CONTROL BUILDING LAYOUT	265423_01
CONDUIT & TRENCH LAYOUT	265406_01
CONDUIT SCHEDULE	265407_01
EARTH GRID LAYOUT	265411_01
FOOTINGS LAYOUT	265496_01

Ausgrid
570 George Street
SYDNEY NSW 2000

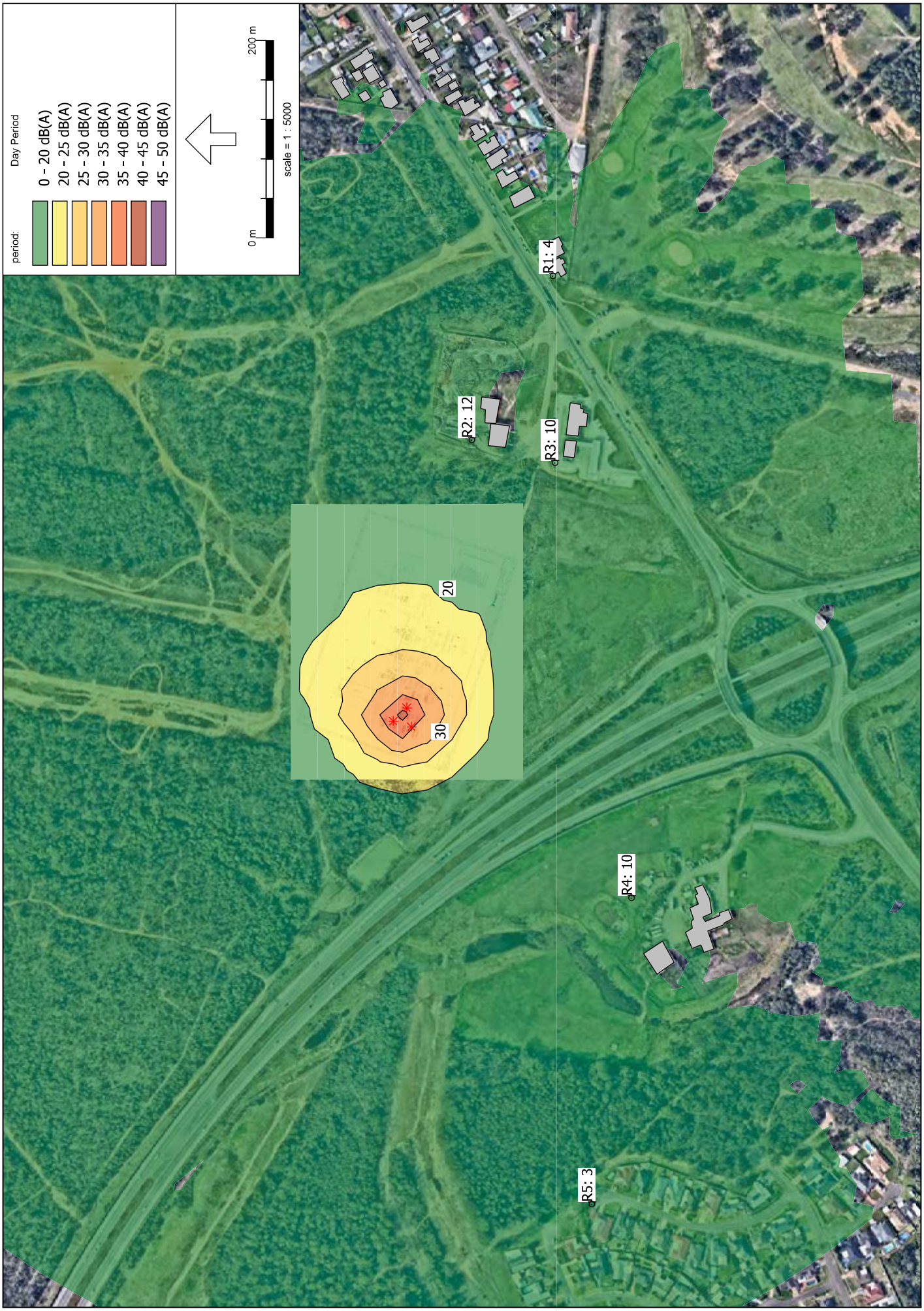
ISSUED FOR: DRAFT

SCALE	1:250
DESIGNED	M.MENG
DRAWN	J.CARVAJALINO
CHECKED	K.LIANG
APPROVED	N.ROBINSON
DATE	19.01.2024
TRIM REF	-
PROJECT NUMBER	-

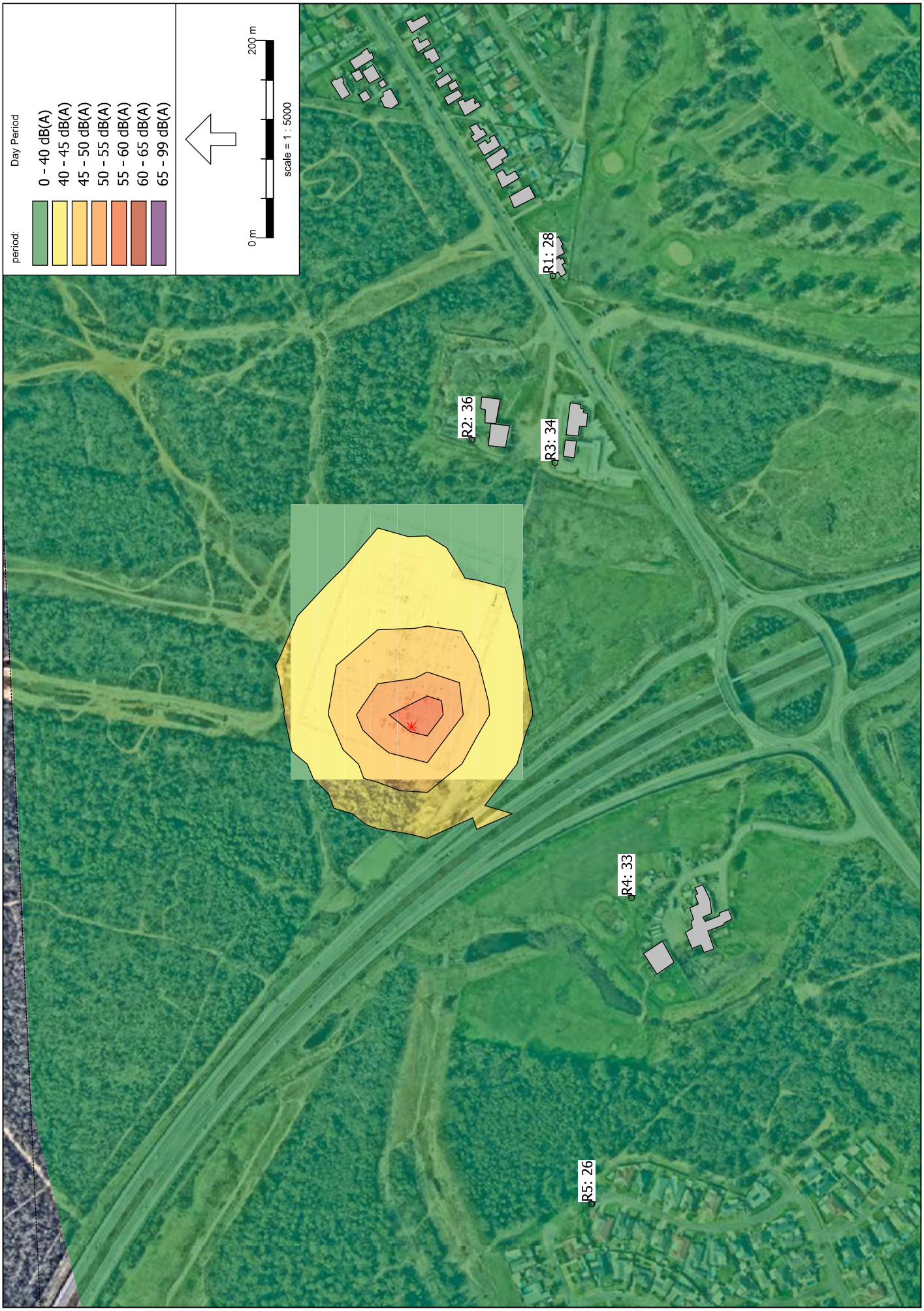
TW 420 EASTERN HUB
132kV SWITCHING STATION
SWITCHYARD
GENERAL ARRANGEMENT
PRIMARY

DRAWING No 265403 | SHEET 02 | AMD D-1 | SIZE A0

Leq, 15 min - Kurri STSS - Operational Scenario.

