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HumeLink

Noise and Vibration Impact Assessment
EIS Technical Report 9

HUMELINK

EIS Technical Report 9 - Noise and Vibration Impact Assessment

Prepared for Transgrid

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BASIS OF REPORT

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

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EXECUTIVE SUMMARY

Background

Transgrid proposes to increase the energy network capacity in southern New South Wales (NSW) through the development of around 360 kilometres of new 500 kilovolt (kV) high-voltage transmission lines and associated infrastructure between Wagga Wagga, Bannaby and Maragle. This project is collectively referred to as HumeLink.

HumeLink would involve construction of a new substation east of Wagga Wagga as well as connection to existing substations at Wagga Wagga and Bannaby. HumeLink would also connect to a future substation at Maragle in the Snowy Mountains (referred to as the future Maragle 500 kV substation), which is subject to a separate major project assessment and approval (reference SSI-9717, EPBC, 2018/836).

Construction of the project is targeted to commence in 2024, subject to the required planning and regulatory approvals. Once construction has commenced, the project is estimated to take approximately 2.5 years to build and become operational in 2026.

This noise and vibration technical report has been prepared to address the Planning Secretary's Environmental Assessment Requirements (SEARs). The report outlines the method used in the assessment, describes the baseline noise environment in the study area and identifies the likely impacts from the project on nearby sensitive receivers. Where impacts are predicted, appropriate measures have been identified to mitigate and manage the impacts.

Construction

The project would involve the construction of new double circuit 500 kV transmission lines and substation construction work to interface with the new transmission line at the existing Wagga 330 kV substation, the proposed Gugaa 500 kV substation, the future Maragle 500 kV substation and the existing Bannaby 500 kV substation. The project would also include up to 14 construction compounds and a worker accommodation facility.

Construction noise and vibration has been assessed based on the Department of Environment and Climate Change, Interim Construction Noise Guideline (ICNG) (DECC, 2009) methodology, referencing other standards and guidelines as appropriate. Representative scenarios have been developed to assess the likely worst-case impacts from the construction of the project. Construction noise impacts have been identified based on the predicted exceedance of the Noise Management Levels (NML), which are based on the monitored existing background noise environment.

Construction work would generally occur in standard day-time hours between 7am and 6pm Monday to Friday and 8am to 1pm on Saturday. Some work would be required outside of standard construction hours.

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Where construction noise has been predicted to exceed the NMLs, the impacts are categorised based on the following classifications from the *Construction Noise and Vibration Guideline* (CNVG) (TfNSW, 2016):

Daytime

- 1 to 10 dB – 'Clearly Audible'
- 11 to 20 dB – 'Moderately Intrusive'
- >20 dB – 'Highly Intrusive'

Out-of-hours

- 1 to 5 dB – 'Noticeable'
- 6 to 15 dB – 'Clearly Audible'
- 15 to 25 dB – 'Moderately Intrusive'
- >25 dB – 'Highly Intrusive'

Construction noise levels are also compared to the highly noise affected criteria of 75 dBA, as per the ICNG.

Construction noise from construction compounds, substation construction and worker accommodation facility

Construction compounds would be required during construction to support staging and equipment laydown, concrete batching, temporary storage of materials, plant and equipment and worker parking required to construct the various elements of the project. Fourteen potential construction compounds have been identified. The proposed use of the construction compounds would be refined as the project design develops.

The construction compounds would involve noise intensive activities such as vegetation clearing, establishment of facilities and internal roads, during site establishment. During construction compound operation, ongoing work such as equipment laydown and concrete batching is expected to produce less noise compared to site establishment. While 14 potential construction compounds are considered by this assessment, it is estimated that only six construction compounds may be required to operate concurrently for 16 months or more, with fewer than that at other times.

The construction noise impacts from construction compounds are summarised below:

- Noise from construction compounds would be greatest during 'site establishment', which is expected to take around three to four weeks per construction compound. During this time, daytime construction noise impacts are predicted at the receivers closest to eight of the 14 potential construction compounds. Worst-case impacts during 'site establishment' are predicted to be:
  - 'Highly intrusive' at up to six and three of the residential receivers closest to Memorial Avenue compound (C14) and Bowmans Lane compound (C15), respectively.
  - 'Moderately intrusive' at the receiver closest to Wagga 330 kV substation compound (C01).
  - 'Clearly audible' at the receivers closest to Snowy Mountains Highway compound (C02), Snubba Road compound (C03), Gregadoo Road compound (C06), Adjungbilly Road compound (C09) and Yass substation compound (C10).
- Compliant with the management levels at all other potential construction compounds.
- One residential receiver nearest to the Memorial Avenue compound (C14) is predicted to be highly noise affected by the construction compound during 'site establishment' which would take around three to four weeks and during 'compound operation' which would occur for the project duration.

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- During 'compound operation' noise levels are expected to decrease relative to site establishment, such that impacts are only predicted at the construction compounds near to Wagga Wagga and Batlow (Wagga 330 kV substation compound (C01), Memorial Avenue compound (C14) and Bowmans Lane compound (C15)).

Some 'other sensitive' receivers (medical, educational and places of worship) in Batlow are predicted to be impacted by 'site establishment' work at the Memorial Avenue compound (C14). The worst-case daytime impacts are predicted to be 'moderately intrusive' at one medical receiver and 'clearly audible' at other nearby educational and place of worship receivers. However, no other sensitive receivers are predicted to be impacted during 'compound operation'. Substation construction would be required at the existing Wagga 330 kV substation, the proposed Gugaa 500 kV substation and existing Bannaby 500 kV substation. Installation of high voltage equipment would be required outside of standard construction hours to accommodate work such as over-sized deliveries and transformer/reactor assembly under outage conditions.

The construction noise impacts from substation construction are summarised below:

- Worst-case daytime substation construction work is predicted to impact up to 10 of the receivers closest to Wagga 330 kV substation and two receivers closest to the proposed Gugaa 500 kV substation, during 'earthwork and vegetation clearance', which would take around two to four months. Worst-case daytime noise levels are predicted to be 'moderately intrusive' at the receiver closest to the Wagga 330 kV substation and 'clearly audible' at the other impacted receivers. During other substation construction work, noise levels are predicted to be 'clearly audible' or compliant at the receiver closest to Wagga 330 kV substation and compliant at all more distant receivers.
- Out of hours work at the Wagga 330 kV substation and the proposed Gugaa 500 kV substations is required for 'installation of high voltage equipment and associated structures', which would take around one month. This work is predicted to have 'noticeable' or 'clearly audible' impacts at up to 14 receivers near to Wagga 330 kV substation and two receivers near to the proposed Gugaa 500 kV substation.
- No exceedances of the NMLs are predicted from construction at Bannaby 500 kV substation.

The project also includes a potential temporary worker accommodation facility on Alfred Street, Tumbarumba to accommodate around 200 construction workers. Similar to construction compounds, the worker accommodation facility would require noise intensive work during site establishment. Once the facility is operational it would involve low noise producing activities such as vehicle movements and the use of generators. The worker accommodation facility operation would occur during all hours.

The construction noise impacts from the worker accommodation facility are summarised below:

- Noise from the accommodation facility would be greatest during 'site establishment' which is expected to take around three to four weeks. During this time daytime construction noise impacts are predicted at up to 48 receivers closest to the facility. Worst-case daytime impacts are predicted to be 'highly intrusive' at the closest receiver, 'moderately intrusive' at six receivers and 'clearly audible' at 41 receivers.
- During 'accommodation facility operation', which would occur for the duration of the project, noise levels are expected to reduce relative to 'site establishment'. Daytime impacts are predicted to be 'moderately intrusive' at the closest receiver and 'clearly audible' at the two other nearby receivers.

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- The worker accommodation facility would operate during all hours, with worst-case night-time impacts from 'accommodation facility operation' predicted at up to 12 of the nearest receivers. Worst-case night-time impacts are predicted to be 'moderately intrusive' at the closest receiver, 'clearly audible' at six receivers and 'noticeable' at five receivers.

Construction noise from transmission lines

Construction of transmission lines would involve a series of activities at each transmission line structure. The work is generally short-term in nature, with around seven separate activities each taking around one to three weeks per transmission line structure. The work would generally occur during standard day-time hours, except where 'overhead string of conductors and earth wires' is required near to infrastructure such as roads, rail and existing transmission lines with strict outage conditions.

Construction noise from transmission lines has been conservatively assessed assuming the required work would occur anywhere in the project footprint. The construction noise impacts from construction of transmission lines are summarised below:

- Noise from transmission line construction would be greatest during scenarios with highly noise intensive equipment such as 'earthwork and clearing'.
- Daytime transmission line construction noise impacts are predicted to be 'highly intrusive' at up to 29 of the closest receivers that are within around 150 metres of the project footprint. However, the work would be relatively short-term with up to around nine weeks of work required for the construction of each transmission line structure.
- A total of up to 398 residential receivers are predicted to have daytime noise impacts from transmission line construction across the project footprint, which spans around 360 kilometres.
- Up to 54 of the receivers nearest to the project footprint are predicted to be highly noise affected by transmission line construction.
- Out of hours 'overhead stringing of conductors and earth wires' work is predicted to have 'clearly audible' or 'noticeable' impacts at up to 24 of the receivers nearest to the existing infrastructure sites, where outage conditions may be required. The work would take around three weeks per site.
- Locations for 'access tracks' and 'brake and winch sites' would be spread across the project footprint, however, final locations are not known at this stage. Receivers are expected to be impacted when these work scenarios occur within around 1,200 metres and 600 metres for 'access tracks' and 'brake and winch sites', respectively.

Construction road traffic noise

Construction road traffic noise has been considered on all identified routes for project construction traffic. The assessment conservatively assumes that the project workforce will mobilise in the 6am to 7am period and is assessed with the more stringent night-time criteria for this period. The likely influence of construction road traffic noise is assessed in accordance with the Road Noise Policy (RNP) criteria, which requires an increase compared to existing road traffic noise, and for the total road traffic noise (existing plus construction) to exceed a certain threshold.

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Increases in road traffic noise due to construction are predicted on the majority of the construction routes because they include local roads with relatively low existing traffic volumes. Construction traffic noise impacts will depend on how close receivers are to the proposed routes. Road noise impacts are predicted for most roads on the construction routes where receivers are located around 10 metres from the road edge. For rural roads, where the closest receivers are set back around 100 metres from the road edge, road noise impacts are predicted on around half of the proposed roads.

Construction vibration

Where vibration intensive equipment is required for work near to sensitive receivers, there is the potential for vibration impacts on buildings and the occupants within. Construction vibration has been assessed based on the recommended minimum working distances presented in the CNVG.

The requirement for vibration intensive equipment, such as vibratory rollers and hydraulic hammers, has been identified for transmission line and substation construction work. Thirteen of the receivers nearest to the project footprint are within the cosmetic damage minimum working distance and 20 of the nearest receivers are within the human comfort minimum offset.

Construction blasting

Blasting would potentially be required during construction for excavation and foundation work with difficult geotechnical conditions. At this stage of the project, specific locations where blasting may be required have not been determined. This report presents methodology to assess impacts from airblast overpressure and ground vibration based on Australian Standard (AS) 2187.2-2006. When specific blasting locations are known, geotechnical investigations and further blast overpressure and vibration assessment would be undertaken, including development of a Blast Management Plan.

Operation

Operation of the project would include the new double circuit 500 kV transmission lines, the proposed Gugaa 500 kV substation, equipment added to the existing Wagga 330 kV substation and existing Bannaby 500 kV substation and connection to the future Maragle 500 kV substation. However, noise emissions from the Wagga 330 kV substation, Maragle 500 kV substation and Bannaby 500 kV substation are expected to be dominated by existing or future non-project related equipment. As a result of the above, an operational noise assessment has been undertaken for the project transmission line and the proposed Gugaa 500 kV substation only.

The operational noise has been assessed based on the Environmental Protection Authority Noise Policy for Industry (NPfI) (EPA, 2017) methodology, with Project Noise Trigger Levels (PNTL) derived from the existing monitored background noise environment. The assessment includes consideration of noise enhancing weather where necessary.

Operational noise from substations

The proposed Gugaa 500 kV substation is located at Gregadoo, approximately 11 kilometres south-east of the existing Wagga 330 kV substation. The substation is proposed to include noise producing equipment such as transformers, auxiliary transformers and shunt reactors.

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Operational noise impacts are predicted at up to three of the closest receivers depending on the inclusion of transformer walls and the presence of noise enhancing weather conditions, such as wet weather. The predicted impacts are generally minor in nature and are only expected to be noticeable during noise enhancing weather conditions. It is expected that the noise criteria can be achieved via suitable positioning of transformer barriers and/or selection of equipment with consideration of sound power levels. The proposed Gugaa 500 kV substation would be designed to comply with the relevant noise criteria.

Operational noise from transmission lines

Noise emissions from the operation of the project high voltage transmission lines has been assessed in terms of offset distance from the project footprint where audible noise is expected to exceed the adopted night-time PNTL with worst-case noise producing weather conditions, such as wet weather. The assessment considers the cumulative noise contribution of the project transmission line and existing parallel transmission lines where appropriate.

At this stage of the project the final transmission line route is not known. The assessment conservatively assumes that the transmission line may be anywhere within the project footprint, with consideration of a 70 metre minimum easement. The distance at which operational transmission line noise impacts are expected varies across the project but is generally around 350 metres.

Up to a total of 65 receivers have been identified to potentially have operational transmission line noise impacts based on worst-case conditions. At the edge of the easement, the worst-case noise levels for the majority of potentially impacted receivers is expected to be around 2 dB to 4 dB above night-time trigger levels with the highest exceedance being up to 15 dB above night-time trigger levels.

During fair weather conditions transmission line noise emissions are expected to be lower, with up to 11 receivers identified to potentially have operational noise impacts from the project transmission lines. At the edge of the easement noise levels may exceed the night-time trigger level by up to 4 dB. The NPfI indicates that after the application of all reasonable and feasible mitigation, residual noise impacts of this magnitude are considered to be of 'marginal' significance. Furthermore, the number of impacted receivers may further reduce when the final transmission line route and easement are defined within the project footprint.

Cumulative

The potential for cumulative construction and operational impacts has been considered between HumeLink and several other nearby projects. Generally, the chance of cumulative noise impacts is considered low due to the distance between adjacent projects and surrounding receivers.

Potential cumulative or consecutive construction noise impacts have been identified with:

- EnergyConnect (NSW – Eastern Section), which includes work in the vicinity of Wagga 330 kV substation
- Jeremiah Wind Farm, which intersects the HumeLink project footprint
- Rye Park Wind Farm, which intersects the HumeLink project footprint.

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Potential cumulative operational noise impacts have been identified with:

- Jeremiah Wind Farm where one receiver is within the offset distance for transmission line operational noise impacts and may also be impacted, based on the concept design assessment of the wind farm
- Rye Park Wind Farm where two receivers are within the offset distance for transmission line operational noise impacts and may also be impacted, based on the Environmental Impact Statement (EIS) assessment of the wind farm.

Mitigation and management of impacts

All feasible and reasonable measures would be applied to reduce the potential noise and vibration impacts from the project. Specific mitigation measures have been recommended based on the predicted impacts.

The exact construction mitigation strategies would be determined as the project progresses when detailed planning information becomes available. The principal contractor would be required to prepare a Noise and Vibration Management Plan (NVMP), detailing the mitigation measures and strategies.

Operational transmission line noise impacts would be confirmed as the project progresses. It is likely that individual agreements would be the most feasible and reasonable mitigation strategy where operational noise impacts are identified. These agreements may include property treatments to reduce noise ingress. Any agreements would be subject to the outcomes of noise monitoring and further discussions with property owners.

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GLOSSARY, ACRONYMS and ABBREVIATIONS

Glossary and abbreviations

Term	Description / Definition
am/pm	Before noon / afternoon
ANZECC	Australian and New Zealand Environmental Conservation Council
AVaTG	*Assessing Vibration: a Technical Guideline,* Department of Environment and Conservation, 2006
Bannaby 500 kV substation	The existing 500 kV substation at Bannaby
BMP	Blast Management Plan
BoM	Bureau of Meteorology
BS	British Standard
CEMP	Construction Environmental Management Plan
CNVG	*Construction Noise and Vibration Guideline,* NSW Roads and Maritime, 2016
construction compounds	Main construction compounds proposed for construction of the project. Each main construction compound would accommodate a range of facilities which may include (but not limited to): • laydown areas • site offices • amenities • construction support facilities such as vehicle and equipment storage, maintenance sheds, chemical/fuel stores and stockpile areas • parking.
CSSI	Critical State Significant Infrastructure
dB	Decibel
dBA	Decibel A-weighted
dBL	Decibel linear
DEC	Department of Environment and Conservation (now EPA)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
DIN	Deutsches Institut für Normung (German institute for standardisation)
DPE	NSW Department of Planning and Environment
easement	A legal right attached to a parcel of land that enables the non-exclusive use of the land by a third party other than the owner. For transmission lines, an easement defines the corridor area where the lines are located and that allows access, construction and maintenance work to take place. The easements for the 500 kV transmission lines would typically be 70 metres wide. However, a few locations would require wider easements up to 110 metres wide at transposition locations and up to 130 metres wide where the new transmission line would parallel the relocated section of Line 51. The easement grants a right of access and for construction, maintenance and operation of the transmission line and other operational assets.

GLOSSARY, ACRONYMS and ABBREVIATIONS

Term	Description / Definition
EIS	Environmental Impact Statement
EPA	NSW Environment Protection Authority
future Maragle 500 kV substation	The future Maragle 500/330 kV substation that would be built under the Snowy 2.0 Transmission Connection Project, which is subject to separate planning approval (reference SSI-9717, EPBC 2018/836)
HNA	Highly noise affected. Relates to construction noise levels of ≥75 dBA and is the point above which there may be strong community reaction to noise construction noise levels.
HumeLink	The project
Hz	Hertz
ICNG	*Interim Construction Noise Guideline*, Department of Environment and Climate Change, 2009
INP	*Industrial Noise Policy* (EPA, 2000)
kV	kilovolt
L_{Aeq}	The average noise level during a measurement period, such as the day-time or night-time
L_{AFmax}	The maximum noise level measured during a monitoring period, using 'fast' weighting
LGA	Local Government Area
MIC	Maximum instantaneous charge, which is the effective charge mass per delay
MVA	Megavolt amperes
MVAr	Megavolt ampere of reactive power
m/s	Metres per second
mm/h	Millimetres per hour
mm/s	Millimetres per second
MW	Megawatt
NATA	National Association of Testing Authorities
NEM	National Electricity Market
NML	Noise Management Level
NPfI	*Noise Policy for Industry* (EPA, 2017)
NSW	New South Wales
NVMP	Noise and Vibration Management Plan
OOH	Out-of-hours
OOHW	Out-of-hours work
PNTL	Project Noise Trigger Level A term from the Noise Policy for Industry that provides a benchmark or objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.
PPV	Peak Particle Velocity

GLOSSARY, ACRONYMS and ABBREVIATIONS

Term	Description / Definition
project (the)	The construction and operation of high voltage transmission lines and associated infrastructure between Wagga Wagga, Bannaby and Maragle, collectively referred to as HumeLink.
project footprint	The area that has been assumed for the purpose of this EIS to be directly affected by the construction and operation of the project. It includes the indicative location of project infrastructure, the area that would be directly disturbed during construction as well as any easement required during operation.
proposed Gugaa 500 kV substation	The new 500/330 kV substation proposed near Wagga Wagga.
RBL	Rating Background Level, which is an overall single-figure background noise level measured in each relevant assessment period
RMS	Roads and Maritime Services (now Transport for NSW)
RNP	*Road Noise Policy*, Department of Environment, Climate Change and Water (DECCW), 2011
SEARs	Planning Secretary's Environmental Assessment Requirements
SLR	SLR Consulting Australia Pty Ltd
standard construction hours	Monday to Friday 7am to 6pm and Saturdays from 8am to 1pm
State Significant Infrastructure (SSI)	State Significant Infrastructure
transmission line route	The location of the transmission line structures along the middle of the transmission line easement.
Transgrid	The project is proposed to be undertaken by NSW Electricity Networks Operations Pty Ltd (referred to as Transgrid). Transgrid is the operator and manager of the main high voltage transmission network in NSW and the ACT and is the Authorised Network Operator for the purpose of an electricity transmission or distribution network under the provisions of the *Electricity Network Assets (Authorised Transactions) Act 2015*.
VDV	Vibration Dose Value
Wagga 330 kV substation	The existing 330/132 kV substation located in Wagga Wagga
Wagga Wagga	When referencing the place name, except when being used to reference the Wagga 330 kV substation
work site	A general word to describe a defined construction location.

1 Introduction

1.1 Overview

The Australian energy landscape is transitioning to a greater mix of low-emission renewable energy sources, such as wind and solar. To support this transition, meet our future energy demands and connect Australian communities and businesses to these lower cost energy sources, the national electricity grid needs to evolve.

Transgrid proposes to increase the energy network capacity in southern New South Wales (NSW) through the development of around 360 kilometres of new 500 kilovolt (kV) high-voltage transmission lines and associated infrastructure between Wagga Wagga, Bannaby and Maragle. This project is collectively referred to as HumeLink. The project would be located across five Local Government Areas (LGAs) including Wagga Wagga City, Snowy Valleys, Cootamundra-Gundagai Regional, Upper Lachlan Shire and Yass Valley. The location of the project is shown on **Figure 1-1**.

HumeLink would involve construction of a new substation east of Wagga Wagga as well as connection to existing substations at Wagga Wagga and Bannaby and a future substation at Maragle in the Snowy Mountains (referred to as the future Maragle 500 kV substation). The future Maragle 500 kV substation is subject to a separate major project assessment and approval (reference SSI-9717, EPBC 2018/836).

The project would deliver a cheaper, more reliable and more sustainable grid by increasing the amount of renewable energy that can be delivered across the national electricity grid, helping to transition Australia to a low carbon future. It would achieve this by supporting the transfer of energy from existing renewable generation as well as facilitate development of new renewable generation in the Wagga Wagga and Tumut Renewable Energy Zones (REZs). The project would provide the required support for the network in southern NSW, allowing for the increase in transfer capacity between new renewable generation sources and the state's demand centres of Sydney, Newcastle and Wollongong. The project would also improve the efficiency and reliability of the current energy transfer in this part of the network.

Furthermore, HumeLink would form a key part of the transmission line infrastructure that supports the transfer of energy within the National Electricity Market (NEM) by connecting with other major interconnectors. The NEM incorporates around 40,000 kilometres of transmission lines across Queensland (QLD), NSW, Australian Capital Territory (ACT), Victoria (VIC), South Australia (SA) and Tasmania (TAS).

Construction of the project is targeted to commence in 2024, subject to the required planning and regulatory approvals. Once construction has commenced, the project is estimated to take approximately 2.5 years to build and would become operational by the end of 2026.

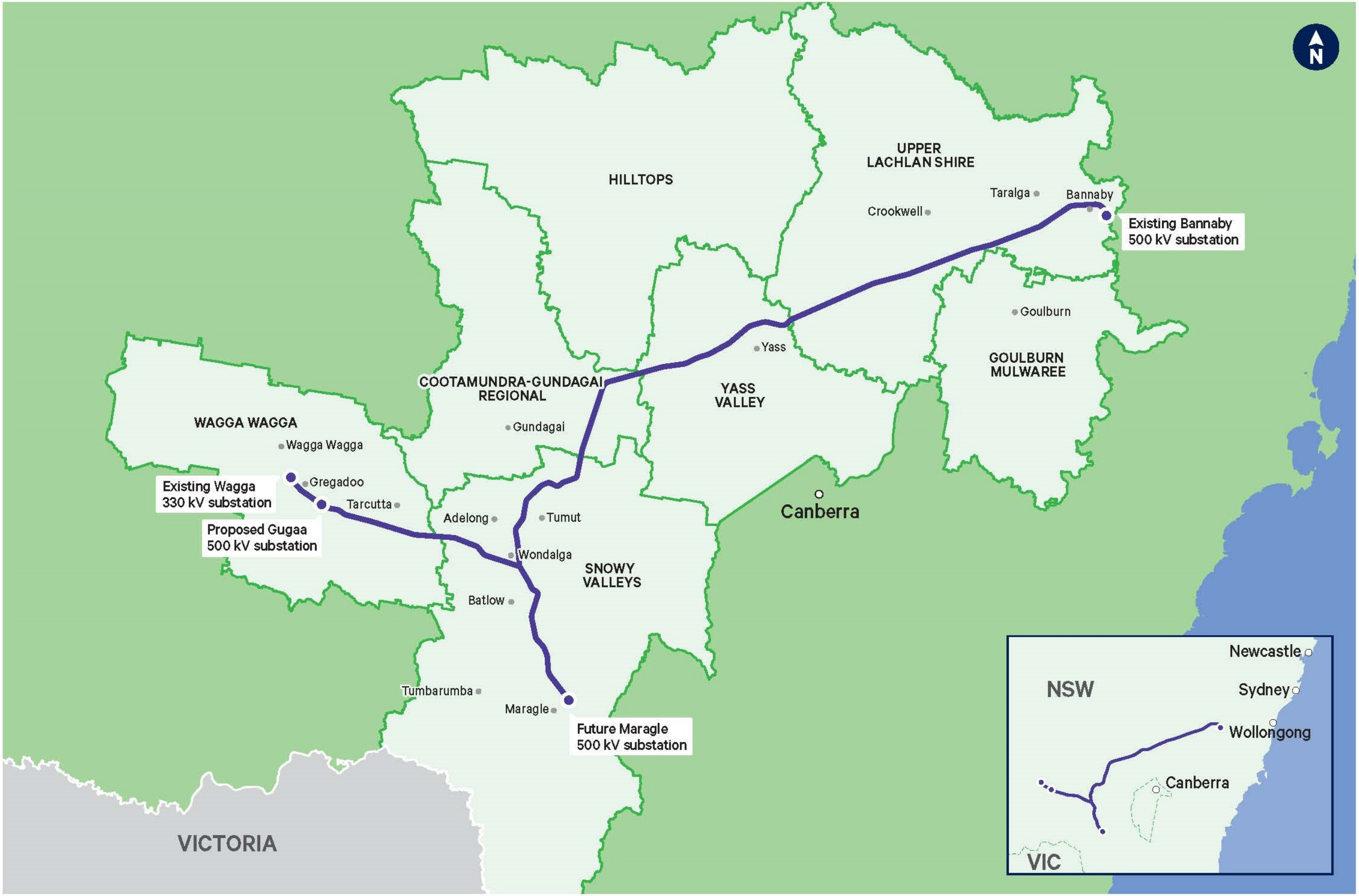
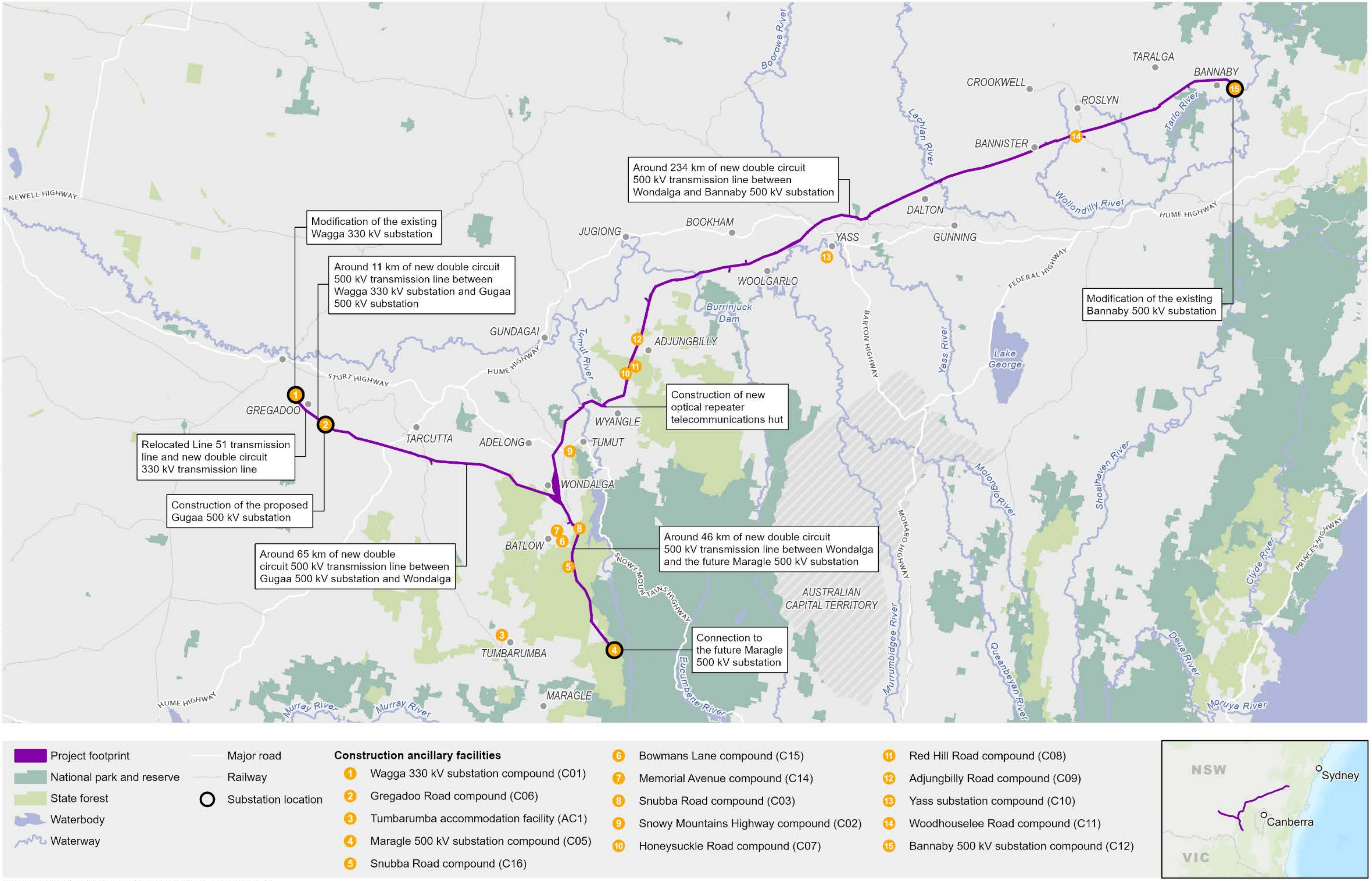


Figure 1-1 Location of the project

1.2 Key components

The project includes the following key components (refer to **Figure 1-2**):

- construction and operation of around 360 kilometres of new double circuit 500 kV transmission lines and associated infrastructure between Wagga Wagga, Bannaby and Maragle
- construction of a new 500/330 kV substation at Gregadoo (proposed Gugaa 500 kV substation) approximately 11 kilometres south-east of the existing Wagga 330/132 kV substation (Wagga 330 kV substation)
- demolition and rebuild of a section of Line 51 (around two kilometres in length) as a double circuit 330 kV transmission line connecting into the Wagga 330 kV substation
- modification of the existing Wagga 330 kV substation and Bannaby 500/330 kV substation (Bannaby 500 kV substation) to accommodate the new transmission line connections
- connection of transmission lines to the future Maragle 500/330 kV substation (Maragle 500 kV substation, approved under the Snowy 2.0 Transmission Connection Project (SSI-9717))
- provision of one optical repeater telecommunications hut and associated connections to existing local electrical infrastructure
- establishment of new and/or upgraded temporary and permanent access tracks
- ancillary works required for construction of the project such as construction compounds, worker accommodation facilities, utility connections and/or relocations, brake and winch sites, and helipad/helicopter support facilities.



Source: *Aurecon, Transgrid, Spatial Services (DCS), ESRI Basemap*

Projection: GDA 1994 MGA Zone 55

HumeLink

FIGURE 1-2: Key components of the project

1.3 Purpose and scope of this report

This report is one of a number of technical reports that form part of the Environmental Impact Statement. The purpose of this technical report is to identify and assess the potential impacts of the project in relation to noise and vibration. It responds directly to the Planning Secretary's Environmental Assessment Requirements (SEARs) outlined in **Section 1.4**.

This report presents indicative construction and operational noise and vibration impacts for the purpose of planning approval and is not intended to be used for any other purpose.

1.4 Secretary's environmental assessment requirements

The NSW Department of Planning and Environment (DPE) provided the SEARs for the EIS on 14 March 2022 (Application Number: SSI-36656827). The requirements specific to noise and vibration, and where these requirements are assessed in this report, are outlined in **Table 1-1**.

Table 1-1 SEARs – noise and vibration

Relevant SEARs	Where addressed
Amenity	
An assessment of the construction, operational and road noise and vibration impacts of the project.	**Construction: Chapter 6** **Operational: Chapter 7**

1.5 Structure of this report

This technical report is structured as follows:

- Chapter 1 – provides an introduction to the report
- Chapter 2 – presents an overview of the project
- Chapter 3 – presents relevant legislative and policy context to the project
- Chapter 4 – documents the methodology for this assessment
- Chapter 5 – details the existing noise environment in the study area
- Chapter 6 – provides an assessment of the potential construction noise and vibration impacts
- Chapter 7 – provides an assessment of the potential operational noise and vibration impacts
- Chapter 8 – provides an assessment of the potential cumulative noise and vibration impacts
- Chapter 9 – identifies mitigation and management measures
- Chapter 10 – provides a conclusion for the noise and vibration assessment
- Chapter 11 – references.

1.6 Key project terms

The report uses specific acoustic terminology, and an explanation of common terms is included in **Attachment A**. A glossary is also at the start of this document which lists the various terms used.

1.6.1 Project footprint

The project footprint is the area that has been assumed for the purpose of this EIS to be directly affected by the construction and operation of the project. It includes the indicative location of project infrastructure, the area that would be directly disturbed during construction and any easement required during operation. The project footprint is shown in **Attachment B.**

1.6.2 Study area

The noise and vibration study area is defined by a two kilometre buffer around the project footprint. The noise and vibration study area is expected to represent the extent of all receivers potentially impacted by noise and vibration from the construction and operation of the project. The noise and vibration study area is shown in **Attachment B**.

2 Project description summary

The project description in this chapter is based on a concept design and indicative construction methodology for the project. The design and construction methodology would continue to be refined and confirmed during detailed design and construction planning by the construction contractors. Further details on the project are provided in Chapters 3 and 4 of the EIS.

2.1 Summary of key components of the project

Key components of the project are summarised in **Table 2-1**.

Table 2-1 Summary of key components of the project

Component	Description
Transmission lines and supporting infrastructure	
Transmission lines and structures	The project includes the construction of new 500 kV transmission line sections between: - Wagga 330 kV substation and Gugaa 500 kV substation (approximately 11 km) - Gugaa 500 kV substation and Wondalga (approximately 65 km) - Wondalga and Maragle 500 kV substation (approximately 46 km) - Wondalga and Bannaby 500 kV substation (approximately 234 km). The transmission line section between the Wagga 330 kV substation and proposed Gugaa 500 kV substation would operate at 330 kV under HumeLink. The project also includes the rebuild of approximately 2 km of Line 51 as a new 330 kV transmission line between the Wagga 330 kV substation and around Ivydale Road, Gregadoo. This would be adjacent to the new transmission line between the existing Wagga 330 kV and proposed Gugaa 500 kV substations. The 500 kV transmission lines would be supported on a series of free-standing steel lattice structures that would range between around 50 m up to a maximum of 76 m in height and generally spaced between 300 to 600 m apart. The typical transmission line structure height would be around 60 m. Earth wire and communications cables would be co-located on the transmission line structures. The 330 kV structures for the rebuild of Line 51 would range between 24 m and 50 m in height and have a typical height of 40 m. Indicative configurations of transmission line structures that may be used as part of the project are shown in Figure 2-1. The type and arrangement of the structures would be refined during detailed design. The footings of each structure would require an area of up to 300 m^2 to 450 m^2, depending on ground conditions and the proposed structure type. Additional disturbance at each structure site may be required to facilitate structure assembly and stringing.
Transmission line easements	The easements for the 500 kV transmission lines are typically 70 m wide. However, a number of locations may require wider easements of up to 110 m wide at transposition locations[1] and up to 130 m wide where the new transmission line would parallel the relocated section of Line 51. The easement provides a right of access to construct, maintain and operate the transmission line and other operational assets. The easement also generally identifies the zone of initial vegetation clearance and ongoing vegetation management to ensure safe electrical clearances during the operation of the lines. Vegetation management beyond the easement may also occur where nearby trees have the potential to fall and breach safety clearances.

[1] Transposition is the periodic swapping of positions of the conductors of a transmission line in order to improve transmission reliability.

Component	Description
Telecommunications hut	Telecommunications huts, which contain optical repeaters, would be required to boost the signal in the optical fibre ground wire (OPGW). One telecommunications hut would be required for the project. The telecommunications hut would be located adjacent to existing transmission line structures. Cables would be installed between the transmission line structure and the local power supply. The telecommunications hut would be surrounded by a security fence. A new easement would be established for the telecommunications hut power connection. The project also involves a telecommunications connection of OPGW between two proposed transmission line structures and the future Rye Park Wind Farm substation (SSD-6693). This removes the need for an additional telecommunications hut in this area of the project.
Substation activities	
Construction of the proposed Gugaa 500 kV substation	A new 500/330 kV substation would be constructed at Gregadoo, about 11 km south-east of the Wagga 330 kV substation. The substation would include seven new 500/330 kV transformers and three 500 kV reactors. The proposed Gugaa 500 kV substation is expected to occupy an area of approximately 22 ha.
Modification of the existing Bannaby 500 kV substation	The existing Bannaby 500 kV substation on Hanworth Road, Bannaby would be expanded to accommodate connections for new 500 kV transmission line circuits. The modification would include changes to the busbars, line bays, bench and associated earthworks, steelwork, drainage, external fence, internal/external substation roads, secondary containment dams, sediment containment dams, cabling, and secondary systems. All of the works would be restricted to the existing substation property.
Modification of the existing Wagga 330 kV substation	The existing Wagga 330 kV substation on Ashfords Road, Gregadoo would be reconfigured to accommodate new bays for two new 500 kV transmission line circuits within the existing substation property. This would include modifications to the busbars, line bays, existing line connections, bench and associated earthworks, relocation of existing high voltage equipment, drainage, external fence, internal substation roads, steelwork, cabling, and secondary systems.
Connection to the future Maragle 500 kV substation	The project would connect to the future Maragle 500 kV substation approved under the Snowy 2.0 Transmission Connection Project (SS1-9717). Construction of the Maragle substation is proposed to be undertaken between 2023 and 2026. Further detail on the Snowy 2.0 Transmission Connection project is available at the Department of Planning and Environment's Major Projects website: www.planningportal.nsw.gov.au/major-projects/project/10591.
Ancillary facilities	
Access tracks	Access to the transmission line structures and the substations would be required during construction and operation. Wherever possible, existing roads, tracks and other existing disturbed areas would be used to minimise vegetation clearing or disturbance. Upgrades to existing access tracks may be required. In areas where there are no existing roads or tracks, suitable access would be constructed. This may include waterway crossings.
Construction compounds	Construction compounds would be required during construction to support staging and equipment laydown, concrete batching, temporary storage of materials, plant and equipment and worker parking required to construct the various elements of the project. Fourteen potential construction compound locations have been identified. The proposed use of the construction compounds and their proposed boundaries/layout would be refined as the project design develops in consultation with relevant stakeholders and the construction contractors.
Worker accommodation facility	Existing accommodation facilities within towns adjacent to the project would provide temporary accommodation for the majority of the construction workers. However, a potential shortage in accommodation has been identified close to the project footprint.

Component	Description
	A potential option to provide additional temporary worker accommodation during the construction period is the establishment of a temporary worker accommodation facility at the corner of Courabyra Road and Alfred Street, Tumbarumba to accommodate about 200 construction workers. The worker accommodation facility would consist of demountable cabins and would be connected to existing utilities. All required amenities for the accommodation facility would be provided including services and worker parking for light and heavy vehicles. However, the ultimate delivery of the project may include multiple temporary worker accommodation facilities in various forms, which would be outlined in the Worker Accommodation Strategy for the project. The strategy will be developed in consultation with councils, and other relevant stakeholders. Any new or changed worker accommodation facility would be subject to additional environmental assessment, as required.
Helipad/helicopter facilities	To facilitate construction of the project, helicopters may be used to deliver materials/equipment and transfer personnel to construction areas particularly within high alpine regions. To enable helicopters to operate safely and allow easy access to the site, a helicopter landing pad would be required. The helipad is expected to occupy an area of around 30 m by 30 m and would be remediated after construction. These areas would typically be located on existing disturbed land not subject to inundation and a reasonable distance from waterways, sensitive receivers and drainage lines. Eight locations have been identified and assessed as potential helipad locations. The exact locations to be used would be confirmed during detailed design by the construction contractors. In addition to this, the existing facilities at the Wagga Wagga Airport and Tumut Airport may be used.
Utility connections, adjustments and protection	The project would require utility connections, adjustments and protection. Such works include interfaces with other transmission lines and connections to existing services for temporary facilities. Potential impacts to existing services and utilities would be confirmed during detailed design and any proposed relocation and/or protection works would be determined in consultation with the relevant asset owners.

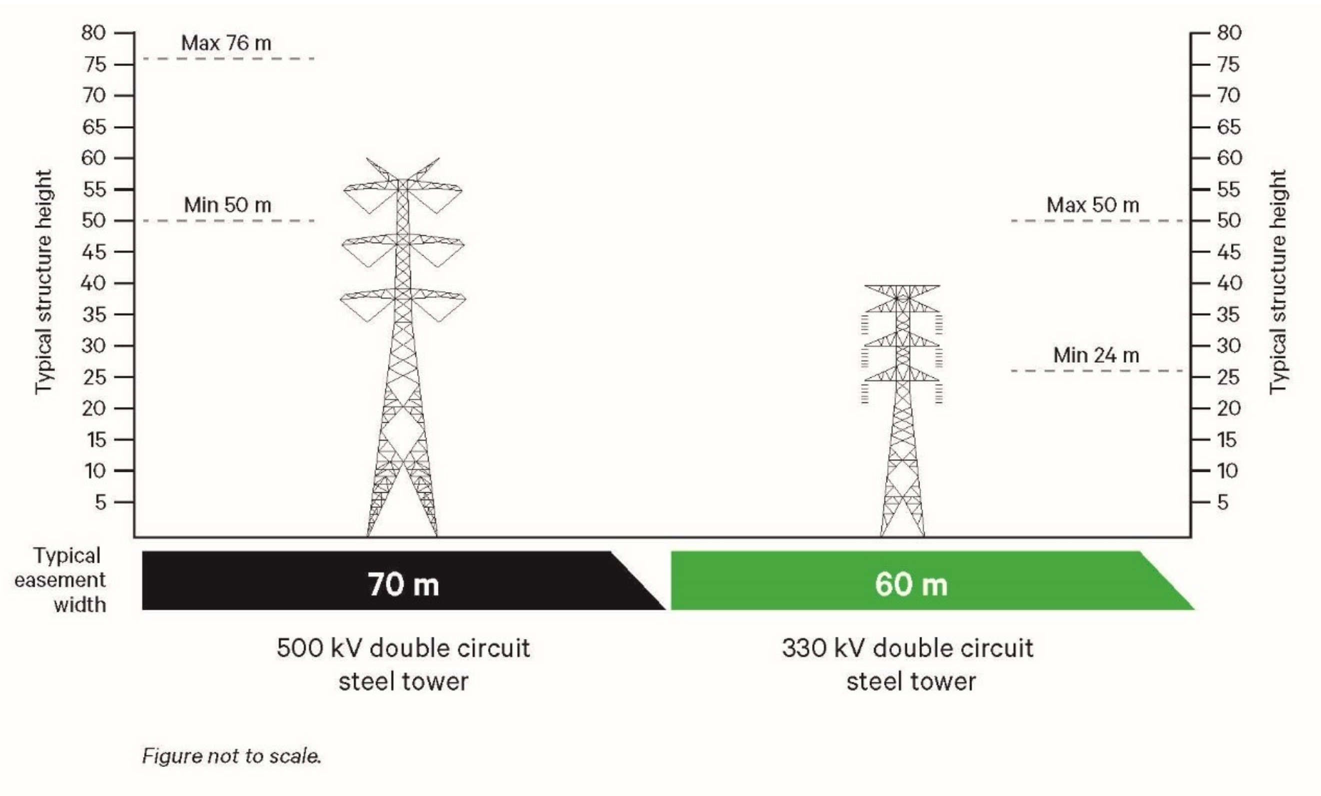


Figure 2-1 Indicative transmission line structures

2.2 Construction of the project

2.2.1 Construction activities

Key construction activities would generally include (but are not limited to):

- site establishment work, such as:
  - clearing of vegetation and topsoil
  - establishment of construction compounds and helipad/helicopter facilities
  - utility relocations and/or adjustments
  - construction of new access tracks and waterway crossings and/or upgrade of existing access tracks to transmission line structures
  - road improvement work
  - establishment of environmental management measures and security fencing
  - construction of temporary worker accommodation
- construction of the transmission lines, including:
  - earthworks and establishment of construction benches and brake and winch sites for each transmission line structure
  - construction of footings and foundation work for the new transmission line structures including boring and/or excavation, steel fabrication works and concrete pours
  - erection of the new transmission line structures

- stringing of conductors, overhead earth wires and OPGW
- installation of associated transmission line structure fittings inclusive of all earthing below ground level

- relocation of a section of Line 51, including:
  - demolition of the existing section of Line 51
  - erection of new transmission line structures for the rebuild of Line 51 in a new location
  - stringing of conductors, overhead earth wires and OPGW
  - installation of associated transmission line structure fittings inclusive of all earthing below ground level
- construction of the proposed Gugaa 500 kV substation, including:
  - bulk earthworks to form the substation bench, access roads, drainage and oil containment structures
  - installation of concrete foundations, bund walls, fire walls, noise walls and kerbs including excavation
  - installation of reinforced concrete and piled foundations for the electrical equipment and associated steel support structures
  - installation of electrical conduits, electrical trenches, site stormwater drainage, oil containment work and associated concrete pits, pipes and tanks including excavation
  - installation of new ancillary and equipment control buildings
  - erection of galvanised steel structures to support electrical equipment
  - installation of electrical equipment on foundations and/or steel support structures
  - installation of conductors, cabling, wiring, electrical panels and electrical equipment
  - erection of the substation site boundary security fencing, including site access gates
  - connection of the proposed transmission lines to the substation
- modification of the existing Wagga 330 kV substation to enable the proposed connection and operation of the new transmission lines, including:
  - demolition and removal of redundant electrical equipment, fencing and cabling
  - bulk earthworks to form the extended substation bench and modified drainage structures
  - installation of concrete foundations and kerbs including excavation
  - installation of reinforced concrete and piled foundations for the electrical equipment and associated steel support structures
  - erection of galvanised steel structures to support electrical equipment
  - installation of electrical equipment on foundations and/or steel support structures
  - installation of electrical conduits, electrical trenches, and modified site stormwater drainage including excavation
  - installation of conductors, cabling, wiring, electrical panels and electrical equipment
  - installation of fencing, lighting and other security features
  - testing and commissioning

- connection of the proposed transmission lines to the substation

- modification of the existing Bannaby 500 kV substation to enable the proposed connection and operation of the new transmission lines, including:
  - bulk earthworks to form the extended substation bench, new access road, modified stormwater drainage, modified oil containment and modified sediment control structures
  - installation of concrete foundations, retaining walls, bund walls, fire walls and kerbs including excavation
  - installation of reinforced concrete and piled foundations for the electrical equipment and associated steel support structures
  - erection of galvanised steel structures to support electrical equipment
  - installation of electrical equipment on foundations and/or steel support structures
  - installation of electrical conduits, electrical trenches, site stormwater drainage, oil containment works and associated concrete pits, pipes and tanks including excavation
  - installation of conductors, cabling, wiring, electrical panels and electrical equipment
  - installation of fencing, lighting and other security features
  - demolish redundant fencing including footings and kerbs
  - testing and commissioning
  - connection of the proposed transmission lines to the substation
- connection of the proposed transmission lines to the future Maragle 500 kV substation, including:
  - stringing conductors between transmission line structures and the future Maragle 500 kV substation gantry (including overhead earth wire (OHEW) and OPGW)
  - installing droppers from the future substation gantry to the switchgear
- construction of the telecommunications hut, including:
  - bulk earthworks to form the pad for the hut
  - excavation and preparation for concrete foundations
  - installation of reinforced concrete and piled foundations
  - excavation and installation of electrical equipment conduits, trenches and general site drainage work
  - installation of the building, site wiring and electrical equipment
  - installation of security fencing and site access gates
- installation of buried cabling from the 500 kV transmission line structures to Rye Park Wind Farm substation
- testing and commissioning of new electrical infrastructure
- demobilisation and rehabilitation of areas disturbed by construction activities.

A number of activities are expected to commence in accordance with the project conditions of approval before the key construction activities outlined above. These activities are considered pre-construction minor work and would comprise low impact activities that would begin after planning approval but prior to approval of the Construction Environmental Management Plan.

2.2.2 Construction program

Construction of the project is targeted to commence in 2024 and is estimated to take about 2.5 years to complete. The project is expected to be fully operational by the end of 2026 (refer to **Figure 2-2**).

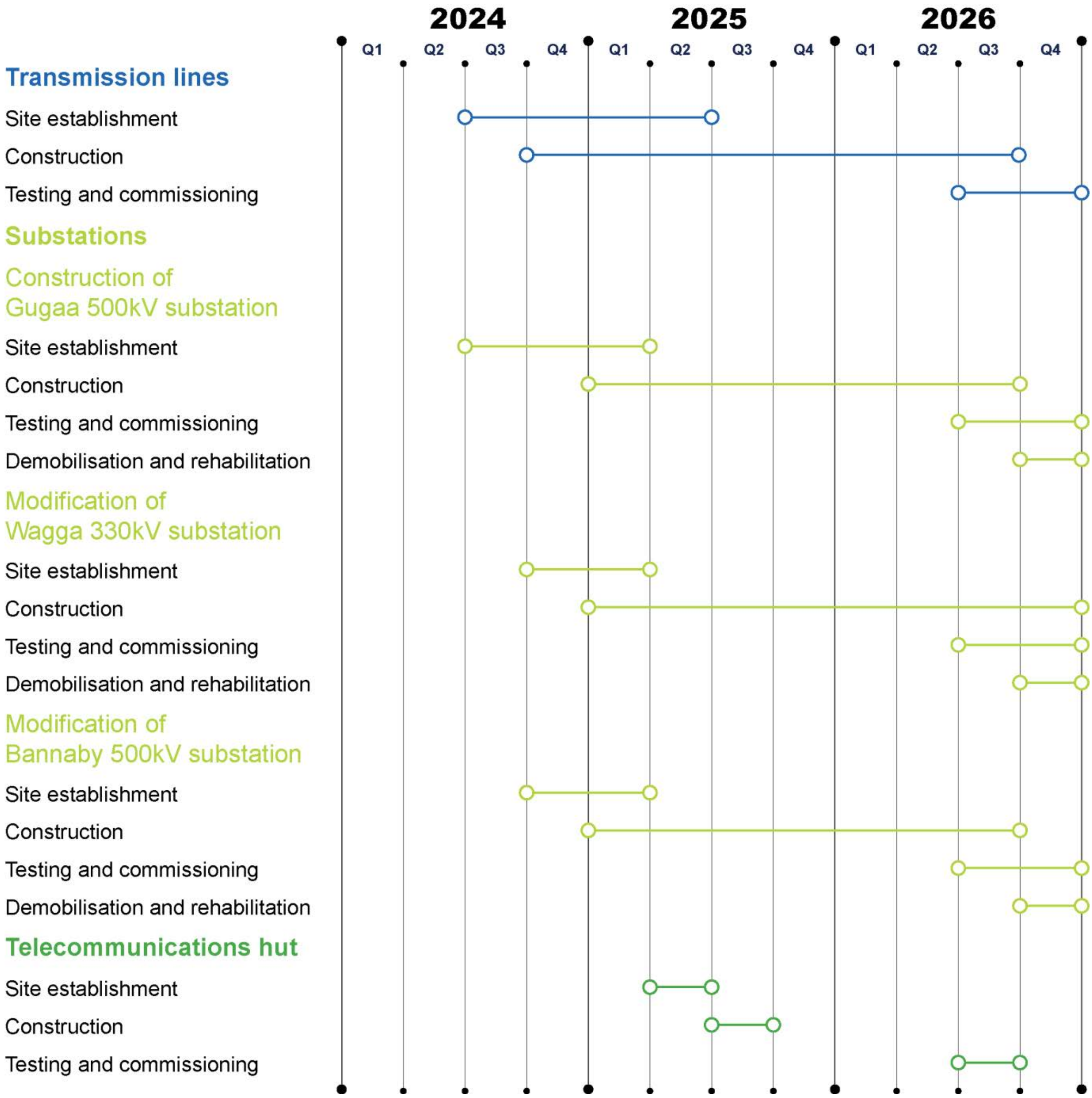


Figure 2-2 HumeLink indicative construction program

2.2.3 Indicative duration of construction activities

Construction at each transmission line structure would be intermittent and construction activities would not occur for the full duration at any one location. Durations of any particular construction activity, and inactive/respite periods, may vary for a number of reasons including (but not limited to):

- multiple work fronts
- resource and engineering constraints
- work sequencing and location.