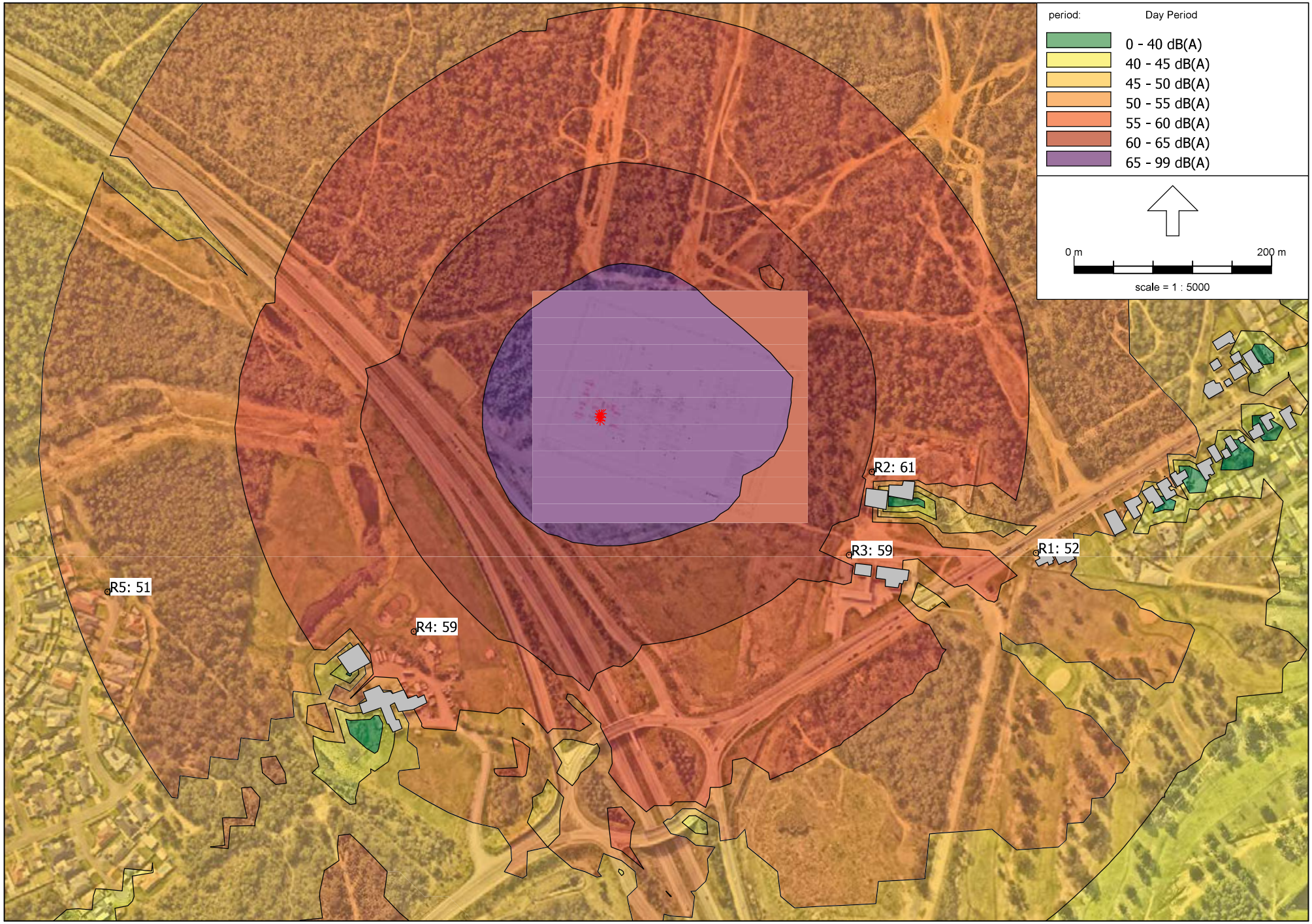


Lmax - Kurri STSS - Operational Scenario - Sleep Disturbance.