Figure 2-3 presents an indicative duration of construction activities associated with an individual transmission line structure.

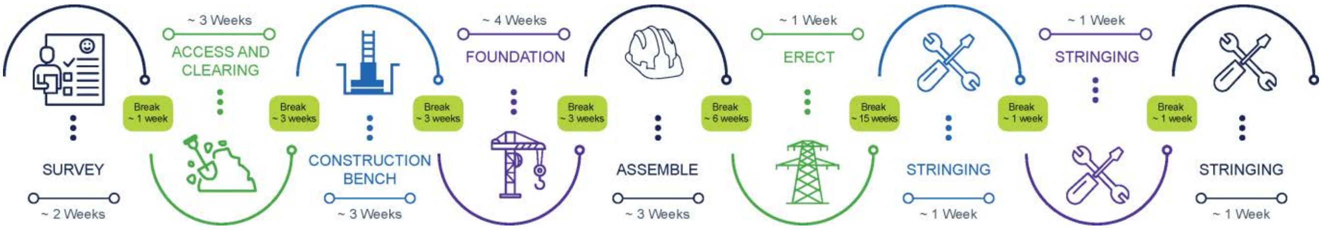


Figure 2-3 Indicative duration and sequence of construction activities for transmission line structures

Construction of the proposed Gugaa 500 kV substation could take up to 2.5 years.

2.2.4 Construction hours

It is expected that construction activities would largely be undertaken during standard construction hours. However, there would be times when working outside of standard construction hours would be required (as defined by the *Interim Construction Noise Guideline* (DECC, 2009)), subject to approval. As the details of construction methodology and project needs are developed, these hours will be refined for certain activities.

Where extended hours are proposed for activities in proximity to sensitive receivers, additional measures would be implemented, and the work would be managed through an out-of-hours work protocol.

A series of work outside the standard construction hours is anticipated to include (but is not limited to) the following:

- transmission line construction at crossings of a main road or railway as these locations are expected to have restricted construction hours requiring some night work for activities such as conductor stringing over the crossing(s)
- work where a road occupancy licence (or similar) is required, depending on licence conditions
- transmission line cutover and commissioning
- the delivery of equipment or materials outside standard hours requested by police or other authorities for safety reasons (such as the delivery of transformer units)
- limited substation assembly work (eg oil filling of the transformers)
- connection of the new assets to existing assets under outage conditions (eg modification and/or connection work at Bannaby 500 kV substation, Wagga 330 kV substation and Maragle 500 kV substation), which is likely to require longer working hours
- emergency work to avoid the loss of lives and/or property and/or to prevent environmental harm

- work timed to correlate with system planning outages
- situations where agreement is reached with affected sensitive receivers
- activities that do not generate noise in excess of the applicable noise management level at any sensitive receiver.

2.2.5 Construction plant and equipment

An indicative list of construction plant and equipment likely to be required during construction is provided below.

- air compressor
- backhoe
- bobcat
- bulldozers
- concrete agitator
- concrete pump
- cranes (various sizes up to 400 tonnes)
- crawler crane with grab attachments
- drill and blast units and associated support plant/equipment
- drones
- dumper trucks
- elevated working platforms
- excavators (various sizes)
- flatbed Hiab trucks
- fuel trucks
- generators
- graders
- helicopters and associated support plant/equipment
- mulchers
- piling rig
- pneumatic jackhammers
- rigid tippers
- rollers (10 to 15 and 12-15 tonnes)
- semi-trailers
- tilt tray trucks
- trenchers
- transport trucks
- watercarts
- winches.

2.2.6 Construction traffic

Construction vehicle movements would comprise vehicles transporting equipment, waste, materials and spoil, as well as workers' vehicles. A larger number of heavy vehicles would be required during the main civil construction work associated with the substations. Non-standard or oversized loads would also be required for the substation work (eg for transformer transport) and transportation of transmission line structure materials and conductors.

Hume Highway, Sturt Highway, Snowy Mountains Highway, Batlow Road and Gocup Road are the main national and state roads proposed to provide access to the project footprint. These roads would be supported by regional and local roads throughout the LGAs of Wagga Wagga City, Snowy Valleys, Yass Valley, Cootamundra-Gundagai Regional and Upper Lachlan Shire that connect to the project footprint.

2.2.7 Construction workers

The construction worker numbers would vary depending on the stage of construction and associated activities. During peak construction activities, the project could employ up to 1,200 full time equivalent construction workers across multiple work fronts. It is expected that the maximum number of construction workers at any one location would not exceed 200.

2.2.8 Testing and commissioning

Prior to energisation of the infrastructure, a series of pre-commissioning activities would be conducted. This would include testing the new transmission lines and substation earthing, primary and secondary equipment.

2.2.9 Demobilisation and rehabilitation

Demobilisation and site rehabilitation would be undertaken progressively throughout the project footprint and would include the following typical activities:

- demobilisation of construction compounds and worker accommodation facility
- removal of materials, waste and redundant structures not required during operation of the project
- removal of temporary fencing and environmental controls.

2.3 Operation and maintenance of the project

The design life of the project is 50 years, which can be extended to more than 70 years for some assets.

The substations and transmission lines would be inspected by field staff and contractors on a regular basis, with other operational activities occurring in the event of an emergency (as required). The project would require about five workers (in addition to Transgrid's existing workers) during operation for ongoing maintenance activities. Likely maintenance activities would include:

- regular inspection (ground and aerial) and maintenance of electrical equipment
- general building, asset protection zone and access road/track
- vegetation clearing/trimming within the easement
- fire detection system inspection and maintenance
- stormwater drainage systems maintenance.

It is expected that these activities would only require light vehicles and/or small to medium plant (depending on the work required).

3 Legislative and policy context and criteria

3.1 Summary of noise and vibration guidelines

Noise and vibration policy and guidelines are implemented at a state level in Australia with the NSW policy published by the NSW Environment Protection Authority (EPA).

The guidelines, policies and referenced standards used to assess noise and vibration impacts from the project are listed in **Table 3-1**. The guidelines and policies aim to protect the community and environment from excessive noise and vibration impacts.

Table 3-1 Noise and vibration guidelines

Guideline/Policy name	Where guideline is used	Section discussed
ICNG, Department of Environment and Climate Change (DECC), 2009	Assessment of construction airborne noise and ground-borne noise impacts on sensitive receivers	**Section 3.2**
Assessing Vibration: a Technical Guideline (AvaTG), Department of Environment and Conservation (DEC), 2006	Assessment of construction vibration impacts on sensitive receivers	**Section 3.4**
Road Noise Policy (RNP), Department of Environment, Climate Change and Water (DECCW), 2011	Assessment of construction traffic impacts	**Section 3.3**
BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2, BSI, 1993	Screening assessment of construction vibration impacts (cosmetic damage) to sensitive buildings and structures	**Section 3.4**
DIN 4150:Part 3-2016 Structural vibration – Effects of vibration on structures, Deutsches Institute fur Normung, 2016	Screening assessment of construction vibration impacts (cosmetic damage) to vibration sensitive heritage buildings and structures, where the structure is found to be unsound	**Section 3.4**
Noise Policy for Industry (NPfI), Environmental Protection Authority (EPA), 2017	Assessment of operational noise impacts, ambient noise monitoring and analysis procedures, and assessment of sleep disturbance	**Section 3.6**
Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration, Australian and New Zealand Environmental Conservation Council (ANZECC), 1990	Assessment of vibration and overpressure from blasting	**Section 3.5**
AS 2187.2-2006 Explosives – Storage and use, Part 2: Use of explosives	Assessment of vibration and overpressure from blasting	**Section 4.3.7**

3.2 Construction airborne noise guidelines

The ICNG is used to assess and manage impacts from construction noise on residences and other sensitive land uses in NSW.

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

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

3.2.1 Residential and commercial receivers

The ICNG approach for determining NMLs at residential receivers is shown in **Table 3-2**. The project specific NMLs for residential receivers are provided in **Section 5.3**.

Table 3-2 ICNG NMLs for residential receivers

Time of day	NML $L_{Aeq(15minute)}$	How to apply
Standard construction hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected Rating Background Level (RBL) + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured average noise level for 15 minutes ($L_{aeq(15minute)}$) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

	Highly noise affected
	75 dBA
		The highly noise affected (HNA) level represents the point above which there may be strong community reaction to noise.
		• Where noise is above this level, the relevant authority (consent, determining or regulatory may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account:
		  ◦ Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences).
		  ◦ If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Outside standard construction hours:	Noise affected RBL + 5 dB	• A strong justification would typically be required for work outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: The rating background level (RBL) and the ICNG refers to the calculation procedures in the NSW *Industrial Noise Policy* (INP). The INP has been superseded by the NpfI. The RBLs have been determined in accordance with the calculation procedures outlined in the NpfI as described in **Chapter 5**.

Note 2: The Laeq is the A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

The ICNG recommends work to be completed during standard construction hours where possible. More stringent requirements are placed on work that is required to be completed outside of standard construction hours (ie during the evening or night-time) which reflects the greater sensitivity of communities to noise impacts during these periods.

3.2.1.1 Sleep disturbance

Major infrastructure projects often require certain work to be completed during the night-time. Where night work is located close to residential receivers there is potential for sleep disturbance impacts.

The ICNG lists five categories of work that might be required to be undertaken outside the standard construction hours:

- the **delivery of oversized equipment or structures** that require special arrangements to transport on public roads
- **emergency work** to avoid the loss of life or damage to property, or to prevent environmental harm

- **maintenance and repair of public infrastructure** where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- **public infrastructure work** that shortens the length of the project and are supported by the affected community
- work where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Where construction work is planned to extend over more than two consecutive nights, the ICNG recommends that an assessment of sleep disturbance impacts should be completed.

The most current method for assessing sleep disturbance from NSW transport infrastructure projects is contained in the NpfI. Although the NpfI sleep disturbance criteria relate to industrial noise, they are considered relevant for reviewing potential impacts from construction noise.

The NpfI defined sleep disturbance criteria is 52 dBA L_{AFmax} or the prevailing background level plus 15 dB, whichever is the greater.

3.2.2 'Other sensitive' land uses and commercial receivers

Non-residential land uses have been identified in the study area, as per the ICNG. These include 'other sensitive' land uses such as educational institutes, medical facilities, outdoor recreational areas and commercial properties. The NMLs for 'other sensitive' receivers are shown in **Table 3-3**.

Table 3-3 NMLs for 'other sensitive' receivers

Land Use	Noise management level $L_{Aeq(15minute)}$ (dBA) (applied when the property is in use)	
	Internal	External
ICNG 'other sensitive' receivers		
Classrooms at schools and other educational institutions	45	55[1]
Hospital wards and operating theatres	45	65[2]
Places of worship	45	55[1]
Active recreation areas (characterised by sporting activities and activities which generate noise)	-	65
Passive recreation areas (characterised by contemplative activities that generate little noise)	-	60
Commercial	-	70
Industrial	-	75
Non-ICNG 'other sensitive' receivers		
Hotel – day-time & evening[3]	50	70[2]
Hotel – night-time[3]	40	60[2]
Child care centres – sleeping areas[4]	40	50[1]

Note 1: It is assumed that these receivers have windows partially open for ventilation which results in internal noise levels being around 10 dB lower than the external noise level.

Note 2: It is assumed that these receivers have fixed windows which conservatively results in internal noise levels being around 20 dB lower than the external noise level.

Note 3: Criteria taken from AS2107.

Note 4: Criteria taken from Association of Australian Acoustical Consultants *Guideline for Child Care Centre Acoustic Assessment*.

3.2.3 Aircraft noise regulation

Noise emissions from flight operations of aircraft in Australia are regulated by the Air Navigation (Aircraft Noise) Regulations 2018, which is made under the *Air Navigation Act 1920*. This Regulation applies to the noise emissions from aircraft including helicopters and remote piloted aircrafts (RPAs, commonly referred to as drones) used during the construction of the project for transportation of construction equipment and materials.

The regulations require that a noise certificate will be issued for the aircraft or RPA where the aircraft meets the relevant standards. These activities are not considered for construction or regulated under the *Protection of the Environment Operations Act 1997* (POEO Act) in NSW.

Any ground activity supporting aircraft operation such as a use of a refuelling truck is assessed against the ICNG.

3.3 Construction traffic noise guidelines

The potential impacts from construction traffic associated with the project when travelling on public roads are assessed under the RNP.

An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2.0 dB due to construction traffic. Where this is considered likely, further assessment is required using the RNP base criteria shown in **Table 3-4**.

Table 3-4 RNP criteria for assessing construction traffic on public roads

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

Where the criteria are exceeded, the RNP requires the project to consider the use of all feasible and reasonable mitigation and management measures to minimise the impacts.

3.4 Construction vibration guidelines

The effects of vibration from construction work can be divided into three categories:

- Those in which the occupants of buildings are disturbed (**human comfort**). Occupants of buildings can sometimes perceive vibration impacts when vibration generating construction work is located nearby. Vibration from construction work tends to be intermittent in nature and AvaTG provides criteria for intermittent vibration based on the Vibration Dose Value (VDV), as shown in **Table 3-5**. While the construction activities for the project are generally not expected to result in continuous or impulsive vibration impacts, criteria are provided in **Table 3-6**.

- Those where building contents may be affected (**building contents**). People perceive vibration at levels well below those likely to cause damage to building contents. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents. Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes or medical imaging equipment, are in buildings near to construction work. No such equipment is expected near to vibration intensive construction work based on the types of buildings and receivers in the noise and vibration study area.
- Those where the integrity of the building may be compromised (**structural/cosmetic damage**). If vibration from construction work is sufficiently high, it can cause cosmetic damage to elements of affected buildings. Industry standard cosmetic damage vibration limits are specified in British Standard BS 7385 and German Standard DIN 4150. The limits are shown in **Table 3-7** and **Table 3-8**.

Table 3-5 Human comfort vibration – vibration dose values for intermittent vibration

Building Type	Assessment Period	Vibration Dose Value[1] ($m/s^{1.75}$)	
		Preferred	Maximum
Critical working areas (eg operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Day-time	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Note 1: The VDV accumulates vibration energy over the day-time and night-time assessment periods and is dependent on the level of vibration as well as the duration.

Table 3-6 Human comfort vibration – preferred and maximum weighted root mean square values for continuous and impulsive vibration acceleration (m/s^2) 1–80 Hertz (Hz)

Location	Assessment period	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
Critical working areas[1]	Day or night-time	0.0050	0.0036	0.010	0.0072
Residential	Day-time	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
Workshops	Day or night-time	0.04	0.029	0.080	0.058
Impulsive vibration					
Critical working areas[1]	Day or night-time	0.0050	0.0036	0.010	0.0072
Residential	Day-time	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Note 1: Such as operating theatres or precision laboratories where sensitive operations are occurring. No such areas have been identified in the study area.

Table 3-7 Cosmetic damage – BS 7385 Transient vibration values for minimal risk of damage

Group	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse[1]	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures. Residential or 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

Note 1: Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values may need to be reduced by up to 50%.

Table 3-8 Cosmetic damage – DIN 4150 guideline values for short-term vibration on structures

Group	Type of structure	Guideline values vibration velocity (mm/s)[1]				
		Foundation, all directions at a frequency of			Topmost floor, horizontal	Floor slabs, vertical
		1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40	20
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified as Group 1 or 2 **and** are of great intrinsic value (eg heritage listed buildings)	3	3 to 8	8 to 10	8	20[1]

Note 1: It may be necessary to lower the relevant guideline value markedly to prevent minor damage.

3.4.1 Heritage buildings or structures

Heritage listed buildings and structures should be considered on a case-by-case basis but as noted in BS 7385 should not be assumed to be more sensitive to vibration, unless structurally unsound. Where a heritage building is deemed to be sensitive, the more stringent DIN 4150 Group 3 guideline values in **Table 3-8** can be applied.

The heritage listed items identified in the study area are detailed in **Section 5.1.1**.

3.4.2 Minimum working distances for vibration intensive work

Minimum working distances for typical vibration intensive construction equipment are provided in the Roads and Maritime (now Transport for NSW) *Construction Noise and Vibration Guideline* (CNVG) (RMS, 2016) and are shown in **Table 3-9**. The minimum working distances are for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from the NSW EPA Vibration Guideline). They are calculated from empirical data which suggests that where work is further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 3-9 Recommended minimum working distances from vibration intensive equipment

Plant item	Rating/Description	Minimum distance		
		Cosmetic damage		Human response (NSW EPA Guideline)
		Residential and light commercial (BS 7385)	Heritage items (DIN 4150, Group 3)	
Vibratory roller	<50 kN (1–2 t)	5 m	11 m	15 m to 20 m
	<100 kN (2–4 t)	6 m	13 m	20 m
	<200 kN (4–6 t)	12 m	25 m	40 m
	<300 kN (7–13 t)	15 m	31 m	100 m
	>300 kN (13–18 t)	20 m	40 m	100 m
	>300 kN (>18 t)	25 m	50 m	100 m
Small hydraulic hammer	300 kg (5 to 12 t excavator)	2 m	5 m	7 m
Medium hydraulic hammer	900 kg (12 to 18 t excavator)	7 m	15 m	23 m
Large hydraulic hammer	1,600 kg (18 to 34 t excavator)	22 m	44 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Piling rig – bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

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

As noted earlier, heritage buildings and structures should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. Where heritage buildings and structures are found to be structurally unsound, a more conservative cosmetic damage objective of 2.5 mm/s Peak Particle Velocity (PPV) (from DIN 4150) would be considered.

3.5 Vibration and overpressure from blasting

Blasting events have the potential to result in brief ground vibration and air overpressure impacts at nearby receivers.

Blasting work for the project would generally be associated with special or difficult foundation work. There could also be some potential areas of difficult or steep terrain where an access track is required and blasting work in a small area of the track may be the most appropriate construction approach.

Blasting also has the benefit of substantially reducing the duration of noise and vibration impacts when compared to traditional earthwork methods.

The ICNG recommends the following hours for blasting:

- Monday to Friday (9am to 5pm)
- Saturday (9am to 1pm)
- no blasting on Sundays or public holidays.

The ICNG requires vibration and overpressure from blasting to be assessed against the ANZECC *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (ANZECC, 1990).

The criteria in the ANZECC guideline are applicable to long-term operations, such as those at mining sites and quarries, and are targeted to protect human comfort from vibration. As a result, guideline levels can be considered conservative in the context of construction, which typically occur for much shorter time periods.

The ANZECC criteria recommends the following vibration and overpressure limits:

- vibration PPV: **5 mm/s**

  The PPV level of 5 mm/s may be exceeded on up to 5 per cent of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/s at any time.

- airblast overpressure: **115 dBL**

  The level of 115 dBL may be exceeded on up to 5 per cent of the total number of blasts over a period of 12 months. The level should not exceed 120 dBL at any time.

3.6 Operational noise guidelines

The NPfI was released in 2017 and sets out the requirements for the assessment and management of operational noise from industry in NSW.

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

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

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

Intrusive and amenity noise levels are not used directly as regulatory limits. They are used to assess the potential impact of noise, assess feasible and reasonable mitigation options and subsequently determine achievable noise requirements.

The NPfI provides guidance on assigning residential receiver amenity noise categories based on the site-specific features shown in **Table 3-10**.

Table 3-10 Residential receiver amenity

Receiver category	Typical planning land use zoning	Typical existing background noise levels (RBL)[1]	Description
Rural	RU1 – primary production RU2 – rural landscape RU4 – primary production small lots R5 – large lot residential E4 – environmental living	Daytime <40 dBA Evening <35 dBA Night <30 dBA	Rural – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Note: Where background noise levels are higher than those presented due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.
Suburban residential	RU5 – village RU6 – transition R2 – low density residential R3 – medium density residential E2 – environmental conservation E3 – environmental management	Daytime <45 dBA Evening <40 dBA Night <35 dBA	Suburban – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.

Receiver category	Typical planning land use zoning	Typical existing background noise levels (RBL)[1]	Description
Urban residential	R1 – general residential R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing) B2 – local centre (boarding houses) B4 – mixed use	Daytime >45 dBA Evening >40 dBA Night >35 dBA	Urban – an area with an acoustical environment that: • is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources • has through-traffic with characteristically heavy and continuous traffic flows during peak periods • is near commercial districts or industrial districts • has any combination of the above.

Note 1: In accordance with the NPfI, the assessment periods are the daytime which is 7am to 6pm Monday to Saturday and 8am to 6pm on Sundays and public holidays, the evening which is 6pm to 10pm, and the night-time which is 10pm to 7am on Monday to Saturday and 10pm to 8am on Sunday and public holidays.

The amenity noise categories contribute to determining the Project Noise Trigger Levels (PNTL), which are levels that if exceeded would indicate a potential noise impact, thereby 'triggering' a management response. The PNTLs are summarised in **Section 5.4**.Operational noise sources from the project are expected to be limited to the proposed Gugaa 500 kV substation and the transmission line route, which are all relatively distant from major towns. Therefore, the amenity noise category for the surrounding receivers have been determined as 'rural', with reference to the NPfI.

3.6.1 Sleep disturbance

The potential for sleep disturbance from project construction maximum noise level events during the night-time period is required to be considered.

The NPfI defines the sleep disturbance screening levels as:

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

A detailed maximum noise level event assessment should be completed where the sleep disturbance screening level is exceeded. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night-time period.

The NPfI refers to the RNP for additional information regarding sleep disturbance. The RNP references *the Health Effects of Environmental Noise – Other Than Hearing Loss,* enHealth Council, 2004 and the *Guidelines for Community Noise*, World Health Organisation, 1999, which indicate that for good sleep over eight hours the indoor L_{AFmax} sound pressure level should ideally not exceed around 45 dBA more than 10 or 15 times per night.

The RNP goes on to conclude that, based on research on sleep disturbance to date:

- maximum internal noise levels below 50 dBA to 55 dBA are unlikely to awaken people from sleep
- one or two events per night with maximum internal noise levels of 65-70 dBA are not likely to affect health and wellbeing significantly.

3.6.2 Corrections for annoying noise characteristics

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, intermittency or dominant low-frequency content. The NPfI specifies the following modifying factor corrections, shown in **Table 3-11**, which are to be applied where annoying characteristics are present. The corrections are to be added to the noise level at the receiver before being compared to the PNTLs.

Table 3-11 NPfI modifying factor corrections

Factor	Assessment/Measurement	When to Apply	Correction[1]
Tonal noise	One-third octave or narrow band analysis	Correction to be applied where the level of one-third octave band exceeds the level of the adjacent bands on both sides by the levels defined in the NPfI.	5 dB[2]
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements	Measure/assess source contribution C and A weighted $L_{eq,t}$ levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and the level to which the thresholds defined in the NPfI are exceeded.	2 or 5 dB[2]
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level	Correction to be applied where the source noise heard at the receiver varies by more than 5 dB and the intermittent nature of the noise is clearly audible. The NPfI further defines intermittent noise as noise where the level suddenly drops/increases several times during the assessment period, with a noticeable change in source noise level of at least 5 dB, for example, equipment cycling on and off. The intermittency correction is not intended to be applied to changes in noise level due to meteorology.	5 dB[3]
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated.	Maximum correction of 10 dB[2] (excluding duration correction)

Note 1: Corrections to be added to the measured or predicted levels.

Note 2: Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

Note 3: Adjustment to be applied to night-time only.

Details of the modifying factor corrections applied in the assessment are provided in **Chapter 7**.

4 Methodology

4.1 Overview of approach

This report has been developed in accordance with the guidelines in **Section 3.1** and the following high-level methodology:

- identification of the noise and vibration study area based on the expected extent of impacts
- identification and classification of all potentially noise and vibration sensitive receivers within the study area
- monitoring of ambient noise at representative locations across the project
- processing the monitored data in accordance with the relevant guidelines to determine the ambient environment and project specific noise management levels
- modelling the construction and operation of the project infrastructure to predict noise and vibration levels at the surrounding sensitive receivers
- comparison of the predicted levels to the project noise and vibration management levels to determine the likely level of impact
- identification of mitigation measures to minimise and manage any predicted noise and vibration impacts.

4.2 Monitoring approach

Unattended ambient noise monitoring was completed in the study area between March and August 2022. The measured noise levels have been used to determine the existing noise environment and to set criteria to assess the potential impacts from the project.

The ambient noise monitoring locations were selected with reference to the procedures outline in the NPfI, to establish representative background noise levels across the project footprint and surrounding land uses. The monitoring locations were selected with reference to guidance in the ICNG and NPfI that background noise monitoring should be conducted to represent the reasonably most-affected receivers, considering existing background levels and shielding between sources and receivers. The measured existing noise levels are representative of receivers that would likely be most affected by the construction of the project.

The noise monitoring equipment continuously measured existing noise levels in 15-minute periods. All equipment carried current National Association of Testing Authorities calibration certificates and the calibration was checked before and after each measurement.

The results of the noise monitoring have been processed with reference to the NPfI to exclude noise from extraneous events and/or data affected by adverse weather conditions, such as strong wind or rain (measured at a locally deployed weather station, Wagga Wagga Bureau of Meteorology (BoM) Weather Station, Goulburn BoM Weather Station and High Range BoM Weather Station), to establish representative existing noise levels for the study area.

4.3 Construction assessment approach

4.3.1 Construction scenarios

4.3.1.1 Construction scenario descriptions

Representative scenarios have been developed to assess the likely impacts from the construction activities. Equipment lists for each scenario and sound power level data is provided in **Attachment C**.

The assessment uses 'realistic worst-case' scenarios to predict the potential airborne noise impacts from the noisiest 15-minute period for each work scenario, as required by the ICNG.

It is expected that there would be relatively long periods where construction noise levels are much lower than the worst-case levels presented in this assessment. There would also be times when work is not audible at receivers due to less noisy items of equipment being used or where work is in distant parts of the project footprint relative to the nearest receivers.

The representative scenarios required to construct the project are listed and described in **Table 4-1**. The scenarios represent one possible way that the project could be constructed and may not necessarily be the same methodology that the contractor engaged to construct the project would use.

Table 4-1 Construction scenario descriptions

Scenario	Description
Substations	
Site establishment	Establishment of temporary construction site offices and amenities for the new and modified substations.
Earthwork and vegetation clearance	Bulk earthworks to form the substation bench, access roads and drainage and oil containment structures including placement of rock/gravel/soil. Excavation and preparation of the site for concrete foundations, bund walls, fire walls, noise walls and kerbs. Vegetation removal as required.
Civil and building work	Installation of reinforced concrete and piled foundations for the electrical equipment and associated steel support structures. Construction of new ancillary and equipment control buildings. Erection of galvanised steel structures to support electrical equipment.
Installation of high voltage equipment and associated structures	Use of cranes to unload and erect building materials, plant, steelwork, electrical equipment and portable buildings. Installation of electrical equipment on foundations and/or steel support structures. Installation of site wiring, electrical panels and electrical equipment.
Pre-commissioning activities	Erection of the substation site boundary security fencing, including site access gates.
Demobilisation and rehabilitation	Surfacing and stabilising works for access, dust and vegetation suppression and drainage. Landscaping outside the substation security fence including establishing grass and vegetation to stabilise exposed soil.
Tie-in work	Connection of the proposed transmission lines to the existing and new substations.

Scenario	Description
Transmission lines	
Site establishment and deliveries	Establishment of transmission line work site and delivery of equipment or materials.
Access tracks	Construction of access tracks to accommodate safe access for construction machinery and materials to each transmission line structure work site.
Earthwork and clearing	Clearing of vegetation at and between the transmission line structures. Clearing of topsoil and excavation work at each transmission line structure site for the installation of foundations, levelling around the individual structure foundations, drainage and grading or preparation for construction at the structure site. Excavations would typically be up to five m in depth. Earthworks and establishment of construction pads and brake and winch sites. This scenario is also representative of the demolition of the existing section of Line 51 connecting to Wagga 330 kV substation.
Construction of structures	Construction of transmission line structures by assembling sections of the structures on the ground and hoisting or lifting successive sections into place using cranes. Alternatively, transmission line structures may be erected in place on the footings by installing individual sections. These transmission line structures would include infrastructure such as step bolts, climbing attachment plates, ladders, platforms, climbing barriers, identification plates, warning plates, other fixtures and fittings for the attachment of earth wires and insulators.
Brake and winch sites	Stringing, tensioning and pulling of transmission line by a ground-pulled draw wire with brake/winch machines (ie brake and winch sites).
Overhead stringing of conductors and earth wires	Stringing of transmission lines (conductors and earthwires) by a line-stringing drone and ground-based support from winches, cranes, etc. Only ground-based activities are assessed under the ICNG (see **Section 4.3.4**).
Decommissioning and rehabilitation	Replacement of topsoil and establishment of grass or suitable vegetation, rehabilitation of access roads or tracks where they are not required for further construction activities or operation of the project. These areas would be restored back to their previous existing conditions as reasonably as possible. Work may also be undertaken to restore: • irrigation and water infrastructure facilities to pre-existing conditions before construction • natural drainage in areas where temporary facilities were provided • fences, gates, and other infrastructure, which may have been damaged during construction. Topsoil would be stockpiled within the project footprint and reused for revegetation and rehabilitation work where required.
Telecommunications hut construction	Construction of one telecommunications hut nearby the transmission line easement. The construction methodology for these telecommunications hut would involve: • installation of reinforced concrete and piled foundations for the building • excavation and installation of electrical equipment conduits, trenches and general site drainage works • installation of the building on foundations • installation of site wiring and electrical equipment • erection of the telecommunications hut site boundary security fencing, including site access gates • surfacing and stabilising works for access, dust, vegetation suppression and drainage.

Scenario	Description
Construction compounds and worker accommodation facility	
Site establishment	Clearing and removal of topsoil and vegetation. Topsoil would be stockpiled within the project footprint and reused for revegetation and rehabilitation works, where required. Establishment of ancillary facilities including construction compounds, batching plants, worker accommodation facility, offices, amenities, workshops and internal roads. Utility adjustments and protection as well as connections to utilities (water and power) to ancillary facilities, where required. Establishment of vehicle access and egress points, truck wheel wash, rumble grids, hardstand areas, laydown areas, car parking and fencing around the perimeter of the construction site where required.
Construction compound operation	Compounds would be required to support construction and would include activities such as: • staging and equipment laydown • temporary storage of materials, plant and equipment • worker parking • concrete batching at Bannaby 500 kV substation compound (C12).
Accommodation facility operation	The worker accommodation facility would consist of demountable cabins and would be connected to existing utilities. Operation of the facility would include power generators, light and heavy vehicle movements.

4.3.1.2 Working hours

Construction of the project would be carried out during standard construction hours where possible. Standard construction hours are defined in the ICNG and shown in **Figure 4-1**.

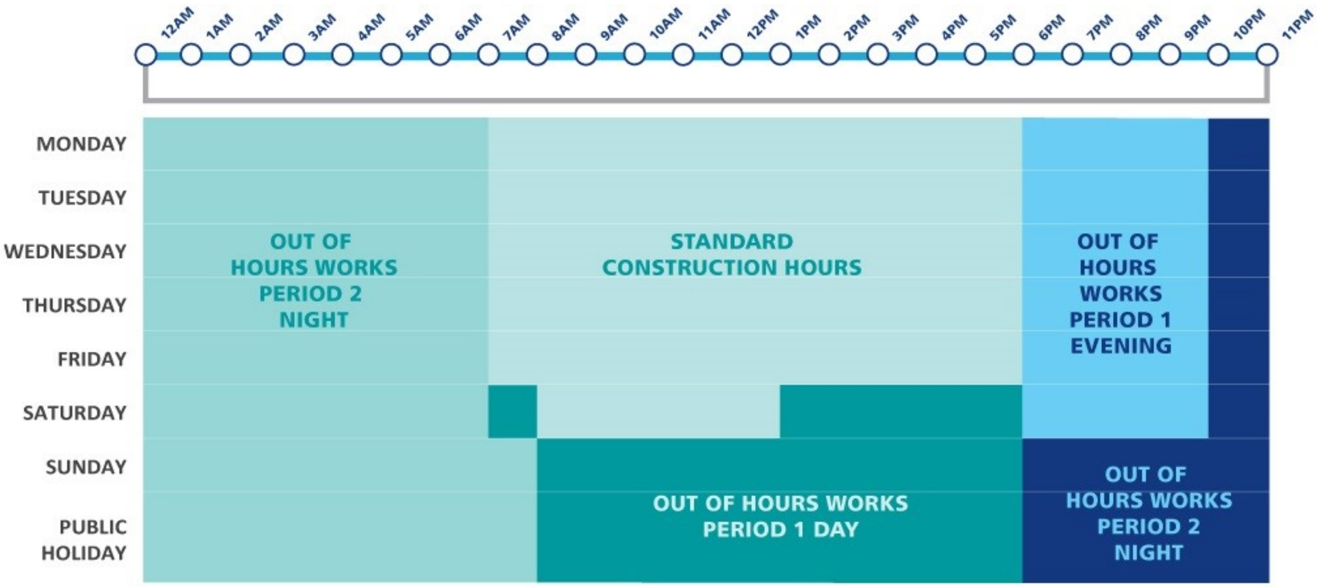


Figure 4-1 Standard construction hours[1, 2, 3]

Note 1: Taken from the *Construction Noise and Vibration Strategy* (TfNSW, 2019).

Note 2: Standard Construction Hours are Monday to Friday 7am to 6pm and Saturdays from 8am to 1pm, as defined in the ICNG.

Note 3: Work outside of Standard Construction Hours is defined as 'Out-of-Hours Work' (OOHW) and can be divided into two periods of sensitivity. OOHW Period 1 relates to evening (and weekend day-time) work, and OOHW Period 2 relates to night-time (and weekend evening) work.

Project specific constraints would require evening and night-time work for some construction activities. A summary of the proposed construction hours for the project is shown in **Table 4-2**.

Table 4-2 Construction scenarios and working hours

Scenario	Estimated Duration[1]	Hours of Work			
		Standard Day-time	Day OOH[2]	Evening	Night-time
Substations					
Site establishment	4 months	✓	-	-	-
Earthwork and vegetation clearance	2-4 months	✓	-	-	-
Civil and building work	12-14 months	✓	-	-	-
Installation of high voltage equipment and associated structures	11-12 months	✓	✓	✓	✓
Pre commissioning activities	3-5 months	✓	-	-	-
Decommissioning and rehabilitation	3 months	✓	-	-	-
Tie in work	3 months	✓	-	-	-
Transmission lines					
Site establishment and deliveries	1-3 weeks per transmission line structure	✓	-	-	-
Access tracks	1–2 days per track	✓	-	-	-
Earthwork and clearing	1-5 days per transmission line structure	✓	-	-	-
Construction of structures	2 weeks per transmission line structure	✓	-	-	-
Brake and winch sites	1-3 weeks per brake and winch site	✓	-	-	-
Overhead stringing of conductors and earth wires	3 weeks per stringing site	✓	✓	✓	✓
Decommissioning and rehabilitation	2-3 days per transmission line structure	✓	-	-	-
Telecommunications hut construction	1-2 months	✓	-	-	-
Construction compounds					
Site establishment	3-4 weeks	✓	-	-	-
Compound operation	Project duration	✓	-	-	-
Worker accommodation facility					
Site establishment	7-10 weeks	✓	-	-	-
Facility operation	20-24 months	✓	✓	✓	✓

Note 1: Durations are indicative and would be confirmed by the construction contractor.

Note 2: OOH = out-of-hours. Day-time out-of-hours is Saturday between 7 am to 8 am and 1 pm to 6 pm, on Sunday and public holidays between 8 am to 6 pm.

Justification for work required to be completed outside of standard construction hours is provided in **Table 4-3**.

Table 4-3 Work outside of standard construction hours

Scenario	Comments/Justification
Substations – installation of high voltage equipment and associated structures	Over-sized equipment deliveries, transformer/reactor assembly work and other work that needs to occur under strict outage conditions.
Transmission lines – overhead stringing of conductors and earth wires	Stringing work near to major roads or other infrastructure with strict outage conditions.
Worker accommodation facility – facility operation	Out-of-hours activities would generally be limited to vehicle movements and operation of 24/7 plant such as generators.

Line stringing work outside of standard day-time hours is assumed to be required at:

- the Snowy Mountains Highway, between Adelong and Tumut
- the Hume Highway, between Holbrook and Tarcutta
- the Hume Highway, between Yass and Bowning
- the Main Southern Railway Line, between Yass and Bowning (adjacent to the Hume Highway)
- up to twelve existing transmission line crossings.

The work site required for this line stringing is assumed to extend up to 500 metres either side of the infrastructure being crossed.

Further investigation of out-of-hours work sites should be considered during the next stages of the project when detailed construction planning information is available. This process is detailed in **Chapter 9**.

4.3.2 Construction compounds approach

A noise model of the study area has been used to predict noise levels from the construction compounds (listed in **Section 6.1** and shown in **Attachment B**) to the surrounding receivers. The model uses International Organisation for Standardisation (ISO) 9613-2:1996 algorithms as implemented in SoundPLAN software to predict noise levels at surrounding receivers.

Local terrain and receivers were digitised in the noise model to develop a three-dimensional representation of the construction compounds and surrounding areas. In the towns of Batlow and Yass, three-dimensional building structures were modelled. Building structures in these more densely populated areas were included to represent the screening effect of the buildings nearest to the construction compounds (ie how buildings act as a barrier in the propagation of sound). A 5.5 metre building height was adopted to represent typical single story residences. This provides a conservative approach compared to assuming multi-storey buildings, since taller buildings would provide a greater screening effect for the receivers that are more distant from the potential construction compounds.

4.3.3 Construction of transmission lines approach

Given the extent of the project across a large geographical area, transmission line construction noise has been assessed based on the two dimensional distance between the project footprint and the surrounding receivers. The assessment uses the ISO 9613-2 method of calculation and assumes flat ground conditions, which represent the worst-case propagation path.

4.3.4 Noise from aircraft operations approach

It is expected that aircrafts including helicopters and drones would be used during construction of the project for material transport where access to a remote site is required and for the stringing of transmission lines.

Aircraft noise is typically assessed at airports where flights occur on a daily basis and affect the acoustic amenity at nearby residences. Given there are only intermittent aircraft operations within the project footprint, it is not considered necessary to generate Air Noise Exposure Forecasts (ANEF) for the project.

Noise mitigation measures applicable to aircraft operations are included in **Chapter 9.**

4.3.5 Construction road traffic noise approach

Construction related traffic has the potential to temporarily increase road traffic noise levels at receivers which are adjacent to construction routes. The potential impacts from construction traffic on public roads have been predicted using the *Calculation of Road Traffic Noise* (CORTN) algorithm. These include 323 road sections which are expected to carry traffic for construction of the project (refer *Technical Report 16 – Traffic and Transport Impact Assessment* for full road details).

The forecast construction traffic volumes have been used to determine where potentially noticeable increases in road traffic noise (ie a greater than 2.0 dB increase above the existing noise level) is likely. Where potential 2.0 dB increases are identified, the total road traffic noise levels are compared to the RNP L_{Aeq} criteria.

The majority of construction traffic movements would occur in the day-time period, however, this assessment conservatively assumes that the construction workers may mobilise traffic between 6am and 7am. Therefore, the peak construction traffic light vehicle movements are assessed during the night-time period.

Several construction routes include unsealed roads. A +7 dB road traffic noise correction has been applied to the predictions for unsealed roads. The following road speeds have been assumed, noting that many of the roads pass through towns where the speed limit would be 50 kilometres per hour and road traffic noise would be lower:

- arterial / sub-arterial roads – 100 kilometres per hour
- sealed local roads – 80 kilometres per hour
- unsealed local roads – 60 kilometres per hour.

A summary of the inputs for the construction road traffic noise assessment are presented in **Attachment D**.

4.3.6 Construction vibration approach

The potential impacts during vibration intensive work have been assessed using the CNVG minimum working distances for cosmetic damage and human response shown in **Table 3-9**. The assessment identifies structures which are within the minimum working distances based on the construction scenarios with vibration intensive equipment as shown in **Table 4-4**.

Table 4-4 Vibration intensive equipment

Scenario	Vibration intensive equipment	Minimum working distance		
		Cosmetic damage	Heritage items	Human response
Substations: Earthwork and vegetation clearance **Transmission Lines:** Access tracks Earthworks and clearing	Medium hydraulic hammer	7 m	15 m	23 m
Transmission Lines: Brake and winch sites	Medium vibratory roller	15 m	31 m	100 m
Substations: Earthwork and vegetation clearance **Transmission Lines:** Access tracks Earthworks and clearing	Large vibratory roller	25 m	50 m	100 m

Note 1: Other items of vibration generating equipment may be required at times during the works, however, they are expected to be less vibration intensive.

The access track locations are subject to refinement during detailed design and have not been considered in the vibration assessment in **Section 6.4.** However, the minimum working distances in **Table 4-4** should be considered when final locations are known.

4.3.7 Construction blasting approach

Airblast overpressure and ground vibration levels for the project are considered based on the methodology contained within Australian Standard (AS) 2187.2-2006.

4.3.7.1 Airblast overpressure

To assess potential airblast overpressure levels at nearby receivers, the following site law[2] formula was adopted from AS 2187.2:

$$\mathrm{P} = K_a \left(\frac{R}{(Q^{1/3})}\right)^a$$

Where:

P = Pressure (kilopascals)

Q = Maximum Instantaneous Charge (effective charge mass per delay), in kg. Explosive loading/detonation sequence/effective charge mass per delay. The maximum charge, in kilograms, initiated at any instant of time

R = Distance from charge (m)

K_a = Site constant

a = Site exponent, a value of -1.45 was adopted as per AS 2187.2

[2] Site law refers to a site specific empirically derived relationship between geological conditions and the propagation of vibration.

The conversion of the 'P' pressure unit to linear decibels (dBL) is completed using the following formula:

$$\mathrm{SPL} = 10\,x \log\left(\frac{P}{P_0}\right)^2$$

An airblast overpressure site constant (K_a) would depend on confinement of the blast and can be confirmed with trial blasts.

4.3.7.2 Ground vibration

To assess potential blasting vibration levels at nearby sensitive receivers, the following site law formula is adopted from AS 2187.2:

$$\mathrm{V} = K_g\left(\frac{R}{(Q^{1/2})}\right)^{-B}$$

Where:

V = ground vibration as vector peak particle velocity (mm/s)

R = distance between charge and point of measurement (metres)

Q = Maximum Instantaneous Charge (effective charge mass per delay), in kg. Explosive loading/detonation sequence/effective charge mass per delay. The maximum charge, in kilograms, initiated at any instant of time.

K_g = a constant related to site and rock properties for estimation purposes

B = a constant related to site and rock properties for estimation purposes, a value of 1.6 was adopted.

The ground vibration site constant (K_g) is determined through trial blasts.

4.4 Operational assessment approach

4.4.1 Operational substation approach

The potential operational noise levels from project substations have been predicted to the surrounding receivers using the CONCAWE industrial noise algorithm in SoundPLAN. The model includes ground topography, ground type (75 per cent absorption for open grass areas) and representative worst-case noise sources from the project.

The potential impacts have been determined by comparing the predicted worst-case noise levels to the NPfI PNTLs in a 15-minute assessment period.

4.4.1.1 Proposed Gugaa 500 kV substation

The proposed Gugaa 500 kV substation would be constructed as part of the project at Gregadoo, around 11 kilometres south-east of the Wagga 330 kV substation. The substation is proposed to include noise producing equipment such as transformers, auxiliary transformers and shunt reactors. An operational noise assessment has been undertaken for this substation, as detailed in **Section 7.1**.

4.4.1.2 Wagga 330 kV substation

The existing Wagga 330 kV substation on Ashfords Road, Gregadoo would be reconfigured to accommodate new bays for two new transmission line circuits (built using 500 kV capable transmission line structures, however energised at 330 kV) within the existing substation property boundary. This would include modifications to the busbars, line bays, existing line connections, bench and associated earthworks, relocation of existing high voltage equipment, drainage, external fence, internal substation roads, steelwork, cabling, and secondary systems.

No additional noise generating equipment, such as transformers or capacitor banks, are proposed at the Wagga 330 kV substation as part of the project. Therefore, there is expected to be negligible change to the operational noise emissions of the substation. An operational noise assessment has not been undertaken for this substation.

4.4.1.3 Bannaby 500 kV substation

The existing Bannaby 500 kV substation on Hanworth Road, Bannaby would be expanded to accommodate connections for new 500 kV transmission line circuits. The modification would include changes to the busbars, line bays, bench and associated earthworks, steelwork, drainage, external fence, internal/external substation roads, secondary containment dams, sediment containment dams, cabling, and secondary systems.

Additional shunt reactors are proposed to be installed at the Bannaby 500 kV substation as part of the project. However, the additional equipment is expected to be substantially quieter than the existing transformers. Therefore, there is expected to be negligible change to the operational noise emissions of the substation. Additionally, the nearest sensitive receivers are around one kilometre from the substation. An operational noise assessment has not been undertaken for this substation.

4.4.1.4 Maragle 500 kV substation

The project would connect to the future Maragle 500 kV substation, which is approved and to be built under the Snowy 2.0 Transmission Connection Project. No additional noise generating equipment, such as transformers or capacitor banks, are proposed to be installed at the future Maragle 500 kV substation as part of the project. Therefore, there is expected to be negligible change to the operational noise emissions of the substation. Additionally, the nearest sensitive receivers are around four kilometres from the substation. An operational noise assessment has not been undertaken for this substation.

4.4.1.5 Weather conditions

Certain weather conditions can increase noise levels by focusing noise towards receivers. Noise-enhancing weather conditions can occur where wind blows from the source to the receiver, or where temperature inversions[3] occur. In these cases, layers of air with different wind speeds or temperatures can cause the sound waves to refract and increase noise levels at receivers.

The NPfI defines 'standard' and 'noise-enhancing' weather conditions as shown in **Table 4-5**. Noise-enhancing weather should be included in an assessment where it occurs for more than 30 per cent of the day-time, evening or night-time period in any season.

[3] Atmospheric conditions where temperatures increase with height above ground level.

Table 4-5 Standard and noise-enhancing weather conditions

Weather Conditions	Meteorological Parameters
Standard	Day-time/evening/night-time: stability categories A–D with wind speed up to 0.5 m/s
Noise-enhancing	Day-time/evening: stability categories A–D with light winds up to 3 m/s Night-time: stability categories A–D with light winds up to 3 m/s and/or stability category F with winds up to 2 m/s

The NPfI contains guidance for determining noise enhancing weather. Data measured between January 2017 and December 2021 at the Wagga Wagga BOM weather station has been used to determine the occurrence of noise-enhancing weather conditions at the site and a summary is shown in **Table 4-6**. The Wagga Wagga BOM weather station was selected due to its proximity to the proposed Gugaa 500 kV substation, where an operational noise assessment with consideration of noise enhancing weather is required.

Table 4-6 Occurrence of noise enhancing weather conditions

Period	Wind Speed from 0.5 to 3 m/s (Frequency of Occurrence > 30%)								Atmospheric Stability Class F or G[1]
	N	NE	E	SE	S	SW	W	NW	
Day-time	-	-	-	-	-	-	-	-	n/a
Evening	-	-	-	-	-	-	-	-	n/a
Night-time	-	-	Yes	-	-	-	-	-	Yes

The weather analysis shows that noise-enhancing weather conditions are expected to be a feature of the area. Worst-case potential conditions of stability category F with 2 m/s source to receiver wind during the night-time period have been considered for the assessment of the proposed Gugaa 500 kV substation.

4.4.1.6 Corrections for annoying noise characteristics

The potential annoying noise characteristics and modifying factor corrections relevant to the substation equipment are:

- **Tonality** – noise generating components including power transformers and reactors are selected to be non-tonal to avoid annoying tonal emissions. Therefore, no corrections for tonality noise have been applied.
- **Low frequency noise** – previous measurements of sources similar to the project indicate that no sources are expected to result in low frequency noise impacts.

4.4.2 Operational transmission line approach

Operation of high voltage transmission lines has the potential to generate audible noise during certain meteorological conditions. To assess the potential noise impacts associated with the project transmission lines, an audible noise report has been completed (*HumeLink Audible Noise and Radio Interference*, (Aurecon Australasia Pty Ltd, 2022)). The sections of the audible noise report relating to the modelling and description of audible noise emissions are summarised in **Attachment E**.

Audible noise associated with the operation of high voltage transmission lines is primarily attributed to the ionisation of air in a small region around the conductors. The electrical discharge from the conductors, known as corona discharge, causes the small surrounding region to become conductive and continually transfer charge from the conductors, resulting in the emission of a broadband hum or crackling noise.

Noise emissions from the project transmission lines are considered in the following sections (refer to **Figure 1-1** for place names) based on altitude and associated meteorological conditions:

- Gugaa to Wagga
- Maragle to Wondalga
- Wondalga to Gugaa
- Wondalga to Bannaby.

There are two conductor arrangements being considered for the project, referred to as Quad Orange and Triple Pawpaw. The assessment in this report is based on the Quad Orange arrangement, which is anticipated to be used for the project. However, **Attachment E** includes information on the expected noise emissions if the Triple Pawpaw conductor arrangement is used for the project. At this stage of the project the final transmission line route is not known. This assessment conservatively assumes that the transmission line may be anywhere within the project footprint, with consideration of a 70 metre minimum easement (ie the transmission line may be anywhere up to a 35 metre buffer within the project footprint). When the final transmission line route and easement is defined within the project footprint, it is expected that noise impacts at most of the surrounding receivers would be less than the conservative scenario based on project footprint that has been used for this assessment.

Where existing 330 kV and 500 kV transmission lines run parallel to the proposed project footprint, their cumulative noise emissions are considered at the surrounding receivers. Existing 132 kV lines were also considered but are expected to produce much lower noise levels that would not contribute to the cumulative impact at surrounding receivers.

4.4.3 Operational maintenance and traffic

The project substations and transmission lines would be inspected on a regular schedule once operational. This work may include:

- line inspection via light vehicles or helicopter
- maintenance activities with a small crew, generally limited to light vehicles or a medium rigid truck as required
- vegetation removal to maintain required clearances.

Project vehicle movements on public roads are not expected to exceed the RNP screening criteria of a >2.0 dB increase (see Section 3.3) for road traffic noise impacts, noting that this level of increase generally requires a 60 per cent increase in traffic.

Therefore, the risk of noise and vibration impacts from operational traffic and maintenance activities at sensitive receivers is considered minimal and has not been quantitatively assessed.

4.4.3.1 Weather conditions

The potential noise emission from high voltage transmission lines is expected to increase during wet weather conditions when water droplets form on the surface of the conductors. It is also understood that higher altitudes and higher temperatures generally result in higher noise emissions.

Three weather scenarios were considered in the audible noise assessment (**Attachment E**) and are described as:

- fair weather – maximum ambient temperature and altitude from historical weather data for the region
- L50 (light rain or mist) – maximum altitude for the relevant section of transmission line and L50 rain simulated at a rate of 0.75 millimetres per hour (noting temperature variation is not supported in the modelling methodology used to represent L50 conditions (see **Attachment E**))
- heavy rain – Typical temperatures during rain, maximum altitude for the region and heavy rain simulated at a rate of 18 millimetres per hour.

Although heavy rain is expected to produce the highest potential noise emissions, the ambient noise environment is also expected to be notably elevated during heavy rain. Therefore, L50 conditions representing light rain and mist are considered to be the governing scenario with respect to the NPfI criteria. It is assumed that the minimum background noise levels specified in the NPfI may occur during L50 conditions (light rain or mist) and the night-time PNTL of 35 dBA is applied.

4.4.3.2 Corrections for annoying noise characteristics

The potential annoying noise characteristics and modifying factor corrections relevant to the transmission lines are:

- **Tonality** – Transmission line noise emissions can include a 100 Hz tonal hum which is dependent on the arrangement of the conductor bundles and distance from the transmission line. The audible noise report (**Attachment E)** considered the transmission line tonal noise and found that its contribution is expected to be negligible at the transmission line easement, particularly during the worst-case L50 weather conditions. Therefore, no corrections for tonality noise have been applied.

5 Existing environment

5.1 Sensitive receivers

Sensitive receivers were identified within the project noise and vibration study area (see **Section 1.6.2**). Receivers potentially sensitive to noise and vibration have been categorised as residential buildings, commercial/industrial buildings, or 'other sensitive' land uses.

The identified receivers surrounding the project are largely residential. The 'other sensitive' receivers in the study area are generally grouped in the towns of Batlow, Tumbarumba and Yass. Four individual places of worship have also been identified in rural areas between Yass and Bannaby. The sensitive receivers relative to the project footprint are shown in **Attachment B**.

Sensitive receivers have been modelled as points surrounding most of the project footprint where they are relatively isolated, however, receivers have been digitised as 3D buildings in the towns of Batlow and Yass as discussed in **Section 4.3.2**.

Some sensitive receivers have been identified within the project footprint. Since the transmission line route within the project footprint is not final at this stage, these receivers have conservatively been included in the assessment and generally result in predictions of high noise and vibration levels from the project. However, if receivers fall within the project's final easement, the properties would be acquired by the project and no longer considered to be sensitive to noise and vibration.

5.1.1 Sensitive heritage receivers

The heritage listed buildings and structures near to the project which are potentially sensitive to vibration are detailed in **Table 5-1**.

Table 5-1 Heritage listed items

Item Name	Address	Heritage significance	Council Local Environmental Plan (LEP) item number	Distance to nearest structure[1]
Ivydale Woolshed	9 Ivydale Road, Gregadoo	Local	I73	700 m
Stone ruin	1149 Gregadoo East Road, Gregadoo	Local	I71	500 m
Elizabeth Nugent grave on College Creek	1615 Humula Road, Tarcutta	Local	I202	430 m
Kiley's Run	Red Hill State Forest, Adjungbilly	Indicative on the Register of National Estate (RNE)	16005	240 m

Note 1: Approximate minimum horizontal distance from the project footprint to the nearest structure of the heritage listed item.

See *Technical Report 3 - Historic Heritage Impact Assessment* for more information on historic heritage items near to the project footprint.

All identified vibration sensitive heritage structures are beyond the recommended minimum working distances for vibration intensive equipment likely required for the project construction, shown in **Table 4-4** (refer to **Section 4.3.6**).

5.1.2 New developments

A review of recently approved potentially noise and vibration sensitive developments in the study area has been completed and the identified developments have been included in the assessment in **Chapter 6** and **Chapter 7**, where appropriate.

5.2 Noise survey and monitoring locations

The noise monitoring locations and results are summarised in **Table 5-2**. Descriptions of each monitoring location and the measured noise environment, together with graphs of the daily measured noise levels, are also in **Attachment F**.

Table 5-2 Summary of noise monitoring results

Location ID	Address	Noise Level (dBA)[1,2]					
		Background noise (RBL)			Average noise level (L_{Aeq})		
		Day	Evening	Night	Day	Evening	Night
L01[3]	83 Ashfords Road, Wagga Wagga	31	29	26	46	43	38
L02	1070 Livingstone Gully Road, Gregadoo	29	<25	<25	52	41	42
L03	Snowy Mountains Highway, Gilmore	45	43	41	58	56	55
L04[4]	1428 Adjungbilly Road, Adjungbilly	39	39[5] (47)	38	53	57	51
L05	Hanworth Road, Bannaby	26	26[5] (27)	<25	44	39	46
L06	14 Memorial Avenue, Batlow	35	35	32	60	53	49
L07	Bowmans Lane, Batlow	29	29[5] (30)	29[5] (30)	46	43	43
L08	Perry Street, Yass	38	38[5] (42)	34	56	58	52
L09	38 Alfred Street, Tumbarumba	30	30[5] (53)	30[5] (39)	54	58	53

Note 1: The RBL and L_{Aeq} noise levels have been determined with reference to the procedures in the NPfI.

Note 2: Day-time is 7am to 6pm, evening is 6pm to 10pm and night-time is 10pm to 7am.

Note 3: Data taken from EnergyConnect (NSW – Eastern Section) Environmental Impact Statement, conducted in 2020.

Note 4: The ambient noise environment at this location was found to be influenced by extraneous noise (likely mechanical plant/equipment in the vicinity of the monitor) and is not considered representative of the surrounding area.

Note 5: The monitored evening or night level was found to be higher than the day-time. In this situation the NPfI requires that the evening or night level be reduced to match the day-time. The monitored level is shown in brackets.

Short-term attended noise monitoring was completed at each ambient monitoring location. The attended measurements allow the contributions of the various noise sources at each location to be determined. Detailed observations from the attended measurements are provided in **Attachment F**.

The attended measurements were generally found to be consistent with the results of the unattended noise monitoring and showed that the existing noise environment are generally controlled by natural sources, such as wildlife and weather, as expected in rural areas.

Urban noise sources were noted to influence the background environment at some locations, including:

- road traffic noise at Gilmore, Yass and Batlow
- industrial noise at Gilmore Sawmill
- occasional aircraft noise at Tumut, Adjungbilly Road and Bannaby.

5.3 Summary of residential NMLs

The residential NMLs, for the assessment of project construction, have been determined using the results from the unattended ambient noise monitoring and are shown in **Table 5-3**.

Table 5-3 Residential Receiver Construction NMLs

Location	Representative background monitoring location	NML ($L_{Aeq(15minute)}$ – dBA)				Sleep disturbance screening criteria (52 dBA or RBL +15 dB whichever is higher)
		Standard construction (RBL +10 dB)	Out-of-hours (RBL +5 dB)			
		Day-time	Day-time[1]	Evening	Night-time	
Gilmore	L03	55	50	48	46	56
Yass	L08	48	43	43	39	52
Batlow	L06	45	40	40	37	52
All other receivers	L01, L02, L05, L07, L09	45	40	35	35	52

Note 1: Day-time out-of-hours is 7am to 8am and 1pm to 6pm on Saturday, and 8am to 6pm on Sunday and public holidays.

Note 2: The minimum RBLs in the NPfI are listed as 35 dBA in the day-time and 30 dBA in the evening and night-time. These minimum RBLs have been adopted for all rural areas of the project. Unattended noise monitoring at several locations confirmed the RBLs to be equal to or less than these levels.

5.4 Project Noise Trigger Levels

The trigger levels for operational industrial noise from the project are summarised in **Table 5-4**, based on the measured background noise levels. The PNTLs are the most stringent of the intrusiveness and amenity trigger level for each period and are highlighted below.

Table 5-4 Project Noise Trigger Levels

Period	Recommended Amenity Noise Level L_{Aeq} (dBA)	Measured Noise Level (dBA)		Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)	
		RBL[1]	$L_{Aeq(period)}$	Intrusiveness	Amenity[2,3]
Day-time	50	35[4]	44-52	**40**	48
Evening	45	30[4]	39-48	**35**	43
Night-time	40	30[4]	36-46	**35**	38

Note 1: RBL = Rating Background Level.

Note 2: The recommended amenity noise levels have been reduced by 5 dB, where appropriate, to give the project amenity noise levels due to other sources of industrial noise being present in the area, as outlined in the NPfI.

Note 3: The project amenity noise levels have been converted to a 15-minute level by adding 3 dB, as outlined in the NPfI.

Note 4: RBL increased to the minimum RBL specified in the NPfI.

6 Construction impact assessment

The following assessment shows the predicted construction noise impacts, which have been assessed based on the exceedance of the noise management levels. Exceedances of the NMLs are presented as per the CNVG exceedance categories in **Table 6-1**, which is considered a suitable guideline for the assessment and management of impacts from the project.

Table 6-1 Exceedance bands and impact colouring

Subjective classification	Exceedance of noise management level		Impact colouring
	Day-time	Out of hours	
Negligible	No exceedance	No exceedance	
Noticeable	-	1 to 5 dB	
Clearly Audible	1 to 10 dB	6 to 15 dB	
Moderately Intrusive	11 to 20 dB	16 to 25 dB	
Highly Intrusive	> 20 dB	> 25 dB	

For most construction activities, it is expected that the construction noise levels would frequently be lower than predicted, as the noise levels presented in this report are based on each scenario occurring at the work site boundary which is the closest point to each receiver.

The assessment is generally considered conservative as the calculations also assume several items of construction equipment are in use at the same time within individual scenarios. In reality, there would frequently be periods when construction noise levels are much lower than the worst-case levels predicted as well as times when no equipment is in use.

It is noted that the assessed scenarios represent one possible way that the project could be constructed and may not necessarily be the same methodology that the construction contractors engaged to construct the project would use. The representative scenarios cover a range of noise producing activities, including highly noise intensive equipment, therefore are considered representative of the worst-case construction noise.

6.1 Construction noise impacts from construction compound sites

A total of 14 possible construction compounds have been identified to support construction of the project. All 14 potential construction compounds have been assessed, however, the construction contractors may not require all of the sites. A worker accommodation facility (Tumbarumba Accommodation Facility (AC1)) is also proposed to support the construction of the project. The construction compound sites and accommodation facility are summarised in **Table 6-2.**

Table 6-2 Construction compound and worker accommodation facility sites

Site Label	Site Name	Locality	Approximate distance to nearest receiver
C01	Wagga 330 kV substation compound	Lake Albert/Gregadoo	280 m
C02	Snowy Mountains Highway compound	Gilmore	60 m
C03	Snubba Road compound	Blowering	780 m
C05	Maragle 500 kV substation compound	Nurenmerenmong	3,750 m

Site Label	Site Name	Locality	Approximate distance to nearest receiver
C06	Gregadoo Road compound	Gregadoo	720 m
C07	Honeysuckle Road compound	Adjungbilly	1,680 m
C08	Red Hill Road compound	Adjungbilly	1,560 m
C09	Adjungbilly Road compound	Adjungbilly	750 m
C10	Yass substation compound	Yass	690 m
C11	Woodhouselee Road compound	Woodhouselee	950 m
C12	Bannaby 500 kV substation compound	Bannaby	1,000 m
C14	Memorial Avenue compound	Batlow	30 m
C15	Bowmans Lane compound	Batlow	50 m
C16	Snubba Road compound	Laurel Hill / Batlow	5,200 m
AC1	Tumbarumba Accommodation Facility	Tumbarumba	60 m

The worst-case construction compound and accommodation facility noise impacts presented in the following sections are also shown in **Attachment G.1** for the day-time period and **Attachment G.2** for the night-time.

6.1.1 Number of NML exceedances

The number of residential receivers where NML exceedances are predicted for the construction compound and worker accommodation facility, is summarised in **Table 6-3** and **Table 6-4** for day-time and OOH work, respectively.

A summary of the number of ‘other sensitive’ receivers where NML exceedances are predicted for the construction compound activities is shown in **Table 6-5**.

A summary of the number of residential receivers where NML exceedances are predicted for the substation activities is shown in **Table 6-6** and **Table 6-7** for day-time and OOH work, respectively. No exceedances of the NMLs are predicted at the existing Bannaby 500 kV substation so it is not included in the below tables.

Results presented in the tables are colour coded as per the exceedance bands shown in **Table 6-1**. A discussion on the results is presented after the tables.

Table 6-3 Residential daytime NML exceedances – Construction compounds and accommodation facility

Scenario	Duration[1]	Number of receivers			
		HNA[2]	With NML exceedance[3]		
			1-10 dB	11-20 dB	>20 dB
Wagga 330 kV substation compound (C01)					
Site establishment	3-4 weeks	-	9	1	-
Compound operation	Project duration	-	5	-	-
Snowy Mountains Highway compound (C02)					
Site establishment	3-4 weeks	-	1	-	-
Compound operation	Project duration	-	-	-	-

Scenario	Duration[1]	Number of receivers			
		HNA[2]	With NML exceedance[3]		
			1-10 dB	11-20 dB	>20 dB
Snubba Road compound (C03)					
Site establishment	3-4 weeks	-	1	-	-
Compound operation	Project duration	-	-	-	-
Gregadoo Road compound (C06)					
Site establishment	3-4 weeks	-	3	-	-
Compound operation	Project duration	-	-	-	-
Adjungbilly Road compound (C09)					
Site establishment	3-4 weeks	-	2	-	-
Compound operation	Project duration	-	-	-	-
Yass substation compound (C10)					
Site establishment	3-4 weeks	-	48	-	-
Compound operation	Project duration	-	-	-	-
Memorial Avenue compound (C14)					
Site establishment	3-4 weeks	1	446	81	6
Compound operation	Project duration	1	338	21	3
Bowmans Lane compound (C15)					
Site establishment	3-4 weeks	-	64	5	3
Compound operation	Project duration	-	13	3	1
Tumbarumba Accommodation Facility (AC1)					
Site establishment	3-4 weeks	-	41	6	1
Accommodation facility operation	Project duration	-	2	1	-

Note 1: Durations should be regarded as indicative and represent a typical work site.

Note 2: Highly Noise Affected, based on ICNG definition (ie predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels. Impact colouring based on CNVG exceedance categories in **Table 6-1**.

Table 6-4 Residential OOH NML exceedances – Accommodation facility

Scenario	Duration[1]	Number of receivers												
		HNA[2]	With NML exceedance[3]											
			Day-time OOH[4]				Evening / Night-time				Sleep disturbance			
			1-5 dB	5-15 dB	15-25 dB	>25 dB	1-5 dB	5-15 dB	15-25 dB	>25 dB	1-5 dB	5-15 dB	15-25 dB	>25 dB
Tumbarumba Accommodation Facility (AC1)														
Accommodation facility operation	Project duration	-	4	2	1	-	5	6	1	-	2	2	1	-

Note 1: Durations should be regarded as indicative and represent a typical work site.

Note 2: Highly Noise Affected, based on ICNG definition (ie predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels. Impact colouring based on CNVG exceedance categories in **Table 6-1**.

Note 4: OOH = Out-of-hours. During the day-time, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

Table 6-5 Other sensitive NML exceedances – Construction compounds

Scenario	Duration[1]	Number of receivers with NML exceedance[2]											
		Commercial			Educational			Medical			Place of worship		
		1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
Memorial Avenue compound (C14)													
Site establishment	3-4 weeks	1	-	-	7	-	-	-	1	-	2	-	-
Compound operation	Project duration	-	-	-	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite.

Note 2: Based on worst-case predicted noise levels. Impact colouring based on CNVG exceedance categories in **Table 6-1**.

A summary of the number of residential receivers where NML exceedances are predicted for the substation activities is shown in **Table 6-6** and **Table 6-7** for day-time and OOH work, respectively. No exceedances of the NMLs are predicted at the existing Bannaby 500 kV substation so it is not included in the below tables.

Table 6-6 Residential day-time NML exceedances – Substations

Scenario	Duration[1]	Number of receivers			
		HNA[2]	With NML exceedance[3]		
			1-10 dB	11-20 dB	>20 dB
Wagga 330 kV substation					
Site establishment	4 months	-	-	-	-
Earthwork and vegetation clearance	2-4 months	-	9	1	-
Civil and building work	12-14 months	-	1	-	-
Installation of high voltage equipment and associated structures	11-12 months	-	1	-	-
Pre commissioning activities	3-5 months	-	-	-	-
Decommissioning and rehabilitation	3 months	-	1	-	-
Tie-in work	3 months	-	-	-	-
Proposed Gugaa 500 kV substation					
Site establishment	4 months	-	-	-	-
Earthwork and vegetation clearance	2-4 months	-	2	-	-
Civil and building work	12-14 months	-	-	-	-
Installation of high voltage equipment and associated structures	11-12 months	-	-	-	-
Pre commissioning activities	3-5 months	-	-	-	-
Decommissioning and rehabilitation	3 months	-	-	-	-
Tie-in work	3 months	-	-	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite.

Note 2: Highly Noise Affected, based on ICNG definition (ie predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels. Impact colouring based on CNVG exceedance categories in **Table 6-1**.

Table 6-7 Residential OOH NML exceedances – Substations

Scenario	Duration[1]	Number of Receivers												
		HNA[2]	With NML Exceedance[3]											
			Day-time OOH[4]				Evening / Night-time				Sleep Disturbance			
			1-5 dB	6-15 dB	16-25 dB	>25 dB	1-5 dB	6-15 dB	16-25 dB	>25 dB	1-5 dB	6-15 dB	16-25 dB	>25 dB
Wagga 330 kV substation														
Installation of high voltage equipment and associated structures	1 month	-	4	1	-	-	9	5	-	-	1	-	-	-
Proposed Gugaa 500 kV substation														
Installation of high voltage equipment and associated structures	1 month	-	1	-	-	-	1	1	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite.

Note 2: Highly Noise Affected, based on ICNG definition (ie predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels. Impact colouring based on CNVG exceedance categories in **Table 6-1**.

Note 4: OOH = Out-of-hours. During the day-time, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

The above assessment of the worst-case impacts shows the following:

Construction compounds and accommodation facility

- No exceedances of the NMLs are predicted at any sensitive receivers for the Maragle 500 kV substation compound (C05), Honeysuckle Road compound (C07), Red Hill Road compound (C08), Woodhouselee Road compound (C11), Bannaby 500 kV substation compound (C12) and Snubba Road compound (C16).
- 'Highly intrusive' (>20 dB) worst-case day-time impacts are predicted at up to 10 receivers closest to Memorial Avenue compound (C14), Bowmans Lane compound (C15) and Tumbarumba Accommodation Facility (AC1) (refer to **Table 6-3**). This is primarily due to the close proximity of the receivers and the low existing background noise levels.
- The residential receiver closest to Memorial Avenue compound (C14) is predicted to be highly noise affected (>75 dBA) during both 'site establishment' and 'compound operation' (refer to **Table 6-3**).
- 'Moderately intrusive' (11-20 dB) worst-case day-time impacts are predicted during 'site establishment' work at the receiver closest to the Wagga 330 kV substation compound (C01). At all other construction compounds, the worst-case impacts are predicted to be 'clearly audible' (1-10 dB) (refer to **Table 6-3**).
- 'Moderately intrusive' (16-25 dB) worst-case night-time impacts are predicted at the closest receiver during 'accommodation facility operation' at Tumbarumba Accommodation Facility (AC1) (refer to **Table 6-4**). This is primarily due to the near proximity of the receivers and the potential for heavy vehicle movements at the facility.
- Sleep disturbance impacts are predicted at up to five of the residential receivers closest to Tumbarumba Accommodation Facility (AC1) (refer to **Table 6-4**). Sleep disturbance impacts would generally be caused by heavy vehicle movements. The number of awakening events would depend on several factors, including the number of heavy vehicles accessing the site during the night-time and the way in which vehicles are operated.

- ‘Other sensitive’ receivers in Batlow are predicted to be impacted during worst-case daytime ‘site establishment’ work at Memorial Avenue compound (C14) (refer to **Table 6-5**), resulting in:
  - ‘Moderately intrusive’ (11-20 dB) impacts at Batlow-Adelong Multipurpose Service (hospital)
  - ‘Clearly audible’ (1-10 dB) impacts at Batlow Technology School, Saint Mary’s School, Saint Mary’s Church and St John’s Anglican Church.
- ‘Site establishment’ work generates more noise and results in more exceedances compared to ‘compound operation’, due to the requirement for more noise intensive equipment, such as dozers and graders. ‘Site establishment’ would, however, be limited to a duration of approximately 3-4 weeks per site.
- Construction compound work is only predicted to exceed the NMLs at ‘other sensitive’ receivers near Memorial Avenue compound (C14) during site establishment.

Substations

- No exceedances of the NMLs are predicted from construction at the Bannaby 500 kV substation.
- ‘Moderately intrusive’ (11-20 dB) worst-case day-time impacts are predicted at the receiver closest to the Wagga 330 kV substation. This impact is only predicted during ‘earthwork and vegetation clearance’ work. ‘Clearly audible’ (1-10 dB) worst-case day-time impacts are predicted at up to nine of the next closest receivers during ‘earthwork and vegetation clearance’. During all other day-time work activities impacts are predicted to be ‘clearly audible’ (1-10 dB) at only the closest receiver or compliant with the NMLs (refer to **Table 6-6**).
- ‘Clearly audible’ (1-10 dB) worst-case day-time impacts are predicted at the two receivers closest to the proposed Gugaa 500 kV substation during ‘earthwork and vegetation clearance’ (refer to **Table 6-6**). The noise levels are predicted to be compliant at all surrounding receivers during all other day-time work activities.
- ‘Clearly audible’ (1-10 dB) worst-case impacts are predicted at the receiver closest to existing Wagga 330 kV substation and proposed Gugaa 500 kV substation during the evening and night-time periods (refer to **Table 6-7**). The only proposed out-of-hours activity is ‘installation of high voltage equipment and associated structures’, where oversized equipment deliveries and transformer/reactor assembly work may need to occur.
- Sleep disturbance impacts are predicted at the residential receiver closest to Wagga 330 kV substation (refer to **Table 6-7**). Sleep disturbance impacts would generally be caused by heavy vehicle movements and more noise intensive equipment such as vacuums and oil pumps required for ‘installation of high voltage equipment’. The number of awakening events would depend on several factors, including the equipment being used and the duration of noisy work.
- No receivers are predicted to be highly noise affected from the proposed construction work at substations.
- No ‘other sensitive’ receivers are predicted to be impacted by the proposed construction work at substations.

The proposed mitigation measures to minimise and manage the predicted impacts are discussed in **Chapter 9**.

6.2 Construction noise impacts from transmission lines

The assessment includes the construction of around 360 kilometres of new double circuit 500 kV transmission lines and associated infrastructure between Wagga Wagga, Maragle and Bannaby. The transmission lines would be supported on a series of free-standing steel lattice structures that would range between around 50 metres up to a maximum of 76 metres in height. The structures would be generally spaced between 300 to 600 metres apart.

Construction work for the transmission lines would typically include the following components of work:

- site establishment work including access tracks, service relocation and vegetation clearance
- civil work including earthwork, construction pads, construction of footings, steel fabrication, concrete pours, erection of transmission line structures and stringing work.

Given the extent of the project, transmission line construction has been assessed conservatively assuming flat geometry between source and receivers. Given this, the predicted construction noise levels are a function of the work scenario sound power level and the distance to the nearest receivers. The predicted noise levels versus distance are shown in **Figure 6-1** for three work scenarios with relatively high, moderate and low sound power levels.

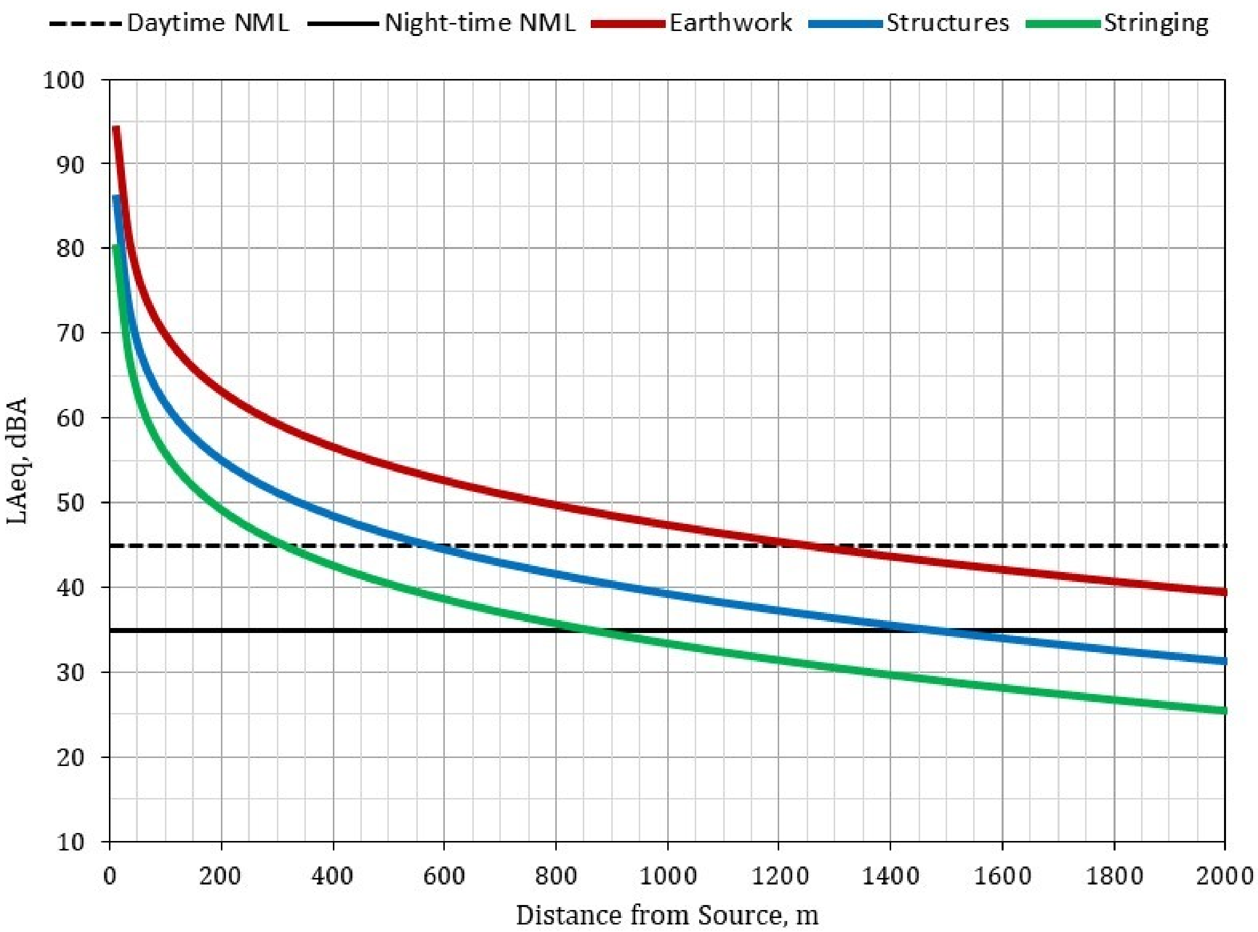


Figure 6-1 Noise levels versus distance for transmission line construction work

The noise propagation in **Figure 6-1** shows:

- Noise intensive work such as 'earthwork and clearing' is expected to meet the day-time NML at a distance of around 1,250 metres.
- Less noise intensive work such as 'overhead stringing of conductors and earth wires' is expected to meet the day-time and night-time NMLs at a distance of 300 metres and 850 metres, respectively.

At this stage of the project the work sites for each scenario are not known. The scenarios associated with the construction of the transmission line structures have been conservatively assessed assuming they may occur anywhere within the project footprint. The location of the 'access track' and 'brake and winch sites' work are subject to change as these would be refined during detailed design. As such, these scenarios have been considered in terms of the distance from the access track and brake and winch site locations at which impacts would be expected.

For most construction activities, it is expected that the construction noise levels would frequently be lower than predicted, as the noise levels presented in this report are based on each scenario occurring at the project footprint boundary which is the closest point to each receiver.

The assessment is generally considered conservative as the calculations assume several items of construction equipment are in use at the same time within individual scenarios. In reality, there would frequently be periods when construction noise levels are much lower than the worst-case levels predicted as well as times when no equipment is in use and no noise impacts occur.

6.2.1 Number of NML exceedances

A summary of the number of residential receivers where NML exceedances were predicted for the transmission line construction work is shown in **Table 6-8** and **Table 6-9** for day-time and OOH work, respectively. A summary of the number of 'other sensitive' receivers where NML exceedances are predicted for transmission line construction work is shown in **Table 6-10**. The worst-case transmission line construction noise impacts are also shown in **Attachment G.3** for the day-time period and **Attachment G.4** for the night-time.

Table 6-8 Residential day-time NML exceedances – Transmission line construction

Scenario	Duration[1]	Number of receivers			
		HNA[2]	With NML exceedance[3]		
			1-10 dB	11-20 dB	>20 dB
Site establishment and deliveries	1-3 weeks per transmission line structure	13	226	56	21
Earthwork and clearing	1-5 days per transmission line structure	14	274	95	29
Construction of structures	2 weeks per transmission line structure	11	134	22	14
Overhead stringing of conductors and earth wires	3 weeks per stringing site	11	47	8	11
Decommissioning and rehabilitation	2-3 days per transmission line structure	11	157	25	16
Telecommunications hut construction	1-2 months	-	1	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite.

Note 2: Highly Noise Affected, based on ICNG definition (ie predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels. Impact colouring based on CNVG exceedance categories in **Table 6-1**.

Table 6-9 Residential OOH NML exceedances – Transmission line construction

Scenario	Duration[1]	Number of receivers												
		HNA[2]	With NML exceedance[3]											
			Day-time OOH[4]				Evening / Night-time				Sleep disturbance			
			1-5 dB	6-15 dB	16-25 dB	>25 dB	1-5 dB	6-15 dB	16-25 dB	>25 dB	1-5 dB	6-15 dB	16-25 dB	>25 dB
Overhead stringing of conductors and earth wires	3 weeks per stringing site	-	5	2	-	-	17	7	-	-	3	-	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite.

Note 2: Highly Noise Affected, based on ICNG definition (ie predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels. Impact colouring based on CNVG exceedance categories in **Table 6-1**.

Note 4: OOH = Out-of-hours. During the day-time, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

Table 6-10 Other sensitive NML exceedances – Transmission line construction

Scenario	Duration[1]	Number of receivers with NML exceedance[2]		
		Place of worship		
		1-10 dB	11-20 dB	>20 dB
Site establishment and deliveries	1-3 weeks per transmission line structure	-	-	1
Earthwork and clearing	1-5 days per transmission line structure	1	-	1
Construction of structures	2 weeks per transmission line structure	-	-	1
Overhead stringing of conductors and earth wires	3 weeks per transmission line structure	-	1	-
Decommissioning and rehabilitation	2-3 days per transmission line structure	-	-	1
Telecommunications hut construction	1-2 months	-	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite.

Note 2: Based on worst-case predicted noise levels. Impact colouring based on CNVG exceedance categories in **Table 6-1**.

Locations for 'access track' and 'brake and winch sites' would be spread across the project footprint, however, final locations are not known at this stage. The distances offset from these locations at which residential receivers are expected to exceed the day-time NMLs are shown in **Table 6-11**.

Table 6-11 Approximated distance at which residential day-time NML exceedances are expected

Scenario	Duration[1]	Distance from work where exceedances occur[3]			
		HNA[2]	1-10 dB	11-20 dB	>20 dB
Access tracks	1–2 days per track	55 m	1190 m	440 m	160 m
Brake and winch sites	1-3 weeks per brake and winch site	30 m	600 m	210 m	70 m

Note 1: Durations should be regarded as indicative and represent a typical worksite.

Note 2: Highly Noise Affected, based on ICNG definition (ie predicted $LA_{eq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels. Impact colouring based on CNVG exceedance categories in **Table 6-1**.

The above assessment during the worst-case impacts shows the following:

- 'Highly intrusive' (>20 dB) worst-case daytime noise impacts are predicted at up to 29 of the receivers closest to the project (refer to **Table 6-8**). During 'earthwork and clearing', 'highly intrusive' (>20 dB) worst-case impacts are predicted at receivers within around 150 metres of the construction work within the project footprint. 'Highly intrusive' (>20 dB) worst-case noise impacts are predicted during all transmission line work scenarios except for 'telecommunications hut construction' due to its small area within the project footprint.
- Up to 14 of the nearest receivers are predicted to be highly noise affected during 'earthwork and clearing' (refer to **Table 6-8**).

- ‘Clearly audible’ (6-15 dB) worst-case night-time impacts are predicted at up to seven receivers during ‘overhead stringing of conductors and earth wires’ where work would be completed outside of standard day-time hours as required based on proximity to roads and other infrastructure with outage conditions (refer to **Table 6-9**).
- Sleep disturbance impacts are predicted at up to three residential receivers closest to the ‘overhead stringing of conductors and earth wires’ work that is likely to be required outside of standard daytime hours due to crossings of existing infrastructure (refer to **Table 6-9**). The number of potential night-time awakenings would depend on several factors, including the type of equipment being used and the duration of the noisy work.
- Two place of worship ‘other sensitive’ receivers, are predicted to be impacted during worst-case daytime transmission line construction (refer to **Table 6-10**), resulting in:
    - ‘Highly intrusive’ (>20 dB) at Greendale Uniting Church (ID: R12), which is around 25 metres north of the project in Broadway, NSW.
    - ‘Clearly audible’ (6-15 dB) at a Saint James Anglican Church (former) (ID: T15), which is around 390 metres south of the project in Woodhouselee, NSW.
- Residential receivers are predicted to exceed the day-time NMLs from ‘access tracks’ and ‘brake and winch sites’ work if they located within around 1,190 metres and 600 metres of the final access track and brake and winch site locations, respectively.
- The construction scenarios are relatively short in duration for each transmission line structure and the worst-case impacts for each receiver are only expected when work is occurring at the closest transmission line structure site. Therefore, each receiver is only expected to experience the presented worst-case impacts for a relatively short duration and impacts will be reduced or compliant with the NMLs when work is more distant.

The proposed mitigation measures to minimise and manage the predicted impacts are discussed in **Chapter 9**.

6.3 Construction road traffic noise impacts

The construction traffic volumes have been compared to the existing traffic volumes on all proposed construction traffic routes. The construction traffic volumes and worst-case potential noise increase are shown in **Attachment D** for all roads on the proposed routes. A summary of the number of roads where there is predicted to be an exceedance of the RNP criteria at residential receivers is shown in **Table 6-12**.

Table 6-12 Summary of construction road traffic noise

Road	Local roads – Unsealed	Local roads – Sealed	Arterial / sub-arterial roads
RNP criteria	**>2.0 dB increase and $L_{Aeq(1hour)}$ 50 dBA**	**>2.0 dB increase and $L_{Aeq(1hour)}$ 50 dBA**	**>2.0 dB increase and $L_{Aeq(15hour)}$ 60 dBA / $L_{Aeq(9hour)}$ 55 dBA**
Total roads	150	104	69
Roads with >2.0 dB increase	150	104	29
Roads with RNP exceedance for receivers at 10 m from road edge	150	104	5
Roads with RNP exceedance for receivers at 50 m from road edge	150	99	-
Roads with RNP exceedance for receivers at 100 m from road edge	150	64	-
Roads with RNP exceedance for receivers at 250 m from road edge	73	10	-
Roads with RNP exceedance for receivers at 500 m from road edge	-	1	-

The above assessment shows:

- Construction traffic is likely to result in a noticeable increase in noise levels (>2 dB) on all local roads and around 40 per cent of the arterial / sub-arterial roads due to low existing traffic volumes on the routes.
- For unsealed local roads, exceedances of the RNP criteria are predicted for:
  - All roads if receivers are 100 metres from the road edge.
  - Around half of the roads if receivers are 250 metres from the road edge.
  - No roads if receivers are 500 metres from the road edge.
- For sealed local roads, exceedances of the RNP criteria are predicted for:
  - All roads if receivers are 100 metres from the road edge.
  - 10 of 104 roads if receivers are 250 metres from the road edge.
  - One road if receivers are 500 metres from the road edge (Clinton Street).
- For arterial / sub-arterial roads, no exceedances of the RNP criteria are predicted for roads where receivers are at least 50 metres from the road edge, which is generally expected to be the case for this class of road.

The assessment is based on the worst-case scenario when the peak construction workforce mobilises in night-time period. It is likely that there will be times during construction when less vehicle movements are required and/or the construction peak occurs during the day-time period, resulting in reduced road traffic noise impacts.

The proposed mitigation measures to minimise and manage the predicted impacts are discussed in **Chapter 9**.

6.4 Construction vibration impacts

Vibration offset distances for the vibration intensive equipment required to complete the work have been determined from the CNVG minimum working distances for cosmetic damage and human response (see **Section 3.4.2**). Receivers within the minimum working distances have been determined and the assessment is summarised in **Table 6-13**. The construction vibration impacts are also shown in **Attachment H**.

Table 6-13 Overview of vibration impacts

Number of receivers with vibration criteria exceedance[1]	
Cosmetic damage	Human comfort
13	20

Note 1: Based on worst-case use of a large vibratory roller.

The above assessment of the worst-case impacts shows:

- The 13 receivers closest to transmission line construction are likely to be within the minimum working distance for cosmetic damage (ie 20 metres for a large vibratory roller). Of these receivers, 11 are within the project footprint.
- The 20 receivers closest to transmission line construction are likely to be within the human comfort minimum working distance (ie 100 metres for a large vibratory roller).
- One of the receivers within the human comfort minimum working distance is Greendale Uniting Church (ID: R12). Two receivers within the cosmetic damage minimum working distance are dilapidated residences (ID: U19 and N25). All other receivers identified within the vibration minimum working distances are residential.

These predictions represent a worst-case situation where a large vibratory roller is in use at the boundary of the project footprint.

The proposed mitigation measures to minimise and manage the predicted impacts are discussed in **Chapter 9**.

6.5 Construction blasting assessment

6.5.1 Construction blasting impacts

At this stage of the project, specific construction work locations where blasting may be required have not been determined. Blasting may be selected as a preferred excavation methodology in particular situations, such as:

- foundations work with difficult geotechnical conditions
- steep terrain where access tracks are required and blasting in a small area of the track would be the most appropriate approach for construction.

The need for blasting would typically be associated with difficult geotechnical conditions. This could be in areas where geological material changes within a foundation or where fault lines or fractures within the foundation dictate the need to change a foundation to a mass or grillage style. It is impossible to predict the quantity of such areas that could be encountered without detailed geotechnical information. With modern rock drilling equipment and an appropriate suite of rock anchor foundation designs, the need for blasting work can be minimised but it is expected that some blasting work would be required.

Based on AS 2187.2, assuming average conditions site constants, the relationship between airblast overpressure and vibration versus distance per kg of charge mass are presented in **Figure 6-2** and **Figure 6-3**, respectively.

Maximum Instantaneous Charge (MIC) calculations would be undertaken for specific sites where blasting is required. Individual blast designs are to be based on meeting the criteria rather than restrictions on MIC, noting that the blast design includes a number of variables including location, aspect if near an open face, etc.

The blasting variables are readily managed through good blasting practices and the implementation of a Blast Management Plan (BMP), which ensures the potential for impacts can be minimised.

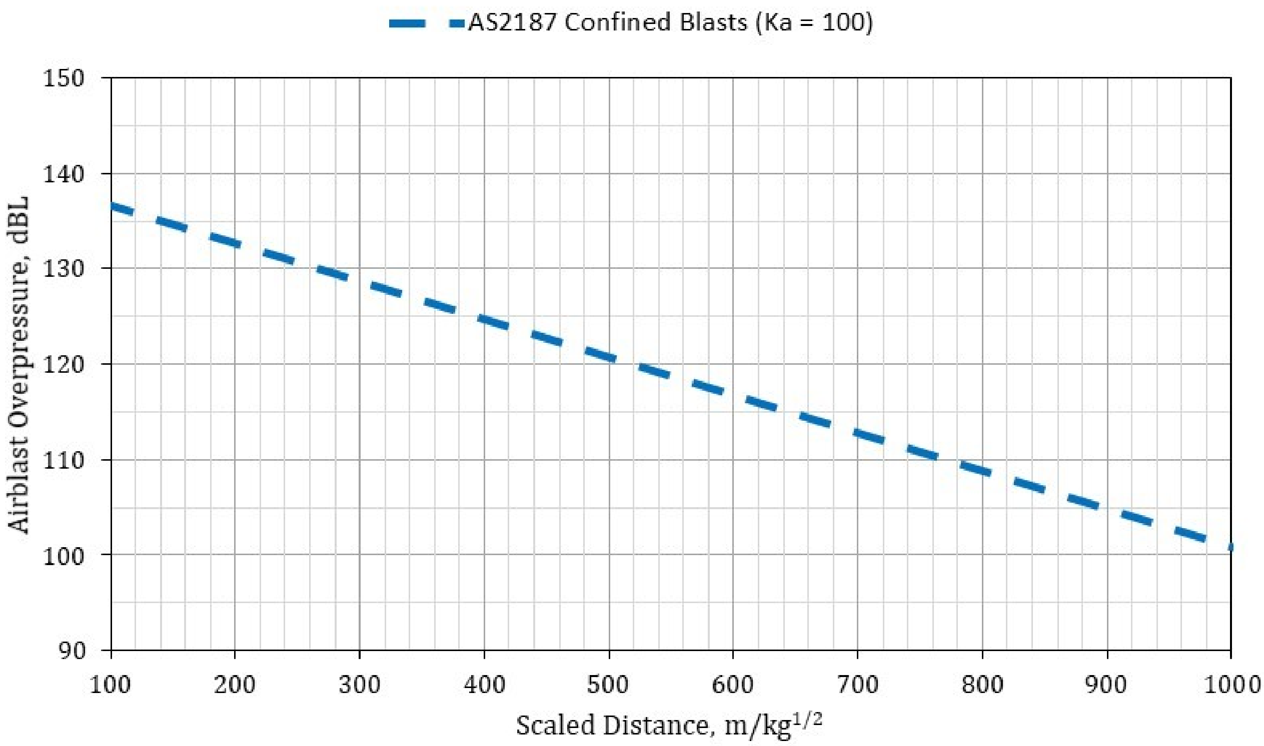


Figure 6-2 Airblast overpressure and distance

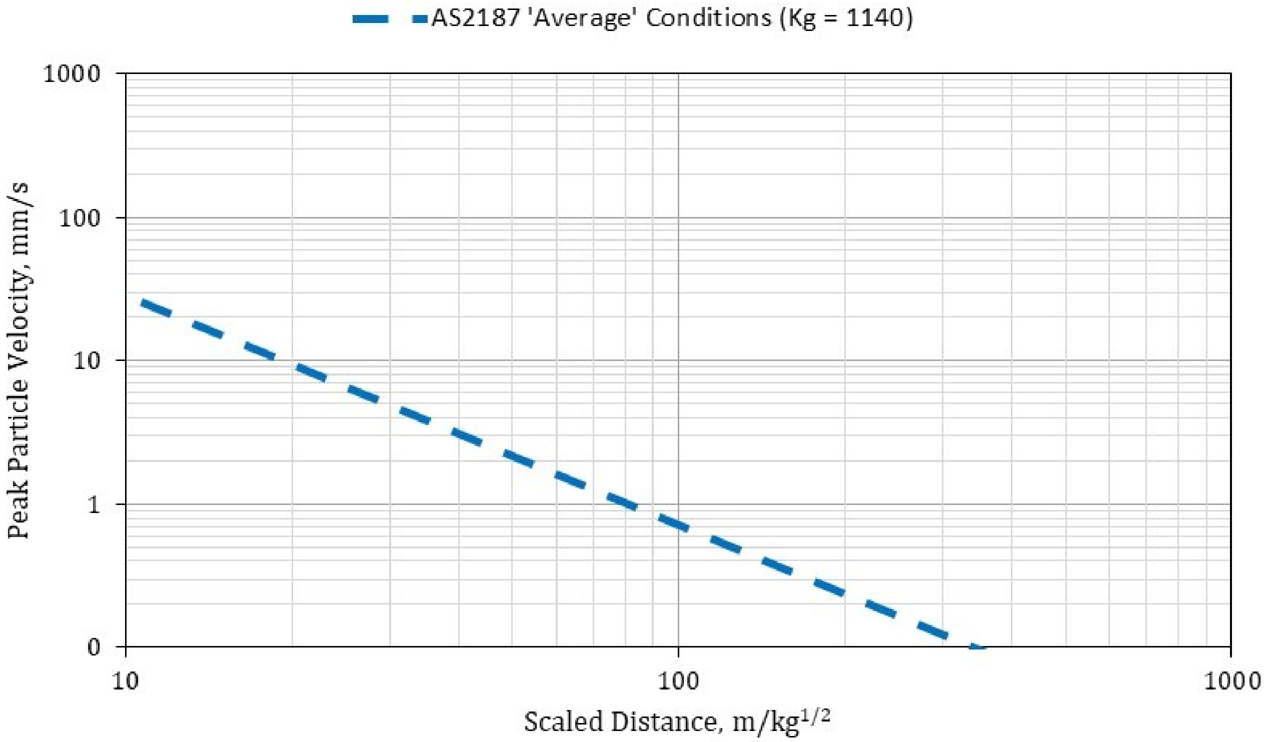


Figure 6-3 Ground vibration and distance

7 Operational impact assessment

7.1 Operational impacts from the proposed Gugaa 500 kV substation

The proposed Gugaa 500 kV substation is located at Gregadoo approximately 11 kilometres south-east of the existing Wagga 330 kV substation. The substation location and nearby receivers is shown in **Figure 7-1**.

Details of the noise generating equipment items at the proposed Gugaa 500 kV substation are shown in **Table 7-1** and **Figure 7-2**.

Table 7-1 Noise generating substation equipment

Equipment	Quantity	Sound power level[1]
525/345/34.5 kV 1,500 MVA power transformer (3 x single phase tanks)	6	105 dBA
34.5 kV/440 V 500k VA 3 phase auxiliary transformer	2	85 dBA
550 kV 181 MVAr 3 phase shunt reactor	2	94 dBA
Neutral Earthing Reactor (NER)	1	80 dBA

Note 1: Based on maximum potential sound power levels provided by Transgrid.

The assessment assumes that all equipment operates in a steady state nature on a 24/7 basis. All noise sources are modelled at a height of two metres above ground level. At this stage the final substation layout is not known as it would continue to be refined during detailed design. The operational noise impacts have been predicted both with and without indicative transformer barriers with a height of four metres.

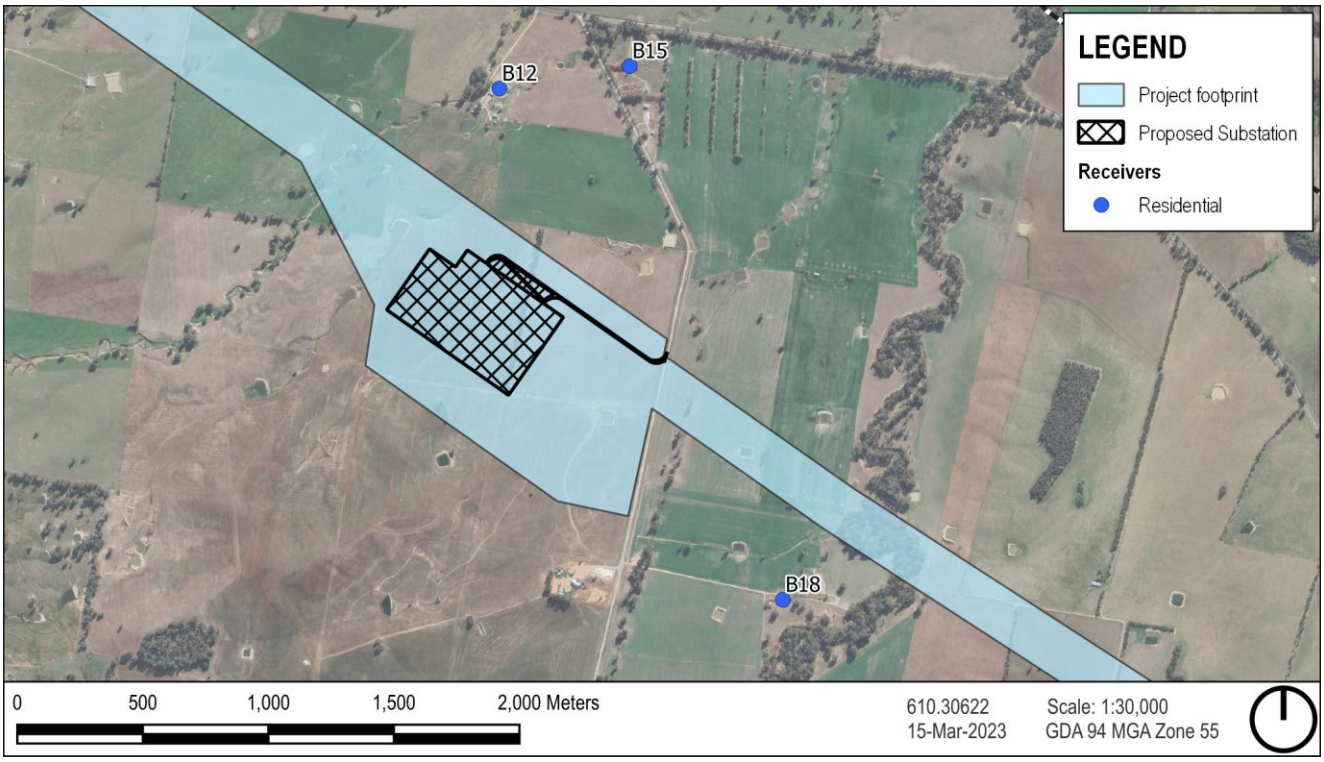


Figure 7-1 Proposed Gugaa 500 kV substation location and nearby receivers

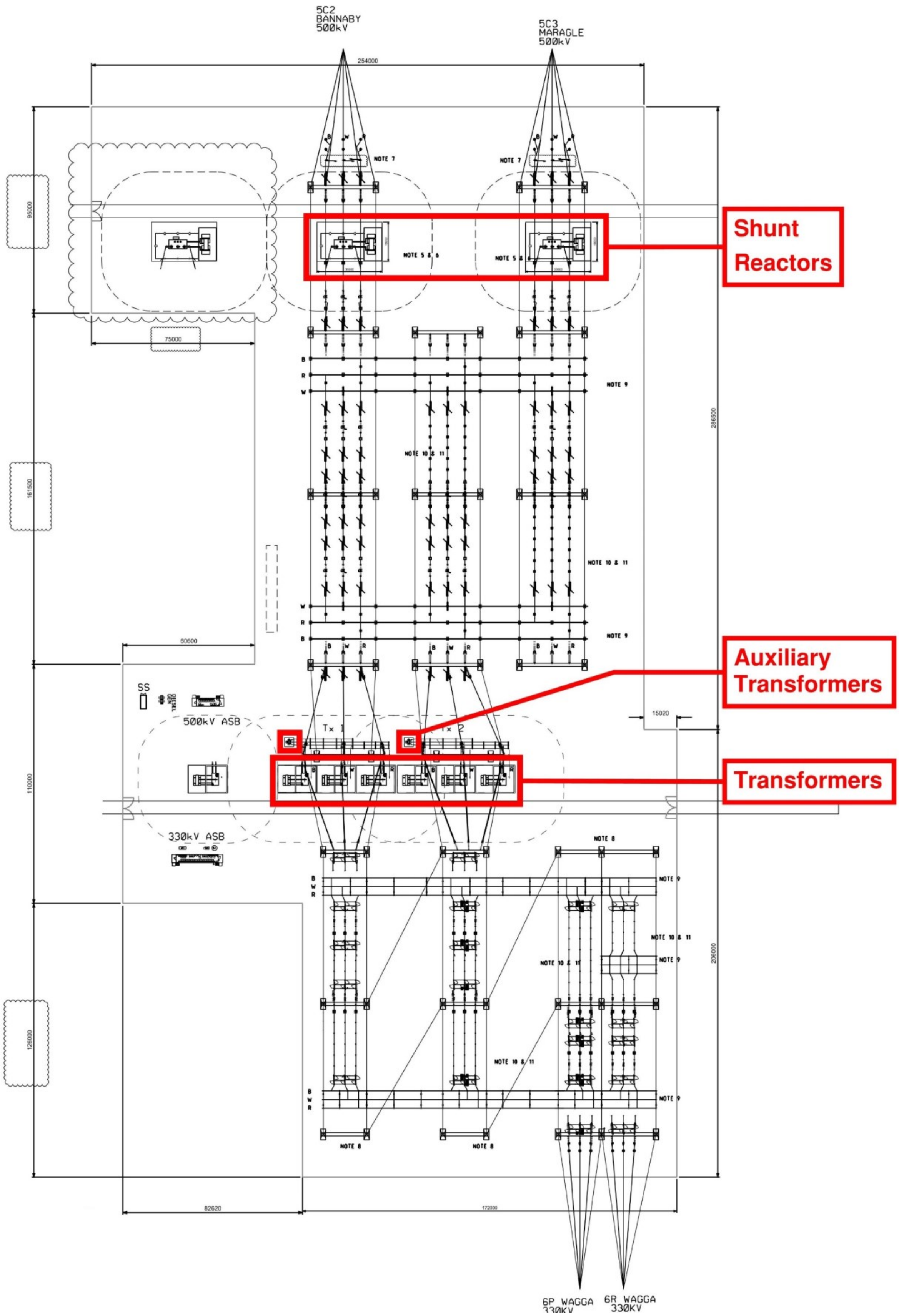


Figure 7-2 Indicative layout of the proposed Gugaa 500 kV substation layout

7.1.1 Predicted noise levels

The three closest residential receivers are predicted to have noise contributions from the operation of the proposed Gugaa 500 kV substation. A summary of the worst-case operational noise assessment at these receivers is shown in **Table 7-2** and **Table 7-3**. The predicted worst-case levels include consideration of noise enhancing weather for the night-time period (refer to **Section 4.4.1.5**) and are compared to the PNTLs to determine the potential impact from the project.