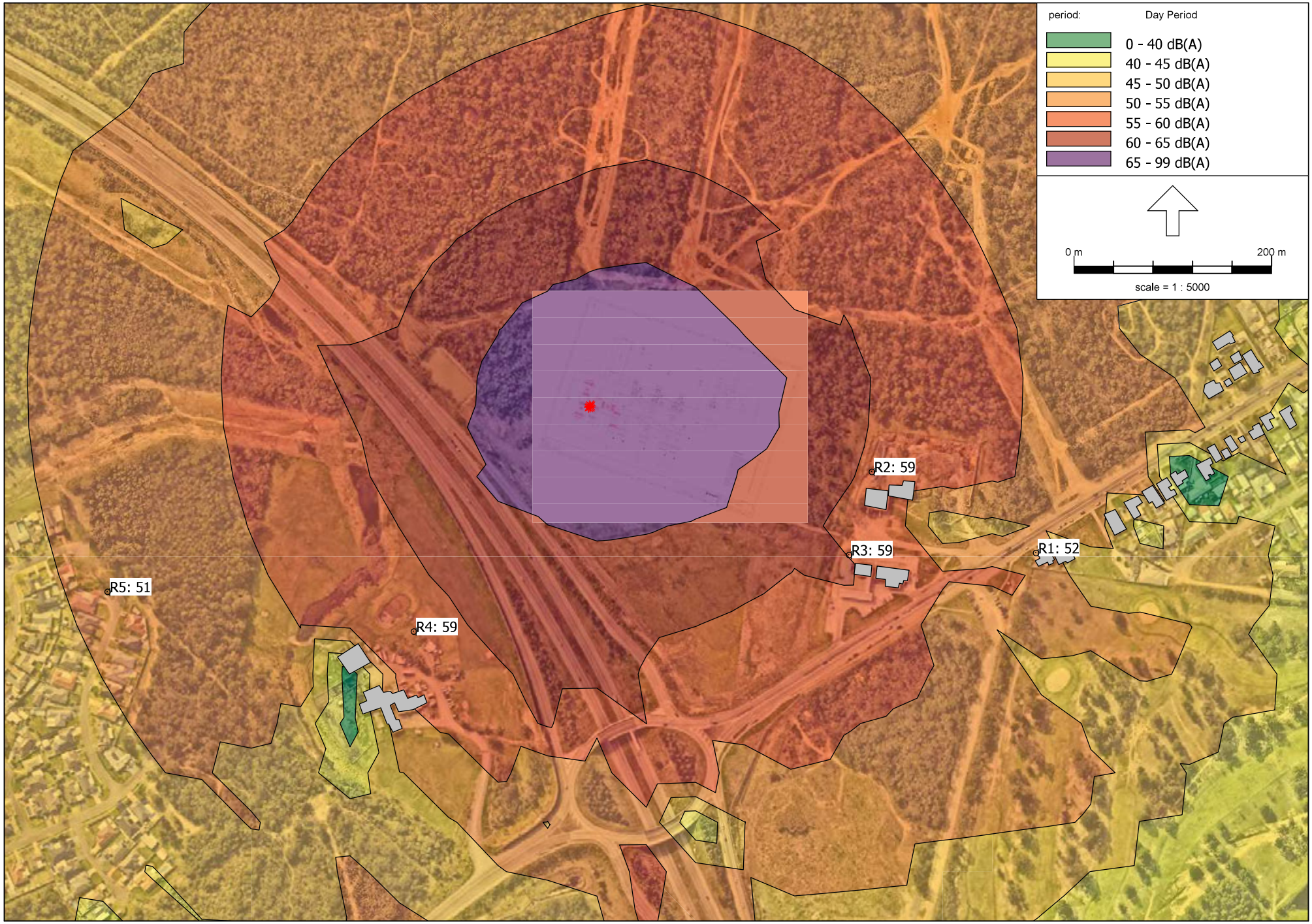
8002-1 Appendix D1c

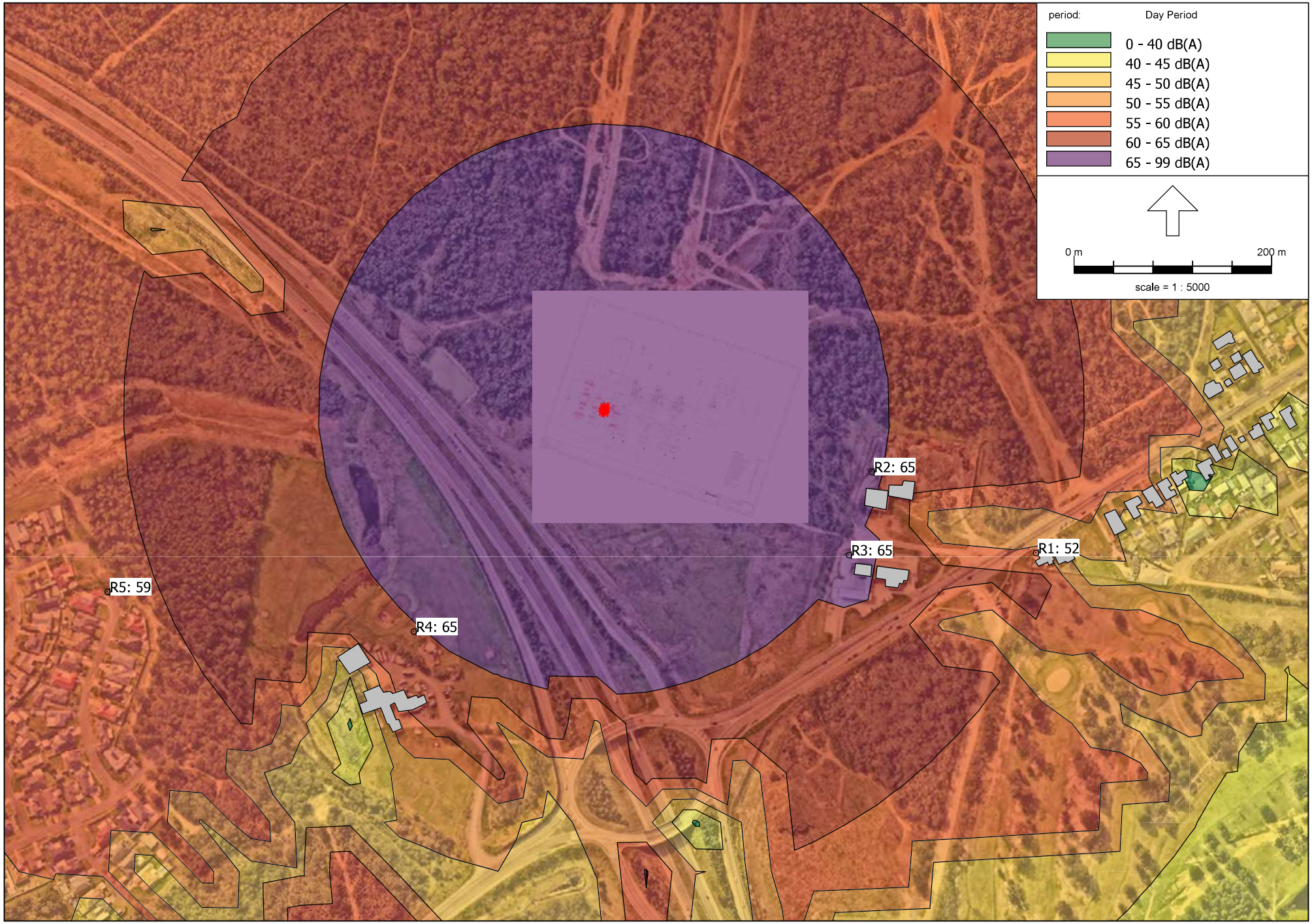
Leq, 15 min - Kurri STSS - Construction Stage 1 - Scenario 1.



Day Design Pty Ltd - Australia

Leq, 15 min - Kurri STSS - Construction Stage 1 - Scenario 2.

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40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
200 m
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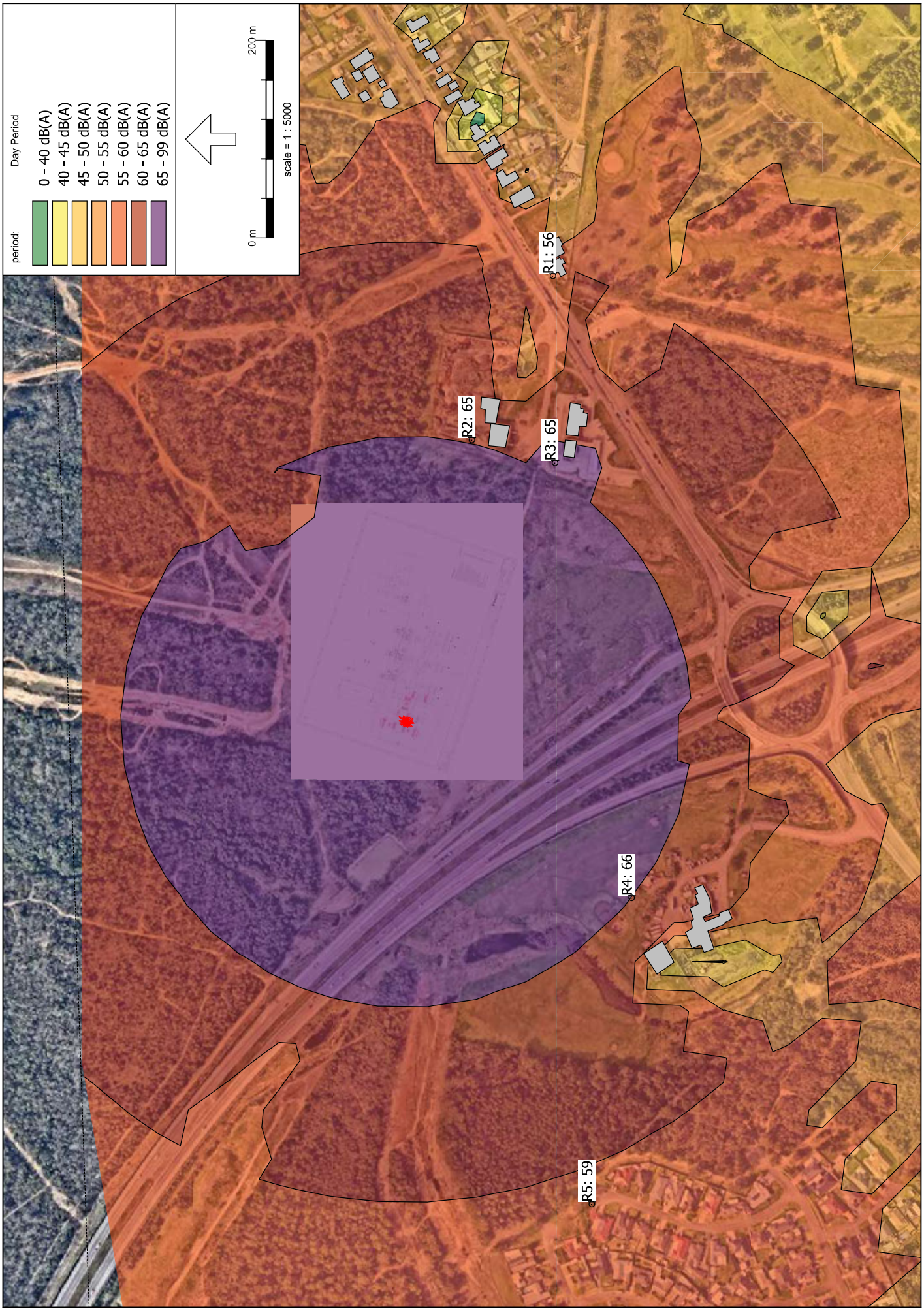
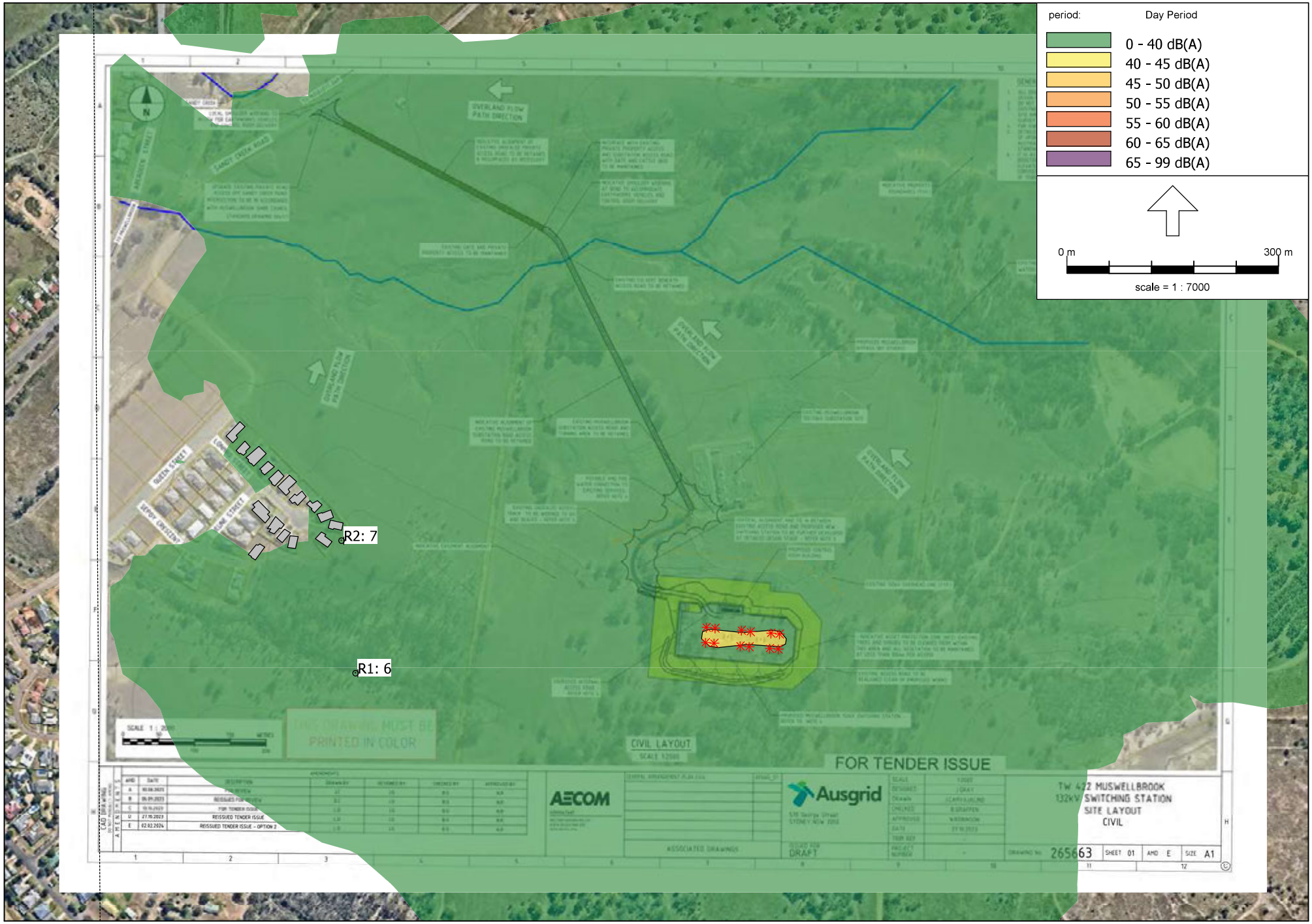
R3: 65
R1: 52
R5: 59
R4: 65