Table 7-2 Proposed Gugaa 500 kV substation operational noise assessment without transformer walls

Receiver ID	Assessment period	Noise level $L_{Aeq(15minute)}$ (dBA)					Compliance
		Criteria	Standard weather		Noise enhancing weather[1]		
			Predicted	Exceedance	Predicted	Exceedance	
B13	Day	40	37	-	41	n/a	Yes
	Evening	35		2		n/a	No
	Night-time	35		2		6	No
	Sleep disturbance	40		-		1	No
B16	Day	40	34	-	38	n/a	Yes
	Evening	35		-		n/a	Yes
	Night-time	35		-		3	No
	Sleep disturbance	40		-		-	Yes
B19	Day	40	29	-	34	n/a	Yes
	Evening	35		-		n/a	Yes
	Night-time	35		-		-	Yes
	Sleep disturbance	40		-		-	Yes

Note 1: Noise enhancing conditions of stability category F with 2 m/s source to receiver wind during the night-time period based on historical data.

Table 7-3 Proposed Gugaa 500 kV substation operational noise assessment with transformer walls

Receiver ID	Assessment period	Noise level $L_{Aeq(15minute)}$ (dBA)					Compliance
		Criteria	Standard weather		Noise enhancing weather[1]		
			Predicted	Exceedance	Predicted	Exceedance	
B13	Day	40	33	-	38	n/a	Yes
	Evening	35		-		n/a	Yes
	Night-time	35		-		3	No
	Sleep disturbance	40		-		-	Yes
B16	Day	40	27	-	31	n/a	Yes
	Evening	35		-		n/a	Yes
	Night-time	35		-		-	Yes
	Sleep disturbance	40		-		-	Yes

Receiver ID	Assessment period	Noise level $L_{Aeq(15minute)}$ (dBA)					Compliance
		Criteria	Standard weather		Noise enhancing weather[1]		
			Predicted	Exceedance	Predicted	Exceedance	
B19	Day	40	29	-	34	n/a	Yes
	Evening	35		-		n/a	Yes
	Night-time	35		-		-	Yes
	Sleep disturbance	40		-		-	Yes

Note 1: Noise enhancing conditions of stability category F with 2 m/s source to receiver wind during the night-time period based on historical data.

The above assessment shows the following:

- Without transformer walls, noise emissions from the proposed Gugaa 500 kV substation are predicted to potentially exceed the PNTLs at the two closest receivers (see receivers B13 and B16 in **Table 7-2)**. The noise emissions are predicted to comply with the PNTLs at all more distant receivers located beyond around 1,200 metres from the substation.
- Without transformer walls, noise emissions are predicted to exceed the PNTLs by up to 6 dB and 2 dB during the night-time with and without noise enhancing weather, respectively (see receiver B13 in **Table 7-2**).
- With transformer walls, noise emissions are predicted to be compliant with the PNTLs at all but the closest receiver, where an exceedance of up to 3 dB is predicted when noise enhancing weather conditions are present during the night-time period (see receiver B13 in **Table 7-3**).

The proposed mitigation measures to minimise and manage the predicted impacts are discussed in **Chapter 9**.

7.2 Operational impacts from transmission lines

The project includes around 360 kilometres of new 500 kV high-voltage transmission lines between Wagga Wagga, Bannaby and Maragle to increase the energy network capacity in southern NSW. The project footprint is located around 1.5 kilometres south of Wagga Wagga, 4.5 kilometres west of Tumut, 4.5 kilometres north of Yass and is otherwise generally distant to any major towns. The majority of sensitive receivers potentially impacted by operational noise from the project transmission lines are scattered rural residences surrounding the transmission line route.

The project proposes to operate the Gugaa to Wagga section of transmission line at 330 kV. The proposed new double circuit transmission line between the existing Wagga 330 kV substation and the proposed Gugaa 500 kV substation would include the construction of 500 kV towers and transmission lines that would be energised at 330 kV. This section would have the capability to be operated at 500 kV if required in the future. Any future energisation at 500 kV would be subject to further assessment and approval. When operating at 330 kV, the Gugaa to Wagga transmission line is predicted to emit noise levels that would be less than 20 dBA at the edge of the easement during worst-case L50 (light rain or mist) conditions. These noise levels are significantly below the relevant PNTLs, therefore, the Gugaa to Wagga section of transmission line has not been considered in the assessment.

7.2.1 Impacted receivers

The operational noise emission of the transmission lines is assessed based on the offset distance at which the night-time PNTL of $L_{Aeq,15min}$ 35 dBA is expected to be reached. The night-time PNTL has been adopted as a conservative screening level representative of periods with low background noise that may also occur during the daytime. These distances are summarised based for the various sections of the project in **Table 7-4**, including the cumulative influence of existing transmission lines.

Table 7-4 Transmission line noise impact zones

Transmission line[1]	Maximum distance from proposed transmission line route where night-time impacts (noise levels >35 dBA) are expected[2]		
	Project only	Cumulative (project plus existing)	
		Direction of parallel line	Direction opposite parallel line
Fair weather			
Maragle to Wondalga Cumulative with TL03, 51 & 66	91.5 m	136.5 m	128 m
Maragle to Wondalga Cumulative with: TL64	91.5 m	223 m	200 m
Wondalga to Gugaa Cumulative with TL51	82.5 m	120 m	118 m
Wondalga to Bannaby Cumulative with TL03, 51 & 61	93 m	129 m	124 m
Wondalga to Bannaby Cumulative with TL5A6 & 5A7	93 m	180 m	170 m
L50 (light rain or mist)			
Maragle to Wondalga Cumulative with TL03, 51 & 66	366 m	392 m	362 m
Maragle to Wondalga Cumulative with: TL64	366 m	442 m	440 m
Wondalga to Gugaa Cumulative with TL51	326 m	348 m	316 m
Wondalga to Bannaby Cumulative with TL03, 51 & 61	348 m	372 m	337 m
Wondalga to Bannaby Cumulative with TL5A6 & 5A7	348 m	470 m	450 m

Note 1: All transmission line sections and names are based on information in the Aurecon Audible Noise & Radio Interference report. See **Attachment E** for further information.

Note 2: All impact distances are based on the modelling presented in the Aurecon Audible Noise & Radio Interference report. See **Attachment E** for further information.

A summary of the worst-case operational noise assessment at the residential receivers surrounding the project transmission line is summarised in **Table 7-5** and shown in **Attachment I**. No 'other sensitive' receivers are predicted to be impacted by operational noise emissions.

Table 7-5 Transmission line operational noise assessment

Transmission line	Number of residential receivers with night-time exceedance		
	Fair weather Project only	L50 (light rain or mist) Project only	L50 (light rain or mist) Cumulative (project plus existing)
Maragle to Wondalga	-	4	4
Wondalga to Gugaa	2	6	6
Wondalga to Bannaby	9	52	55
Total	**11**	**62**	**65**

The above assessment during the worst-case impacts shows the following:

- During fair weather conditions when noise emissions are lower, 11 residential receivers are expected to potentially experience noise levels above the most stringent night-time PNTL.
- During L50 conditions (light rain or mist), which is expected to be the worst-case condition for audible noise generation, 62 of the receivers closest to the project footprint are predicted to potentially exceed the most stringent night-time PNTL.
- Cumulative noise emissions from the project and existing 330 kV lines are expected to be marginally greater than the noise emission from the project transmission lines alone where the existing line would run parallel to the project. During L50 conditions (light rain or mist), 65 of the receivers closest to the project footprint are predicted to potentially exceed the night-time PNTL due to cumulative transmission line noise emissions.
- Worst-case project transmission line noise levels at the edge of the easement are predicted to be up to around 50 dBA during L50 conditions (light rain or mist), which exceeds the night-time PNTL by 15 dB. During fair weather, project transmission line noise levels at the edge of the easement are predicted to be up to around 39 dBA, which exceeds the night-time PNTL by 4 dB.
- The average distance between the identified potentially impacted receivers and the assumed easement (35 metres within the project footprint) is around 200 metres. At this distance, project transmission line noise levels are predicted to be around 37 dB to 39 dB during L50 conditions (light rain or mist), which marginally exceed the night-time PNTL by around 2 dB to 4 dB.

The proposed mitigation measures to minimise and manage the predicted impacts are discussed in **Chapter 9**.

8 Cumulative assessment

Assessing cumulative impacts involves the consideration of the proposed impact in the context of noise and vibration The assessment of cumulative impacts also considers projects that are currently under development, or at the planning state that may also influence the assessment of this project's potential impacts. Cumulative impacts can potentially arise from the interaction of the construction and operation activities of the project and other future projects nearby.

The cumulative impact assessment was prepared in accordance with the *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPE, 2022). Projects with the potential for cumulative impacts with the project were identified through a review of publicly available information and environmental impact assessments from the following databases in March 2023:

- DPE's Major Projects register
- NSW Government's Southern Regional Planning Panel project register
- NSW Independent Planning Commission project register
- EPBC Act Public Portal
- Transport for NSW Projects Map.

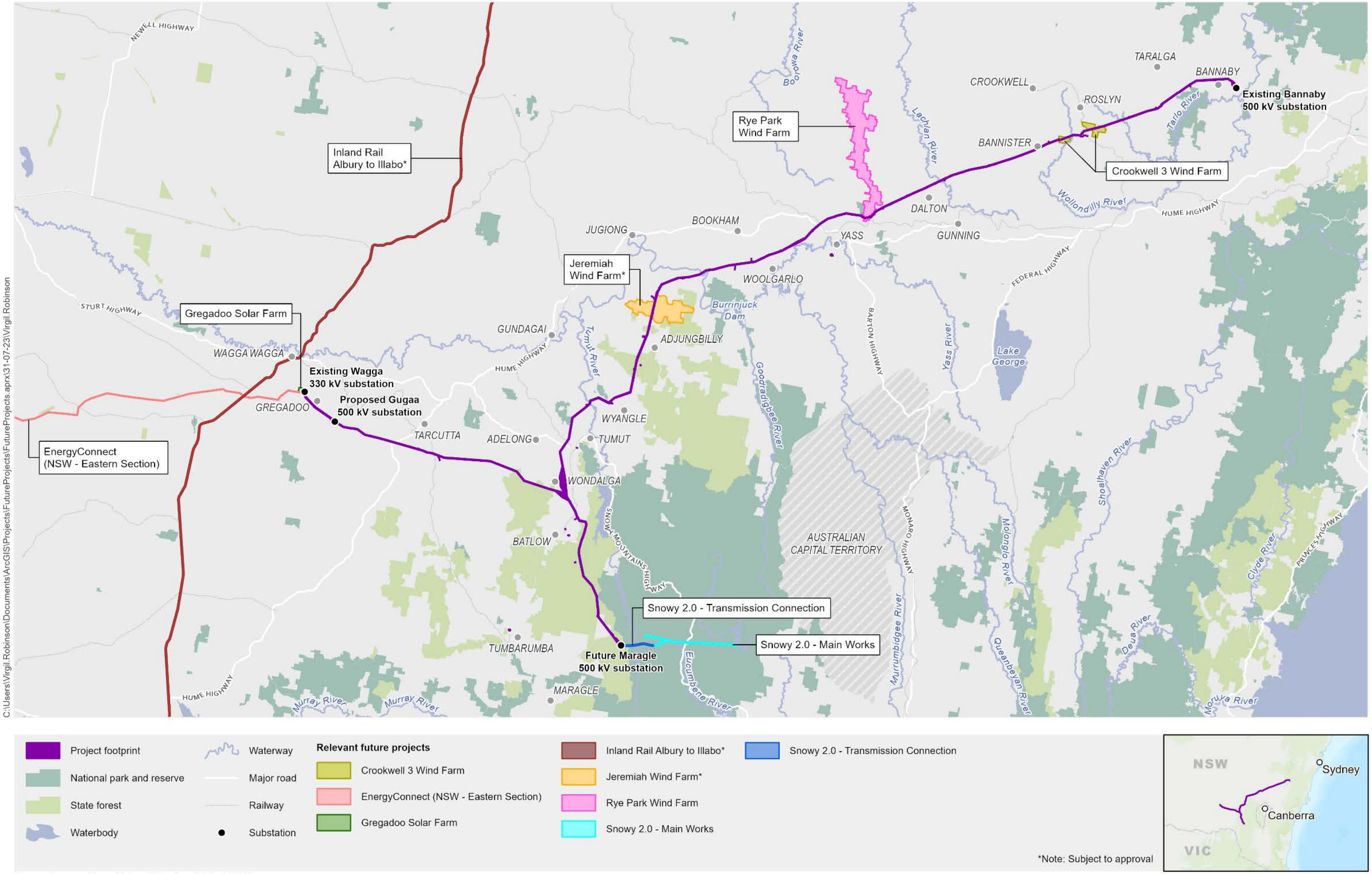
Searches were limited to the LGAs of Wagga Wagga City, Snowy Valleys, Yass Valley, Cootamundra-Gundagai Regional, Upper Lachlan Shire, Goulburn-Mulwaree, and Hilltops.

8.1 Summary of projects considered

Based on the above searches, the following projects are to be considered in the cumulative impact assessment for each of the key matters:

- EnergyConnect (NSW – Eastern Section)
- Gregadoo Solar Farm
- Jeremiah Wind Farm
- Rye Park Wind Farm
- Victoria to NSW Interconnector West (VNI West)
- Snowy 2.0 - Transmission Connection
- Snowy 2.0 - Main Works
- Inland Rail – Albury to Illabo
- Crookwell 3 Wind Farm.

Figure 8-1 shows the location of relevant future projects with respect to HumeLink's project footprint.



Source: *Aurecon, Transgrid, Spatial Services (DCS), ESRI Basemap*

1:925,000

0 20 40km

Projection: GDA 1994 MGA Zone 55

HumeLink **Noise and Vibration**

FIGURE 8-1: Relevant future projects

8.2 Construction impacts

Concurrent cumulative construction noise and vibration impacts can occur where multiple work activities are being completed near to a specific receiver at the same time. Additionally, if more than one project occurs in the same area consecutively, there may be a prolonged effect from the extended duration of construction impacts. This effect is termed 'construction fatigue'.

The potential cumulative impacts from this project and other projects would continue to be considered as the project progresses when detailed construction planning is developed. This would consider the potential impact from concurrent construction activities and the operation of other projects and this project. Specific management and mitigation measures designed to address potential impacts would be developed and used to minimise the impacts as far as practicable, in consultation with the affected community, as outlined in **Chapter 9**.

8.3 Operational impacts

Cumulative operational noise impacts can occur where multiple industrial noise sources operate near to the same sensitive receivers. The assessment has considered cumulative noise from existing and proposed transmission infrastructure in **Chapter 7**. **Attachment I** shows the receivers closest to the proposed Gugaa 500 kV substation are beyond the project transmission line impact zone, therefore cumulative impacts from proposed transmission line and substations are not expected.

The NPfI aims to limit continuing increases in noise levels from progressive developments with the application of the amenity criteria. The recommended amenity noise levels represent the objective for the total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To account for cumulative noise from the project with other industrial activity in the area, the recommended amenity noise level is reduced by 5dB(A) to give the project amenity noise level. The project amenity noise level is used in conjunction with the project intrusiveness noise level to determine PNTLs for operational noise from the project (refer to **Section 5.4**). Adopting the PNTL where there is the potential for cumulative operational noise impacts from other projects ensures that the NPfI amenity criteria is not exceeded.

Where cumulative impacts may occur from project transmission line audible noise and nearby wind farms, it is noted that worst-case noise impacts from transmission lines require relatively still weather conditions whereas worst-case noise impacts from wind farms require higher wind speeds. Therefore, the likelihood of a noticeable cumulative operational noise impact between such projects is considered minor.

8.4 Detailed cumulative assessment

A detailed review of each project and its potential interface with HumeLink in terms of noise and vibration is shown in **Table 8-1**. The projects are considered in terms of the following potential noise impacts:

- **Cumulative construction noise**

  Where concurrent construction work is being completed near to a particular area, the worst-case noise levels could theoretically increase by around 3 dB (ie a logarithmic adding of two sources of noise at the same level). The likelihood of worst-case noise levels being generated by two different work activities at the same time is, however, considered low and rather than increase construction noise levels, the impact of concurrent construction work would generally be limited to a potential increase in the duration, and annoyance, of noise impacts on the affected receivers.

- **Consecutive construction noise**

  The successive work in a particular area may result in consecutive impacts (ie 'construction fatigue') at the surrounding receivers due to construction work being in the area for an extended period. Mitigation measures aimed at short-term construction work may be less effective where receivers are affected by longer duration impacts from several projects.

- **Cumulative operational noise**

  Where industrial noise of a similar nature is emitted near to a particular area, the worst-case noise levels could theoretically increase by around 3 dB (ie a logarithmic adding of two sources of noise at the same level). However, similar to cumulative construction noise the likelihood of worst-case noise levels being generated by two different industrial sources at the same time is considered low and rather than increase operational noise levels, the impact of would generally be limited to a potential increase in the duration, and annoyance, of noise impacts on the affected receivers.

Table 8-1 Summary of potential cumulative noise and vibration impacts identified

Project	Details	Status	Distance/interface	Timing	Potential Impacts
EnergyConnect (NSW – Eastern Section)	EnergyConnect (NSW – Eastern Section) includes a new transmission line connecting the existing Buronga substation and existing Wagga 330 kV substation, and construction of the new Dinawan substation (170 km west of Wagga Wagga). It also involves associated infrastructure (optical repeater structures), new and/or upgrade of access tracks as required and ancillary works to support construction.	EIS approved 2022	HumeLink and EnergyConnect (NSW – Eastern Section) both require modification and/or connection to the existing Wagga 330 kV substation. HumeLink work at Wagga 330 kV substation is indicatively planned to occur between late 2024 and late 2026, subject to approval. Both projects are proposed to connect to the Wagga 330 kV substation, so there would be no overlapping sections of transmission line. The operational noise emissions in this area are expected to be dominated by the existing noise producing plant at Wagga 330 kV substation.	Early 2023 – late 2024 Upgrade and expansion of the existing Wagga 330 kV substation as part of EnergyConnect (NSW – Eastern Section) to be complete by August 2024	The potential overlap of construction work would be limited to a short period (a few months) and would likely involve the demobilisation of EnergyConnect work and the mobilisation of HumeLink work. This may result in cumulative and/or consecutive construction noise impacts. There are not expected to be any cumulative operational noise impacts.
Gregadoo Solar Farm	Gregadoo Solar Farm development covers around 150 ha of land bounded by Boiling Down Road, Redbank Road and Mitchel Road. The development is a 47 Megawatt (MW) photovoltaic (PV) solar farm at Gregadoo, Wagga Wagga. Access to site is from Boiling Down Road, Gregadoo.	EIS approved 2018 Modification 2 approved 2021	The Gregadoo Solar Farm site is located immediately northwest of the Wagga 330 kV substation. The operational noise levels associated with a solar farm development are relatively low. The Gregadoo Solar Farm EIS predicts the operational noise emissions at the nearest receivers to be less than the existing background levels.	Construction expected to commence mid-2023 9 months to construct	There are not expected to be any cumulative noise impacts.
Jeremiah Wind Farm	Jeremiah Wind Farm is located around 29 km east of Gundagai in the Adjungbilly area.	EIS in preparation	The HumeLink project footprint intersects the Jeremiah Wind Farm development area.	Project approval anticipated in 2023	Cumulative construction noise impacts may occur.

Project	Details	Status	Distance/interface	Timing	Potential Impacts
	The project proposes a 65 turbine wind farm with a maximum tip height of 300 m, battery energy storage system and associated ancillary infrastructure		HumeLink construction work in this area is limited to transmission line construction, indicatively planned to occur between 2024 and 2026 with construction requiring around a total of up to around 12 weeks per transmission line structure. One receiver (ID: Q27) in this area is within the offset distance for potential operational transmission line noise impacts. This receiver is also relatively near to the proposed Jeremiah Wind Farm, with worst-case noise levels between 35 and 40 dB predicted in the assessment of the concept design.	Construction expected to be 24-30 months	Operational noise emissions from the HumeLink transmission line and Jeremiah Wind Farm turbines may be approximately equivalent and result in a cumulative noise impact at one receiver.
Rye Park Wind Farm	Rye Park Wind Farm is located to the west of Rye Park, to the north-west of Yass and south-east of Boorowa. The project includes maximum 80 wind turbines with a maximum tip height of 200 m. The project also includes construction of associated infrastructure (substations, operation and maintenance facilities) and upgrades to local roads.	EIS approved 2017 Modification 1 approved 2021 Modification 2 preparation 2022	The HumeLink project footprint intersects the southern extent of Rye. HumeLink construction work in this area is limited to transmission line construction, indicatively planned to occur between 2024 and 2026 with construction requiring up to a total of around 12 weeks per transmission line structure.	Under construction since Dec 2021 with commissioning scheduled for June 2023 Original EIS suggested an 18-24 month construction period	Consecutive construction noise impacts may occur. Operational noise emissions from the HumeLink transmission line and Rye Park Wind Farm turbines may be approximately equivalent and result in a cumulative noise impact at two receivers.

Project	Details	Status	Distance/interface	Timing	Potential Impacts
			Two receivers (ID: Q36 and Q63) in this area are within the offset distance for potential operational transmission line noise impacts. These receivers are also relatively near to the proposed Rye Park Wind Farm, with worst-case noise levels between 35 and 40 dB predicted in the EIS assessment of the wind farm.		
Victoria to NSW Interconnector West (VNI West)	Victoria to NSW Interconnector West (VNI West) involves targeted interconnector expansion between Victoria and NSW to address transmission network limitations and to improve supply reliability. VNI West is still in the scoping/market modelling phase to assess the technical and economic viability of expanding transmission interconnector capacity between Victoria and NSW. Several options have been developed with new interconnector corridors (VNI 6 – 8) connecting to the existing Wagga 330 kV substation.	Scoping / market modelling phase Underwriting agreement with Commonwealth Government April 2022	Since the possible alignment of VNI West is not known at this time, potential cumulative operational impacts cannot be assessed, however would be considered as part of that project if it progresses.	Construction proposed to commence in 2026 with commissioning by 2028.	No cumulative construction noise impacts are expected. Potential cumulative operational noise impacts are not known at time of this assessment.
Snowy 2.0 – Transmission Connection	Snowy 2.0 Transmission Connection includes a new transmission connection between the proposed Snowy 2.0 pumped hydro and generation project to the existing high voltage transmission network.	EIS approved 2022	HumeLink includes connection to the future Maragle 500 kV substation that will be constructed under Snowy 2.0 – Transmission Connection.	Construction expected to begin in late 2023 with expected completion by end of 2025	No cumulative noise impacts are expected.

Project	Details	Status	Distance/interface	Timing	Potential Impacts
	This includes construction of a new substation in Bago State Forest (the future Maragle 500 kV substation), new access tracks and upgrade of existing access tracks and ancillary works to support construction.		The sensitive receivers nearest to the future Maragle 500 kV substation (area of overlap) are over 3.5 km away and are not expected to have any noise impacts from HumeLink.		
Snowy 2.0 – Main Works	Snowy 2.0 main works include an underground pumped hydro power station and ancillary infrastructure. Main works at Talbingo Reservoir site include excavated rock placement, portal construction and tunnelling, access roads and ancillary facilities for emplacement activities and tunnelling support.	EIS approved 2020 Modification 1 approved 2022	Talbingo Reservoir site is around 5 km east of transmission lines between the future Maragle 500 kV substation and Bannaby 500 kV substation.	Construction began in October 2020 with expected completion by 2026	No cumulative noise impacts are expected.
Inland Rail – Albury to Illabo	Inland Rail A2I involves the upgrade 185 km of rail track from Albury to Illabo. The upgrade of rail track passes through Wagga Wagga. Key issues could include workforce availability and accommodation capacity around Wagga Wagga during peak construction periods with a large influx of workers using short-term accommodation during the scheduled rail possessions in March and September 2024.	EIS exhibited between 17/08/22 and 28/09/22 Responding to submissions	Roughly 9 km north-west of existing Wagga 330 kV substation.	Construction is proposed to commence in early 2024 and is expected to take about 16 months.	No cumulative noise impacts are expected.

Project	Details	Status	Distance/interface	Timing	Potential Impacts
Crookwell 3 Wind Farm	Crookwell 3 Wind Farm involves 16 wind turbines up to 157 m in height, connected to the grid via the 330 kV transmission line. Given timing, there could be potential for "construction fatigue" type impacts related to construction noise and construction traffic management.	Addendum EIS approved 2019	The HumeLink project footprint intersects Crookwell 3 Wind Farm. HumeLink construction work in this area is limited to transmission line construction, indicatively planned to occur between 2024 and 2026 with construction requiring up to a total of around 12 weeks per transmission line structure. Three receivers (ID: T3, T19 and T14 in this area is within the offset distance for potential operational transmission line noise impacts. These receivers are also relatively near to Crookwell 3 Wind Farm, with worst-case noise levels between 35 and 40 dB predicted in the EIS assessment.	Detailed design and pre-construction activities are being carried out with main construction work expected to take about 18 months once commenced	Consecutive construction impacts may occur. Operational noise emissions from the HumeLink transmission line and Crookwell 3 Wind Farm turbines may be approximately equivalent and result in a cumulative noise impact at three receivers.

9 Mitigation and management measures

9.1 Overview of approach

Potential noise and vibration impacts have been identified in the construction and operational assessments in **Chapter 6** and **Chapter 7**, respectively. Where exceedances are identified, reasonable and feasible mitigation measures would be used to manage the impacts. This report recommends in principle mitigation measures and where further assessment would be undertaken. An overview of the approach to mitigation is provided below. Specific mitigation measures are provided in the section that follows.

9.1.1 Construction mitigation approach

The NMLs identified in this report have been applied to determine where measures for the control of potential construction noise impacts are required. The project should apply all feasible and reasonable work practices to meet the NMLs, where possible, and inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels, duration of noise generating construction work, and contact details during construction.

A Noise and Vibration Management Plan (NVMP) will be prepared to provide the framework and mechanisms for the management and mitigation of all potential noise and vibration impacts from the project. The NVMP will include:

- identification of nearby sensitive receivers
- description of work, construction equipment and hours of work would be completed and quantify resulting impacts at sensitive receivers.
- criteria for the project and approval conditions
- procedures and mitigation measures for potential impacts during out-of-hours work
- requirements for noise and vibration monitoring
- details of how community consultation in relation to noise and vibration would be completed
- procedures for handling complaints
- details on how respite would be applied where ongoing high impacts are expected at certain receivers.

If blasting is required, a Blast Management Plan (BMP) will be prepared to minimise the potential for impacts. The BMP would be based on the methodologies and requirements set out in AS 2187.2-2006 and the ANZEC guideline. The BMP would:

- identify blast sensitive receivers
- set blast overpressure limits, vibration limits and blast monitoring requirements
- document the blast design process and management approach
- identify landowner notification requirements.

The implementation of a BMP in accordance with the relevant standards and guidelines is expected to achieve compliance with the noise and vibration criteria at surrounding sensitive receivers. If blasting amenity criteria cannot be met than there would be no blasting and other methods would be carried out such as rock breakers.

Specific construction mitigation measures recommended for the project are listed in **Section 9.2.**

9.1.2 Operational mitigation approach

Where operational noise from the project is predicted to exceed the relevant noise criteria, feasible and reasonable operational noise mitigation and management measures would be considered, with the aim of reducing noise emissions to the relevant criteria.

The typical hierarchy for mitigation and management of industrial noise sources is as follows:

- reducing noise emissions at the source (ie noise source control)
- reducing noise in transmission to the receiver (ie noise path control)
- reducing noise at the receiver (ie at-receiver control).

Specific operational mitigation measures recommended for the project are listed in **Section 9.2.**

9.2 Specific mitigation measures

Based on the assessment and identified impacts in this report, **Table 9-1** lists the recommended project specific mitigation measures to minimise and manage the impacts.

Table 9-1 Recommended specific mitigations measures

Reference	Impact	Mitigation measures	Timing	Relevant location	Responsibility
NV1	Construction noise	Where receivers are predicted to be noise affected and near construction compounds or fixed work areas with long durations (ie several months), path control, such as hoarding or earth bunds will be investigated. Practical measures will be implemented where required. Positioning of site structures will also be considered to act as barriers between noisy work and receivers where practical.	Detailed design and construction	Wagga 330 kV substation compound (C01) Memorial Avenue compound (C14) Bowmans Lane compound (C15) Tumbarumba Accommodation Facility (AC1)	Contractor
NV2	Construction noise	An out-of-hours work (OOHW) protocol that details how the project will identify, assess and approve out of hours work outside standard construction hours that are likely to generate noise levels that exceed the relevant noise management levels at sensitive receivers will be developed and implemented. The protocol will include provisions to: • carry out additional assessments for work proposed outside standard construction hours, to confirm noise levels at potentially affected sensitive receivers and determine suitable mitigation measures to minimise noise levels • notify and engage with potentially noise affected receivers about upcoming work outside standard construction hours and address any associated complaints. • identify appropriate respite for noise affected receivers (where required). The OOHW protocol will not apply to the operation of the worker accommodation facility.	Detailed design and construction	All locations	Contractor

Reference	Impact	Mitigation measures	Timing	Relevant location	Responsibility
NV3	Construction noise and vibration	If blasting is required, a Blast Management Plan (BMP) will be developed to minimise the potential for impacts. Maximum Instantaneous Charge calculations will be undertaken for specific sites where blasting is required. Individual blast designs will be based on meeting the criteria rather than restrictions on maximum instantaneous charge. All blasts, including initial trial blasts will be monitored to obtain data which can be used to confirm site constants and compliance with blasting criteria. Landowner notification and consultation requirements will be identified in the Blast Management Plan.	Detailed design and construction	All locations	Contractor
NV4	Construction noise and vibration	The likelihood of cumulative construction noise impacts will be reviewed as the project progresses and detailed construction schedules are available for all projects considered for cumulative impacts. Coordination will occur between the various projects to minimise concurrent work in the same areas, where possible. The potential consecutive impacts from HumeLink and other projects will be investigated further as the project progresses. Specific additional management and mitigation measures designed to address potential consecutive impacts will be developed and used to minimise the impacts as far as practicable, in consultation with the affected communities.	Detailed design and construction	All locations	Contractor
NV5	Construction noise	Where construction is likely to result in exceedances of NMLs at sensitive receivers, mitigation and management measures will be implemented where practicable and appropriate. This will include (but is not limited to) the following measures: • select quieter plant and equipment and use alternative construction methods to minimise noise levels • plan and schedule concurrent noisy activities to minimise the number of items of noisy plant operating at one time and cumulative noise levels • install screens or use barriers to mitigate noise from stationary noise sources • maximise the offset distance between noisy plant and sensitive receivers • orient noisy plant and equipment away from sensitive receivers • use noise source controls, such as residential class mufflers, to reduce noise from all regularly used plant including cranes, excavators and trucks	Construction	All locations	Contractor

Reference	Impact	Mitigation measures	Timing	Relevant location	Responsibility
		• use non-tonal reversing alarms in place of traditional beeper reversing alarms during out-of-hours where noise impacts are predicted • turn off machinery when not in use • confirm equipment is maintained in accordance with manufacture's requirements to minimise generation of excessive noise • operate machinery in a manner which reduces occurrence of maximum noise level events, such as excavator bucket impacts, material drop heights, steel on steel impacts and dragging materials across hard surfaces • provide awareness training regarding noise mitigation measures to be implemented as part of regular toolbox meetings • notify and consult with potentially noise affected receivers about upcoming noisy activities • confirm that noise affected receivers outside standard construction hours and highly noise affected sensitive receivers are managed with consideration to the CNVG additional mitigation measures such as notifications, verification, and respite where appropriate.			
NV6	Construction noise	Monitoring will be carried out for noise intensive activities that have the potential to cause noise exceedances at sensitive receivers, to confirm that actual levels are consistent with the predictions and that appropriate mitigation measures have been implemented.	Construction	All locations	Contractor
NV7	Construction noise	All construction vehicle movements will adhere to the following measures: • out-of-hours vehicle movements will be minimised where possible • construction delivery vehicles will be fitted with straps rather than chains for unloading, wherever possible • use of engine compression brakes will be avoided at night and in residential areas • site access points and roads/flight paths will be located as far as possible away from sensitive receivers • traffic flow, parking and loading/unloading areas will be planned to minimise reversing movements • construction inductions will include driver behaviour requirements to minimise vehicle noise emissions.	Construction	All locations	Contractor

Reference	Impact	Mitigation measures	Timing	Relevant location	Responsibility
NV8	Construction vibration	Where vibration intensive work is required within the recommended minimum working distances and is considered likely to exceed the cosmetic damage criteria: • different construction methods with lower source vibration levels will be investigated and implemented, where feasible • vibration monitoring will be undertaken at the start of work to determine actual vibration levels at the receiver • work will be ceased if the monitoring indicates vibration levels are likely to, or do, exceed the relevant criteria.	Construction	All locations	Contractor
NV9	Operational substation noise	The design and layout of the proposed Gugaa 500 kV substation will comply with the NPfI criteria. The design will consider the following measures to mitigate potential noise impacts: • positioning of transformer barriers • selection of equipment with consideration of sound power levels • acoustic modelling of noise levels at surrounding receivers from all noise-generating substation equipment.	Detailed design and operation	Proposed Gugaa 500 kV substation	Designer and Transgrid
NV10	Operational transmission line noise	Receivers potentially noise affected by operational transmission line noise will be reviewed once the final project transmission line route, conductor arrangement and any property acquisitions are known. For each residence where potential operational noise levels are predicted to exceed project trigger levels, noise monitoring to confirm actual operational noise levels would be carried out: • at representative locations within six months of the commencement of operation; and • at the request of the landowner of the residence at any time within two (2) years after the commencement of operation. The noise monitoring will occur during weather/atmospheric conditions conducive to generating the corona effect. For residences where the monitoring identifies corona discharge levels above 35 dB(A) $L_{Aeq,15min}$ at the reasonably most affected point of the residence, consultation will be undertaken with the landowner of the affected residence to identify solutions. Once the appropriate solutions have been agreed with the landowner, these will be implemented within 12 months.	Detailed design and operation	Transmission lines	Designer and Transgrid

10 Conclusion

This report has been prepared to address the project SEARs in relation to the assessment of noise and vibration impacts of the project. The report describes the existing noise environment surrounding the project and outlines the methodology and assessment of impacts from the construction and operation of the project. Where impacts are predicted, appropriate mitigation measures have been recommended to mitigate and manage the impacts.

10.1 Construction

The project would involve the construction of new 500 kV transmission lines and substation construction works between the Wagga 330 kV substation, the proposed Gugaa 500 kV substation, the future Maragle 500 kV substation and the Bannaby 500 kV substation. The project would also include a telecommunications hut, construction compounds and a worker accommodation facility.

Representative work scenarios detailing typical plant and equipment have been developed to assess the potential construction noise impacts of the project. The assessment identifies noise impacts during day-time and out of hours periods as required. Impacts are also identified at various 'other sensitive' receivers in the study area, including educational, medical and place of worship receivers.

The assessment has predicted construction noise impacts from eight of the 14 potential construction compounds, with a larger number of receivers predicted to be impacted near construction compounds that are in or near to towns. Noise impacts are also predicted from substation construction work at Wagga 330 kV substation and the proposed Gugaa 500 kV substation.

Transmission line construction is generally predicted to have high noise impacts, but the impacts are only expected when work is at the transmission line structures closest to each receiver which would be relatively short-term.

Construction noise impacts are generally predicted to be 'highly intrusive' at the closest receivers during the highest impact work such as construction compound site establishment and when transmission line construction is closest to each receiver. A total of up to 701 receivers are predicted to potentially exceed the management levels from compound construction work during site establishment. A total of up to 398 receivers are predicted to potentially exceed the management levels from transmission line construction work.

Construction road traffic noise has been conservatively assessed assuming the construction traffic peak hour occurs at 6am to 7am, with the more stringent night-time criteria. Construction traffic has been compared to the existing traffic on all proposed routes to determine the relative increase and total road traffic noise levels. Notable increases in road traffic noise (ie greater than 2.0 dB) are predicted on most construction routes, particularly where construction traffic is required on local roads with low existing traffic volumes.

Construction vibration has been assessed based on the vibration intensive equipment identified in the construction scenarios, including hydraulic hammers and vibratory rollers. The recommended minimum offset distances for human comfort and cosmetic damage have been considered with 20 of the nearest receivers within the human comfort minimum offset.

The potential requirement for blasting has been identified, although specific locations have not been determined at this stage. Airblast overpressure and vibration levels versus distance have been presented based on average conditions. When specific blasting locations are known, geotechnical investigations and further blast overpressure and vibration assessment would be undertaken, including development of a Blast Management Plan.

The project would apply all feasible and reasonable mitigation to reduce the potential construction impacts. Best practice measures have been recommended in this report. Specific strategies would be determined as the project progresses and a NVMP is developed.

10.2 Operational

The project would involve operation of around 360 kilometres of new 500 kV transmission line and connection to the existing Wagga 330 kV substation, the proposed Gugaa 500 kV substation, the future Maragle 500 kV substation and the existing Bannaby 500 kV substation.

Operational noise has been assessed at the proposed Gugaa 500 kV substation. New or changed noise impacts are not expected at the other substations since the project related equipment is expected to be substantially less noise producing than the existing equipment. Assessment of the proposed Gugaa 500 kV substation identified potential noise impacts of up to 6 dB above the trigger levels at the closest receivers. The proposed Gugaa 500 kV substation would be designed to comply with the relevant noise criteria at all receivers.

Audible noise from the operation of the project transmission lines has been assessed based on the project footprint and a minimum easement of 70 metres. The assessment has considered the effect of weather conditions on audible noise emission. Up to 65 receivers expected to potentially experience audible noise impacts have been identified based on distance to the project footprint and the most stringent night-time criteria.

Operational transmission line noise impacts will continue to be considered as the project progresses and confirmed with noise monitoring post-construction. Individual receiver agreements are expected to be the most feasible and reasonable mitigation option where operational noise impacts remain.

10.3 Cumulative

Potential cumulative impacts from the construction and operation of HumeLink and other nearby projects have been identified. The potential for cumulative noise impacts is generally considered low due to the distance between receivers and adjacent projects. Where cumulative construction impacts occur, they are expected to be relatively short-term during the overlapping periods of construction.

Consultation with applicable nearby projects will be undertaken to minimise potential cumulative construction noise impacts. Community feedback and any noise complaints would be considered to determine areas with potential cumulative noise impacts.

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ATTACHMENT A

Acoustic terminology

1 Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that in common usage 'noise' is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x 10^{-5} Pa.

2 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3 Sound Power Level

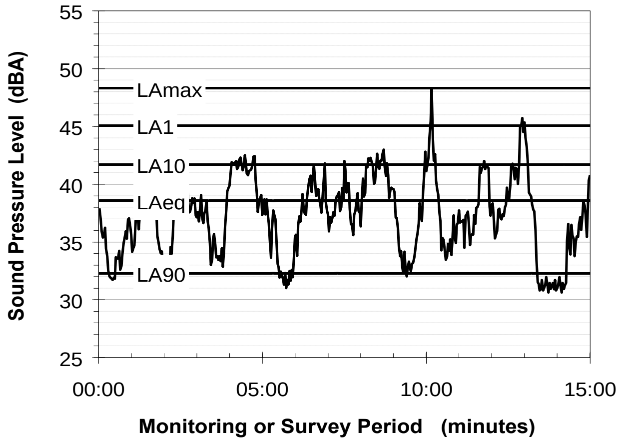
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_W, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

L_{Aeq} The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the 'repeatable minimum' L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition, the method produces mean or 'average' levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than 'broad band' noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

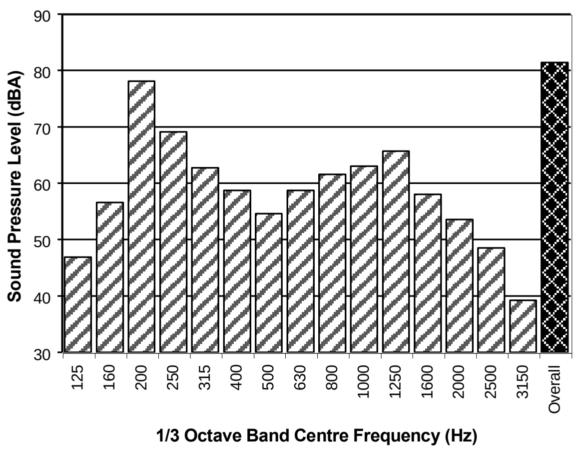
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/V_o), where V_o is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used by some organisations.

9 Human Perception of Vibration

People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

10 Over-Pressure

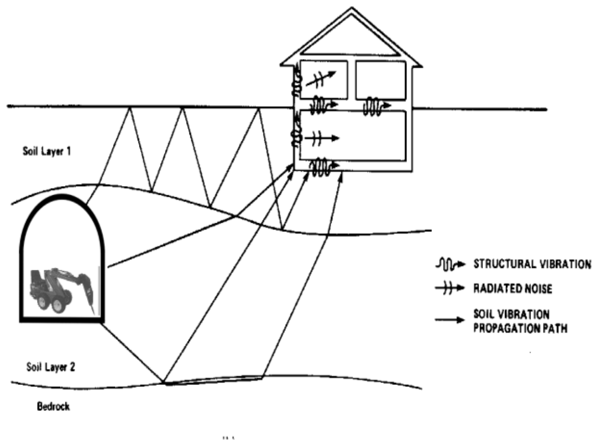
The term 'over-pressure' is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

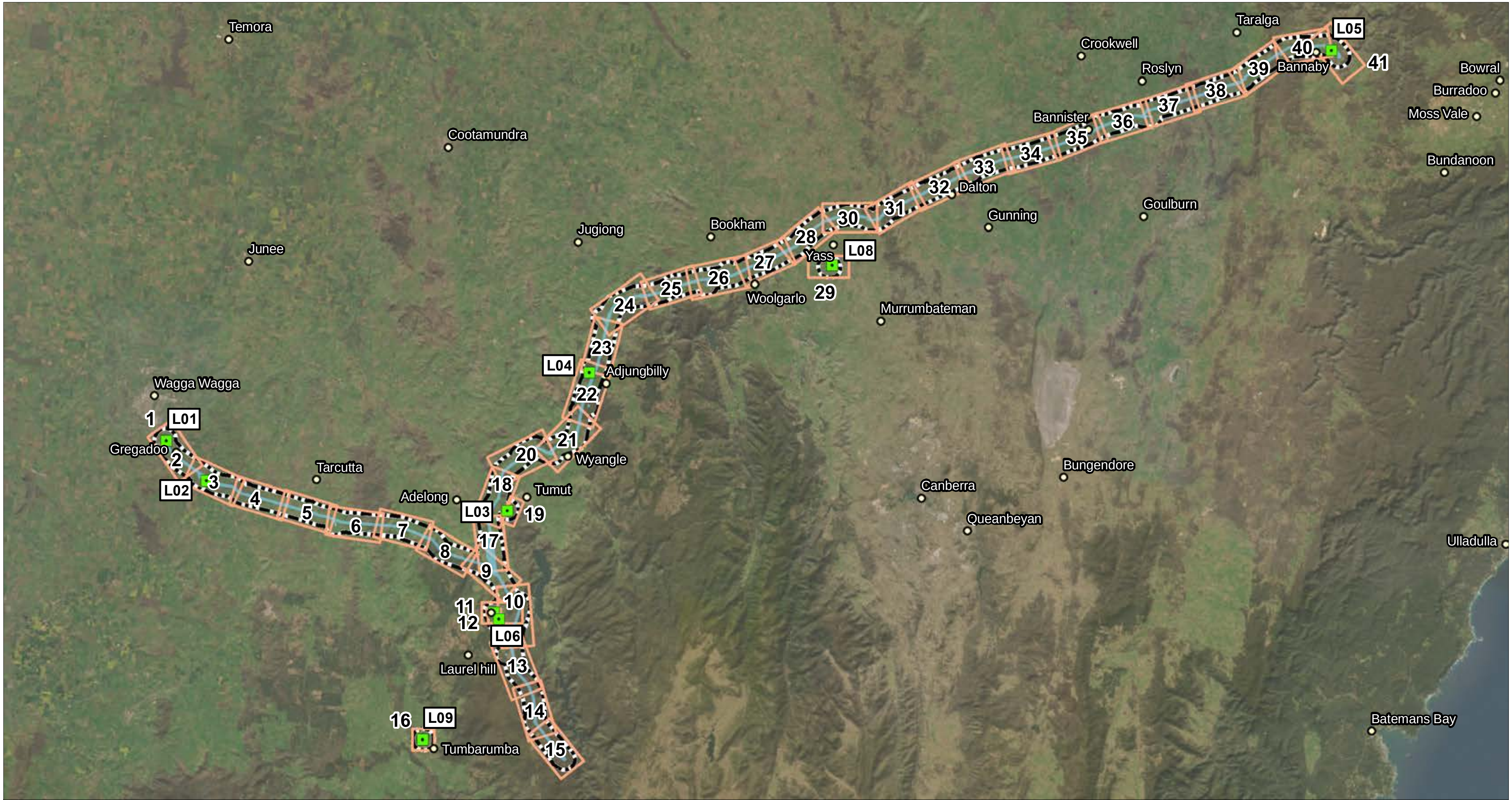
The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise

ATTACHMENT B

Project and receiver map



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Scale:	1:1,100,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City
Monitoring locations
Study area
Project footprint

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP

ATTACHMENT B

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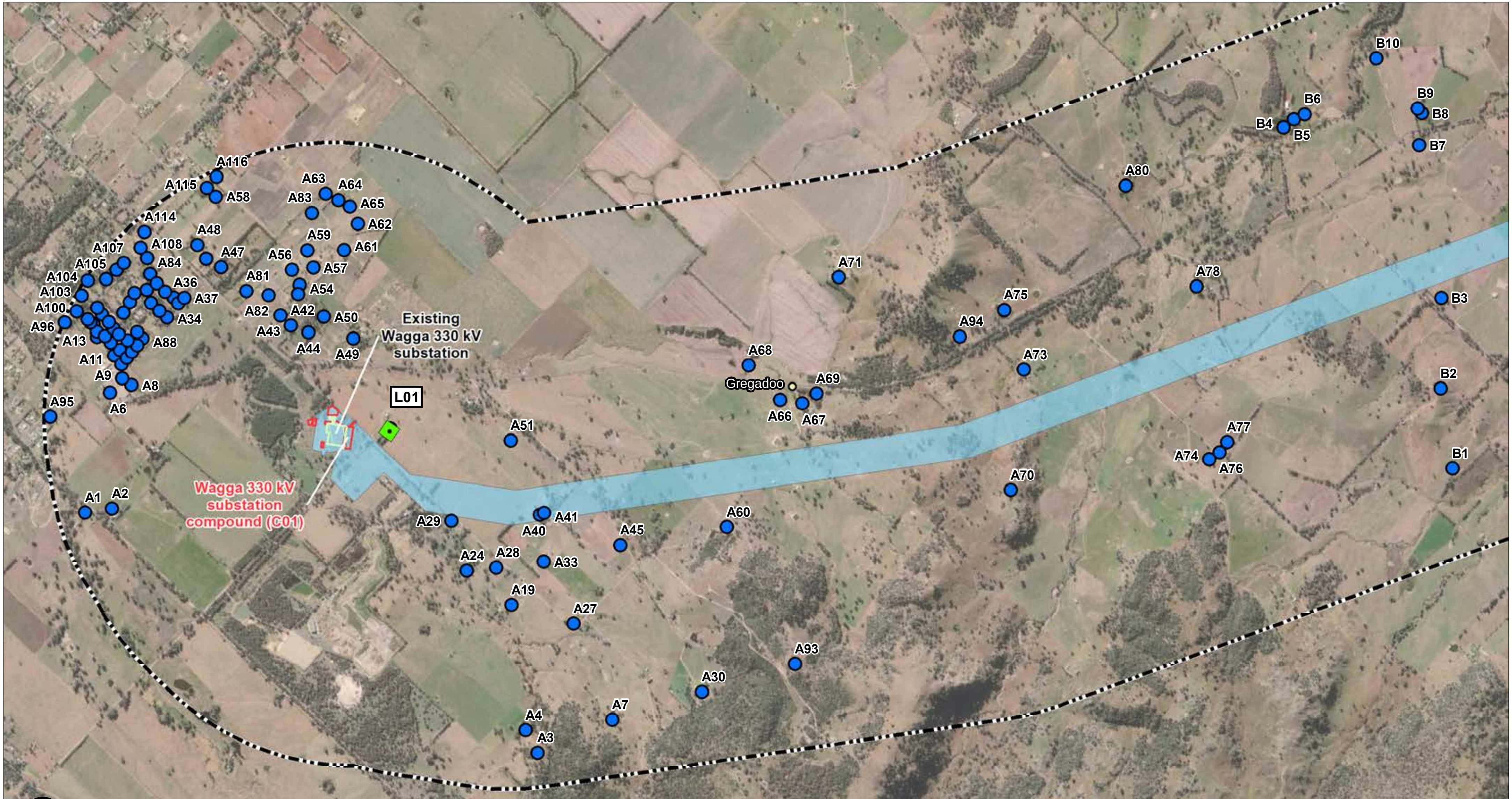

0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

- City
- Study area
- Monitoring locations

Receiver Points

- Other (Outdoor Active)
- Other (Place of Worship)
- Residential

Receiver Buildings

- Commercial
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Project components

- Substation
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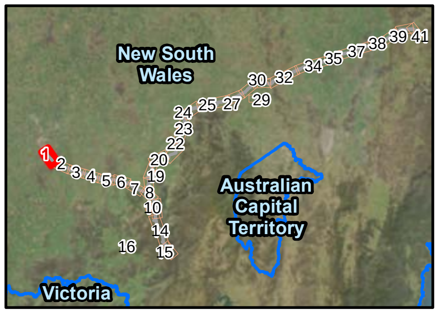

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0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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SLR

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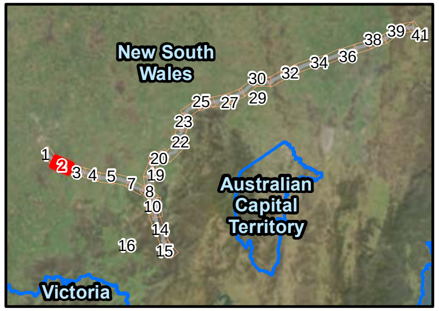

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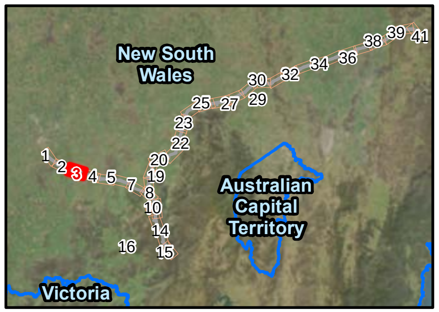

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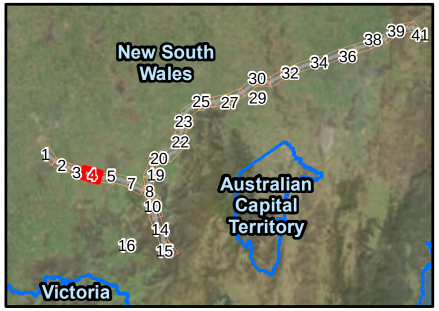

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IMPACT ASSESSMENT

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0 250 500 1,000 Metres

SLR

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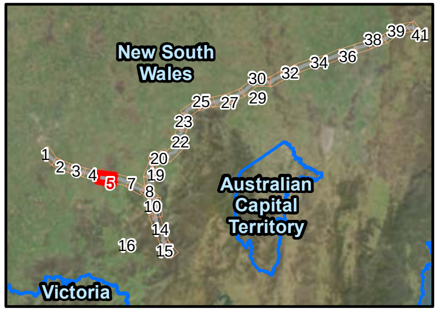

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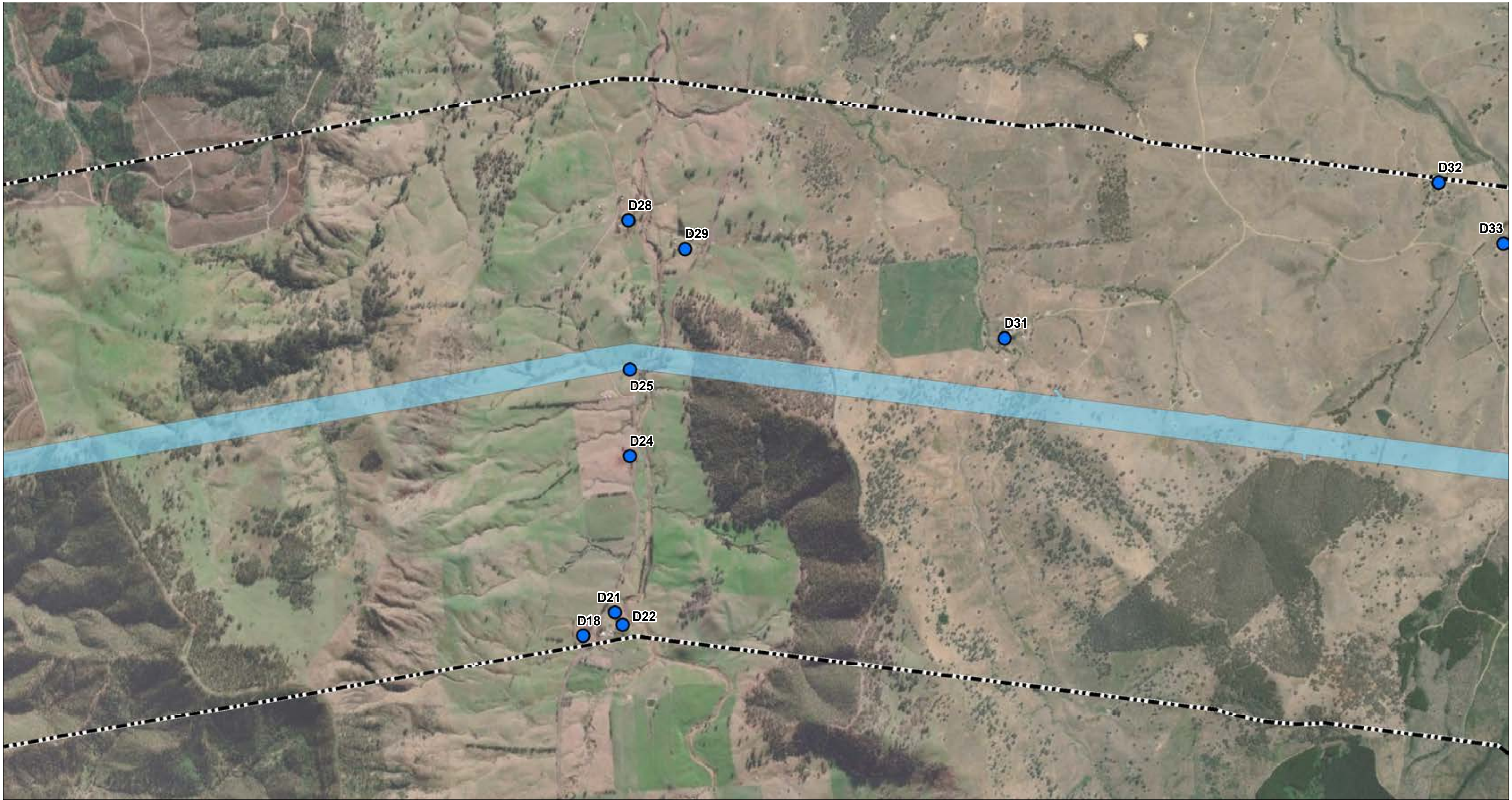

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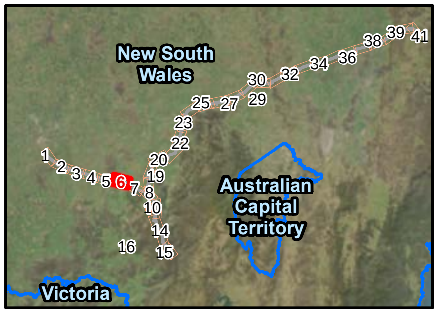

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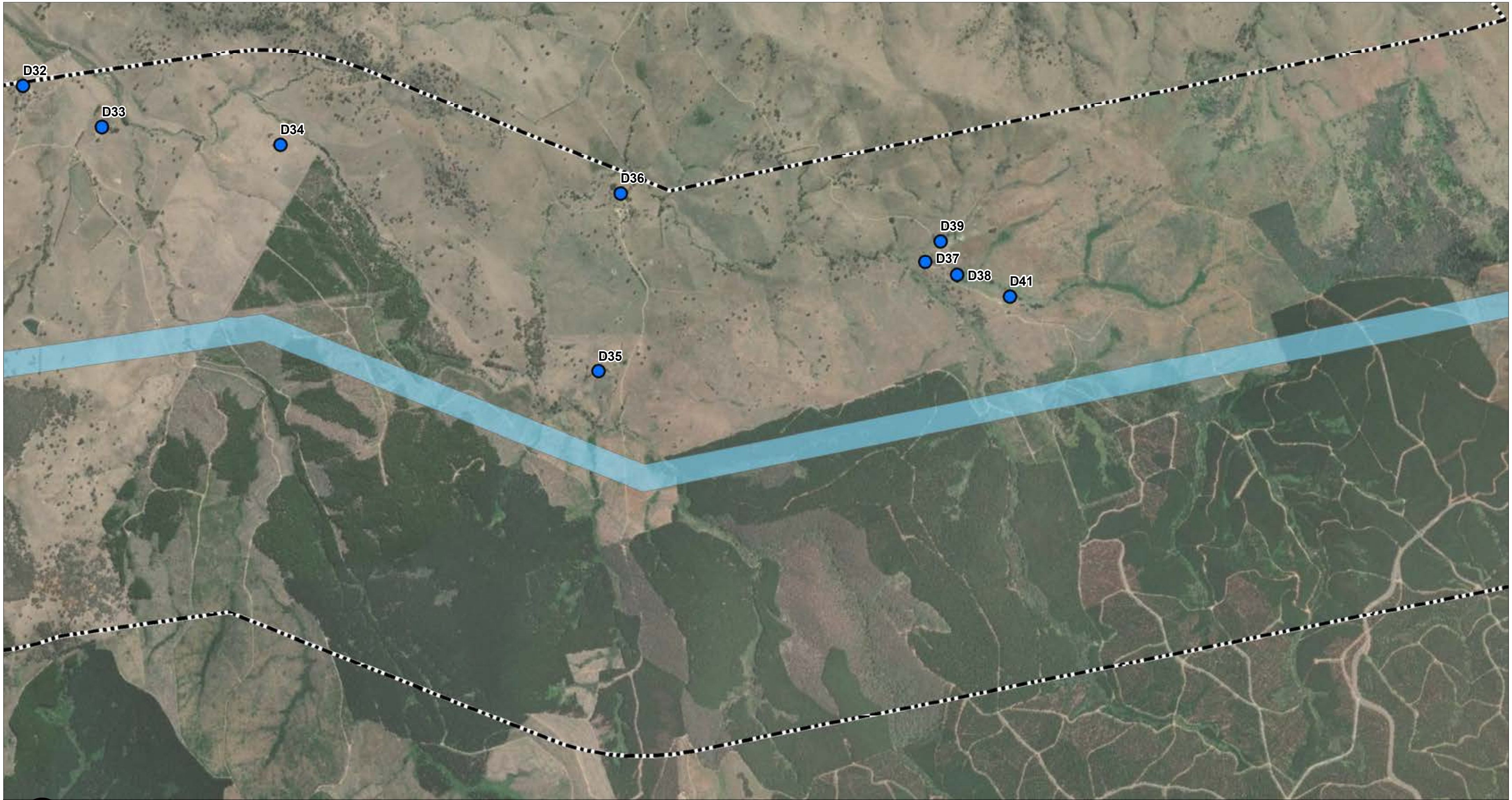

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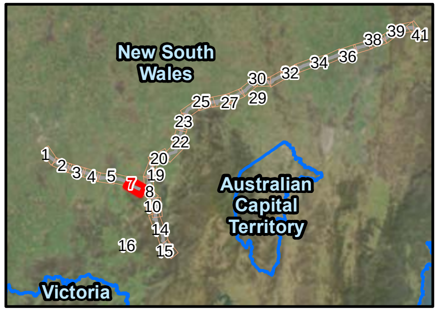

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NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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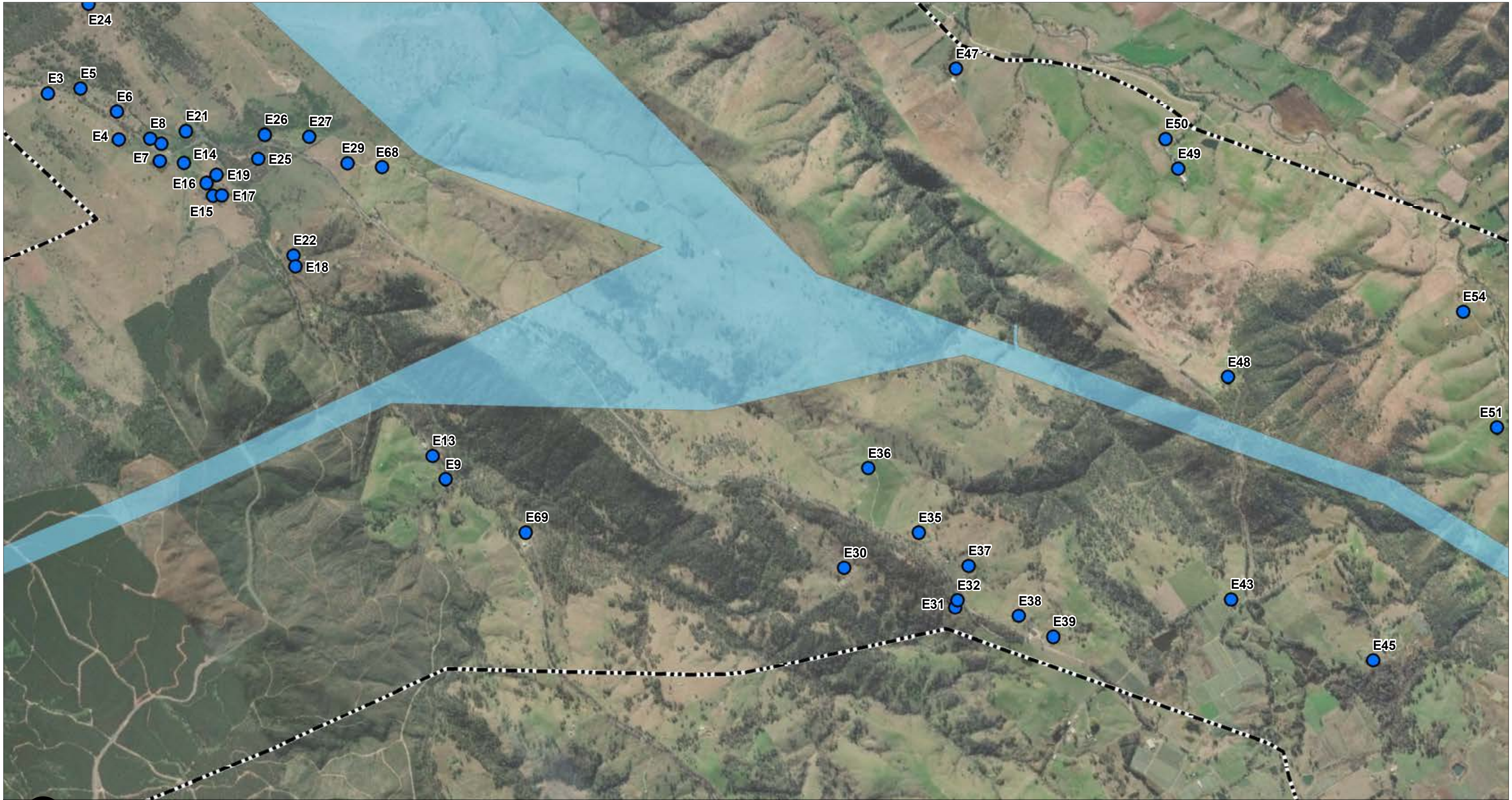

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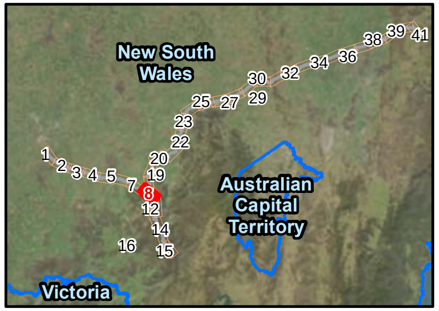

HUMELINK
NOISE AND VIBRATION
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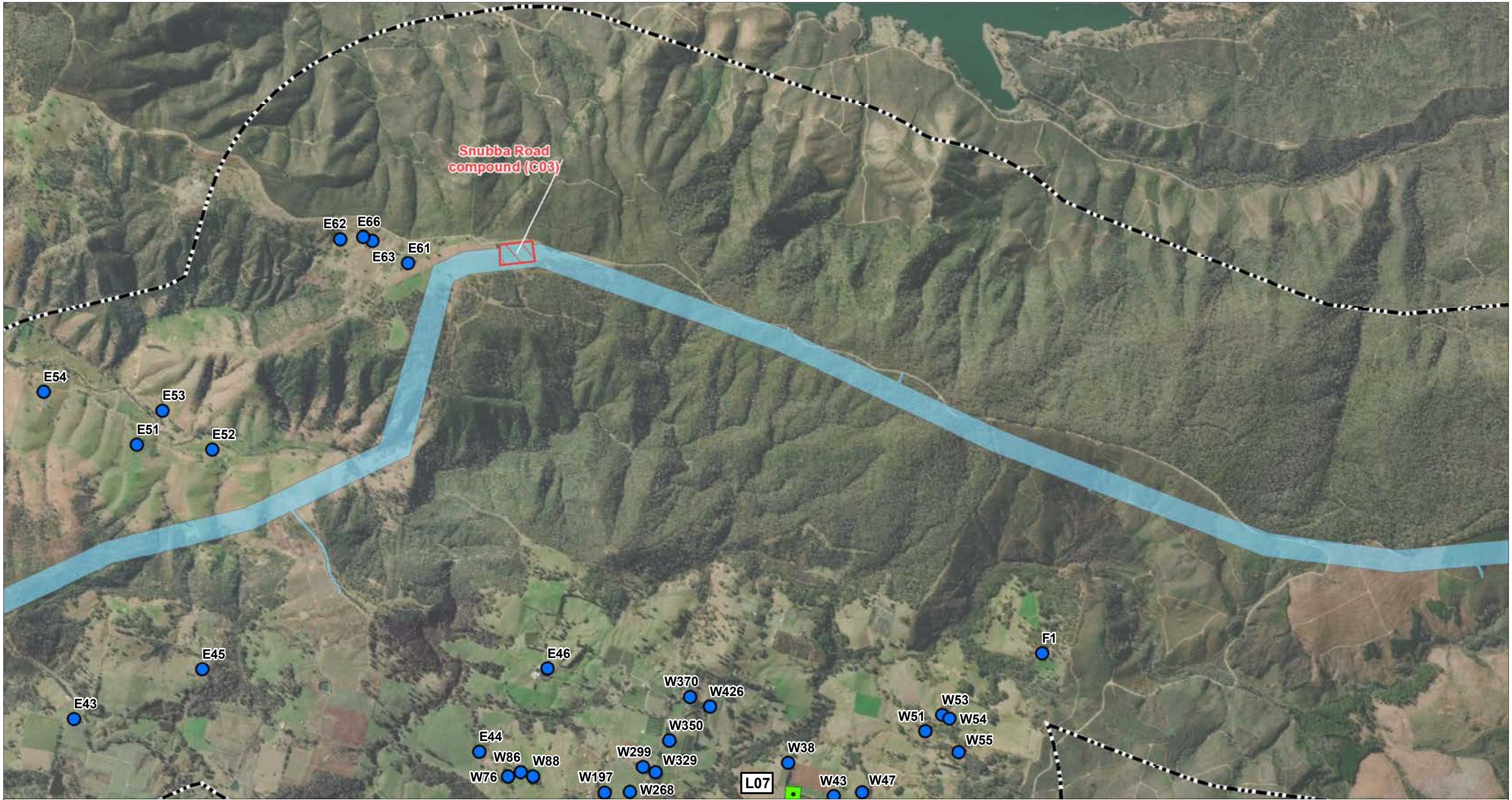

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SLR

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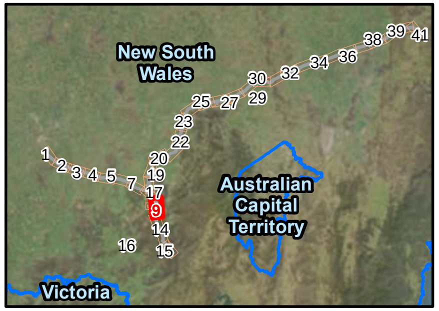

HUMELINK
NOISE AND VIBRATION
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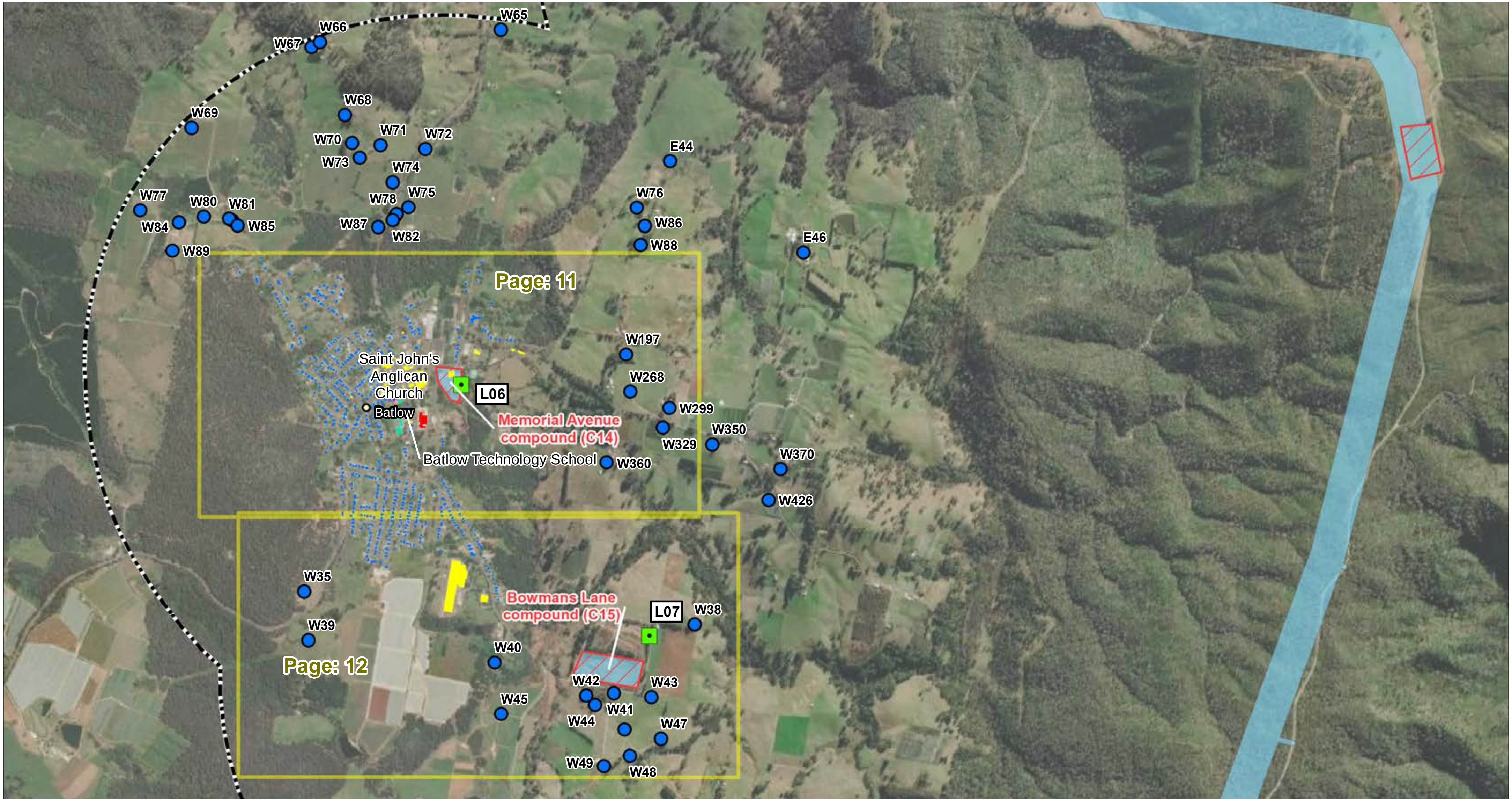

0 150 300 600 Metres

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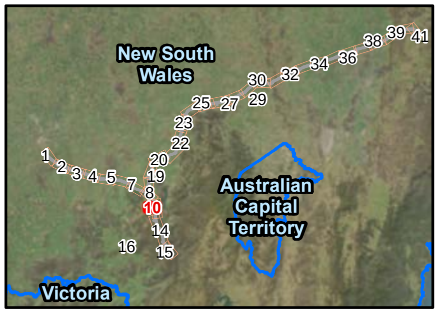

HUMELINK
NOISE AND VIBRATION
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PROJECT AND RECEIVER MAP
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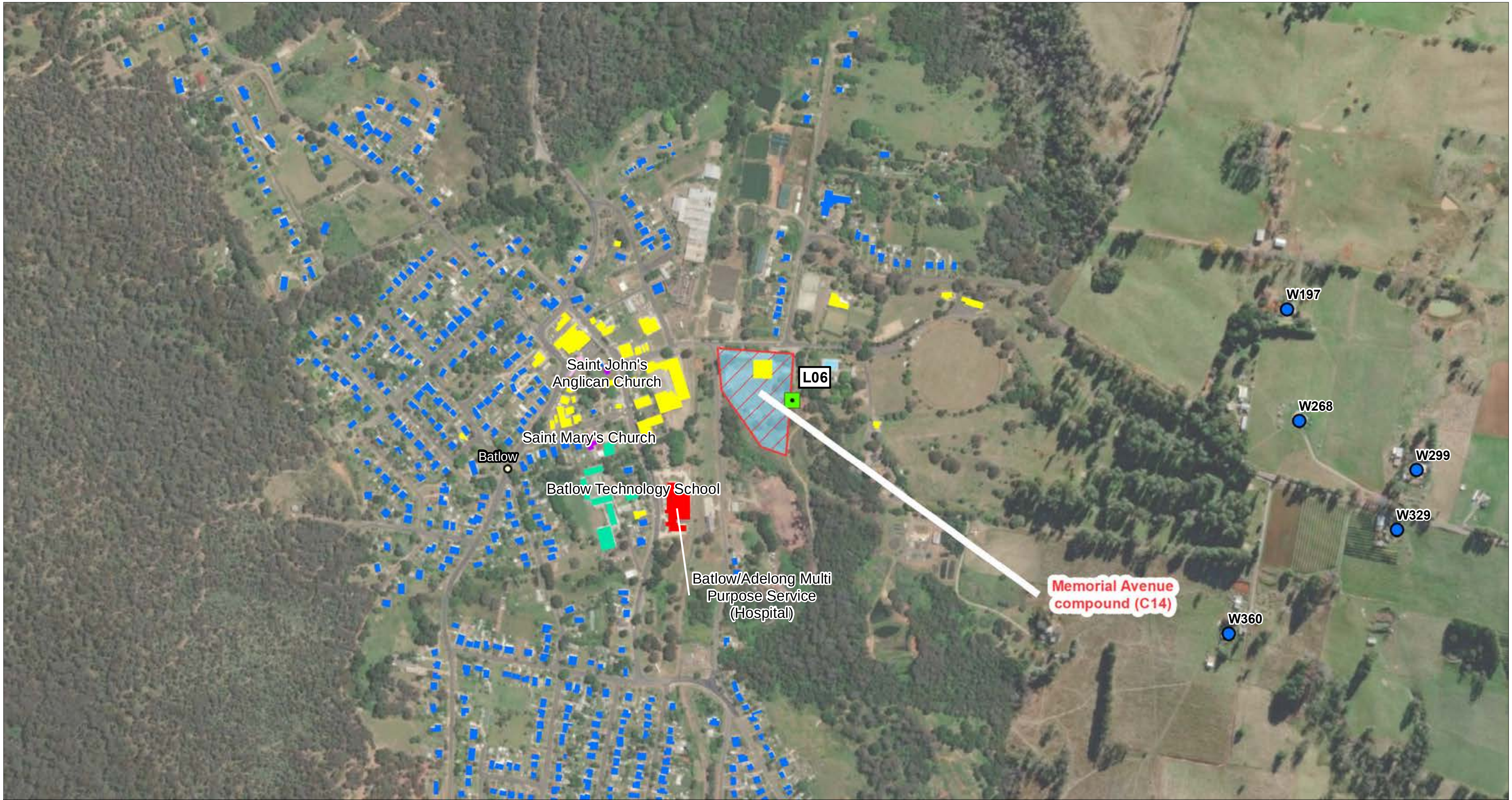
ATTACHMENT B



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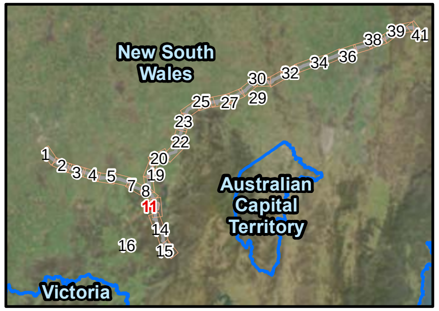

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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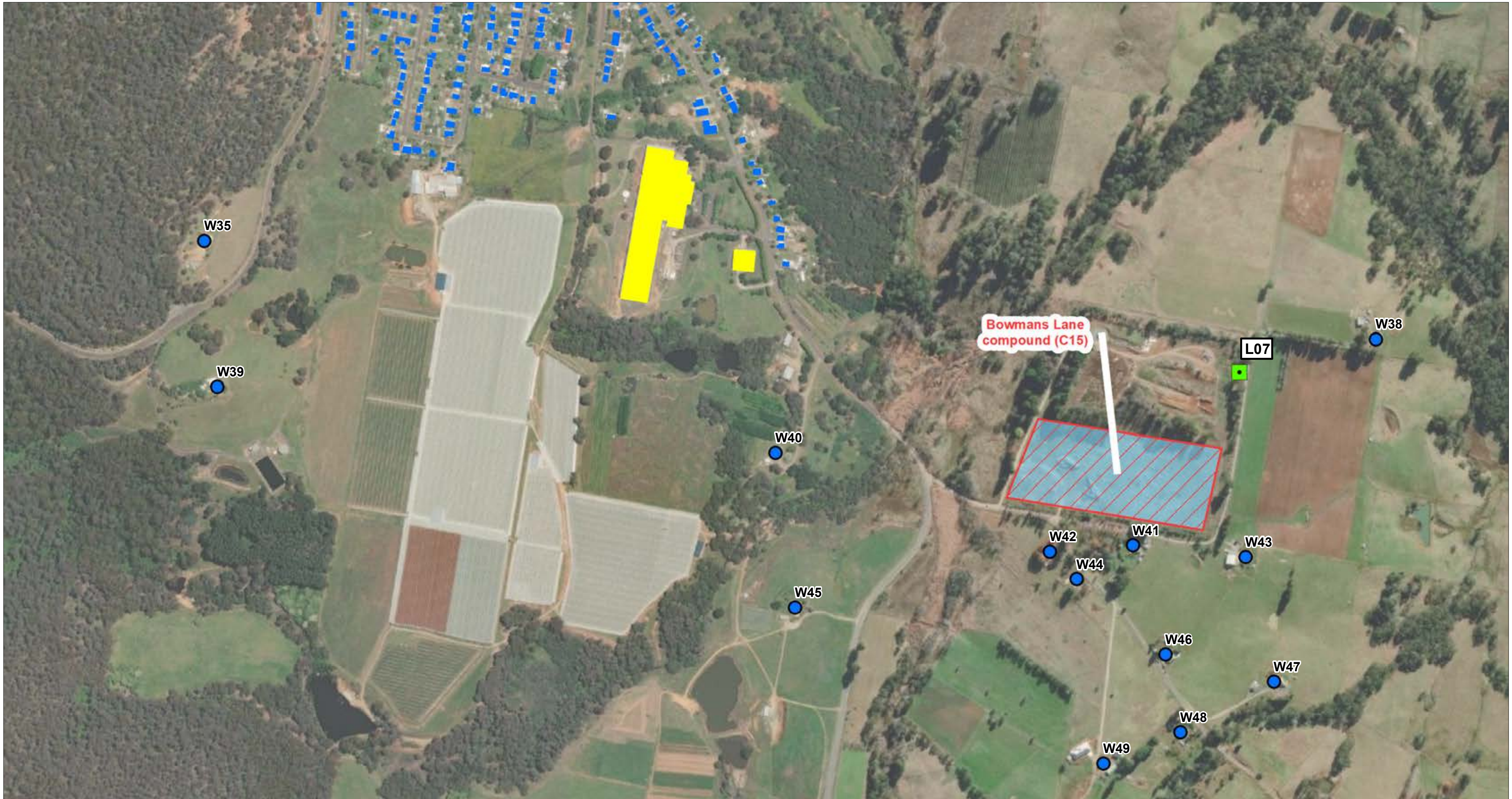
ATTACHMENT B



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Project Number: 610.30622
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0 50 100 200 Metres

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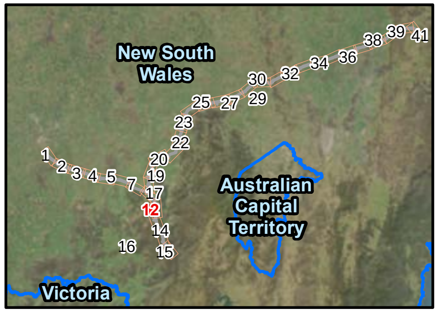

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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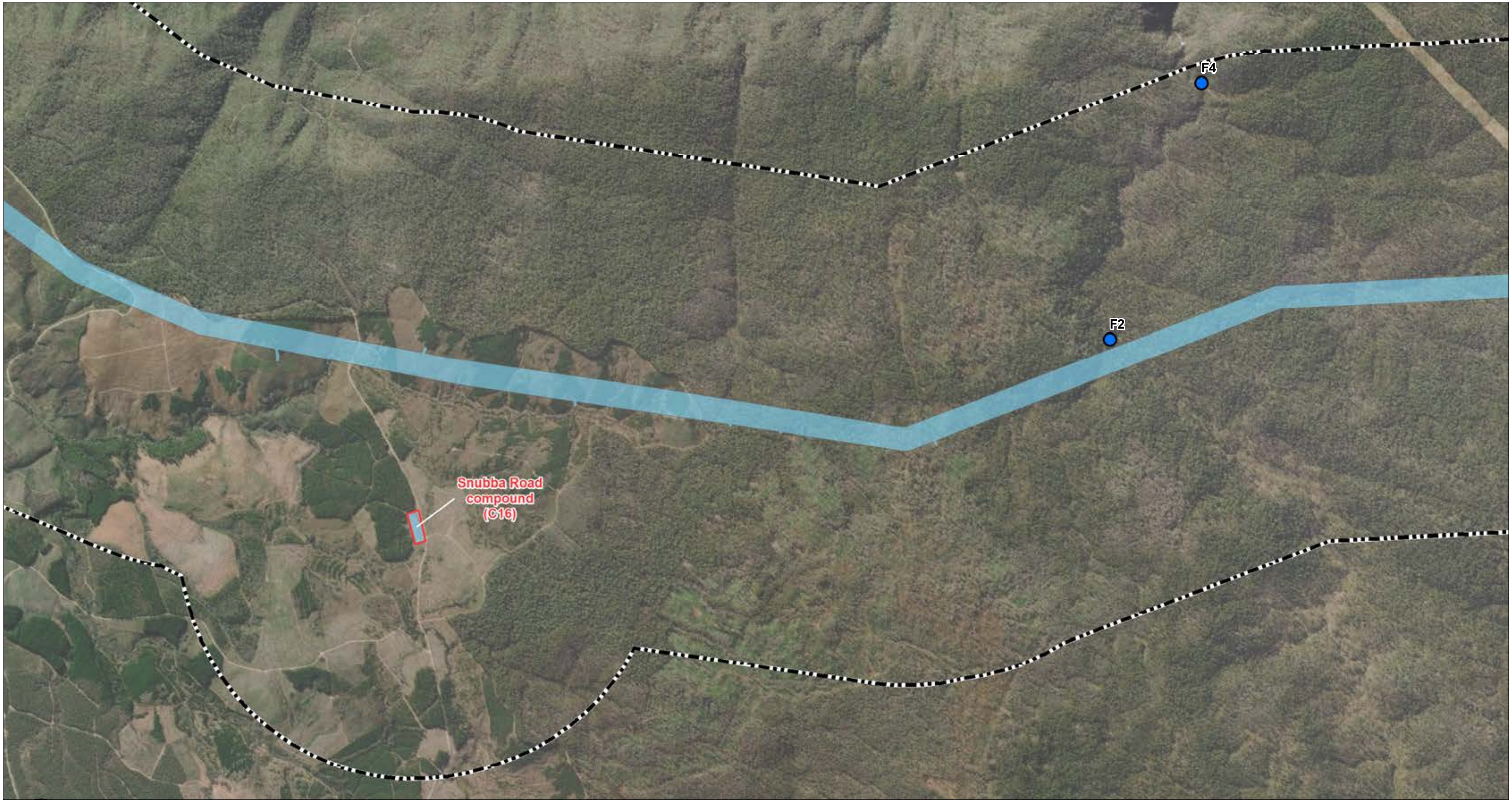
ATTACHMENT B



0 250 500 1,000 Metres

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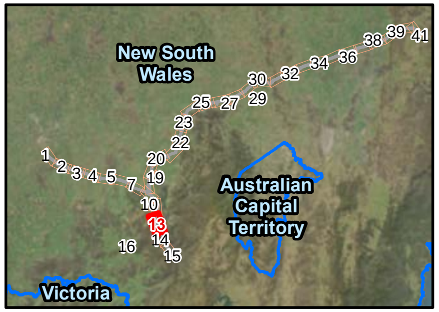

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

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0 250 500 1,000
Metres

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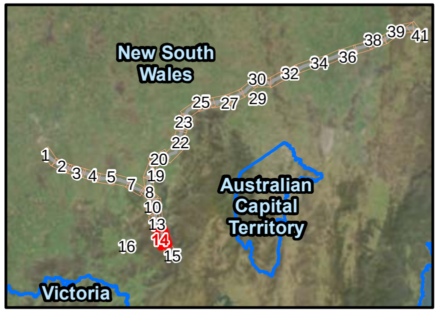

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\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig PROJECT AND RECEIVER MAP DDP_new.mxd

0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Monitoring locations

Receiver Points

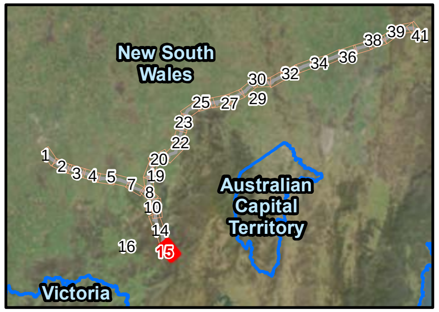
Other (Outdoor Active)
Other (Place of Worship)
Residential

Receiver Buildings

Commercial
Other (Child Care)
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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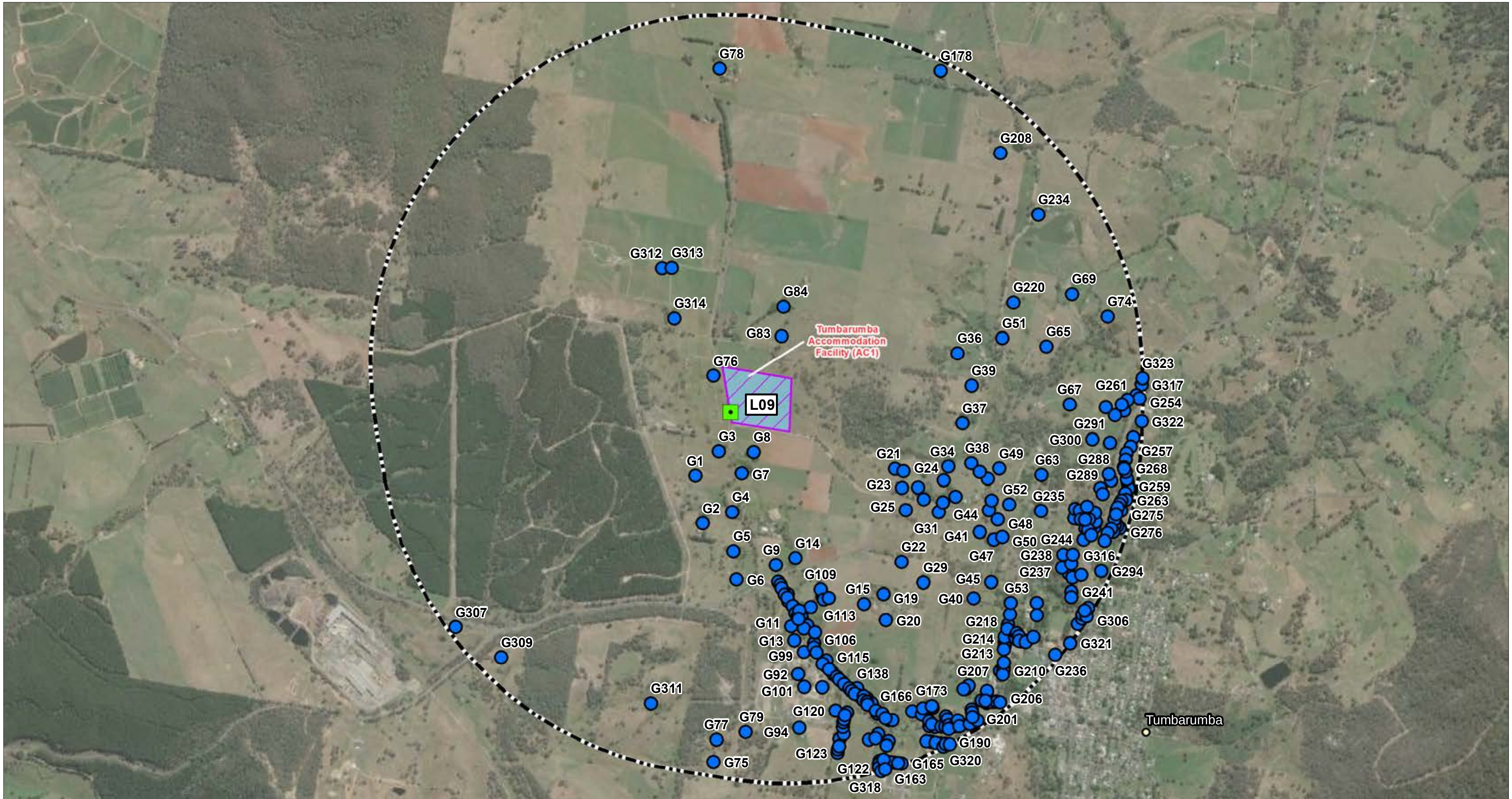
ATTACHMENT B



0 150 300 600 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:30,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Monitoring locations

Receiver Points

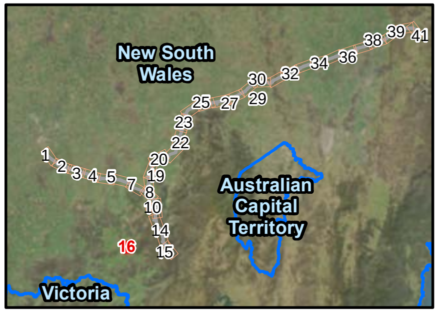
Other (Outdoor Active)
Other (Place of Worship)
Residential

Receiver Buildings

Commercial
Other (Child Care)
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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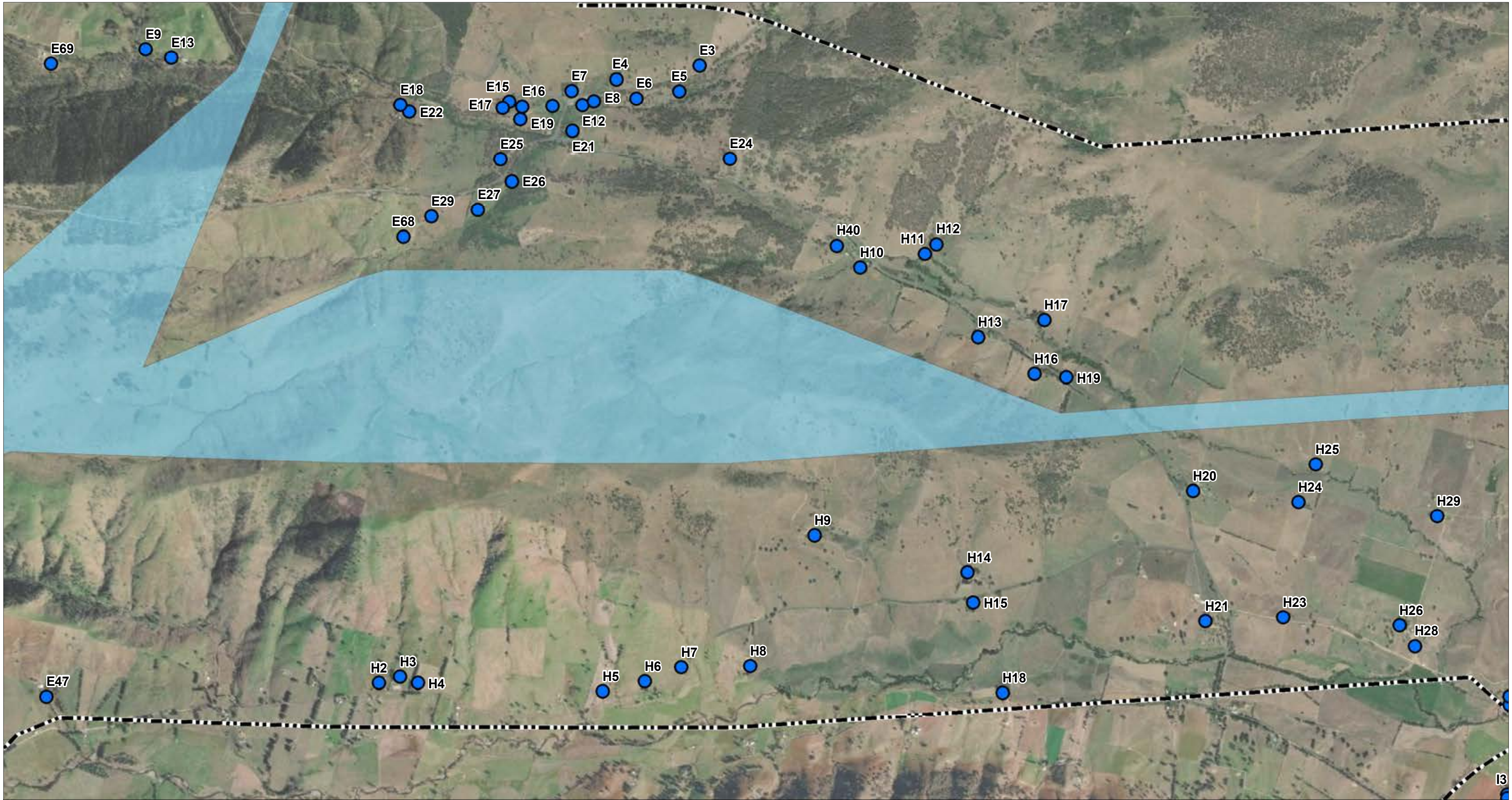


0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Monitoring locations

Receiver Points

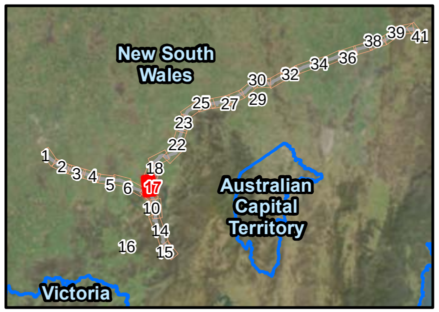
Other (Outdoor Active)
Other (Place of Worship)
Residential

Receiver Buildings

Commercial
Other (Child Care)
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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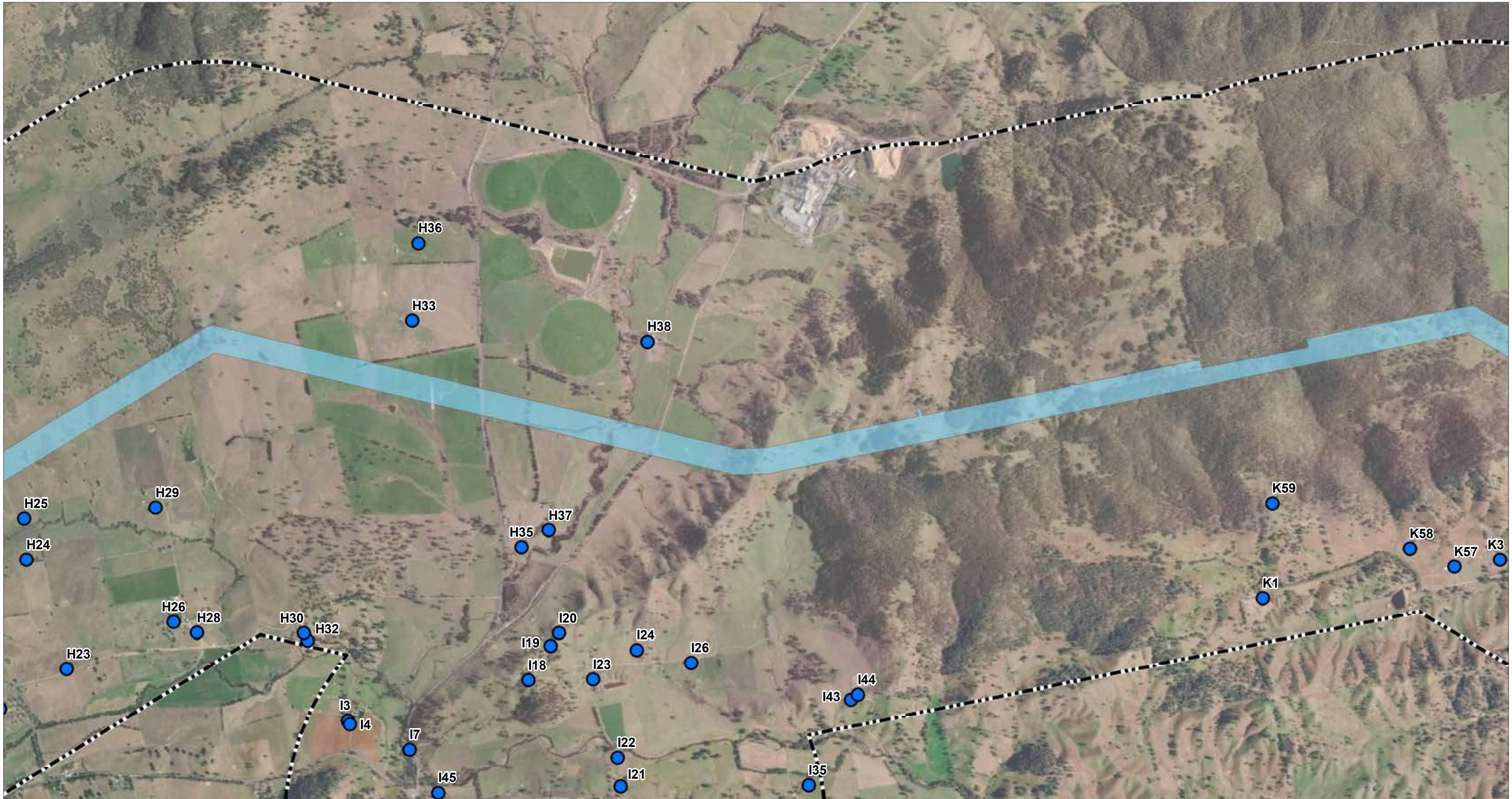

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Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

SLR

- City
- Study area
- Monitoring locations

Receiver Points

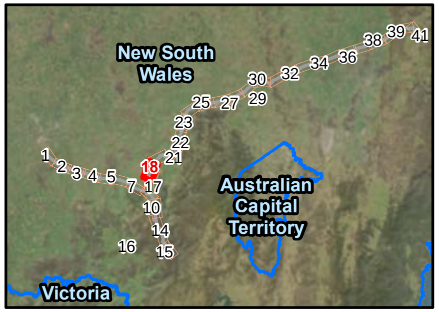
- Other (Outdoor Active)
- Other (Place of Worship)
- Residential

Receiver Buildings

- Commercial
- Other (Child Care)
- Other (Educational)
- Other (Hotel)
- Other (Medical)
- Other (Place of Worship)
- Residential

Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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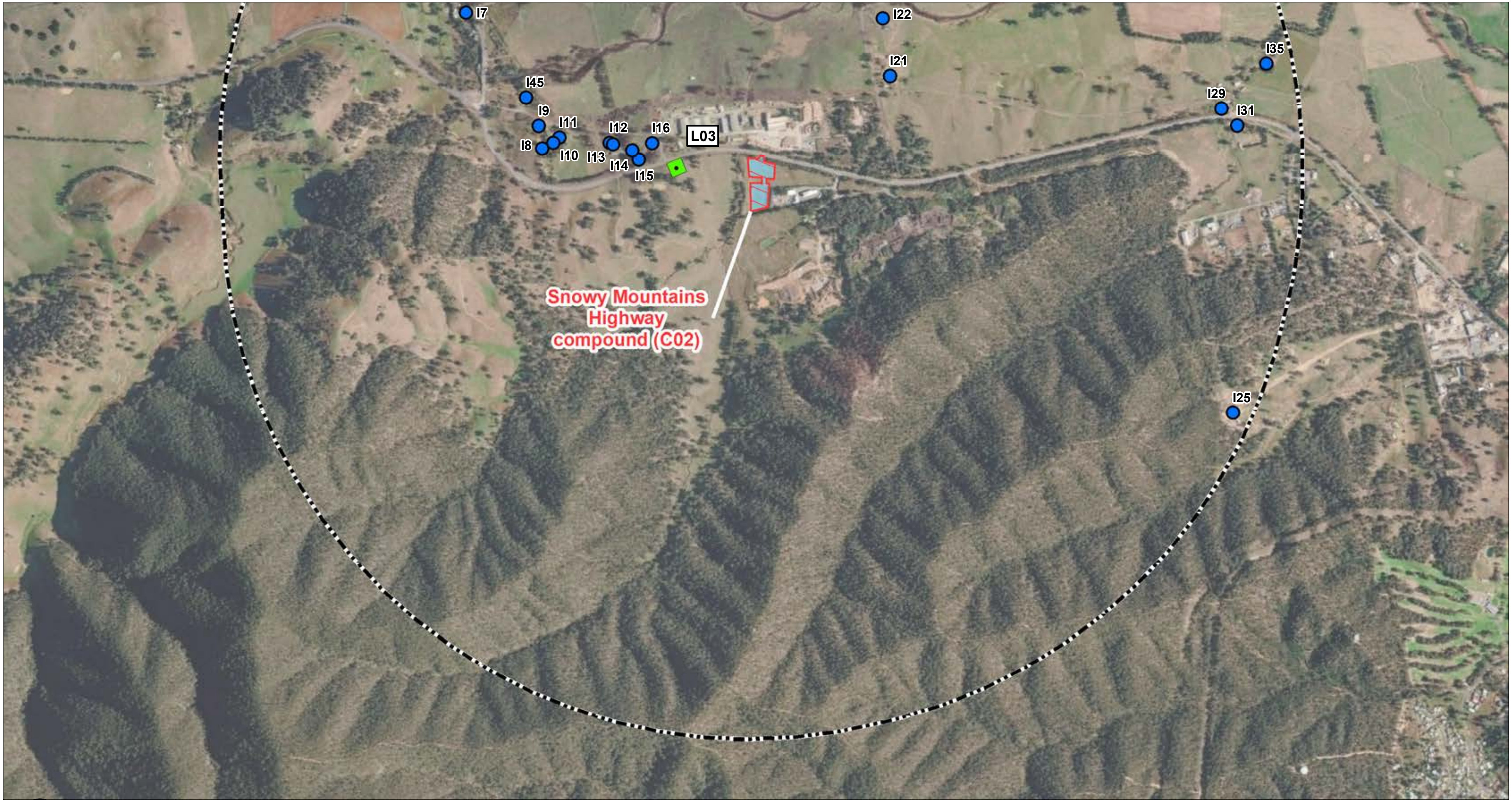