Leq, 15 min - Kurri STSS - Construction Stage 2 - Scenario 2.

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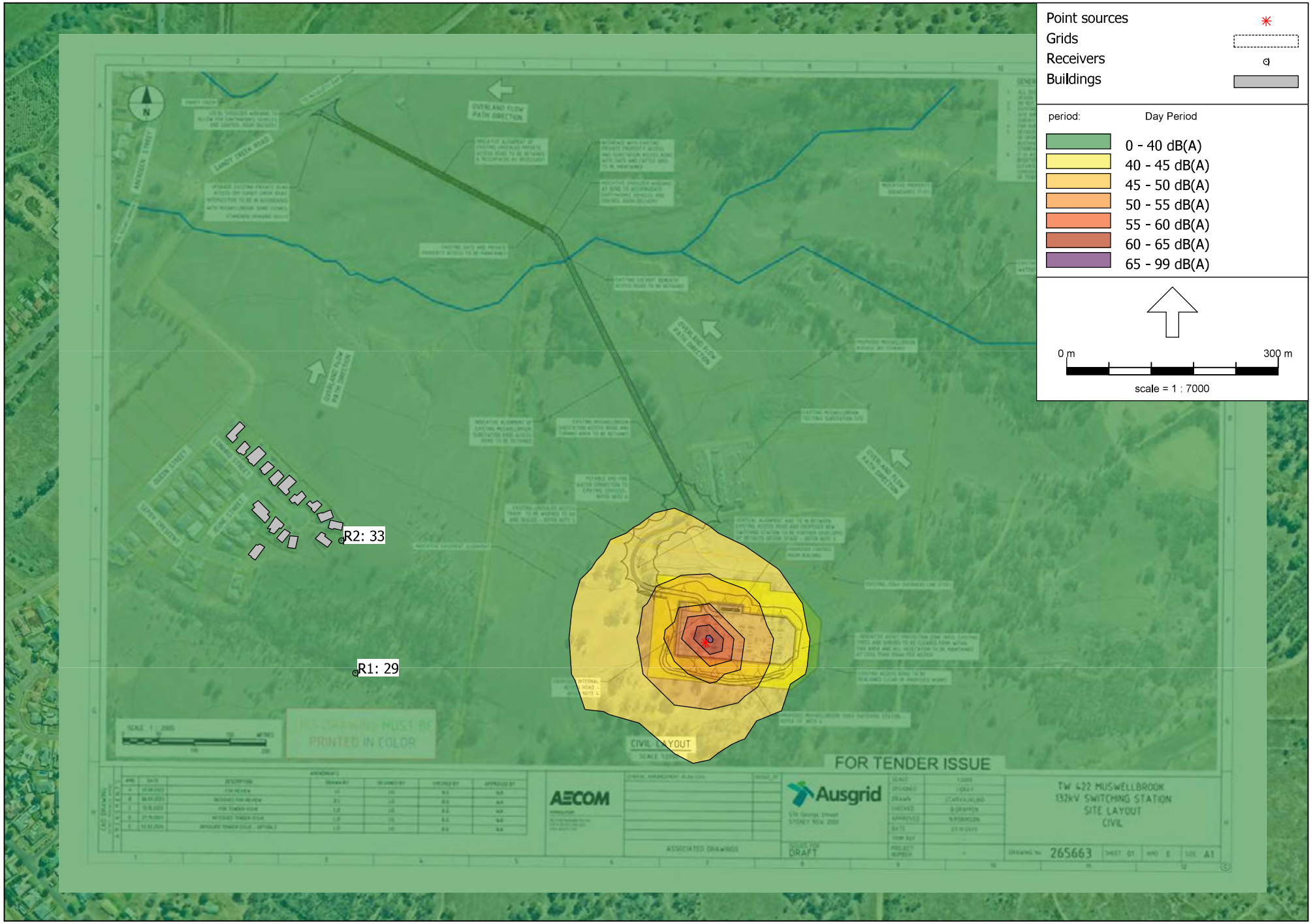
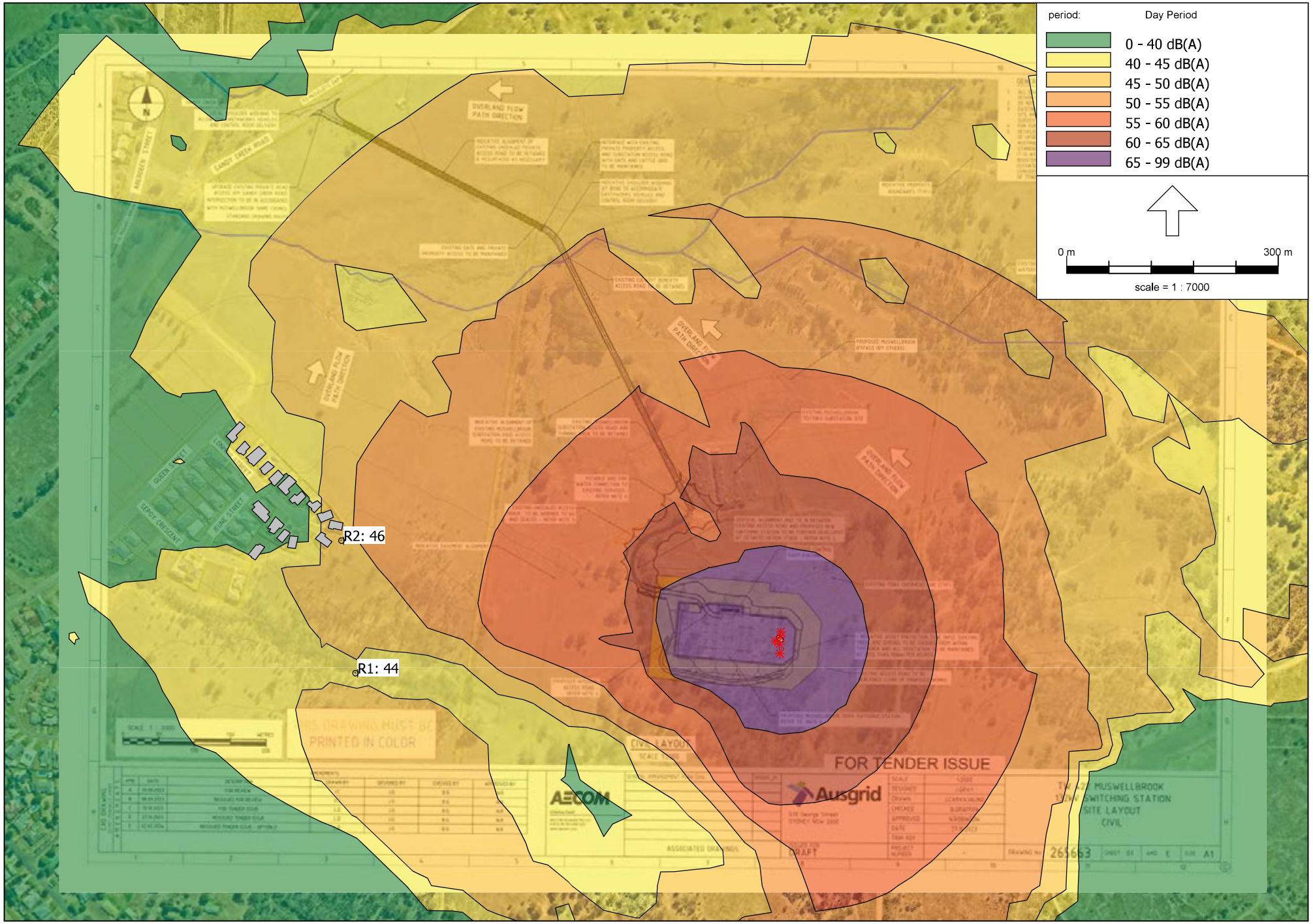
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
300 m
scale = 1 : 7000
R2: 7
R1: 6
FOR TENDER ISSUE
CIVIL LAYOUT
AECOM
Ausgrid
TW 422 MUSWELLBROOK
132kV SWITCHING STATION
SITE LAYOUT
CIVIL
DRAFT
265663
SHEET 01
AMD E
SIZE A1

Lmax - Sandy Creek STSS - Operational Scenario - Sleep Disturbance.