0 100 200 400 Metres

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Scale:	1:20,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Monitoring locations

Receiver Points
Other (Outdoor Active)
Other (Place of Worship)
Residential

Receiver Buildings
Commercial
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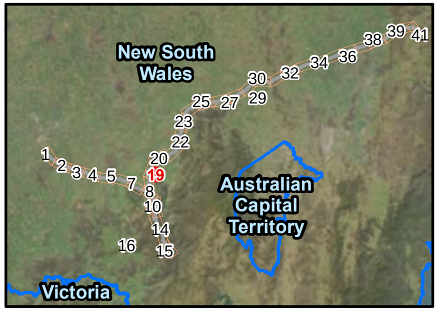
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components
Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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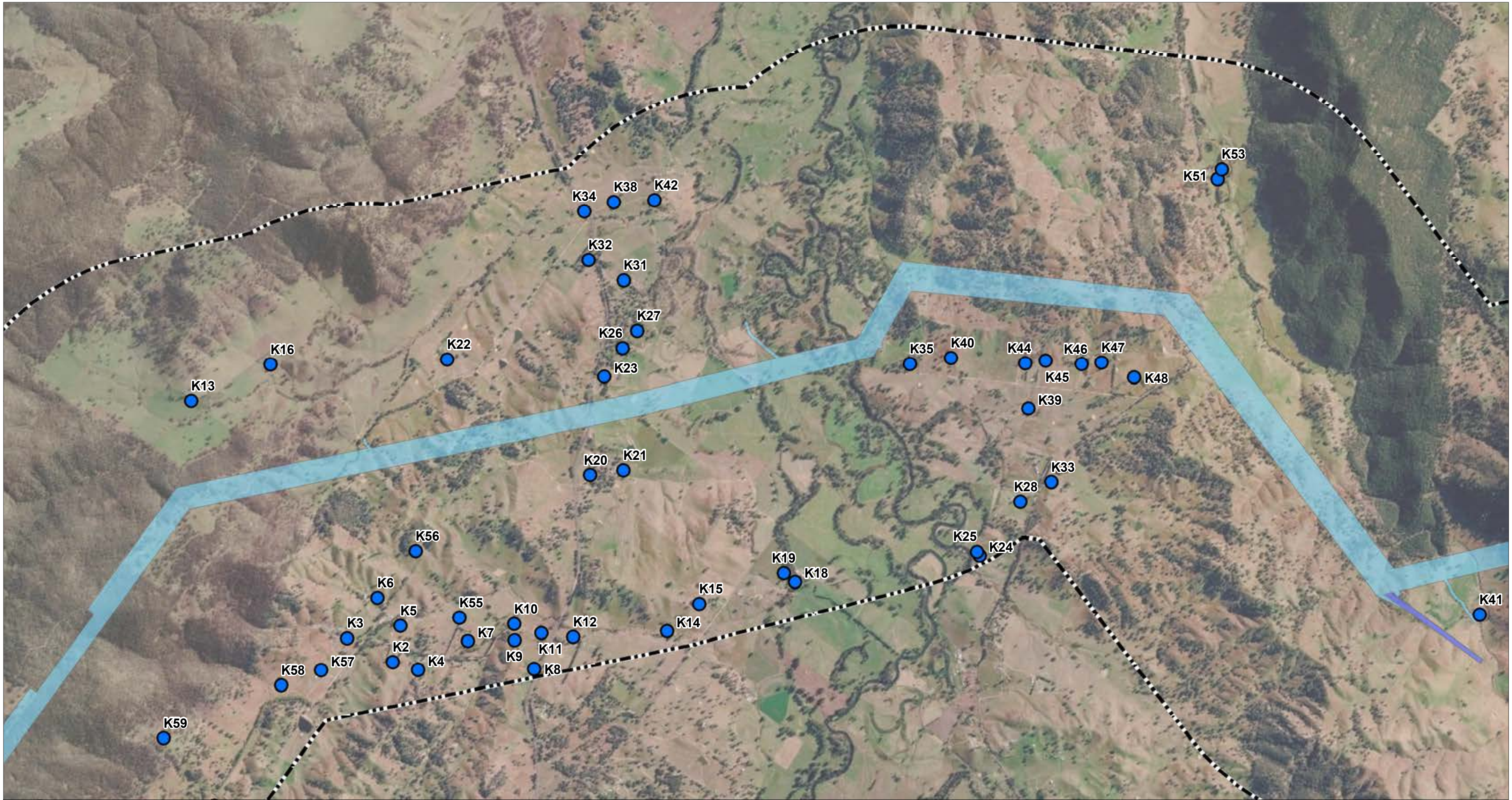


0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:45,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

SLR

- City
- Study area
- Monitoring locations

Receiver Points

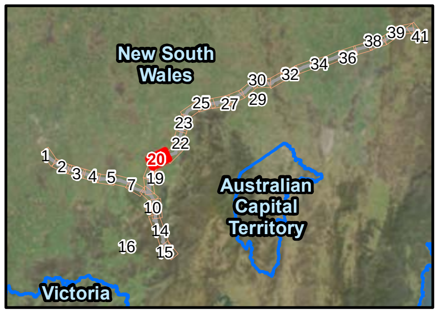
- Other (Outdoor Active)
- Other (Place of Worship)
- Residential

Receiver Buildings

- Commercial
- Other (Child Care)
- Other (Educational)
- Other (Hotel)
- Other (Medical)
- Other (Place of Worship)
- Residential

Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:45,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Monitoring locations

Receiver Points

Other (Outdoor Active)
Other (Place of Worship)
Residential

Receiver Buildings

Commercial
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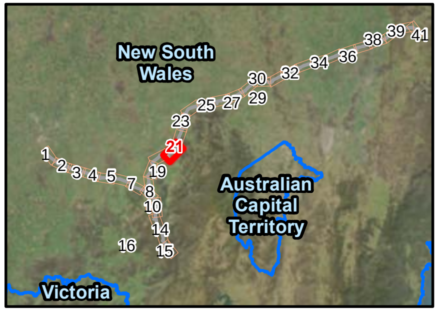
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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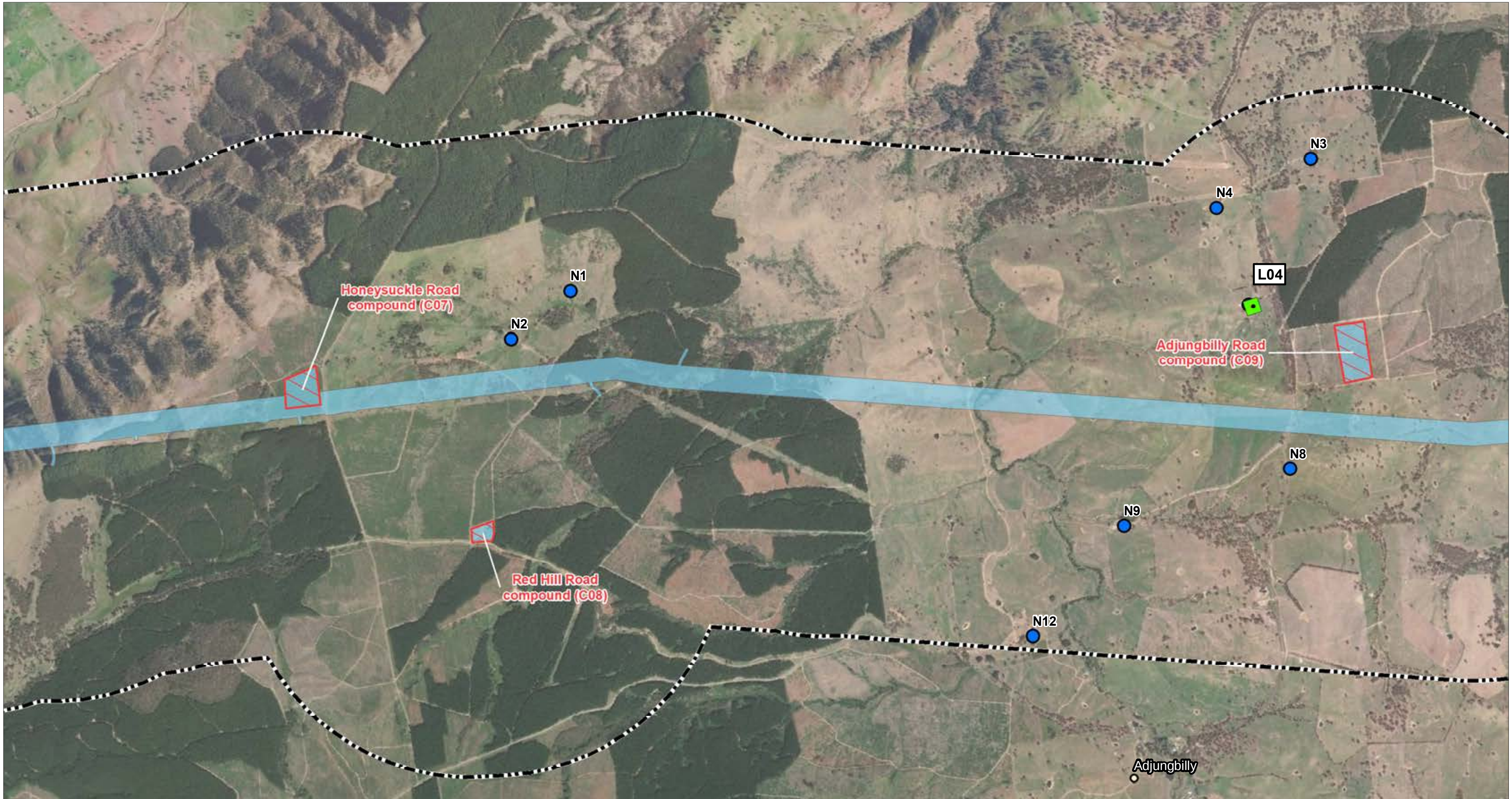


0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:45,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City

Study area

Monitoring locations

Receiver Points

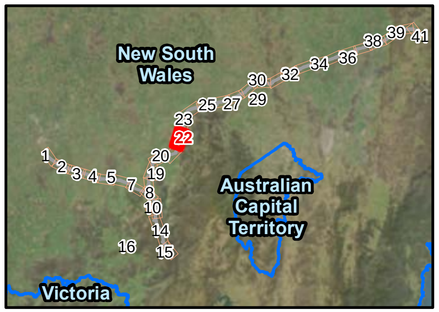
- Other (Outdoor Active)
- Other (Place of Worship)
- Residential

Receiver Buildings

- Commercial
- Other (Child Care)
- Other (Educational)
- Other (Hotel)
- Other (Medical)
- Other (Place of Worship)
- Residential

Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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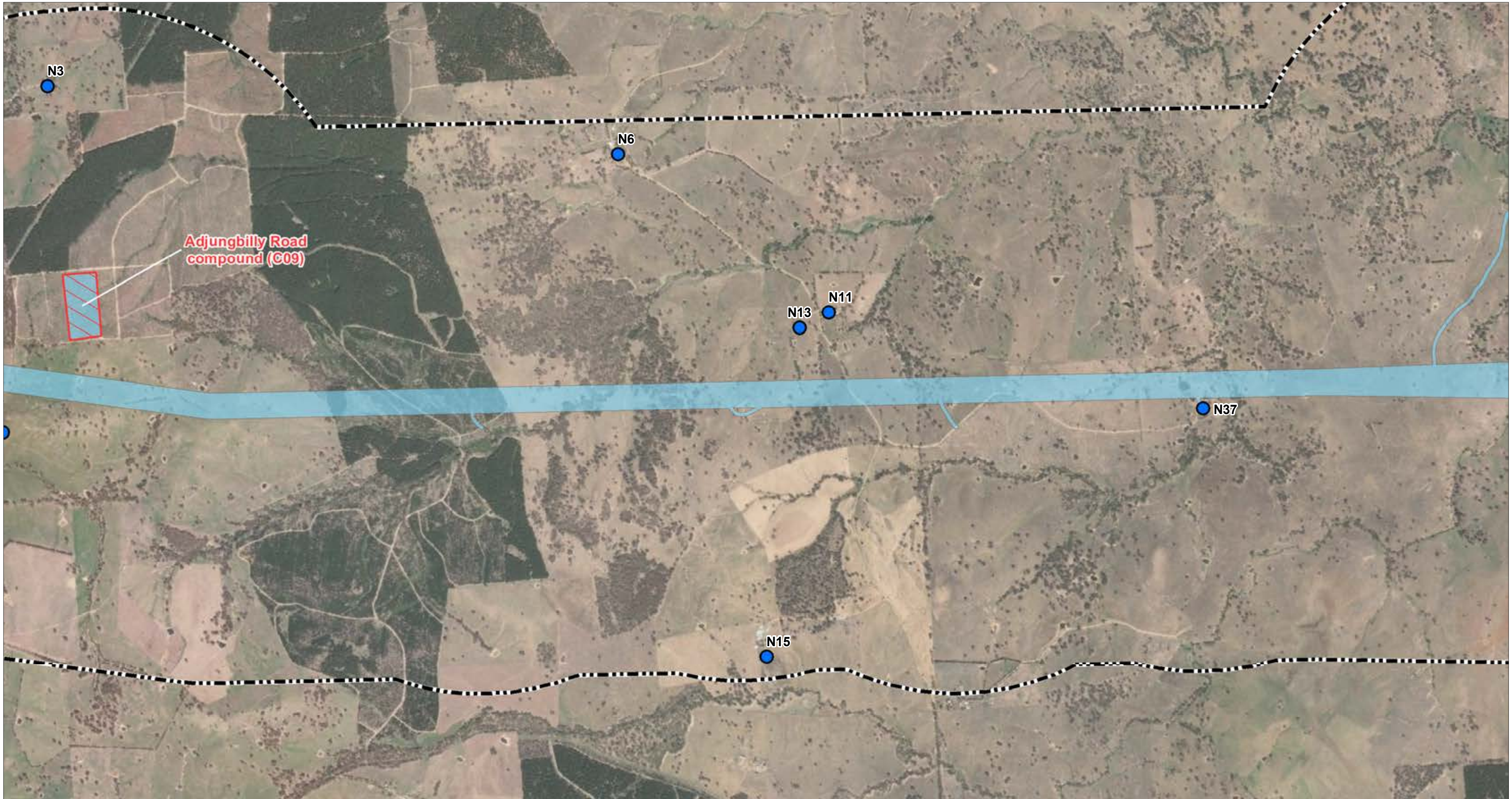
ATTACHMENT B



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

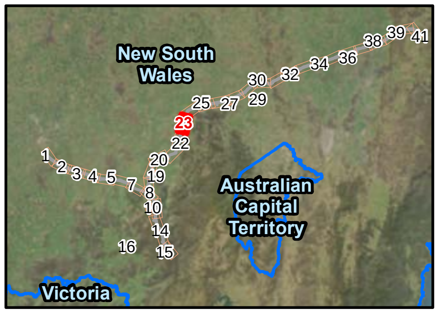
SLR

City
Study area
Monitoring locations

Receiver Points
Other (Outdoor Active)
Other (Place of Worship)
Residential

Receiver Buildings
Commercial
Other (Child Care)
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components
Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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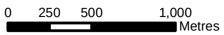

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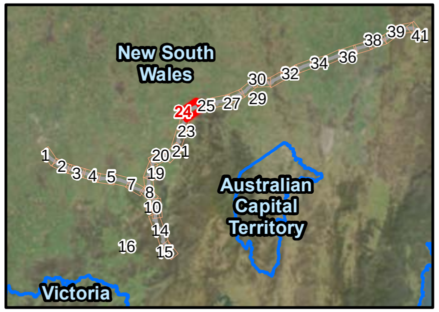
Scale:	1:45,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Monitoring locations

Receiver Points
Other (Outdoor Active)
Other (Place of Worship)
Residential

Receiver Buildings
Commercial
Other (Child Care)
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components
Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Monitoring locations

Receiver Points

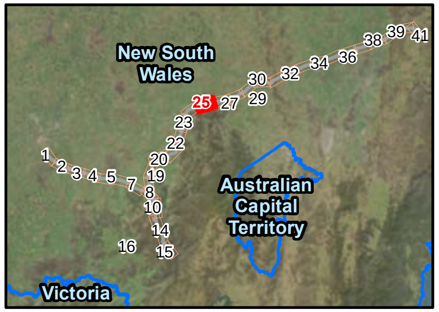
Other (Outdoor Active)
Other (Place of Worship)
Residential

Receiver Buildings

Commercial
Other (Child Care)
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
PAGE 25 OF 41

ATTACHMENT B

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0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:45,000 at A4
Project Number:	610.30622
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City
Study area
Monitoring locations

Receiver Points

Other (Outdoor Active)
Other (Place of Worship)
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Receiver Buildings

Commercial
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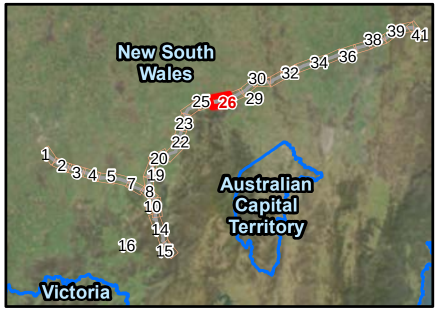
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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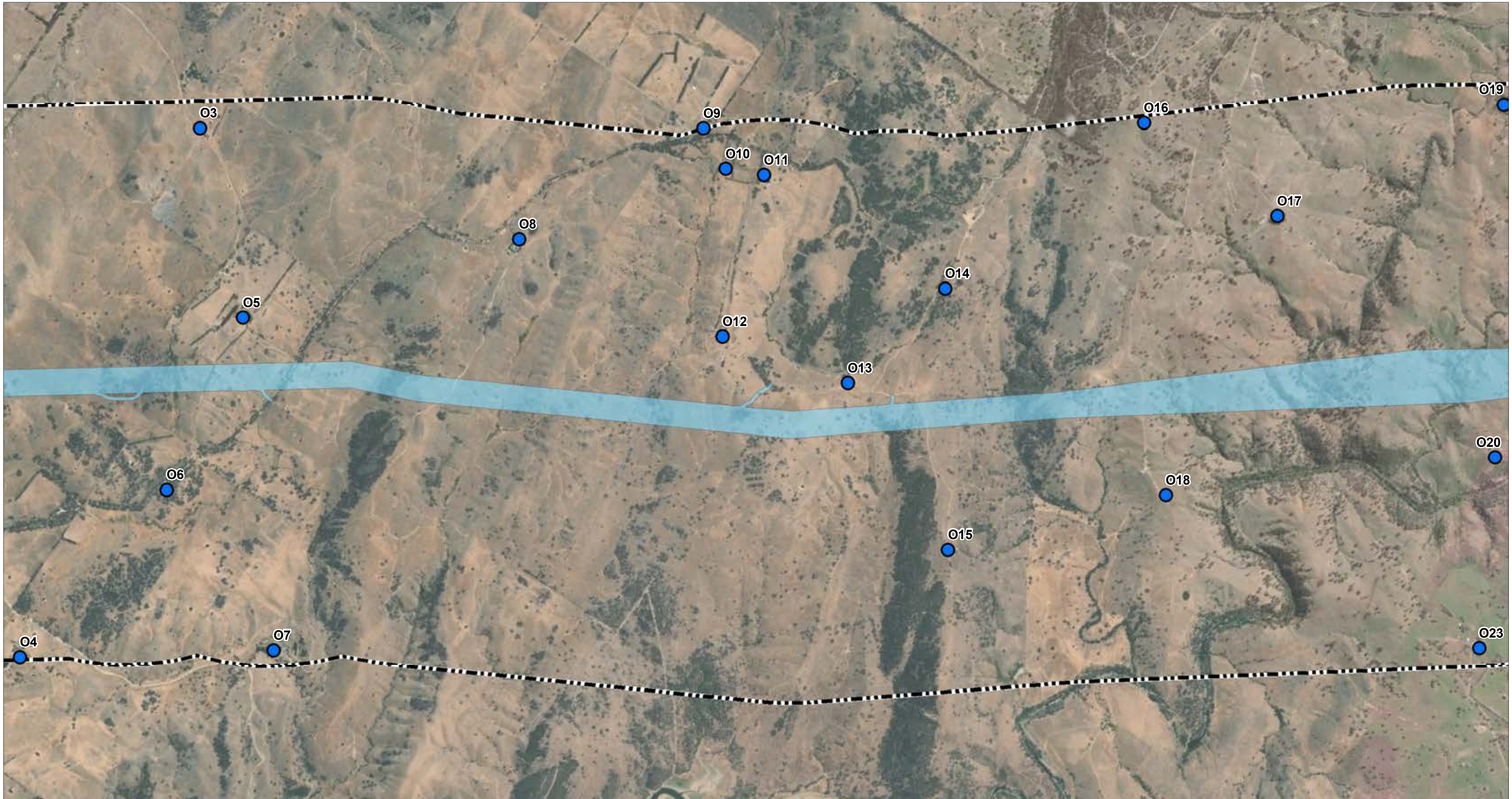

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Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
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City
Study area
Monitoring locations

Receiver Points
Other (Outdoor Active)
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Residential

Receiver Buildings
Commercial
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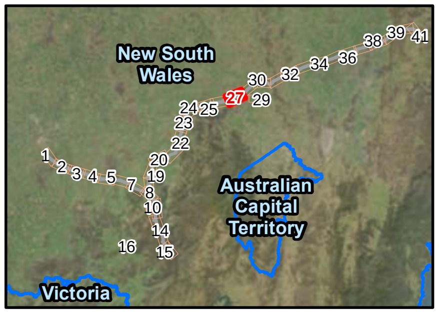
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

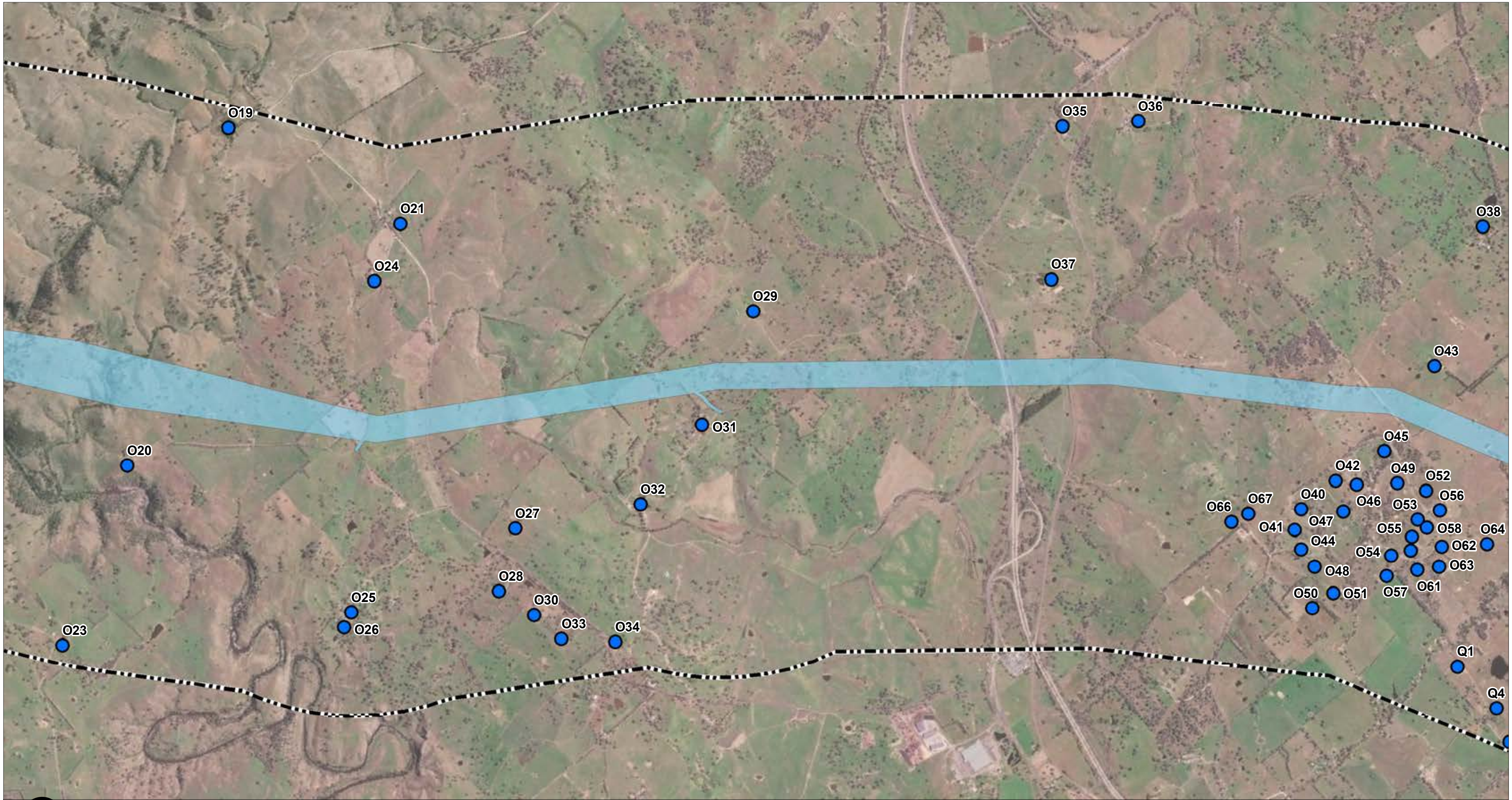
Project components
Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
PAGE 27 OF 41

ATTACHMENT B



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Monitoring locations

Receiver Points

Other (Outdoor Active)
Other (Place of Worship)
Residential

Receiver Buildings

Commercial
Other (Child Care)
Other (Educational)
Other (Hotel)
Other (Medical)
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Residential

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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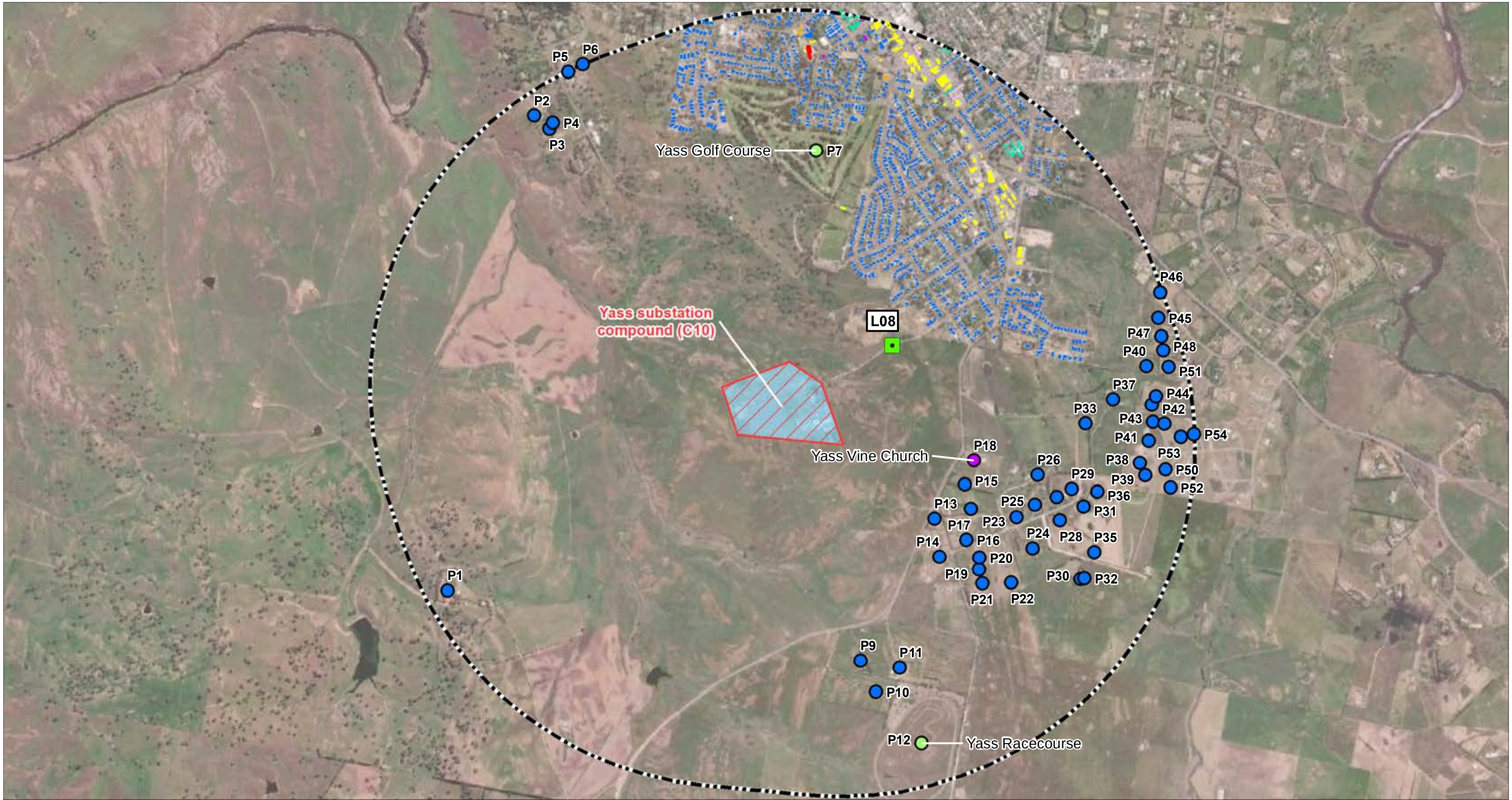
ATTACHMENT B

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig PROJECT AND RECEIVER MAP DDP_new.mxd



0 150 300 600 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:30,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Monitoring locations

Receiver Points
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Receiver Buildings
- Commercial
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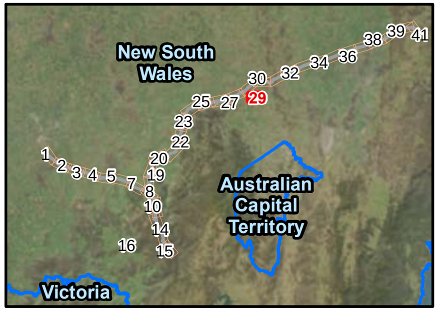
- Other (Hotel)
- Other (Medical)
- Other (Place of Worship)
- Residential

Project components
- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
PAGE 29 OF 41

ATTACHMENT B

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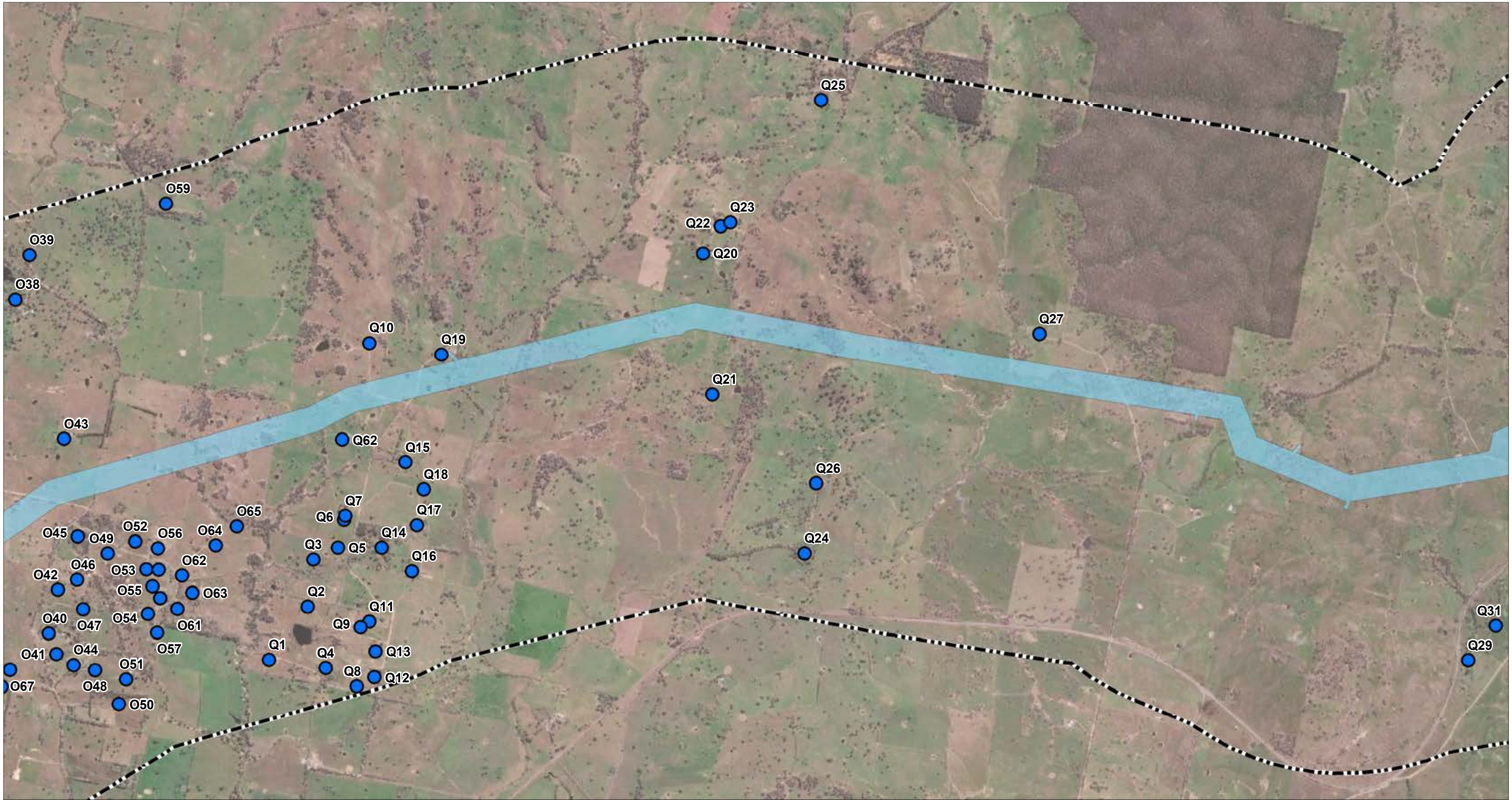

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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City
Study area
Monitoring locations

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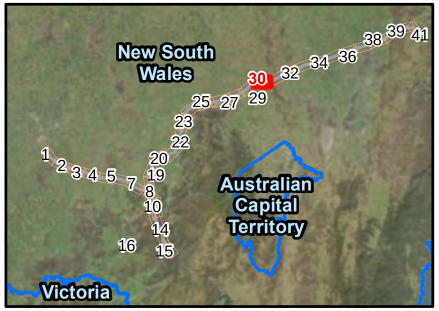
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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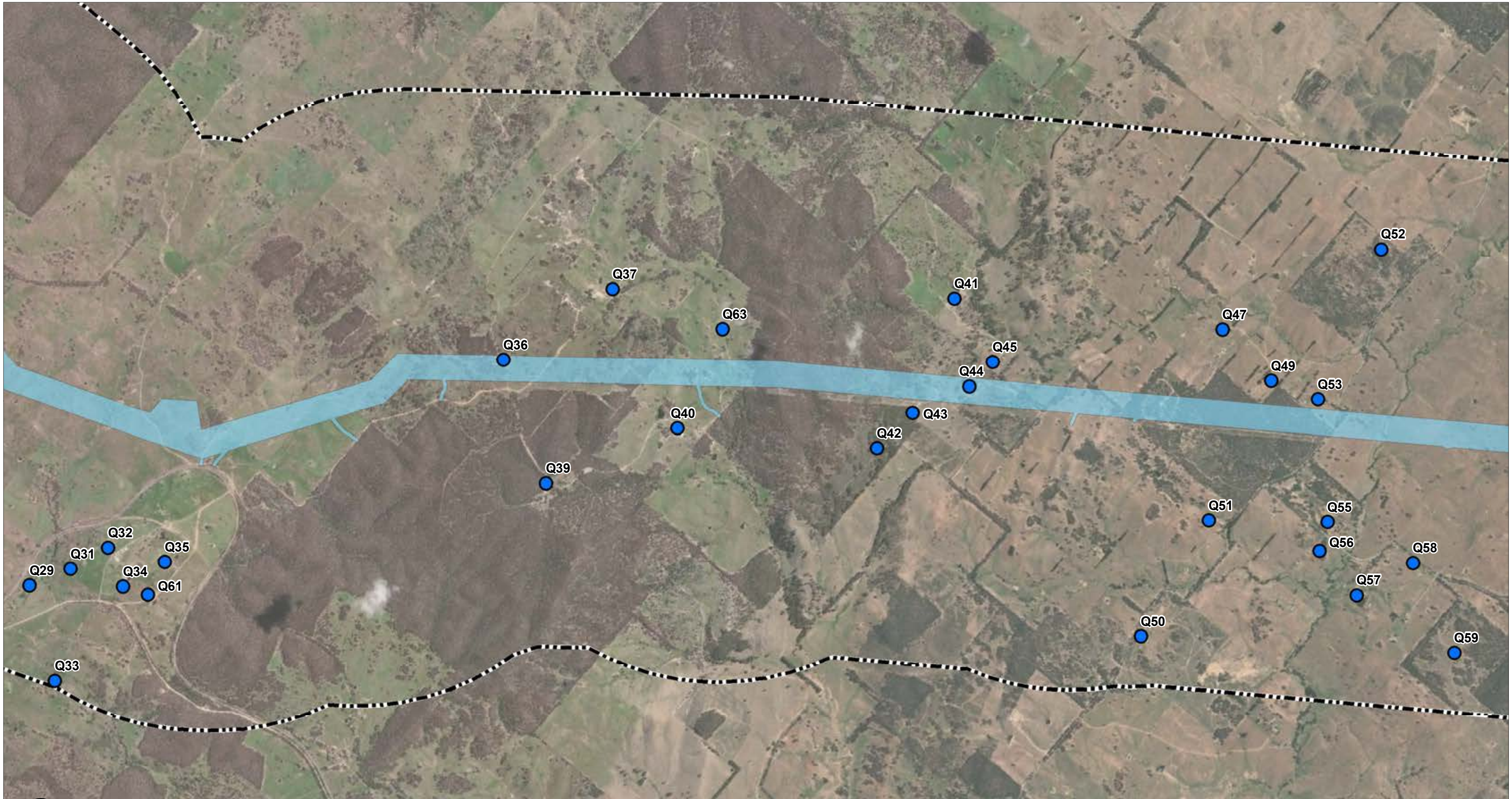
ATTACHMENT B



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Coordinate System:	GDA 1994 MGA Zone 55
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City
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Monitoring locations

Receiver Points

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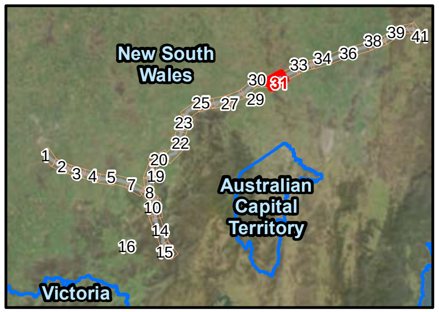
Residential

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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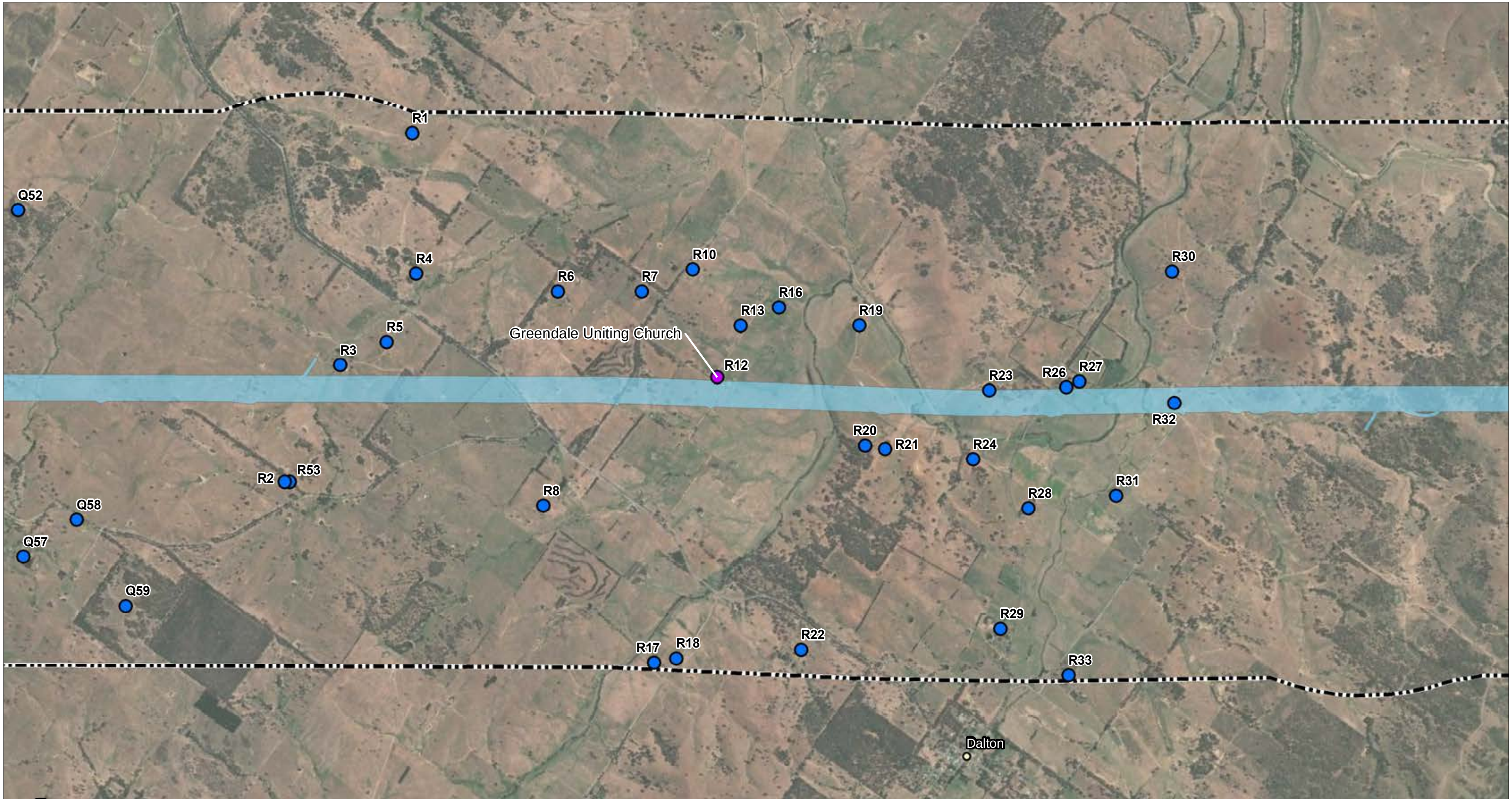

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

SLR

- City
- Study area
- Monitoring locations

Receiver Points

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- Other (Place of Worship)
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Receiver Buildings

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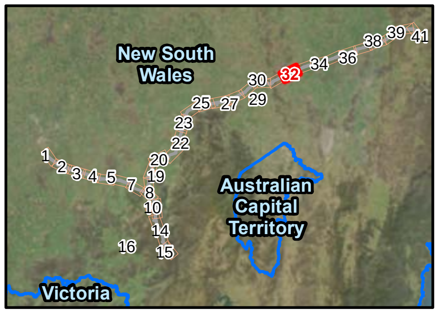
Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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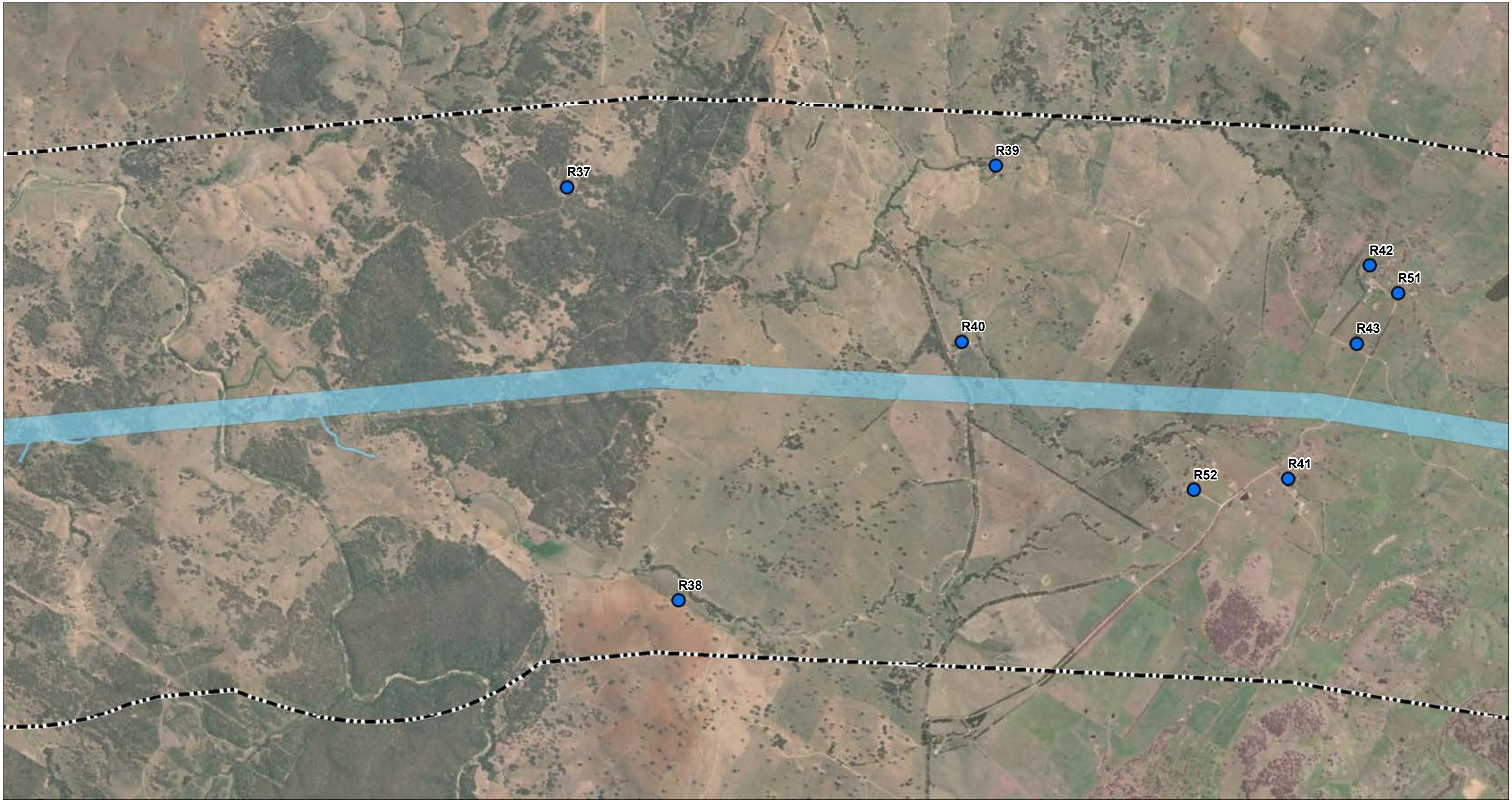


0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Monitoring locations

Receiver Points

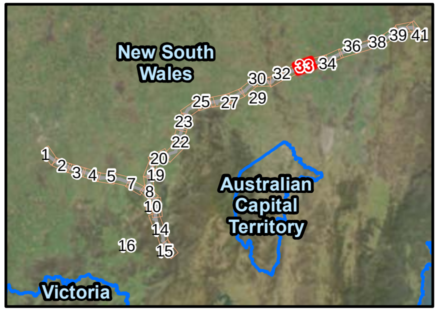
Other (Outdoor Active)
Other (Place of Worship)
Residential

Receiver Buildings

Commercial
Other (Child Care)
Other (Educational)
Other (Hotel)
Other (Medical)
Other (Place of Worship)
Residential

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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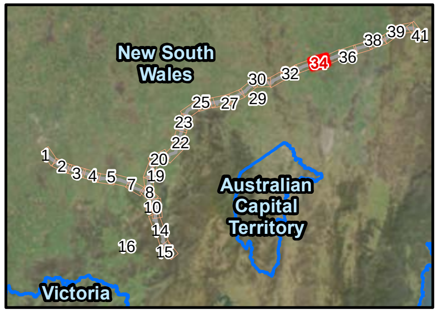

HUMELINK
NOISE AND VIBRATION
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PROJECT AND RECEIVER MAP
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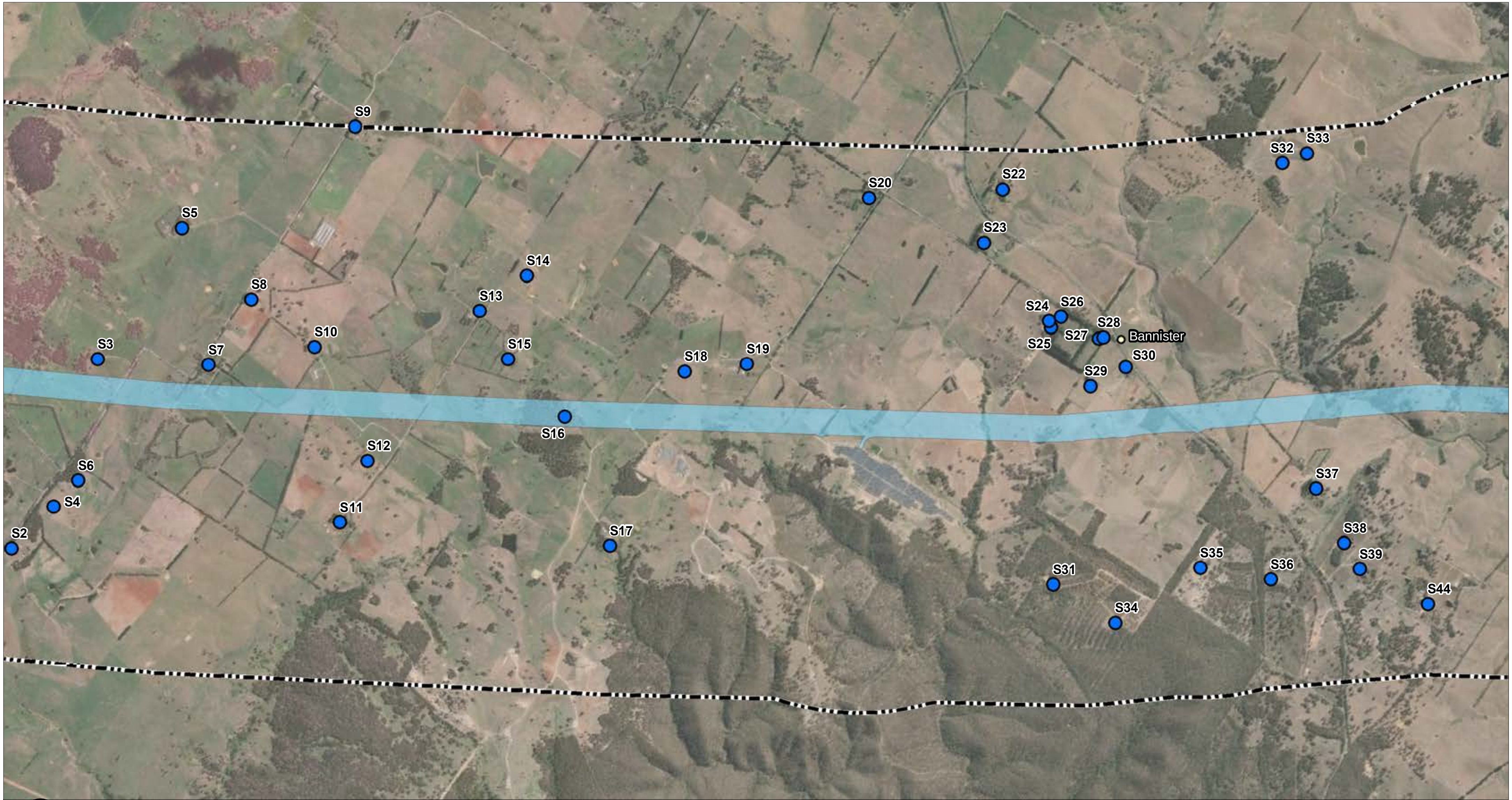

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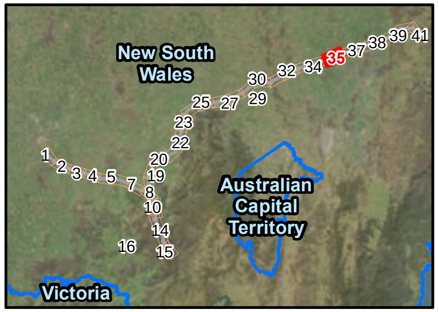

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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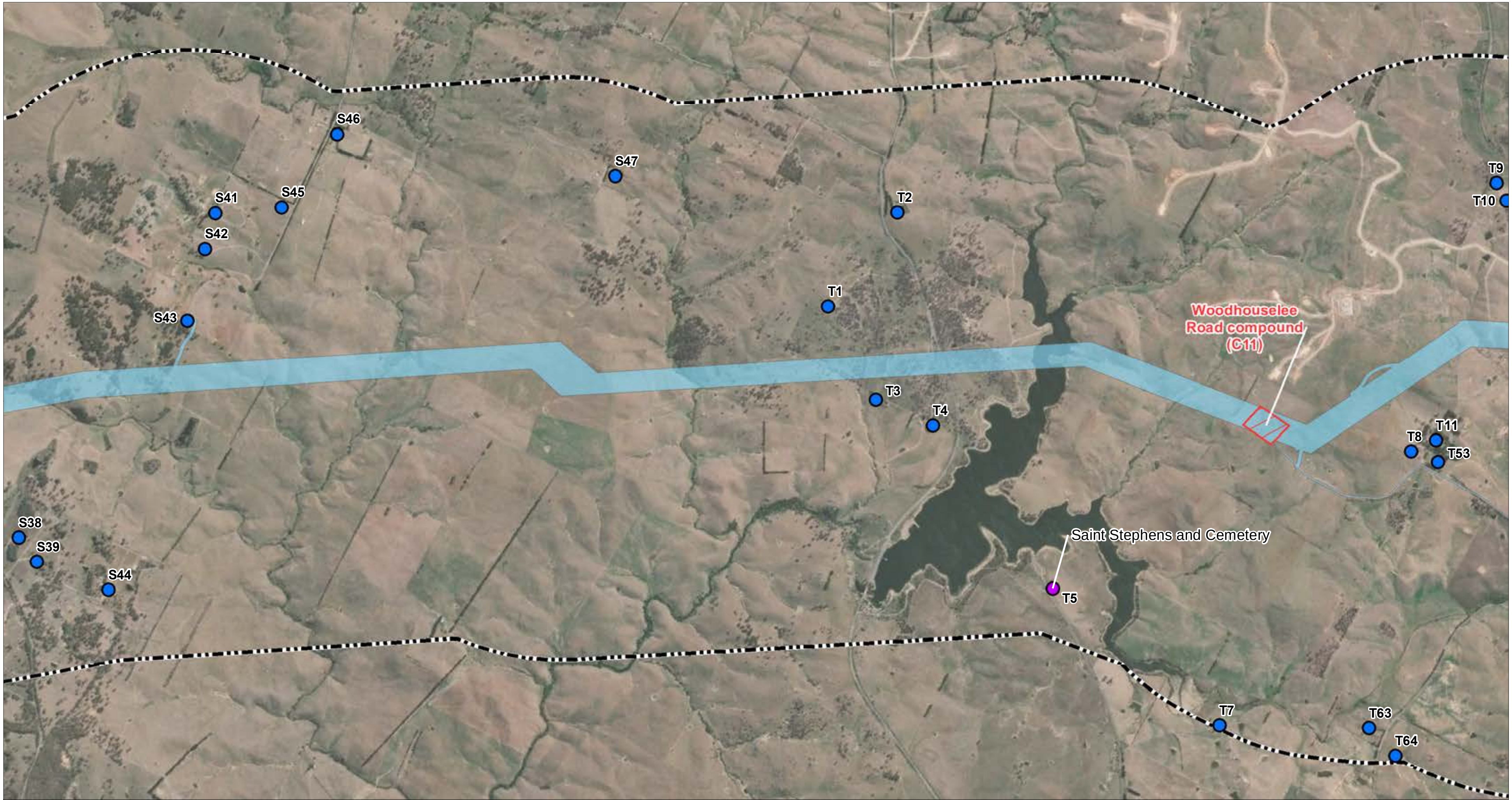

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
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Drawn by:	AN

SLR

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Receiver Points
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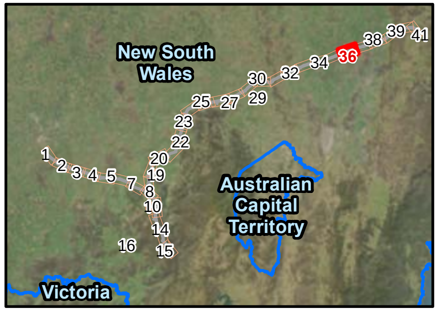

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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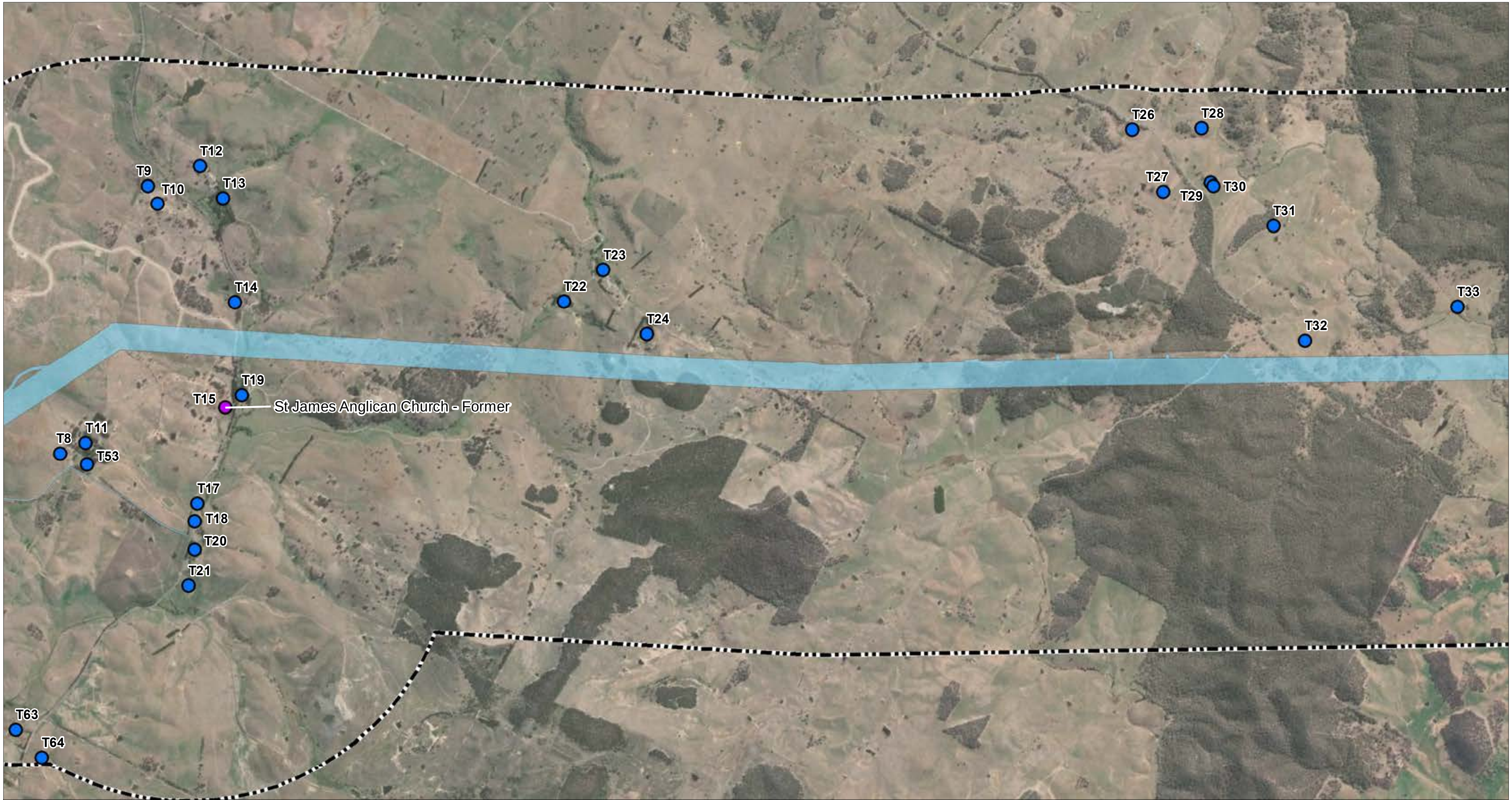

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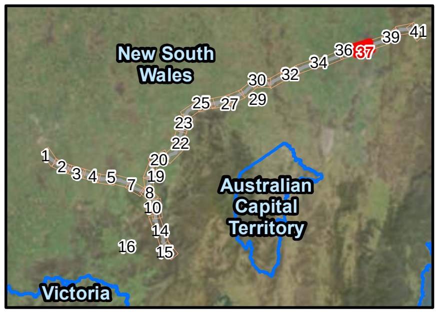

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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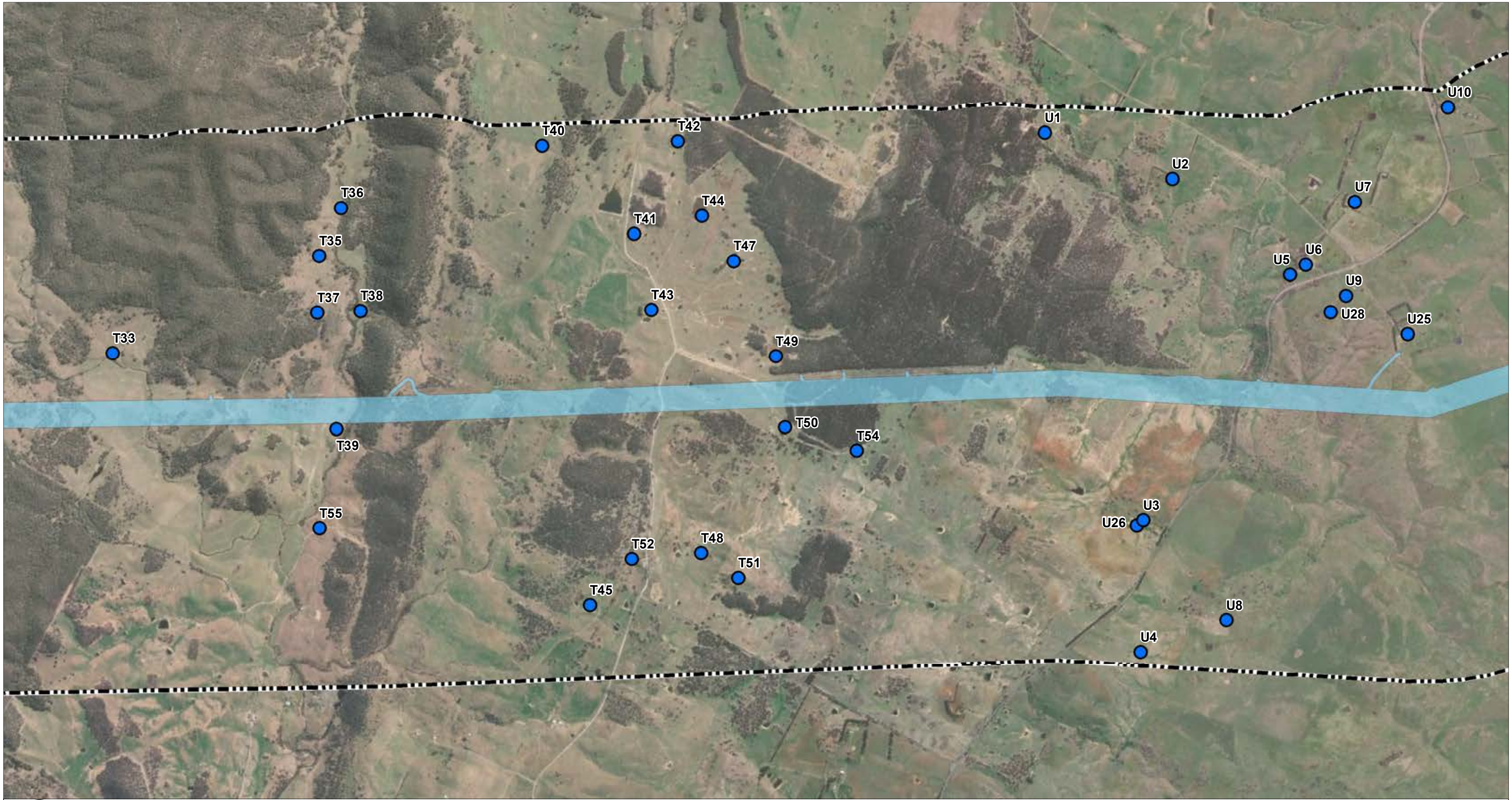

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Scale:	1:40,000 at A4
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SLR

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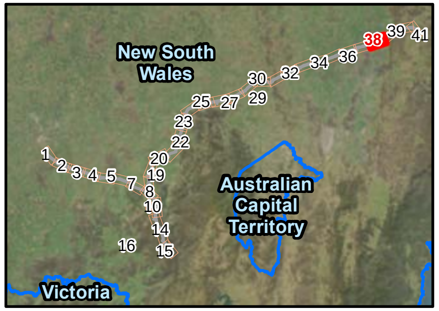

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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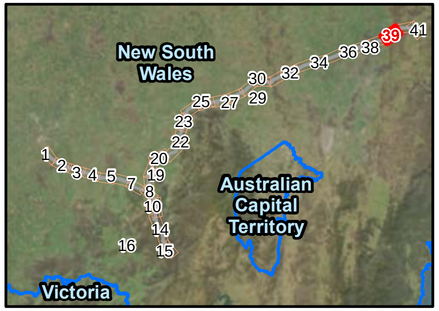

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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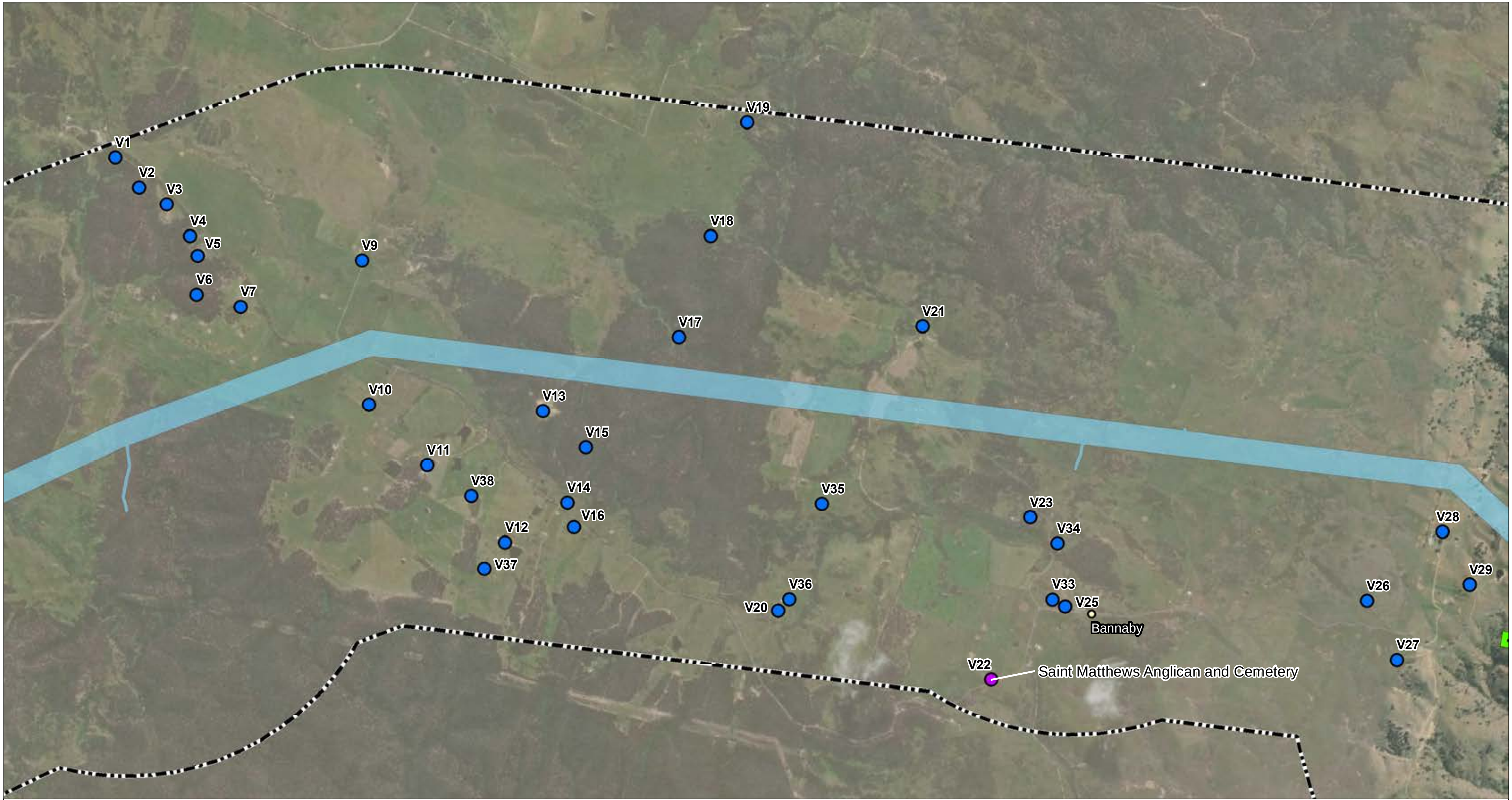

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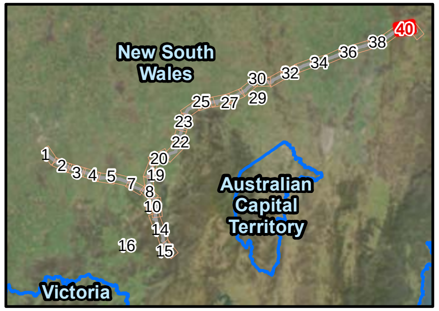

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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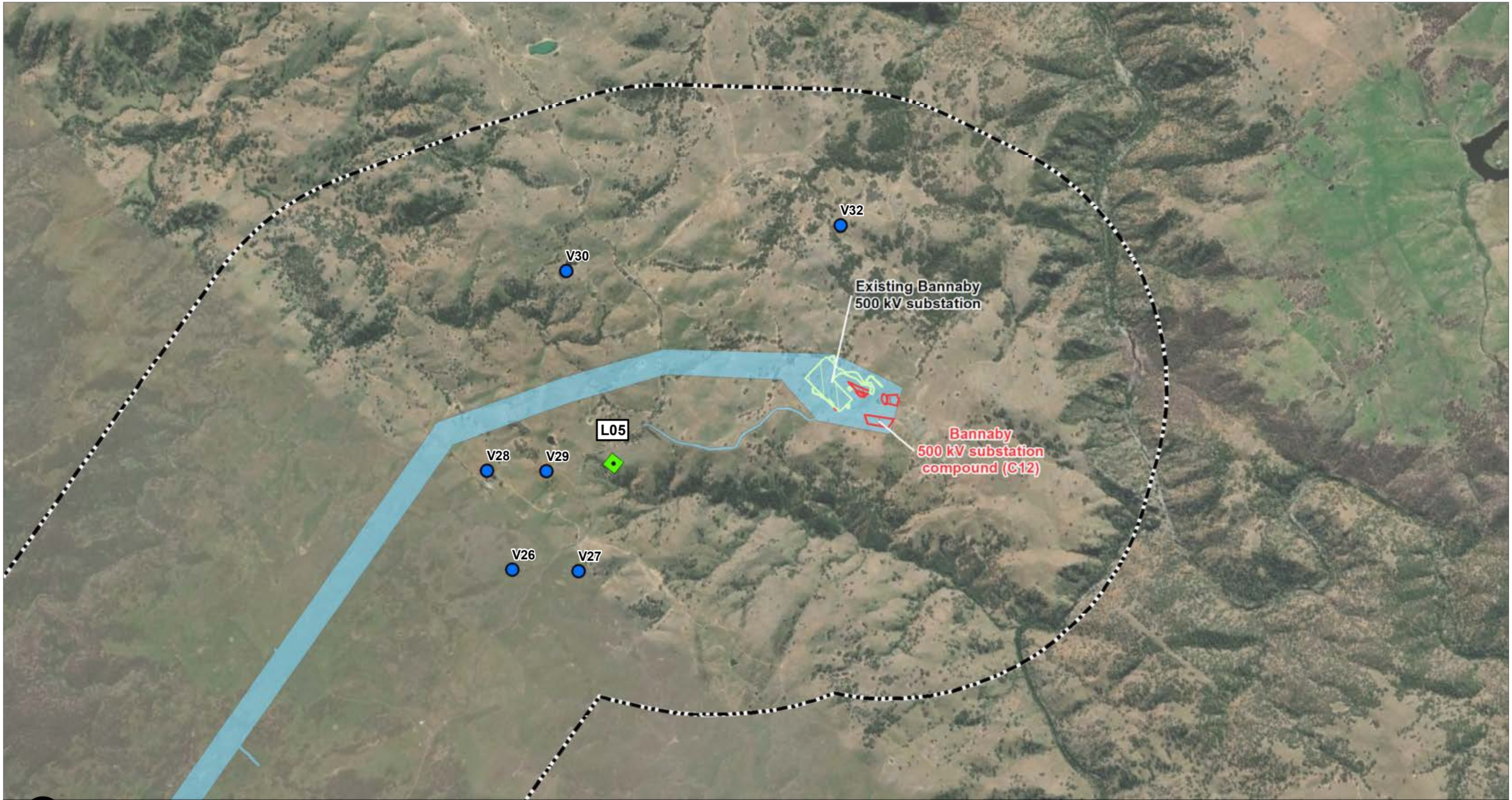
ATTACHMENT B



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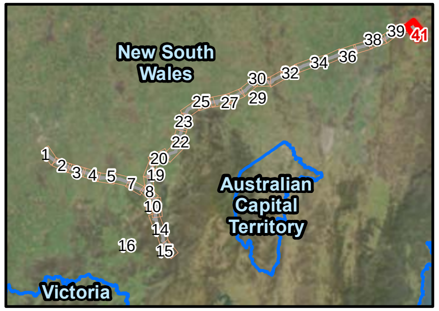

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

PROJECT AND RECEIVER MAP
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ATTACHMENT B

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ATTACHMENT C

Construction scenarios and equipment

Equipment lists and sound power levels

ID	Construction scenario	Total sound power level (dBA)	Backhoe	Chainsaw[1]	Concrete pump	Concrete truck	Concrete vibrator	Crane – Fixed	Crane – Franna	Crane – Truck mounted	Dozer	Elevated work platform	Excavator - 10t	Excavator - 20t	Excavator - 40t	Excavator - Breaker	Generator – Attenuated	Grader	Grinder[1]	Hand tools	Light vehicle	Puller / Tensioner	Roller – Smooth drum	Roller - Vibratory	Skid steer loader	Telehandler	Truck	Truck - Dump	Truck - Flatbed	Vacuum and oil pumps	Water cart	Winch
	Sound power level[2] (dBA)		111	119	109	109	113	113	98	108	116	98	100	105	115	123	92	113	110	104	103	103	107	109	107	98	108	110	103	109	107	103
	Estimated on-time in any 15-minute period		15	15	15	15	15	7.5	7.5	7.5	7.5	3	7.5	7.5	7.5	7.5	15	15	7.5	15	5	15	15	15	15	7.5	7.5	5	7.5	15	15	15
	Substations																															
W.001	Site establishment	109							X					X													X					
W.002	Earthwork and vegetation clearance	122									X				X	X								X				X				
W.003	Civil and building work	114			X	X			X	X			X						X								X					
W.004	Installation of high voltage equipment and associated structures	113								X		X							X								X			X		
W.005	Pre commissioning activities	104										X								X												
W.006	Site clean-up and landscaping	112							X	X										X					X		X					
W.007	Tie-in work	105							X			X								X												
	Transmission lines																															
W.008	Site establishment and deliveries	119		X					X	X			X														X					
W.009	Access tracks	122									X				X	X		X						X								
W.010	Earthwork and clearing	122									X				X	X								X								
W.011	Brake and winch sites	115									X											X		X								

	Equipment	Total sound power level (dBA)	Backhoe	Chainsaw[1]	Concrete pump	Concrete truck	Concrete vibrator	Crane – Fixed	Crane – Franna	Crane – Truck mounted	Dozer	Elevated work platform	Excavator - 10t	Excavator - 20t	Excavator - 40t	Excavator - Breaker	Generator – Attenuated	Grader	Grinder[1]	Hand tools	Light vehicle	Puller / Tensioner	Roller – Smooth drum	Roller - Vibratory	Skid steer loader	Telehandler	Truck	Truck - Dump	Truck - Flatbed	Vacuum and oil pumps	Water cart	Winch
W.012	Construction of structures	114			X	X			X	X									X								X					
W.013	Overhead stringing of conductors and earth wires	108								X																						X
W.014	Decommissioning and rehabilitation	115							X	X								X		X					X		X					
W.015	Telecommunications hut construction	113			X	X			X				X							X							X					
	Construction compounds																															
W.016	Site establishment	121	X		X		X	X	X		X	X	X	X				X					X		X			X	X		X	
W.017	Compound operation	116			X	X	X							X			X				X					X	X					
	Worker accomodation facility																															
W.018	Site establishment	121			X		X			X	X	X		X				X					X		X						X	
W.019	Facility operation	106															X				X						X					

Note 1: Equipment classed as 'annoying' in the ICNG.

Note 2: Sound power level data is taken from the RMS *Construction Noise and Vibration Guideline,* TfNSW *Construction Noise and Vibration Strategy,* AS 2436-2010, and DEFRA Noise Database.

ATTACHMENT D
Construction traffic volumes

Table 1 Existing and construction road traffic volumes

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Abbots Lane	Wagga Wagga City	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Angels Lane	Wagga Wagga City	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Ashfords Road	Wagga Wagga City	Local road	Sealed	24	6	237	54	33	8	24	28	96	140	24	-	4.6
Big Springs Road	Wagga Wagga City	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Burkinshaws Lane	Wagga Wagga City	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Byes Lane	Wagga Wagga City	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Centenary Avenue	Wagga Wagga City	Local road	Sealed	82	18	790	179	110	25	30	16	120	80	30	-	4.6
Comatawa Road	Wagga Wagga City	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Coreinbob Road	Wagga Wagga City	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Coreinbob Siding Road	Wagga Wagga City	Local road	Unsealed	24	6	237	54	33	8	16	12	64	60	16	-	3.7
Gregadoo East Road	Wagga Wagga City	Local road	Sealed	82	18	790	179	110	25	40	42	160	210	40	-	4.6
Gregadoo-Ladysmith Road	Wagga Wagga City	Local road	Sealed	41	9	395	90	55	13	20	16	80	80	20	-	4.6
Hammond Avenue	Wagga Wagga City	State road	Sealed	673	237	7360	2591	992	349	30	20	120	100	30	-	0.3
Hume Highway (between Humula Road and Comatawa Road)	Wagga Wagga City	National road	Sealed	69	71	814	833	217	222	30	20	120	100	30	-	0.9
Humula Link Road	Wagga Wagga City	Local road	Sealed	41	9	395	90	55	13	8	8	32	40	8	-	4.6
Humula Road	Wagga Wagga City	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Ivydale Road	Wagga Wagga City	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Keajura Road	Wagga Wagga City	Local road	Sealed	41	9	395	90	55	13	16	16	64	80	16	-	4.6
Kooringal Road	Wagga Wagga City	Local road	Sealed	82	18	790	179	110	25	16	12	64	60	16	-	4.6
Kyeamba Avenue	Wagga Wagga City	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Kyeamba Street	Wagga Wagga City	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Livingstone Gully Road	Wagga Wagga City	Local road	Unsealed	16	4	158	36	22	5	40	42	160	210	40	-	3.7
Mates Gully Road	Wagga Wagga City	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Mitchell Road	Wagga Wagga City	Local road	Sealed	82	18	790	179	110	25	24	28	96	140	24	-	4.6
Oberne-Umbango Road	Wagga Wagga City	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Stewarts Road	Wagga Wagga City	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Sturt Highway (east of Tumbarumba Road)	Wagga Wagga City	State road	Sealed	118	42	1294	456	174	61	16	16	64	80	16	-	1.0
Sturt Highway (east of RAAF BASE Wagga Wagga)	Wagga Wagga City	State road	Sealed	155	55	1698	598	229	81	16	16	64	80	16	-	0.8
Sturt Highway (west of Elizabeth Avenue)	Wagga Wagga City	State road	Sealed	288	102	3154	1110	425	150	16	16	64	80	16	-	0.4
Sydney Street	Wagga Wagga City	Local road	Sealed	82	18	790	179	110	25	16	12	64	60	16	-	4.6
Trewalla Road	Wagga Wagga City	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Tumbarumba Road	Wagga Wagga City	Regional road	Sealed	43	7	439	70	48	8	16	16	64	80	16	-	3.6
Tywong Street	Wagga Wagga City	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Vincent Road	Wagga Wagga City	Local road	Sealed	41	9	395	90	55	13	20	16	80	80	20	-	4.6
Westbrook Road	Wagga Wagga City	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Adelong Road	Snowy Valley	State road	Sealed	207	73	2265	797	305	107	8	8	32	40	8	-	0.3
Albury Street	Snowy Valley	State road	Sealed	74	26	809	285	109	38	8	8	32	40	8	-	0.8
Alfred Street	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	20	4	80	20	20	-	3.7
Ash Creek Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Back Creek Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Back Kunama Road	Snowy Valley	Local road	Unsealed	24	6	237	54	33	8	4	2	16	10	4	-	3.7

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Back Nacki Creek Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Back Sandy Gully Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Bago Creek Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Bago Forest Way	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Barneys Highway	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Bartoman Street	Snowy Valley	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Batlow Road (between Snowy Mountain Highway and East Gilmore Road)	Snowy Valley	State road	Sealed	52	18	566	199	76	27	30	20	120	100	30	-	2.5
Batlow Road (south of Herrings Road)	Snowy Valley	State road	Sealed	37	13	404	142	55	19	30	20	120	100	30	-	3.2
BB Feeder Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Black Boot Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Bogong Street	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Booths Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Browns Forest Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Browns Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Brungle Creek Link Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Brungle Creek Road	Snowy Valley	Local road	Unsealed	24	6	237	54	33	8	16	12	64	60	16	-	3.7
Brungle Road	Snowy Valley	Local road	Sealed	41	9	395	90	55	13	16	16	64	80	16	-	4.6
Buddong Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Bullongra Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Central Logging Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Cockatoo Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Courabyra Road	Snowy Valley	Local road	Sealed	41	9	395	90	55	13	20	4	80	20	20	-	4.6
Dog Tree Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Dunns Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
East Bago Powerline Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
East Gilmore Road	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Ellerslie Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Ellerslie Woolshed Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Elliott Way	Snowy Valley	Regional road	Sealed	43	7	439	70	48	8	10	12	40	60	10	-	2.9
Fitzroy Street	Snowy Valley	State road	Sealed	148	52	1618	569	218	77	20	16	80	80	20	-	0.8
Forest Road	Snowy Valley	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Forsters Road	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	4	2	16	10	4	-	4.6
Gadara Lane	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Gadara Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Gocup Road (West ff Tumut)	Snowy Valley	State road	Sealed	52	18	566	199	76	27	20	16	80	80	20	-	2.1
Grahamstown Road	Snowy Valley	Local road	Sealed	24	6	237	54	33	8	8	8	32	40	8	-	4.6
Green Hills Access Road	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Green Hills Forest Way	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Greenhills Road	Snowy Valley	Local road	Sealed	41	9	395	90	55	13	4	2	16	10	4	-	4.6
Herrings Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	16	16	64	80	16	-	3.8
Honeysuckle Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Hugel Trail	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Hurdle Creek Trail	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Hydes Old Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Inglis Street	Snowy Valley	State road	Sealed	74	26	809	285	109	38	8	8	32	40	8	-	0.8
Keenans Road	Snowy Valley	Local road	Sealed	8	2	79	18	11	3	2	10	8	50	2	-	4.7
Kileys Creek Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Kileys Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Kopsens Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Kunama Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Kurrajong Avenue	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Lower Bago Road	Snowy Valley	Local road	Sealed	41	9	395	90	55	13	16	16	64	80	16	-	4.6
Mate Street	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Meadow Creek Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Memorial Avenue	Snowy Valley	Local road	Sealed	24	6	237	54	33	8	2	18	8	90	2	-	4.6
Mill Road	Snowy Valley	Local road	Sealed	24	6	237	54	33	8	2	18	8	90	2	-	4.6
Millers Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Minjary Street	Snowy Valley	State road	Sealed	37	13	404	142	55	19	8	8	32	40	8	-	1.5
Monterey Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Mount Hugel Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Mount Pleasant Creek Trail	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Murrays Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Nellis Street	Snowy Valley	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
New Maragle Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Northern Boundary Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Nursery Access Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Oberne Ellerslie Trail	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Old Tumbarumba Road	Snowy Valley	Local road	Sealed	24	6	237	54	33	8	4	2	16	10	4	-	4.6
Old Western Boundary Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
One Tree Hill Trail	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Palmer Street	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Park Avenue	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	4	2	16	10	4	-	4.6
Perkins Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Pierces Boundary Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Pioneer Street	Snowy Valley	Local road	Sealed	24	6	237	54	33	8	8	8	32	40	8	-	4.6
Pound Creek Road	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Pound Creek Upper Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Powerline Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Powerline Trail	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Prickle Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Quartz Street	Snowy Valley	Local road	Sealed	24	6	237	54	33	8	8	8	32	40	8	-	4.6
Red Hill Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	12	14	48	70	12	-	3.7
Reedy Street	Snowy Valley	State road	Sealed	74	26	809	285	109	38	16	16	64	80	16	-	1.5
Right Arm Creek Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Roches Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Rocky Gully Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Running Waters Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Selwyn Street (Adelong)	Snowy Valley	Regional road	Sealed	17	3	176	28	19	3	8	8	32	40	8	-	4.2
Selwyn Street (Batlow)	Snowy Valley	Local road	Sealed	24	6	237	54	33	8	16	12	64	60	16	-	4.6
Sharpes Creek Feeder Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Sharps Creek Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Sharps Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Shedleys Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Sixty Five Feeder Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Snowy Mountains Highway (west of Batlow Road)	Snowy Valley	State road	Sealed	96	34	1051	370	142	50	48	20	192	100	48	-	1.6
Snubba Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	40	16	160	80	40	-	3.7
Spyglass Trail	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Stewarts Road	Snowy Valley	Local road	Sealed	8	2	79	18	11	3	16	12	64	60	16	-	4.7
Stockmans Creek Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Stud Horse Feeder Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Sturgess Trail	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Taradale Road	Snowy Valley	Local road	Sealed	41	9	395	90	55	13	8	8	32	40	8	-	4.6
Tooma Road	Snowy Valley	Regional road	Sealed	60	10	614	97	67	11	4	2	16	10	4	-	0.5
Townsend Street	Snowy Valley	Local road	Sealed	8	2	79	18	11	3	16	12	64	60	16	-	4.7
Tumut Street	Snowy Valley	State road	Sealed	96	34	1051	370	142	50	8	8	32	40	8	-	0.6
Travers Street	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Webbs Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Wee Jasper Road (north of Tumut)	Snowy Valley	Regional road	Sealed	60	10	614	97	67	11	20	16	80	80	20	-	2.9
West Branch Feeder	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
West Gilmore Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Westbrook Road	Snowy Valley	Local road	Sealed	24	6	237	54	33	8	16	12	64	60	16	-	4.6
Westwood Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Wilsons Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Wiltys Road	Snowy Valley	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Wondalga Road	Snowy Valley	Regional road	Sealed	26	4	263	42	29	5	16	16	64	80	16	-	5.0
Yarrawonga Road	Snowy Valley	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Yaven Creek Road	Snowy Valley	Local road	Sealed	24	6	237	54	33	8	16	12	64	60	16	-	4.6
Yellowin Access Road	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	20	16	80	80	20	-	4.6
Yellowin Road	Snowy Valley	Local road	Sealed	16	4	158	36	22	5	4	2	16	10	4	-	4.6
Adelong Road	Cootamundra-Gundagai	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Adjungbilly Road	Cootamundra-Gundagai	Local road	Sealed	16	4	158	36	22	5	14	16	56	80	14	-	4.6
Brungle Creek Link Road	Cootamundra-Gundagai	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Brungle Road	Cootamundra-Gundagai	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Bundarbo Road	Cootamundra-Gundagai	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Eagle Street	Cootamundra-Gundagai	State road	Sealed	52	18	566	199	76	27	8	8	32	40	8	-	1.1
Edwardstown Road	Cootamundra-Gundagai	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Fernhill Road	Cootamundra-Gundagai	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Fullers Lane	Cootamundra-Gundagai	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Gobarralong Road	Cootamundra-Gundagai	Local road	Sealed	24	6	237	54	33	8	16	12	64	60	16	-	4.6
Gocup Road (south of South Gundagai)	Cootamundra-Gundagai	State road	Sealed	44	16	485	171	65	23	8	8	32	40	8	-	1.3
Hume Highway (north of Coolac)	Cootamundra-Gundagai	National road	Sealed	178	182	2092	2141	557	570	20	16	80	80	20	-	0.3
Hume Highway (east of Snowy Mountain Highway)	Cootamundra-Gundagai	National road	Sealed	114	116	1337	1368	356	364	20	16	80	80	20	-	0.4
Hume Highway (west of South Gundagai)	Cootamundra-Gundagai	National road	Sealed	114	116	1337	1368	356	364	20	16	80	80	20	-	0.4
Honeysuckle Road	Cootamundra-Gundagai	Local road	Unsealed	16	4	158	36	22	5	10	12	40	60	10	-	3.7
Hopewood Road	Cootamundra-Gundagai	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Maryvale Road	Cootamundra-Gundagai	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Middle Street	Cootamundra-Gundagai	Local road	Sealed	41	9	395	90	55	13	8	8	32	40	8	-	4.6
Middleton Drive	Cootamundra-Gundagai	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Nanangroe Road	Cootamundra-Gundagai	Local road	Unsealed	24	6	237	54	33	8	16	12	64	60	16	-	3.7
Parsons Creek Road	Cootamundra-Gundagai	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Red Hill Road	Cootamundra-Gundagai	Local road	Unsealed	16	4	158	36	22	5	12	14	48	70	12	-	3.7
Red Strip Road	Cootamundra-Gundagai	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Rileys Flat Road	Cootamundra-Gundagai	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Sawmill Creek Road	Cootamundra-Gundagai	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Sheridan Street	Cootamundra-Gundagai	Local road	Sealed	57	13	553	125	77	18	8	8	32	40	8	-	4.6
Snowball Road	Cootamundra-Gundagai	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Snowy Mountains Highway (East of Hume Highway)	Cootamundra-Gundagai	State road	Sealed	44	16	485	171	65	23	16	12	64	60	16	-	1.9
Stockdale Road	Cootamundra-Gundagai	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Tumblong Road	Cootamundra-Gundagai	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
West Street	Cootamundra-Gundagai	Regional road	Sealed	43	7	439	70	48	8	20	16	80	80	20	-	3.7
Black Range Road	Yass Valley	Local road	Sealed	24	6	237	54	33	8	16	16	64	80	16	-	4.6
Burrinjuck Road	Yass Valley	Regional road	Sealed	26	4	263	42	29	5	16	12	64	60	16	-	4.3
Barton Highway	Yass Valley	State road	Sealed	296	104	3235	1139	436	154	16	16	64	80	16	-	0.4
Childowla Road	Yass Valley	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Comur Street	Yass Valley	Regional road	Sealed	302	48	3072	487	333	53	16	12	64	60	16	-	0.6
Cooks Hill Road	Yass Valley	Local road	Sealed	24	6	237	54	33	8	8	8	32	40	8	-	4.6
Elms Road	Yass Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Fagan Drive	Yass Valley	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Fairy Hole Road	Yass Valley	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Grand Junction Road	Yass Valley	Local road	Sealed	82	18	790	179	110	25	20	16	80	80	20	-	4.6

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Greenwood Road	Yass Valley	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Hardwicke Lane	Yass Valley	Local road	Unsealed	24	6	237	54	33	8	4	2	16	10	4	-	3.7
Hillview Drive	Yass Valley	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Hovell Street	Yass Valley	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Hume Highway (between Yass Valley Way and Lachlan Valley Way)	Yass Valley	State road	Sealed	407	143	4448	1566	600	211	30	20	120	100	30	-	0.4
Hume Highway (between Burley Griffin Way and Burrinjuck Road)	Yass Valley	State road	Sealed	251	89	2750	968	371	131	30	20	120	100	30	-	0.6
Hume Highway (between Yass Valley Way and Barton Highway)	Yass Valley	State road	Sealed	214	76	2345	826	316	111	30	20	120	100	30	-	0.7
Hume Street	Yass Valley	Local road	Sealed	41	9	395	90	55	13	8	8	32	40	8	-	4.6
Laidlaw Street	Yass Valley	Regional road	Sealed	302	48	3072	487	333	53	20	16	80	80	20	-	0.8
Lucernvale Road	Yass Valley	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Mcintosh Lane	Yass Valley	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Orion Street	Yass Valley	Local road	Sealed	41	9	395	90	55	13	8	8	32	40	8	-	4.6
Perry Street	Yass Valley	Local road	Sealed	24	6	237	54	33	8	4	26	16	130	4	-	4.6
Pollux Street	Yass Valley	Local road	Sealed	41	9	395	90	55	13	20	16	80	80	20	-	4.6
Talmo Road	Yass Valley	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Turtons Road	Yass Valley	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Wargeila Road	Yass Valley	Local road	Sealed	24	6	237	54	33	8	16	16	64	80	16	-	4.6
Warroo Road	Yass Valley	Local road	Sealed	82	18	790	179	110	25	16	16	64	80	16	-	4.6
Yass Valley Way (west of Barton Highway)	Yass Valley	Regional road	Sealed	276	44	2809	445	304	48	20	16	80	80	20	-	0.8
Adavale Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Alton Hill Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Back Arm Road	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Bannaby Road	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	20	16	80	80	20	-	4.6
Bannister Lane	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	16	16	64	80	16	-	3.8
Binda Road	Upper Lachlan Shire	Regional road	Sealed	43	7	439	70	48	8	4	2	16	10	4	-	0.7
Blakney Creek South Road	Upper Lachlan Shire	Local road	Sealed	8	2	79	18	11	3	4	2	16	10	4	-	4.7
Boorowa Road	Upper Lachlan Shire	Regional road	Sealed	35	5	351	56	38	6	4	2	16	10	4	-	0.9
Brooklands Street	Upper Lachlan Shire	Regional road	Sealed	26	4	263	42	29	5	8	8	32	40	8	-	3.2
Bulleys Crossing	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Bunnaby Street	Upper Lachlan Shire	Regional road	Sealed	17	3	176	28	19	3	8	8	32	40	8	-	4.2
Butcher Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Carnells Lane	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Carrabungla Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Carrington Street	Upper Lachlan Shire	State road	Sealed	37	13	404	142	55	19	8	8	32	40	8	-	1.5
Chapel Street	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Clancys Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Collector Road	Upper Lachlan Shire	Regional road	Sealed	26	4	263	42	29	5	16	12	64	60	16	-	4.3
Colyer Street	Upper Lachlan Shire	Local road	Sealed	41	9	395	90	55	13	16	12	64	60	16	-	4.6
Coolalie Road	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Crookwell Road	Upper Lachlan Shire	State road	Sealed	74	26	809	285	109	38	16	16	64	80	16	-	1.5
Cullerin Road	Upper Lachlan Shire	Regional road	Sealed	26	4	263	42	29	5	16	12	64	60	16	-	4.3
Dalton Road (South of Dalton)	Upper Lachlan Shire	Regional road	Sealed	17	3	176	28	19	3	16	12	64	60	16	-	5.5
Dalton Road (west of Gunning)	Upper Lachlan Shire	Regional road	Sealed	17	3	176	28	19	3	16	12	64	60	16	-	5.5

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Dawes Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Dawsons Creek Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Dowlings Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Elms Road	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Felled Timber Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Flacknell Creek Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Gorham Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Goulburn Road	Upper Lachlan Shire	State road	Sealed	74	26	809	285	109	38	16	12	64	60	16	-	1.2
Goulburn Street	Upper Lachlan Shire	State road	Sealed	67	23	728	256	98	35	16	16	64	80	16	-	1.6
Grabben Gullen Road (north of Cullerin Road)	Upper Lachlan Shire	Regional road	Sealed	17	3	176	28	19	3	16	16	64	80	16	-	6.3
Greendale Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Gundaroo Street	Upper Lachlan Shire	Regional road	Sealed	26	4	263	42	29	5	16	12	64	60	16	-	4.3
Gunning Street	Upper Lachlan Shire	Regional road	Sealed	26	4	263	42	29	5	16	12	64	60	16	-	4.3
Gurrundah Road	Upper Lachlan Shire	Local road	Sealed	24	6	237	54	33	8	16	12	64	60	16	-	4.6
Hanworth Road	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	40	34	160	170	40	-	4.6
Harley Road	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Hawthornes Tree Road	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	4	2	16	10	4	-	4.6
Hillcrest Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Hillgrove Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Howards Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Hume Highway (south of Gunning)	Upper Lachlan Shire	State road	Sealed	222	78	2426	854	327	115	16	16	64	80	16	-	0.6
Hume Street	Upper Lachlan Shire	Regional road	Sealed	43	7	439	70	48	8	16	12	64	60	16	-	3.1

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Jerrawa Road	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	16	16	64	80	16	-	4.6
Kerrawarry Creek Trail	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Kialla Road	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	16	16	64	80	16	-	4.6
Lade Vale Road	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Laggan Road	Upper Lachlan Shire	Regional road	Sealed	35	5	351	56	38	6	8	8	32	40	8	-	2.6
Laggan-Taralga Road	Upper Lachlan Shire	Regional road	Unsealed	43	7	439	70	48	8	16	12	64	60	16	-	2.5
Loop Road	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Lower Greendale Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Menzies Lane	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Middle Arm Road	Upper Lachlan Shire	Local road	Sealed	41	9	395	90	55	13	16	16	64	80	16	-	4.6
Mount Rae Road	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Northcott Street	Upper Lachlan Shire	Regional road	Sealed	26	4	263	42	29	5	16	12	64	60	16	-	4.3
Offleys Lane	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Orchard Street	Upper Lachlan Shire	Regional road	Sealed	43	7	439	70	48	8	16	12	64	60	16	-	3.1
Parsons Lane	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Pejar Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Prices Lane	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Range Road	Upper Lachlan Shire	Local road	Sealed	41	9	395	90	55	13	16	16	64	80	16	-	4.6
Rhyanna Road	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	16	12	64	60	16	-	3.7
Robertson Lane	Upper Lachlan Shire	Local road	Sealed	24	6	237	54	33	8	16	12	64	60	16	-	4.6
Roslyn Road	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Rugby Road	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Rye Park Road	Upper Lachlan Shire	Regional road	Sealed	26	4	263	42	29	5	16	12	64	60	16	-	4.3

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Saleyards Road	Upper Lachlan Shire	Local road	Sealed	41	9	395	90	55	13	8	8	32	40	8	-	4.6
Sapphire Road	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	16	12	64	60	16	-	4.6
Sheldricks Lane	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Soldiers Settlement Road South	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Spicers Lane	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	8	8	32	40	8	-	3.7
Spring Street	Upper Lachlan Shire	Local road	Sealed	41	9	395	90	55	13	16	16	64	80	16	-	4.6
Stink Pot Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Storriers Lane	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Strathaird Lane	Upper Lachlan Shire	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Taralga Road	Upper Lachlan Shire	Regional road	Sealed	43	7	439	70	48	8	20	16	80	80	20	-	3.7
Tarlo Number 1 Trail	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	4	2	16	10	4	-	3.8
Third Creek Road	Upper Lachlan Shire	Local road	Unsealed	16	4	158	36	22	5	4	2	16	10	4	-	3.7
Veterans Road	Upper Lachlan Shire	Local road	Sealed	8	2	79	18	11	3	4	2	16	10	4	-	4.7
Walkoms Lane	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	16	12	64	60	16	-	3.8
Walsh Street	Upper Lachlan Shire	Local road	Sealed	24	6	237	54	33	8	16	12	64	60	16	-	4.6
Walshs Road	Upper Lachlan Shire	Local road	Unsealed	8	2	79	18	11	3	8	8	32	40	8	-	3.8
Warrataw Street	Upper Lachlan Shire	Regional road	Sealed	26	4	263	42	29	5	16	12	64	60	16	-	4.3
Wheeo Road	Upper Lachlan Shire	Local road	Sealed	24	6	237	54	33	8	4	2	16	10	4	-	4.6
Willis Street	Upper Lachlan Shire	Regional road	Sealed	26	4	263	42	29	5	16	12	64	60	16	-	4.3
Woodhouselee Road	Upper Lachlan Shire	Local road	Sealed	24	6	237	54	33	8	24	16	96	80	24	-	4.6
Yass Street	Upper Lachlan Shire	Regional road	Sealed	43	7	439	70	48	8	16	12	64	60	16	-	3.1
Clinton Street	Goulburn Mulwaree	Local road	Sealed	122	28	1184	269	165	38	8	8	32	40	8	-	4.6
Cowper Street	Goulburn Mulwaree	State road	Sealed	222	78	2426	854	327	115	8	8	32	40	8	-	0.3

Road name	LGA	Road classification	Pavement type	Road traffic volume (in one direction)												Worst-case road traffic noise increase, dB (all periods)
				Existing						Construction						
				Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		Peak (1 hour)		Day (7am - 10pm)		Night (10pm - 7am)		
				LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	
Crookwell Road (north of Sooley Creek)	Goulburn Mulwaree	State road	Sealed	89	31	971	342	131	46	8	8	32	40	8	-	0.7
Fitzroy Street	Goulburn Mulwaree	State road	Sealed	111	39	1213	427	164	58	8	8	32	40	8	-	0.6
Goldsmith Street	Goulburn Mulwaree	State road	Sealed	111	39	1213	427	164	58	8	8	32	40	8	-	0.6
Gurrundah Road	Goulburn Mulwaree	Local road	Sealed	33	7	316	72	44	10	8	8	32	40	8	-	4.6
Hume Highway (west of Federal Highway)	Goulburn Mulwaree	State road	Sealed	207	73	2265	797	305	107	8	8	32	40	8	-	0.3
Hume Street	Goulburn Mulwaree	State road	Sealed	251	89	2750	968	371	131	8	8	32	40	8	-	0.3
Marble Hill Road	Goulburn Mulwaree	Local road	Sealed	16	4	158	36	22	5	8	8	32	40	8	-	4.6
Middle Arm Road	Goulburn Mulwaree	Local road	Sealed	82	18	790	179	110	25	8	8	32	40	8	-	4.6
Norwood Road	Goulburn Mulwaree	Local road	Sealed	16	4	158	36	22	5	4	2	16	10	4	-	4.6
Range Road	Goulburn Mulwaree	Local road	Sealed	41	9	395	90	55	13	8	8	32	40	8	-	4.6
Wheeo Road	Goulburn Mulwaree	Local road	Sealed	41	9	395	90	55	13	8	8	32	40	8	-	4.6

ATTACHMENT E

Audible noise report data

HumeLink
Project Development Support

Audible Noise & Radio Interference Report

Transgrid

December 2022

Executive summary

This report investigates the audible noise and radio interference expected to be produced by new 500 kV and 330 kV double circuit transmission lines constructed as part of the HumeLink project. The relevant standards and appropriate limits or targets are discussed, and computer modelling is reported. Potential project risks are listed.