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Day Period
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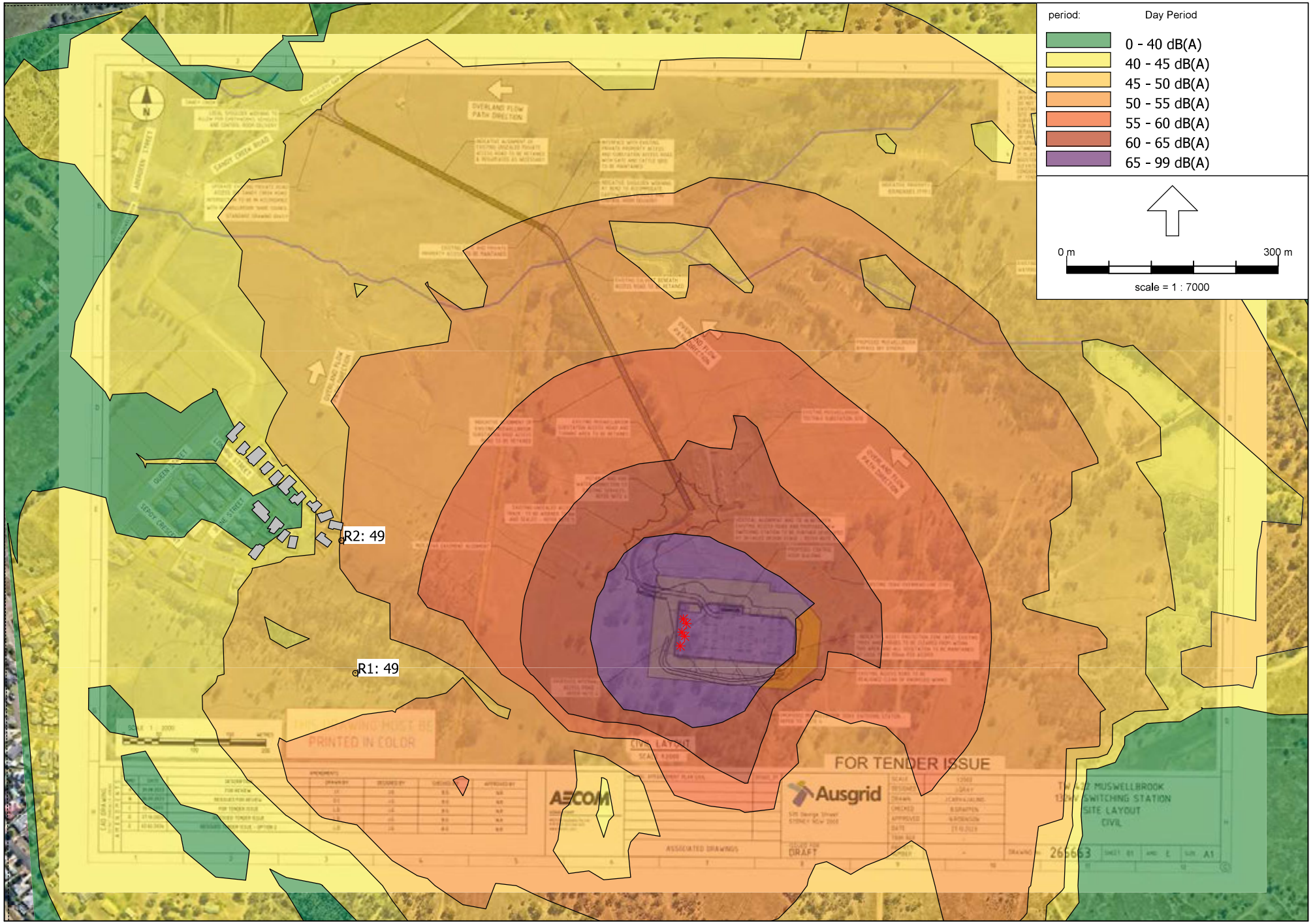
40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
300 m
scale = 1 : 7000
R2: 46
R1: 44
FOR TENDER ISSUE
Ausgrid
AECOM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Day Period
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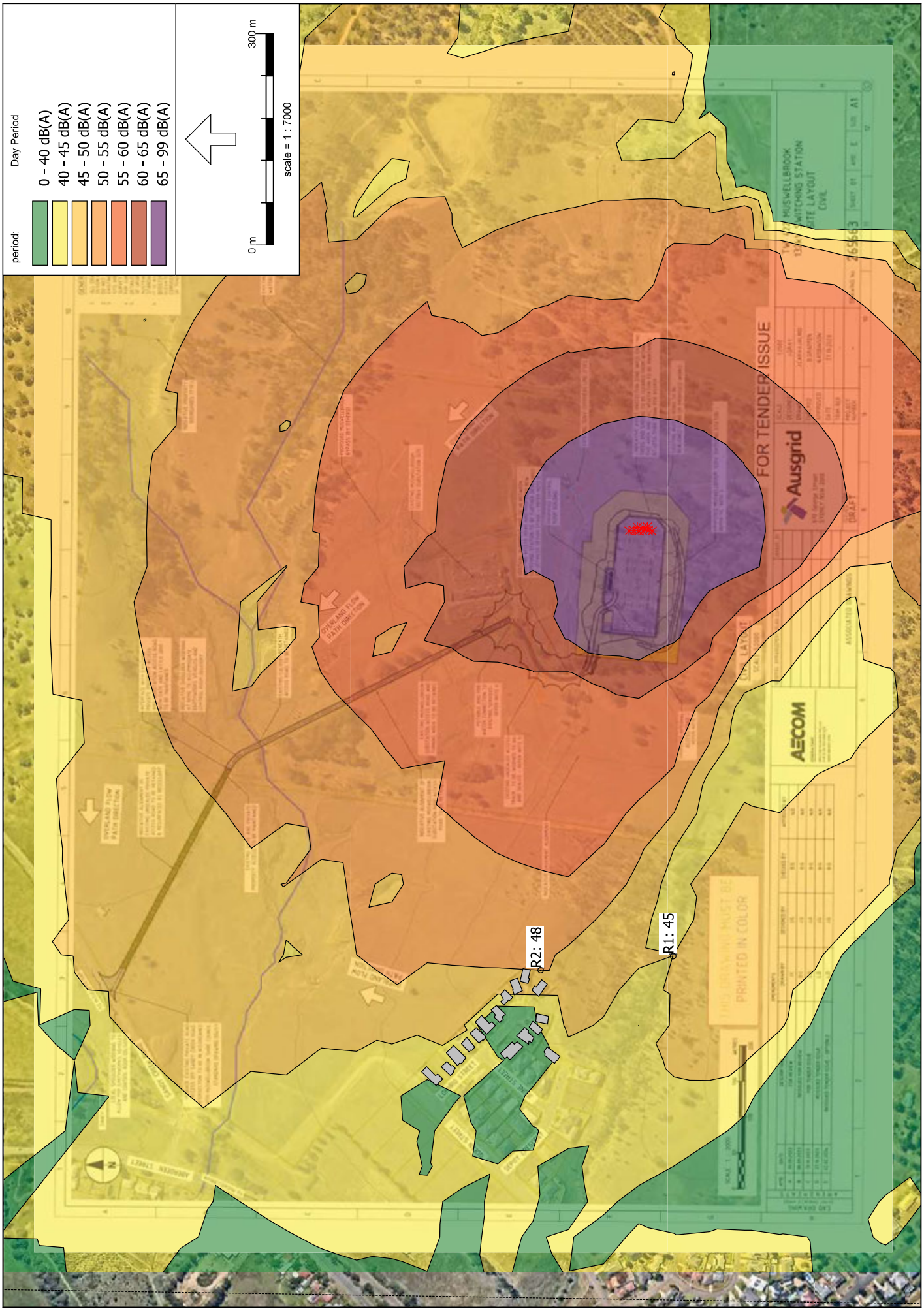
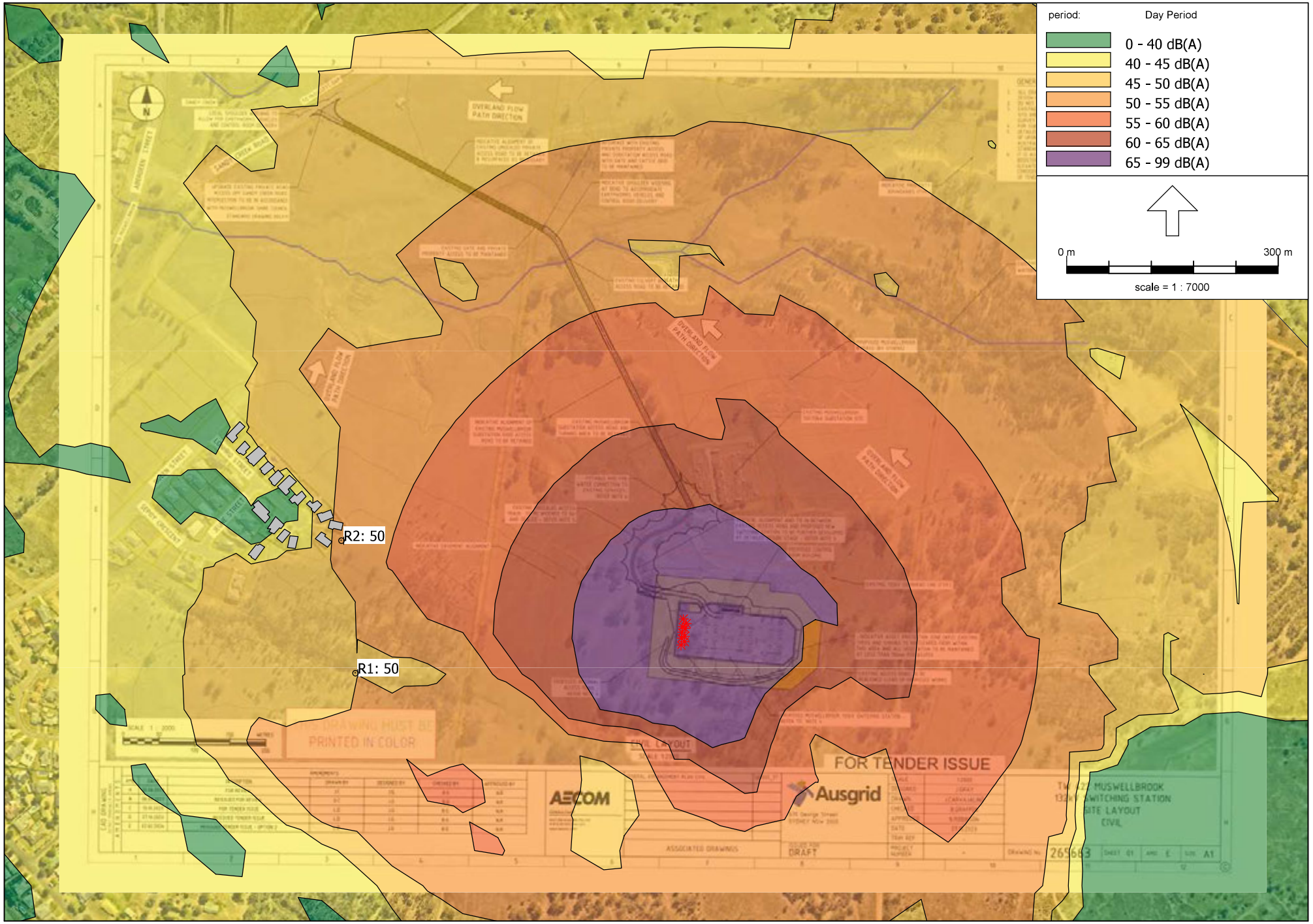
40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
300 m
scale = 1 : 7000
R2: 49
R1: 49
FOR TENDER ISSUE
Ausgrid
AECOM

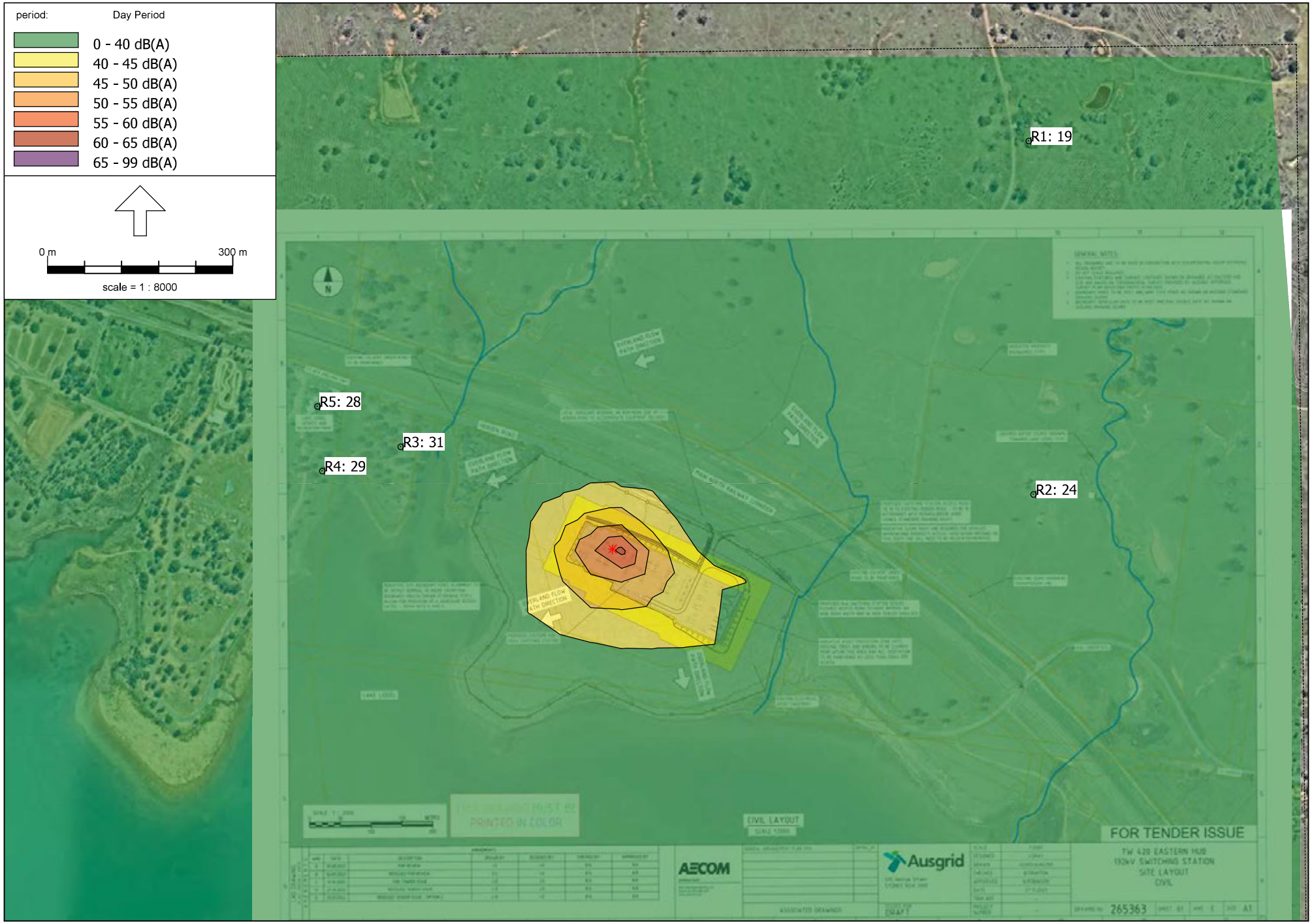
Leq, 15 min - Sandy Creek STSS - Stage 2 - Construction Scenario 1.



Leq, 15 min - Sandy Creek STSS - Stage 2 - Construction Scenario 2.




period:
Day Period
0 - 40 dB(A)
40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
300 m
scale = 1 : 8000
R1: 7
R2: 12
R3: 17
R4: 15
R5: 14
CIVIL LAYOUT
FOR TENDER ISSUE
TW 420 EASTERN HUB
132kV SWITCHING STATION
SITE LAYOUT
CIVIL
AECOM
Ausgrid
DRAFT
265363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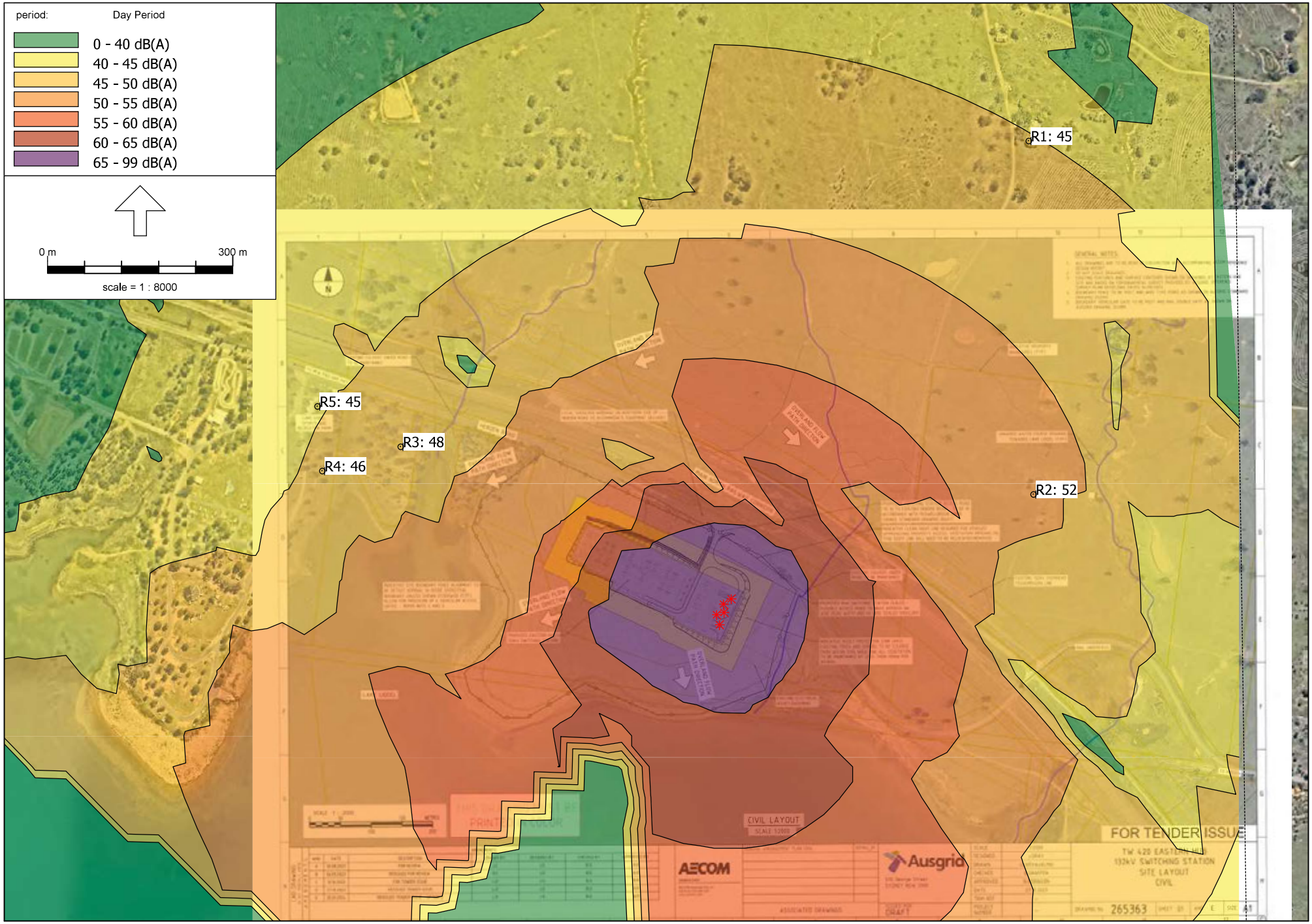
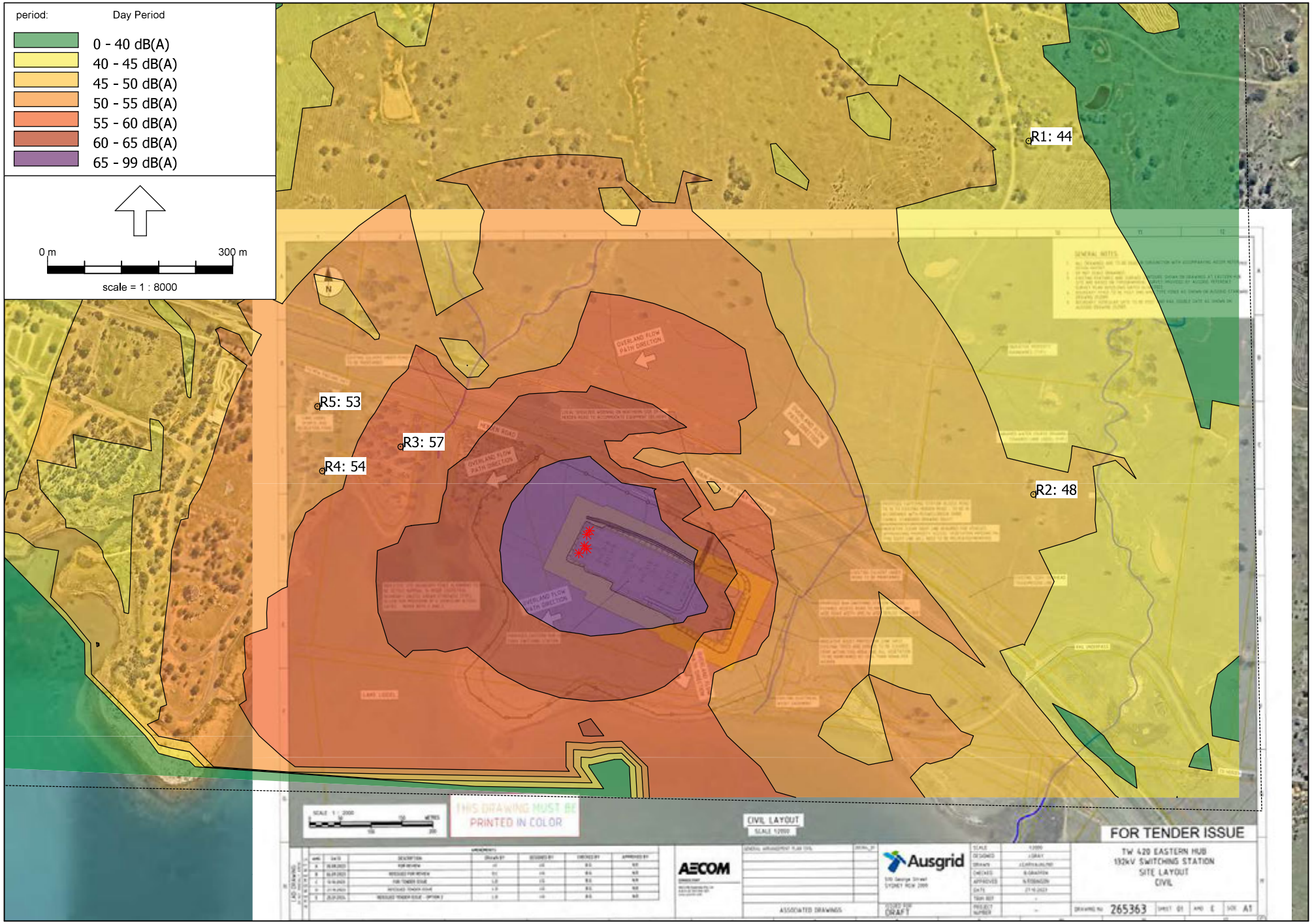
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
300 m
scale = 1 : 8000
R1: 19
R2: 24
R3: 31
R4: 29
R5: 28
FOR TENDER ISSUE
AECOM
Ausgrid

Leq, 15 min - Antiene STSS - Stage 1 Construction Scenerio 1.

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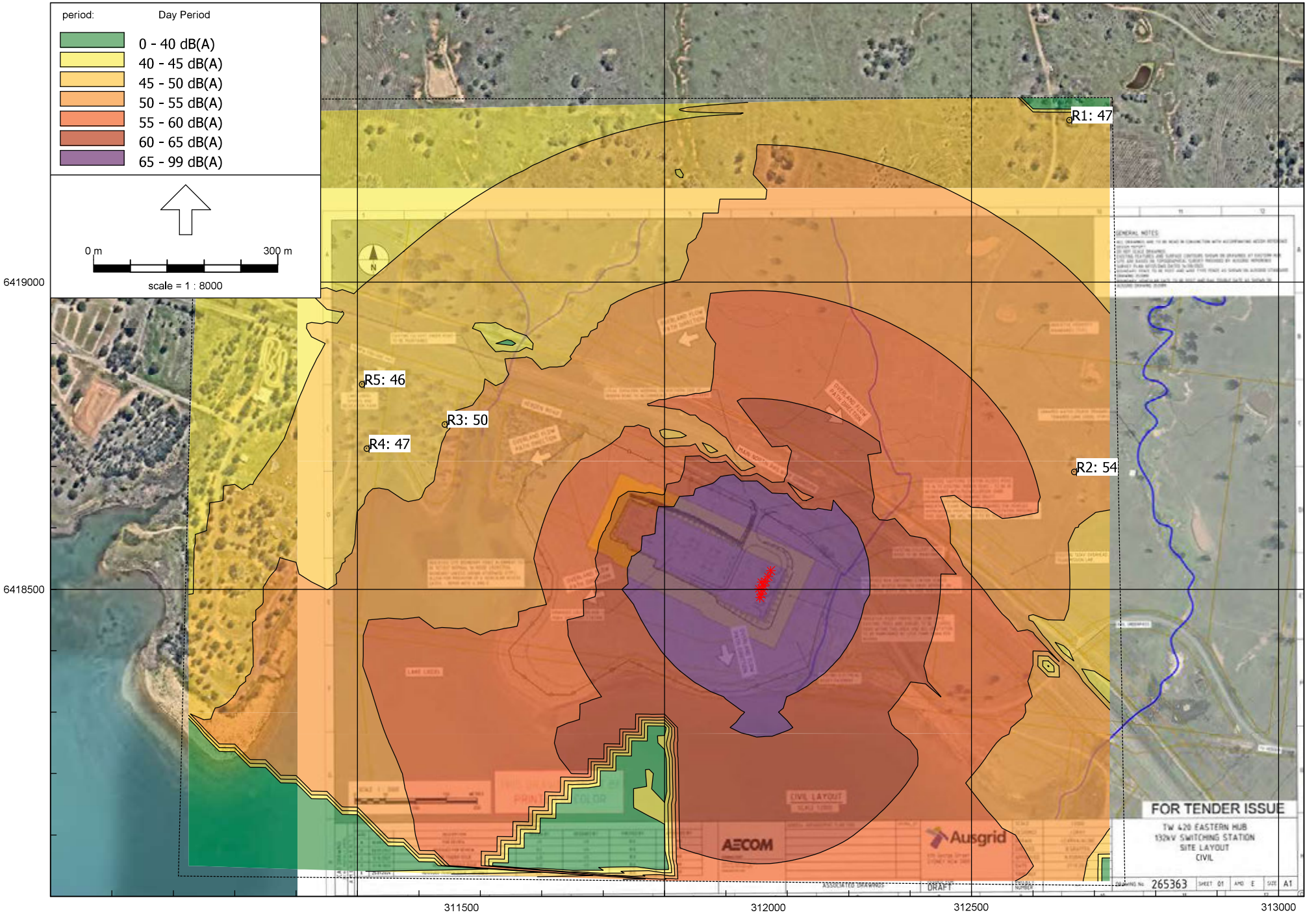
Day Period
0 - 40 dB(A)
40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
300 m
scale = 1 : 8000
R1: 44
R2: 48
R3: 57
R4: 54
R5: 53
THIS DRAWING MUST BE PRINTED IN COLOR
CIVIL LAYOUT
FOR TENDER ISSUE
AECOM
Ausgrid
TW 420 EASTERN HUB
132kV SWITCHING STATION
SITE LAYOUT
CIVIL
265363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40 - 45 dB(A)
45 - 50 dB(A)
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55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
300 m
scale = 1 : 8000
R1: 47
R2: 54
R3: 50
R4: 47
R5: 46
6419000
6418500
311500
312000
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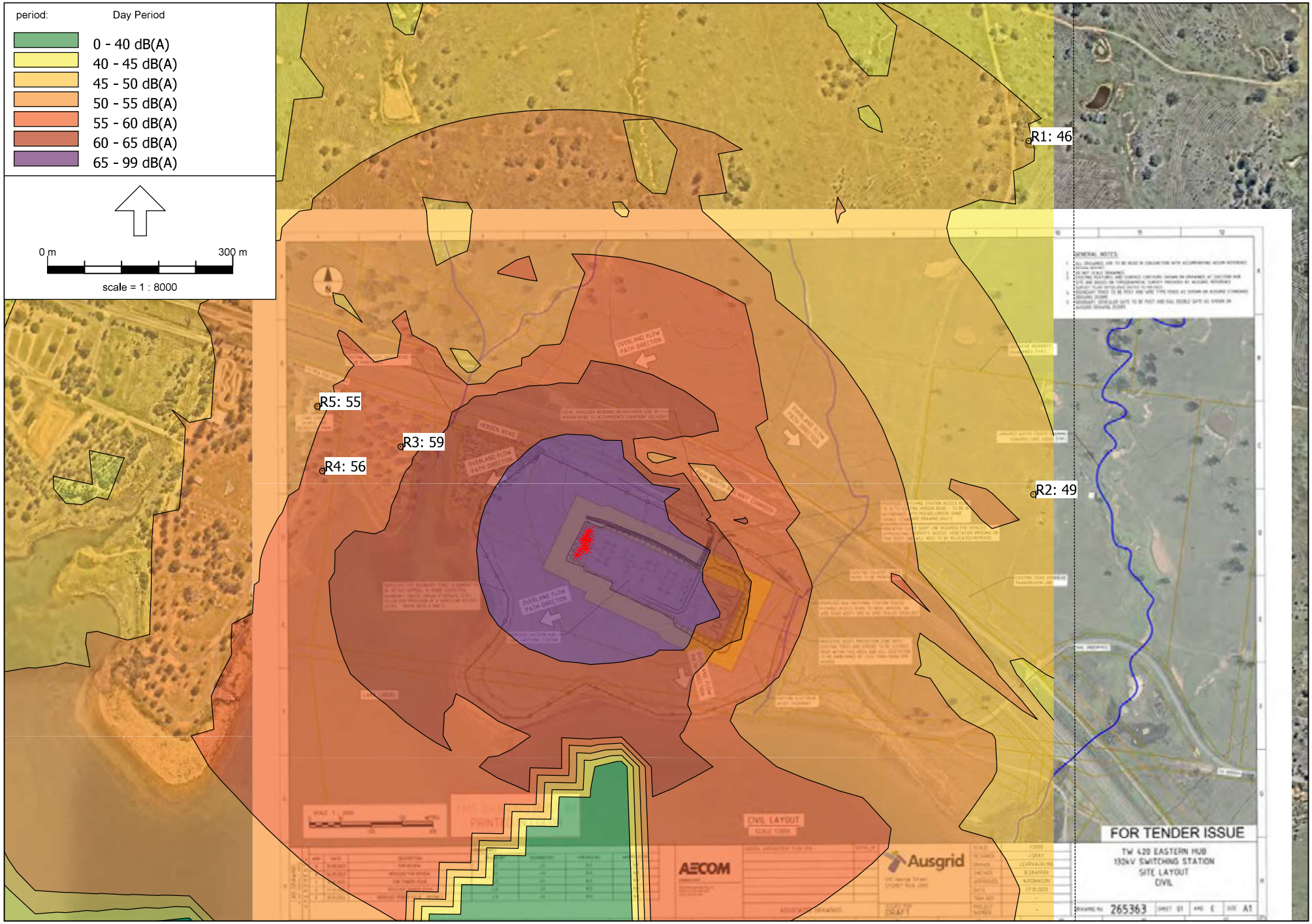
313000
FOR TENDER ISSUE
TW 420 EASTERN HUB
132kV SWITCHING STATION
SITE LAYOUT
CIVIL
AECOM
Ausgrid
DRAFT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Day Period
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40 - 45 dB(A)
45 - 50 dB(A)
50 - 55 dB(A)
55 - 60 dB(A)
60 - 65 dB(A)
65 - 99 dB(A)
0 m
300 m
scale = 1 : 8000
R1: 46
R2: 49
R3: 59
R4: 56
R5: 55
FOR TENDER ISSUE
TW 420 EASTERN HUB
132kV SWITCHING STATION
SITE LAYOUT
CIVIL
AECOM
Ausgrid

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". 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 Noise Policy for Industry, 2017).
- **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 – 2020 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.

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 2018)

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.

Table C.1 Modifying factor corrections
(See definitions in Section C2)

Factor	Assessment/ Measurement	When to apply	Correction[1]	Comments
Tonal noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method (*ISO1996.2-2007 – Annex D*).	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.	5 dB [2, 3]	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. **Note:** Narrow-band analysis using the reference method in *ISO1996-2:2007, Annex C* may be required by the consent/regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.
Low frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10–160 Hz	Measure/assess source contribution C- and A-weighted Leq,T levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2dB(A) positive adjustment applies for the daytime period.	2 or 5 dB[2]	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.

Table C.1 Modifying factor corrections – continued

Factor	Assessment/ Measurement	When to apply	Correction[1]	Comments
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	Adjustment to be applied for **night-time only**
Duration	Single-event noise duration may range from 1.5 min to 2.5 h.	One event in any assessment period.	0 to 20 dB(A)	The project noise trigger level may be increased by an adjustment depending on duration of noise (see Table C3).
Maximum Adjustment	Refer to individual modifying factors.	Where two or more modifying factors are indicated.	Maximum correction of 10 dB(A)[2] (excluding duration correction).	

Notes:

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