Contents

Figures

Tables

1 Introduction

1.1 General

Audible noise and radio interference are two of the design parameters for the design of the HumeLink 500 kV and 330 kV transmission lines. This assessment will look at different methods and weather cases to calculate audible noise and radio interference. Sensitive areas will be identified, with mitigation strategies.

This report will inform Transgrid regarding risks for audible noise and radio interference.

1.2 References

Australian Standards

AS 1055:2018 Acoustics – Description and measurement of environmental noise

AS 2344:2016 Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 MHz to 3000 MHz

Guidelines

NSW EPA Noise Policy for Industry, 2017

Publications

Al-Faraj, M.A., Shwehdi, M.H, Farag, A.S (1997) Environmental Effect on High Voltage AC Transmission Lines Audible Noise IECEC-97 Proceedings, Thirty-Second Intersociety Energy Conversion Engineering Conference, 27 July – 1 August, Hawaii USA. IEEE Xplore.

CIGRE (2010) Audible Noise Levels of Transmission Overhead Lines standard configurations EHV (Extra High Voltage) operated in the Czech Republic. B2-109

CIGRE (2020) Audible Noise Management of Newly Reconducted Transmission Lines. B2-305

CIGRE (2004) Methods for Limiting Radio Interference from EHV OHL Insulator Sets. B2-302

CIGRE (1998) The Egyptian Experience for Electric & Magnetic Fields and Radio Noise with Compact and Traditional Towers. 22/33/36-09

EirGrid (2016), Evidence Based Environmental Studies Study 8: Noise, Literature review and evidence based field study on the noise effects of high voltage transmission development. Accessed 28 April 2022 at [https://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Evidence-Based-Environmental-Study-8-Noise.pdf]

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IEEE, A Comparison of methods for calculating audible noise of high voltage transmission lines: A report prepared by a Task Force of the Corona and Field Effects Subcommittee. ISSN: 1558-1705 DOI: 10.1109/MPER.1982.5519926

IEEE, Audible Noise Calculation for Different Overhead Transmission Lines. ISBN: 978-1-5386-2910-9 DOI: 10.1109/UPEC.2018.8542082

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Straumann, U., Weber, H.J. (2010) Potential reduction of audible noise from new and aged overhead transmission line conductors by increasing their hydrophilicity, *CIGRE 2010*, B2-113, Paris

Transgrid. (2020). Transmission Line Design Manual for 220kV, 330kV and 500kV – Major New Build TLDM-MNB. Transgrid.

2 Input parameters

Input parameters were obtained from the following documents in addition to the relevant standards as per Table 1-1:

- HumeLink Preliminary Conductor Selection and Structure Selection Report
- HumeLink Concept Design Report
- HumeLink Transmission Lines EMF Assessment.

2.1 Electrical

- Phase Conductor = Two conductor options are being considered namely ACSR Orange x 4 with 460 mm spacers and ACSR Pawpaw x 3 with 550 mm spacers (Non-Alpine).
- Phase Conductor = Two conductor options are being considered namely ACSR Orange x 4 with 460 mm spacers and ACSR Pawpaw x 3 with 550 mm spacers (Alpine).
- Double Circuits modelled as minimum reactance phasing, namely

  A C

  B B

  C A

- Shield Conductor = ACSR Lemon and OPGW B (Non-Alpine)
- Shield Conductor = 19/4.25 SC/AC and OPGW ASLH-Z(SA)bb 96 SMF (27SA 184) (Alpine)
- Voltage = 1.08 pu (540 kV or 354 kV)
- Current = 3,464 A at 120° C
- Maximum E-field = 9.1 kV/m
- Minimum ground clearance = *11 m(500 kV) or 8 m(330 kV)
- RI Frequency = 0.5 MHz.

Transmission lines produce approximately the same level of radio noise across frequencies up to 0.5 MHz, but this then drops off rapidly as the frequency increases above 0.5 MHz. Accordingly, 0.5 MHz is selected as a worst case for study in the bands below VHF. 30 MHz is also examined in section 4.5 below, as an indication of worst case expected RI noise in the VHF (30 MHz - 300 MHz) and UHF (300 MHz – 3GHz) bands.

**Minimum ground clearance will produce worst case results and are therefore used as a conservative approach in this study. Accordingly, actual noise or RF results measured on site will likely be below the calculated levels.*

2.2 Geometry

2.2.1 Existing 330 kV single circuit horizontal tower (alpine and non-alpine)

The following geometry is used to model lines running in parallel to new 500kV lines, for the purpose of calculating cumulative noise. The specific example follows the geometry of the SA type tower of Line 66, Lower Tumut to Murray.

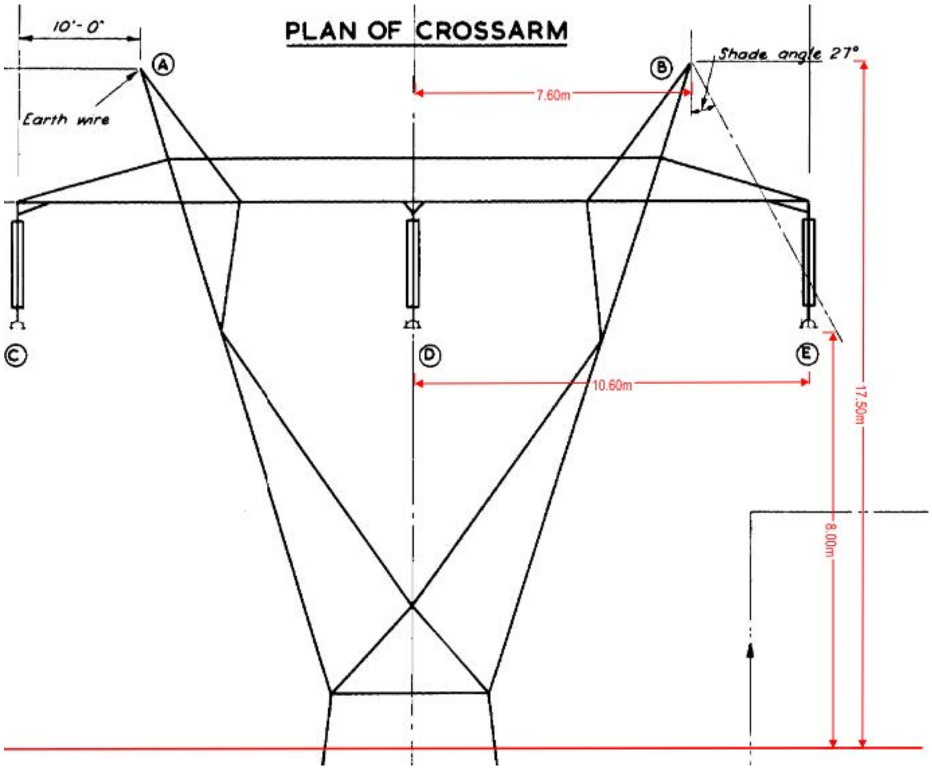


Figure 2-1: 330kV single circuit tower geometry (SA)

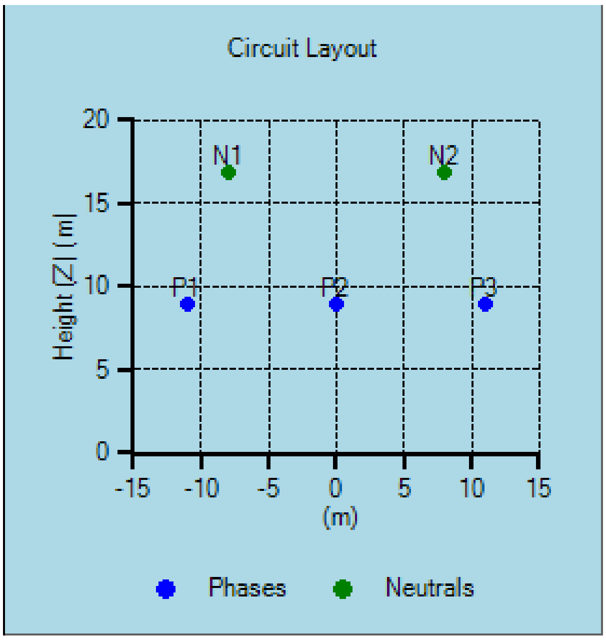
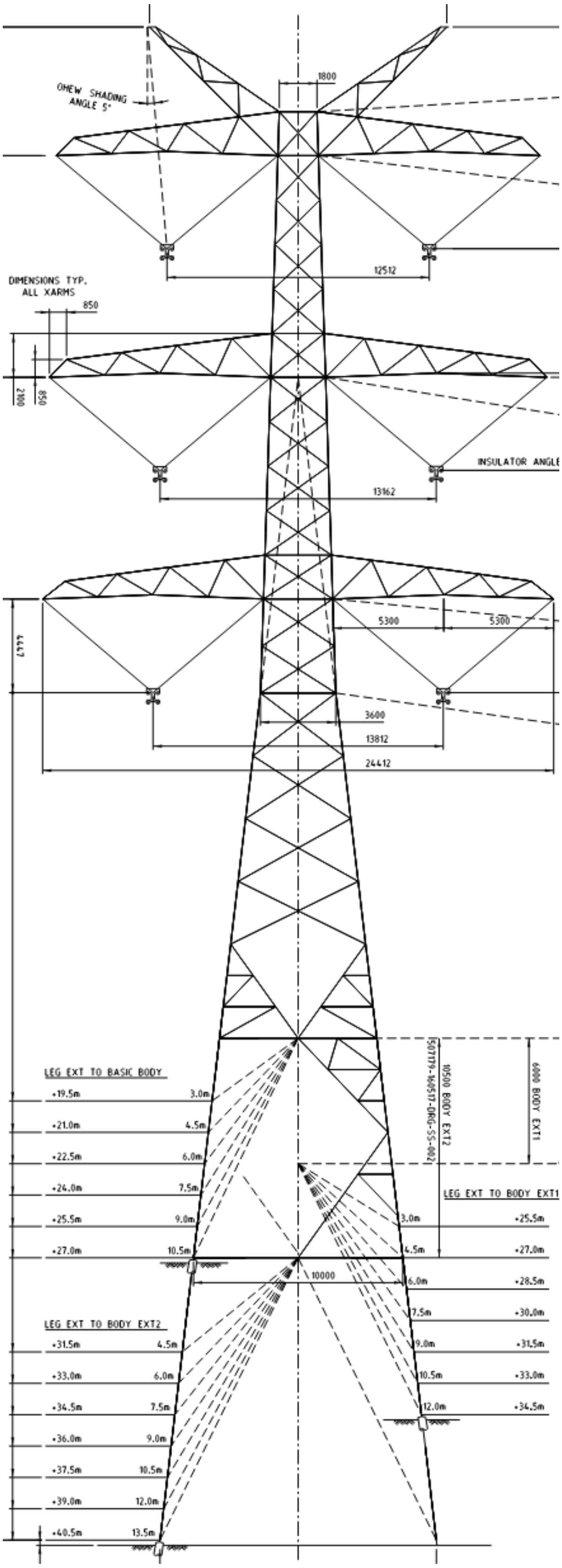
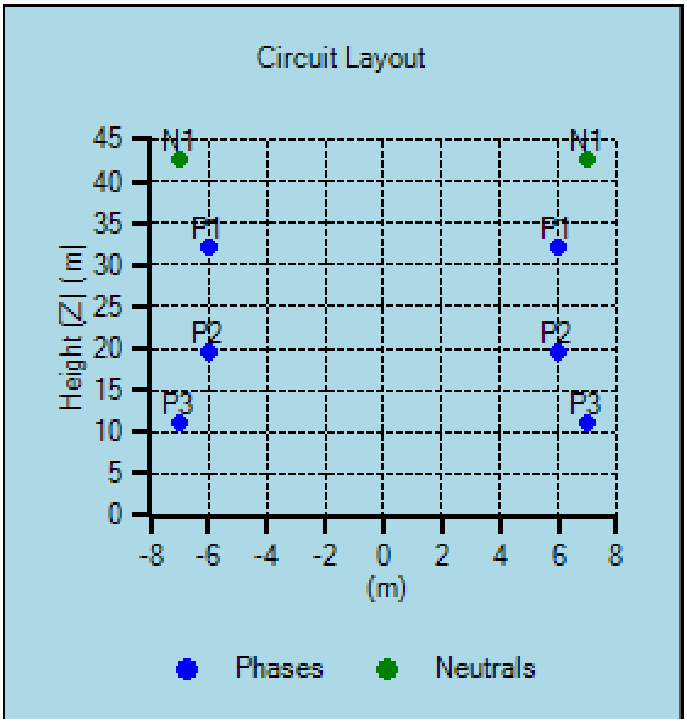


Figure 2-2: 330kV single circuit tower geometry (CDEGS)

- Phase separation = 10.6 m
- Shield wire separation = 15.2 m
- Ground Clearance midspan = 8 m (conservative worst case)

2.2.2 HumeLink 500 kV non-alpine double circuit vertical tower (VSE)

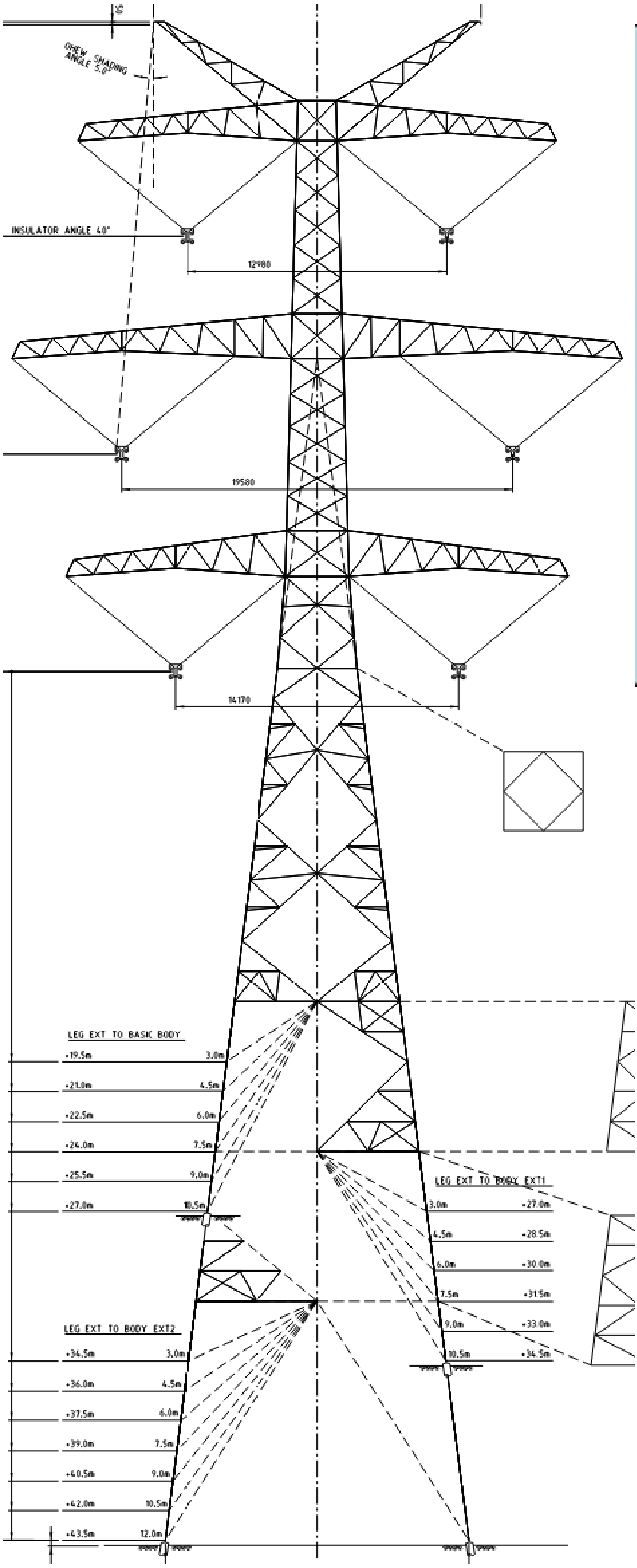


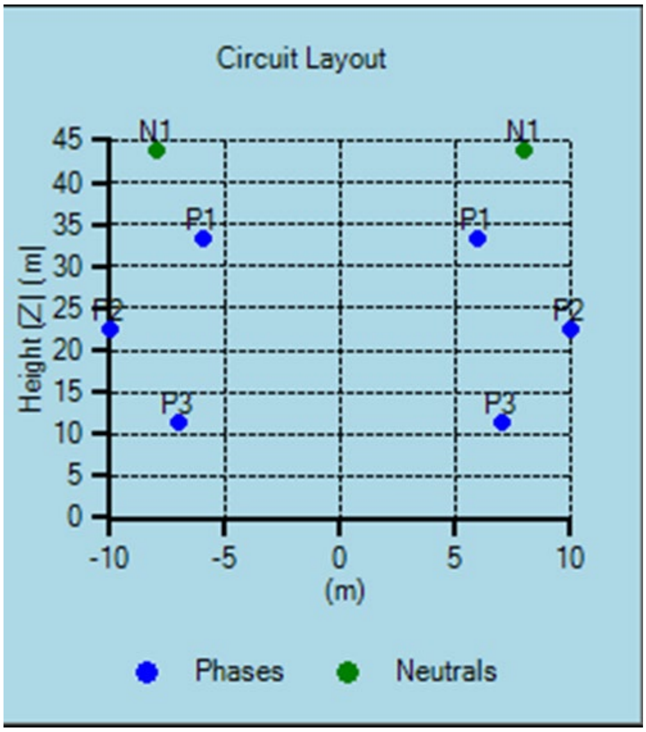


- Vertical phase separation = 10.6 m
- Circuit separation:
  Top phase = 12.51 m,
  Middle phase = 13.16 m and
  Bottom phase = 13.81 m.
- Shield wire separation = 14.2 m
- Ground Clearance midspan = 11 m (conservative worst case)

Figure 2-3: 500kV double circuit tower outline type VSE (extract from TL-799081)

2.2.3 HumeLink 500 kV alpine double circuit vertical tower (VSL)



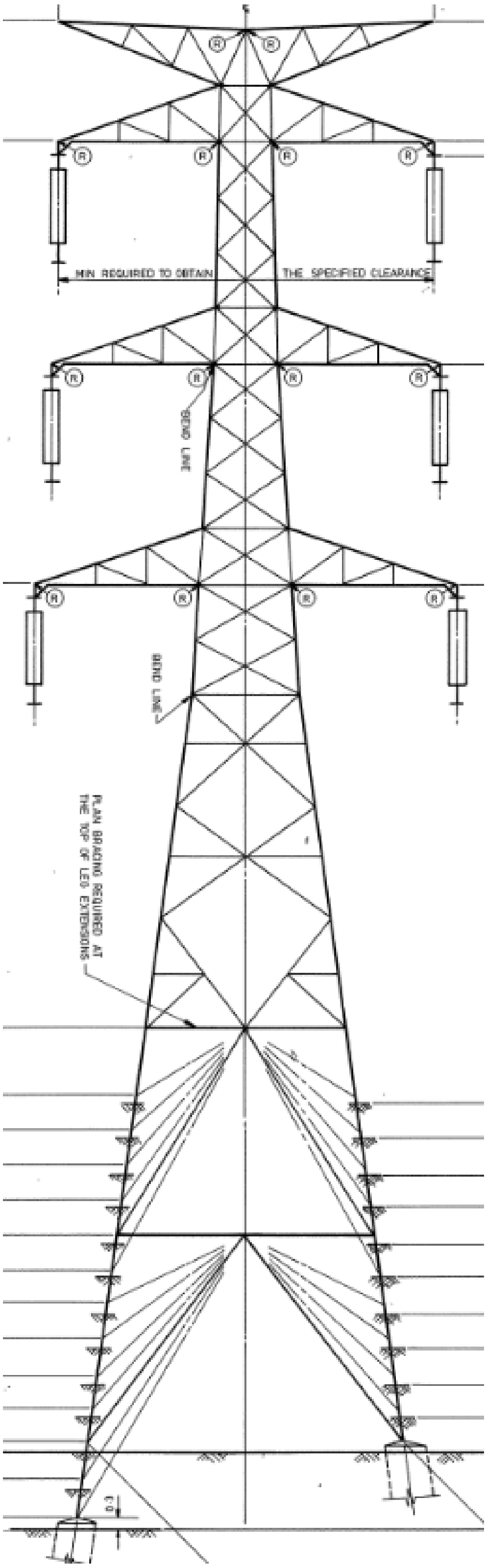


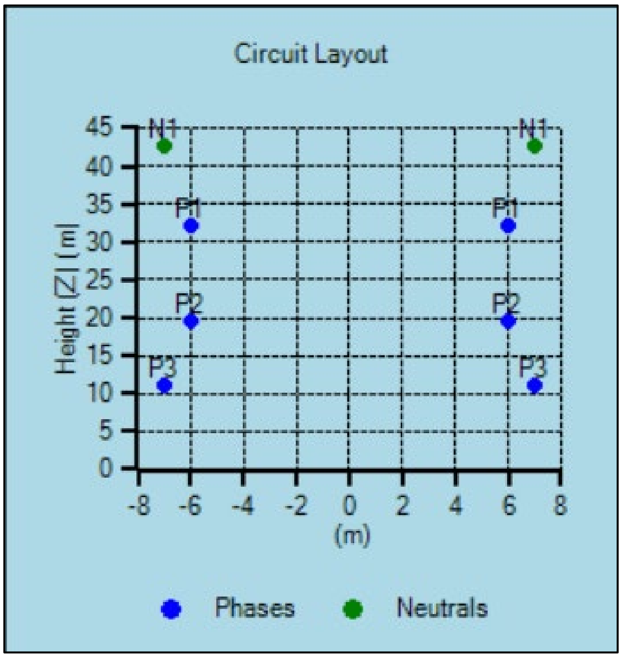
- Phase separation = 10.9 m
- Circuit separation:
  Top phase = 12.98 m,
  Middle phase = 19.57 m and
  Bottom phase = 14.17 m.
- Shield wire separation = 16.38 m
- Ground Clearance midspan = 11 m (conservative worst case)

Figure 2-4: 500kV Double Circuit Tower Outline type VSL (extract from TL-799084)

2.2.4 HumeLink 330 kV double circuit vertical tower (DSP)

New 330 kV double circuit towers will be used for a section of the route between proposed Gugaa substation and existing Wagga 330 kV substation. These are assumed to be based on the geometry of 330 kV tower type DSP.





- Vertical phase separation = 7.05 m
- Circuit separation:
  Top phase = 11.82 m,
  Middle phase = 12.05 m and
  Bottom phase = 12.95 m.
- Shield wire separation = 11.97 m
- Ground Clearance midspan = 8 m
  (conservative worst case)

Figure 2-5: 330 kV double circuit tower type DSP (extract from TL-141353)

2.3 Weather

From our simulations it was concluded that higher altitudes and temperatures produce higher noise levels. CDEGS software was used for calculations involving fair weather and heavy rain, however it does not support custom rain rates. EPRI applets were used for L50 light rain. L50 is used to represent very light rain and mist. However, custom temperatures are not supported in EPRI.

The following assumptions were made for weather cases to produce worst case results:

- **Fair Weather**: Use maximum ambient temperature and altitude from historical weather data[1] for the region.
- **L50 or Light Rain**: Use maximum altitude. Temperature is not supported in the EPRI applets. L50 rain is simulated at a rate of 0.75 mm/h.
- **Heavy Rain**: Use typical expected temperatures during rain and maximum altitude for the region. Heavy rain is simulated at a rate of 18 mm/h.

Light rain or mist conditions were considered. Based on evidence provided in the EPRI AC Transmission Line Reference Book, it is expected that heavy rain produces higher audible noise than light rain (refer to Figure 2-6 below). A similar conclusion is documented in papers by EirGrid[2] and Al-Faraj[3]. However, during heavy rain the ambient noise is very high due to the rain hitting various objects. It is therefore of more interest to look at light (L50) rain since this will cause more noise than fair weather, while the sound of the light rain is not expected to mask the sound of the transmission line so effectively.

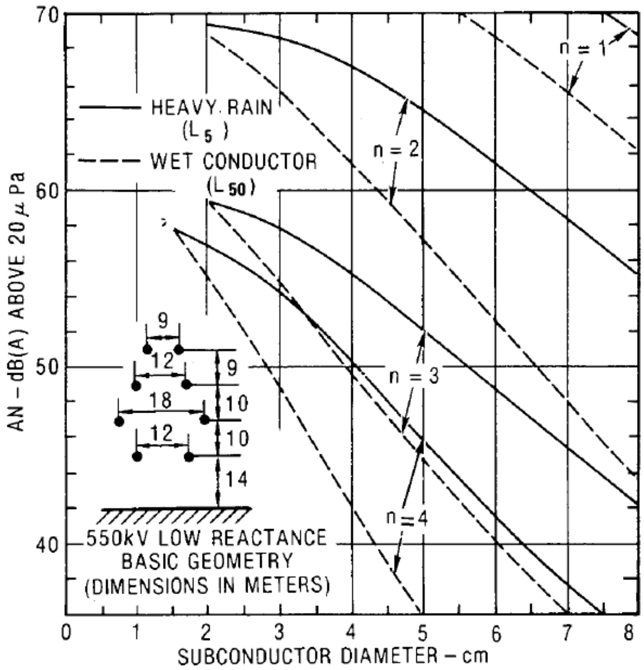


Figure 6.4.27. Audible noise, dB(A), at 15 m from the outer phase.

Figure 2-6: EPRI: Audible Noise

Due to dependence on altitude, the project is divided into three portions, and the highest altitude relevant to the portion used for the noise calculations, as shown in the table below.

[1] www.timeanddate.com/weather/australia/wagga-wagga/climate and Climate History (meteorology.com.au)

[2] EirGrid (2016) Evidence Based Environmental Studies Study 8: Noise, Literature review and evidence based field study on the noise effects of high voltage transmission development.

[3] Al-Faraj, M.A., Shwehdi, M.H, Farag, A.S (1997) Environmental Effect on High Voltage AC Transmission Lines Audible Noise IECEC-97 Proceedings, Thirty-Second Intersociety Energy Conversion Engineering Conference

Table 2-1: Weather cases for noise

Weather Case	Altitude	Temperature
Route 1: Maragle to Wondalga DC Alpine		
Fair Weather	1250 m	39 °C
Light Rain	1250 m	Not supported in EPRI applets
Heavy Rain	1250 m	26 °C
Route 2: Wondalga to Gugaa DC Non-Alpine		
Fair Weather	720 m	38 °C
Light Rain	720 m	Not supported in EPRI applets
Heavy Rain	720 m	25 °C
Route 3: Wondalga to Bannaby DC Non-Alpine		
Fair Weather	935 m	39 °C
Light Rain	935 m	Not supported in EPRI applets
Heavy Rain	935 m	26 °C
Route 4: Gugaa to Wagga Wagga DC Non-Alpine		
Fair Weather	340 m	38 °C
Light Rain	340 m	Not supported in EPRI applets
Heavy Rain	340 m	25 °C

2.4 Observation zone

- Height above ground = 1.8 m (typical ear height of a person standing)
- Width = Easement width 70 m DC + 170 m on both sides.

2.5 Limits

2.5.1 Audible noise

With the absence of standards or guidelines on noise limits applicable to lines, the following guidelines are derived from Figure 2-7. The recommended project noise level for industrial developments is 5 dBA below the recommended amenity noise level. The NSW EPA Noise Policy for Industry (2017) specifically applies to generators and substations, specifically doesn't apply to wind turbines and is silent regarding transmission lines.

Table 2.2: Amenity noise levels.

Receiver	Noise amenity area	Time of day	L_{Aeq}, dB(A)
(see Table 2.3 to determine which residential receiver category applies)			Recommended amenity noise level
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom – internal	All	Noisiest 1-hour period when in use	35 (see notes for table)
Hospital ward internal external	 All All	 Noisiest 1-hour Noisiest 1-hour	 35 50
Place of worship – internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50

Figure 2-7: NSW EPA Noise Limits for Industry (2017), table 2.2

The EPA recommended maximum audible noise level is 35 dB(A), which is not practical for EHV overhead lines especially during wet conditions. In accordance with the EPA document, practical measures should be taken to minimize noise where it is predicted to be above 35 dB(A). Reasonable attempts should be made to minimize the noise by centring the line away from dwellings.

Ambient noise during rain can vary substantially due to different factors such as rainfall rate, wind and surface types. It is therefore difficult to predict a maximum value. In addition, the noise from a transmission line is of a different character to noise from mining operations or industrial premises.

The impact of transmission line audible noise was first reported by Perry in 1972. These general guidelines are still widely referenced. From the guidelines in Figure 2-8 below it can be seen that noise levels below 52.5 dB(A) at the edge of the easement will cause no to low complaints.

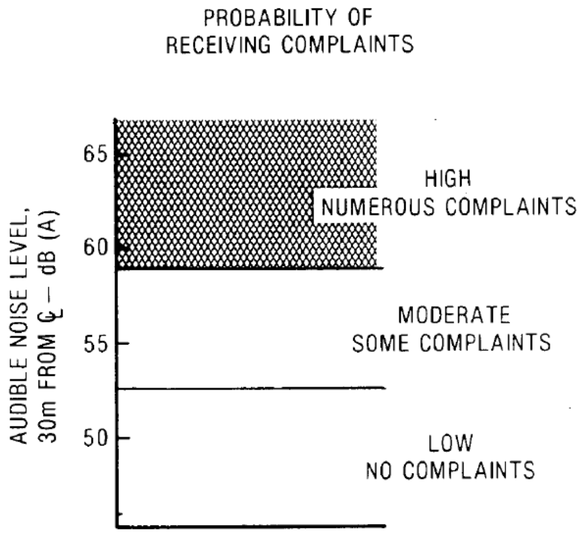


Figure 6.3.4. Audible-noise complaint guidelines (17).

Figure 2-8: EPRI- Perry's Audible Noise Complaint Guidelines

The value of 52.5 dB(A) is therefore recommended as the target maximum value during light rain for the HumeLink project. While it is not a compliance level, it is recommended in order to avoid nuisance to neighbours.

- Maximum recommended Audible Noise (L50 rain) = 52.5 dB(A)

2.5.2 Radio Interference

AS 2344 Tables 1 and 2 give the following limits for Radio Interference, as follows. In the terminology of AS 2344, the project is located in "Zone C", and the "boundary of the line corridor" is interpreted as the edge of the easement, as detailed above in Section 2.4, Observation zone.

TABLE 1

LIMITS OF RADIATED RADIO DISTURBANCE 0.15 MHz TO 30 MHz

Frequency (MHz)(5)	Field strength(2) (dBµA/m) at the boundary of the line corridor(1) or 30 m from an installation		
	Region 3 (Australia)		
	Zone A	Zone B	Zone C
0.15–0.3	–4.5	5.5	–1.5
0.3–3(3)	–18.5	–8.5	–15.5
3 to 30(4)	–18.5 to –31.5	–8.5 to –21.5	–15.5 to –28.5

NOTES:

1 The corridor width is determined by the relevant regulatory authority or from Table 3 where no regulation is applicable.

2 The limits of Tables 1 and 2 apply at the distances defined in Clause 7(c).

3 The limits given for Region 3 apply to rural areas and to urban areas not serviced by local m.f. broadcasts. For urban areas serviced by local broadcast stations, the limits may be increased by 14 dB over the frequency range of 0.5 MHz to 1.7 MHz.

4 The limit decreases linearly with the logarithm of the frequency from 3 MHz to 30 MHz.

5 At the transition frequency the lower limit applies.

Figure 2-9: AS 2344 Table 1 Limits of Radiated Radio Disturbance 0.15 MHz to 30 MHz

TABLE 2

LIMITS OF RADIATED RADIO DISTURBANCE 30 MHz TO 3000 MHz

Frequency (MHz)	Field Strength (dBµV/m) at the boundary of the line corridor or 30 m from an installation
30–230	30
230–1 000	37
1 000–3 000*	60

* This frequency shall apply only if it is established that there is a radio disturbance emission with a fundamental frequency exceeding 200 MHz.

Figure 2-10: AS 2344 Table 2 Limits of Radiated Radio Disturbance 30 Mhz to 3000 Mhz

2.5.3 Calculation of the radio interference limit according to AS2344

Classification of the HumeLink lines using AS 2344 Table 1 (Figure 2-11 below) identifies them in Region 3 and Zone C.

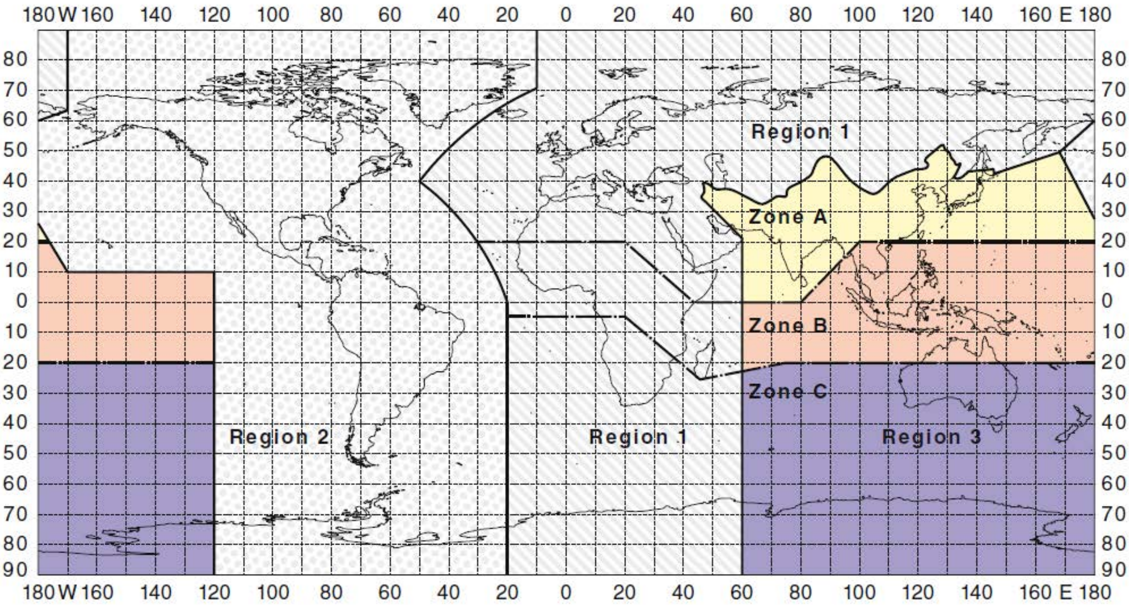


FIGURE 1 MAP SHOWING THE REGIONS AND ZONES

Figure 2-11: AS 2344 Figure 1, Map Showing the Regions and Zones

- 0.3 to 3 MHz Limit according to AS 2344 Table 1 is -15.5 dBμA/m
- AS 2344 page 9 specifies the following formula to convert dBμA/m to dBμV/m:
- Limit in dBμV/m = Limit in dBμA/m + 51.5

  = -15.5 + 51.5*

  = 36 dBμV/m

  *Where 51.5 represents the characteristic impedance of free space (377 ohms) in decibels.

Accordingly, the adopted limit, maximum radio interference at 0.5 MHz (Fair Weather), is 36 dBμV/m.

This limit is still conservative in comparison to other international standards.

3 Audible noise

3.1 Method selection

In the project Preliminary Conductor Selection and Structure Report (refer Table 1-1), the GE empirical method was used to calculate the estimated dB at a distance from the line. The GE method produced good average results.

In the following IEEE study various methods were compared by comparing the difference in calculated value and actual measured value. The data was obtained from the IEEE, *A comparison of Methods for Calculating Audible Noise of HV transmission lines* document. The table below represent the difference in dB:

Table 3-1: Difference between calculated and measured values in dB (IEEE, extract)

Method	AEP	BPA	GE	GE	ENEL	Ontario Hydro	CRIEPI	EdF	FGH	IREQ	Best
Weather	Avg	L50	L50	L5	HR	HR	HR	HR	Max	Max	
Line 1 Horizontal 525kV	-1.6	-0.2	-1.1	1.7	-3.6	-0.8	NA	-3.6	-6.4	-10.5	BPA
Line 2 Horizontal 525kV	-1.8	-0.2	0.6	3	-1.5	0.6	NA	-1	-1.4	-4.3	BPA
Line 3 Horizontal 525kV	1.6	0.3	1.3	1.7	4	3.1	NA	4.4	4.3	2.2	BPA
Line 4 Delta SC 525kV	NA	-2.4	-1	0.8	2	NA	-0.8	1.1	2.3	0.8	GE
Line 6 Horizontal 735kV	-0.6	0.2	1.1								BPA
Line 7 Horizontal 735kV	-0.2	0.3	3.8								BPA
Line 8 Horizontal 765kV	-1.1	-0.9	-0.4	2	-0.1	-1.4	-0.9	-0.4	0	-2.5	FGH
Line 9 Horizontal 765kV	-1	-0.2	-1.3	1.5	-0.5	-3	-1.3	-0.7	-0.4	-0.4	BPA
Line 10 Horizontal 775kV	0.6	0.1	-1.1	-2.5	0.6	0.9	-2.3	0.9	1.8	-2.8	BPA
Line 11 Horizontal 1050kV	NA	4.1	4.2	3	2.5	NA	-3.1	1.1	0.9	0.6	IREQ
Line 12 Horizontal 1050kV	-5.7	-0.5	0.4	0.6	0.2	-8.8	-5.4	0.7	1	1	ENEL
Line 13 Delta SC 1150kV	NA	-0.5	0.6	1.9	2.3	Na	NA	2	2.4	2.3	BPA

From the above comparison the BPA method is the most accurate across a wide variety of line configurations and voltages.

The EPRI method was not part of the above study and therefore further research was done to find a comparison between the BPA and EPRI methods. In the "IEEE, Audible Noise Calculation for Different Overhead Transmission Lines" document, laboratory results were compared with the BPA and EPRI methods.

The following figures represent laboratory results (TUG) and calculated results from BPA and EPRI on the conductor bundles.

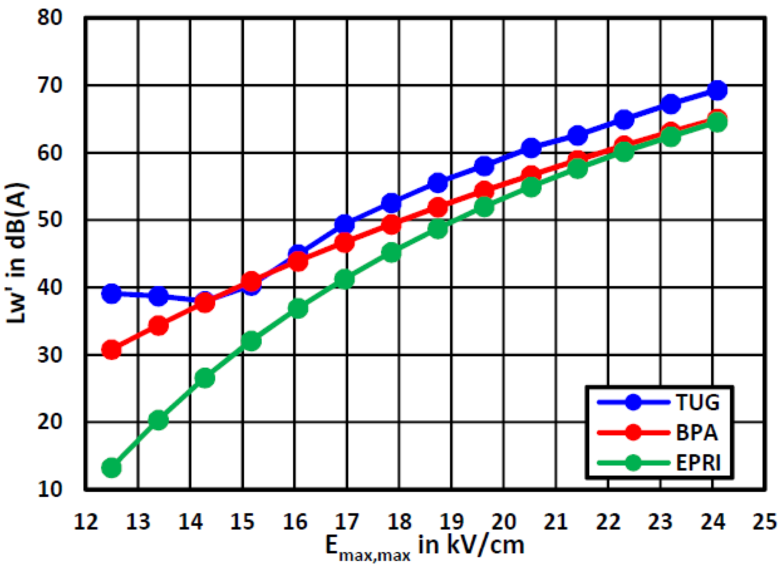


Figure 3-1: Comparison between the sound power levels from laboratory experiments and prediction equations. (AC, precipitation rate: 2mm/h)

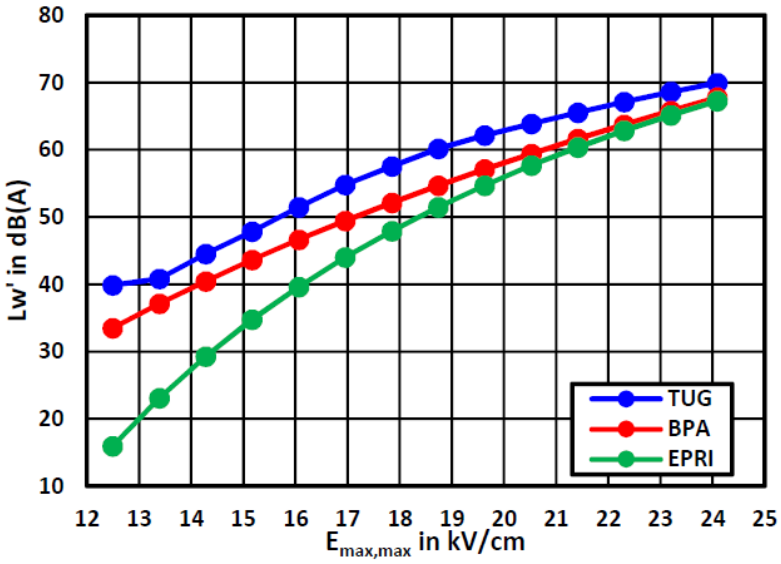


Figure 3-2: Comparison between the sound power levels from laboratory experiments and prediction equations. (AC, precipitation rate: 8mm/h)

It can be seen from the above that the sound power levels obtained from the laboratory results (TUG) are slightly higher than the BPA and EPRI predictions. It should be noted that the BPA and EPRI equations were designed for moderately aged conductors (two to three years in operation). Aged conductors are expected to be more quiet than new conductors. The difference between the methods reduce as the surface gradient voltage increases.

Further comparisons between the methods were done on a typical Danube AC 400 kV tower setup.

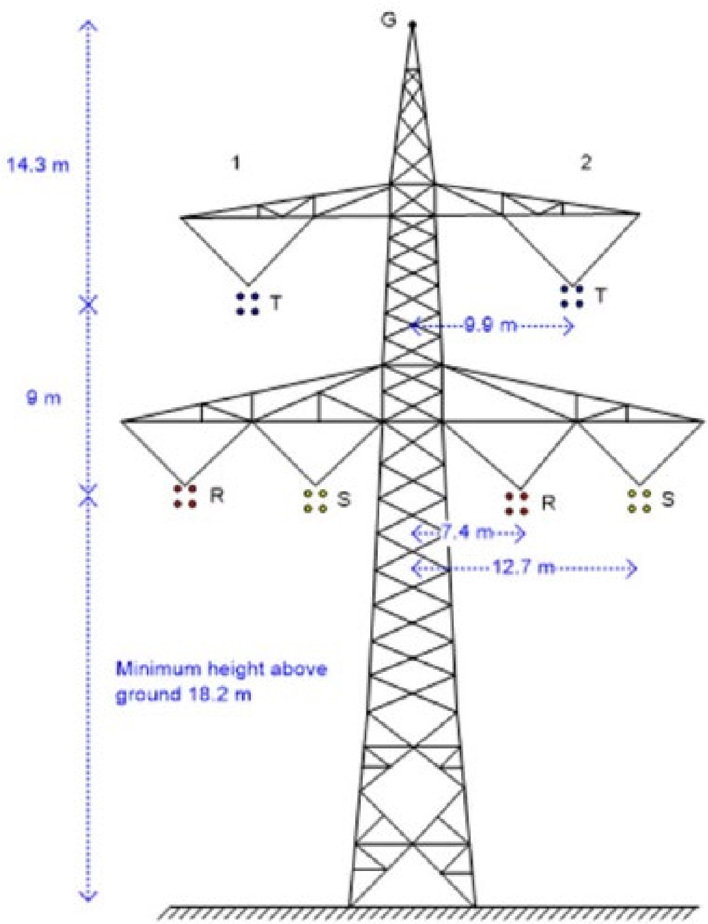


Figure 3-3: Typical Danube AC 400 kV Tower Setup

Line	E kV/cm	L_w' in dB(A) ref 1 pW/m		
		TUG	BPA	EPRI
		5 mm/h		
R1	20.15	62.44	57.41	55.43
T1	17.09	54.04	48.85	43.64
S1	21.27	65.01	60.24	58.92
R2	21.14	64.74	59.93	58.54
T2	16.99	53.72	48.54	43.17
S2	20.20	62.56	57.55	55.60
SLA in dB(A) ref 20 µPa		44.8*	39.91	39.70

*Calculated with BPA propagation model

Figure 3-4: Audible noise prediction of Danube 400 kV AC tower setup

From the above it can be seen that the total A-weighted sound level (SLA) at a reference point from the line differ by about 5dB between the TUG results and the predicted results from BPA and EPRI.

Both the BPA and EPRI methods seem similar with acceptable outcome. The EPRI method was used on other Transgrid projects and therefore it would be beneficial for comparison reasons to use the EPRI method in this project.

3.2 Hum, or tonal noise

From CIGRE B2-305 it can be observed that 100 Hz tonal noise can be higher than wideband noise during rain. Tonal calculations were not carried out as part of the assessment in CIGRE B2-305 because it was difficult to predict, further research will be required in the future to calculate tonal noise.

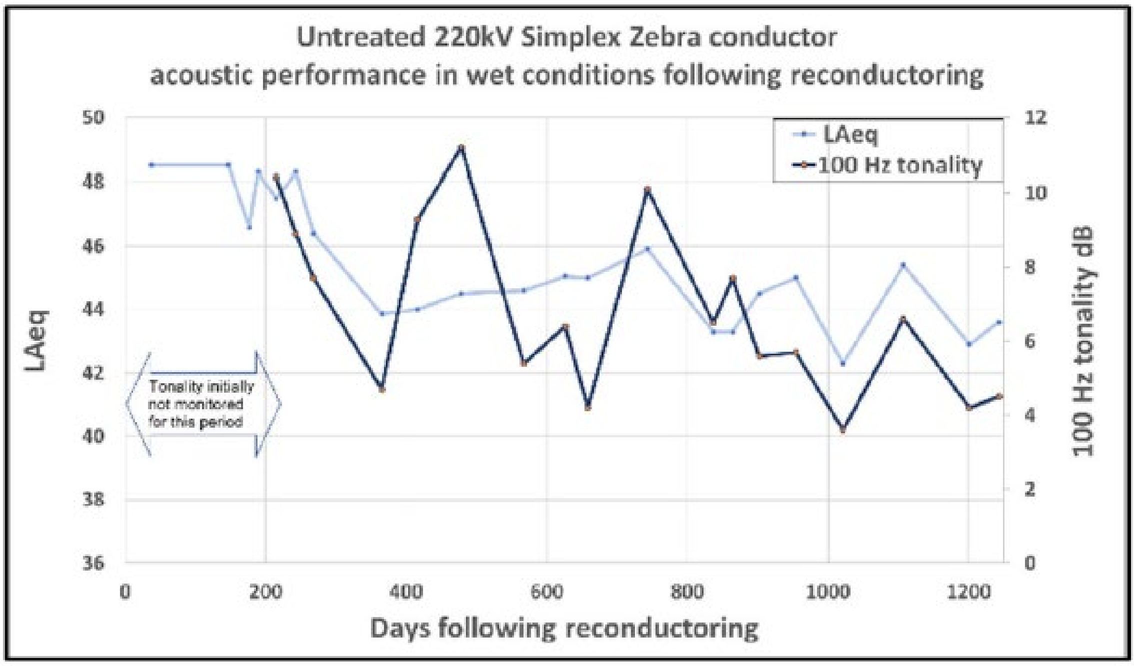


Figure 3-5: Cigre B2-205: Wideband and tonal audibility after reconductoring.

Dulling of new conductor surfaces using glass bead blasting reduce wideband noise but result in high long-term tonality.

3.3 Modelling

CDEGS, SESEnviroPlus module version 16.2 was used to simulate the noise.

The following inputs were used:

- Air Resistivity: 1 x 10^{18} Ω.m
- Soil Resistivity: 100 Ω.m
- Conductor Bundle: 4 x Orange or 3 x PawPaw
- Phase Energization: 540 kV (or 354 kV for Gugaa to Wagga Wagga) at 3464 A
- Observation Profile Height: 1.8m
- Acoustical Noise Method: Semi-Empirical EPRI (USA)
- Altitude: As per Table 2-1: Weather cases for noise
- Temperature: As per Table 2-1: Weather cases for noise
- Weather: Fair Weather, Heavy Rain (18 mm/h) and L50 Rain (Modelled in EPRI Applets)

The CDEGS, SESEnviroPlus module version 16.2 does not support hum or tonal noise modelling, therefore EPRI Applets were used to model hum during rain for comparison.

- Altitude: 100m as per EPRI applet
- Weather: L50 Rain (0.75 mm/h).

3.4 Results

3.4.1 Audible Noise (Alpine)

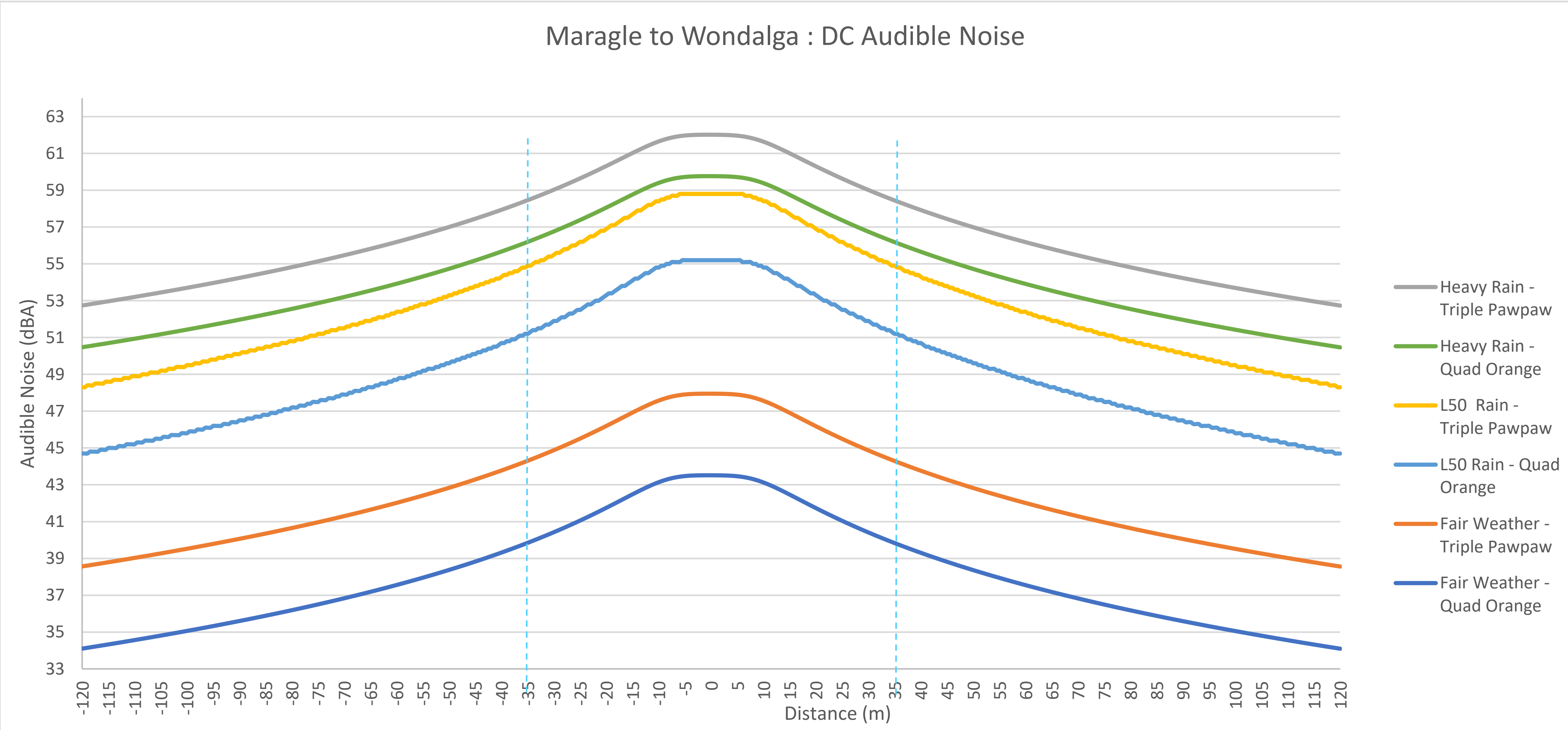


Figure 3-6: Audible Noise: Maragle to Wondalga DC

3.4.2 Audible Noise (Non-Alpine)

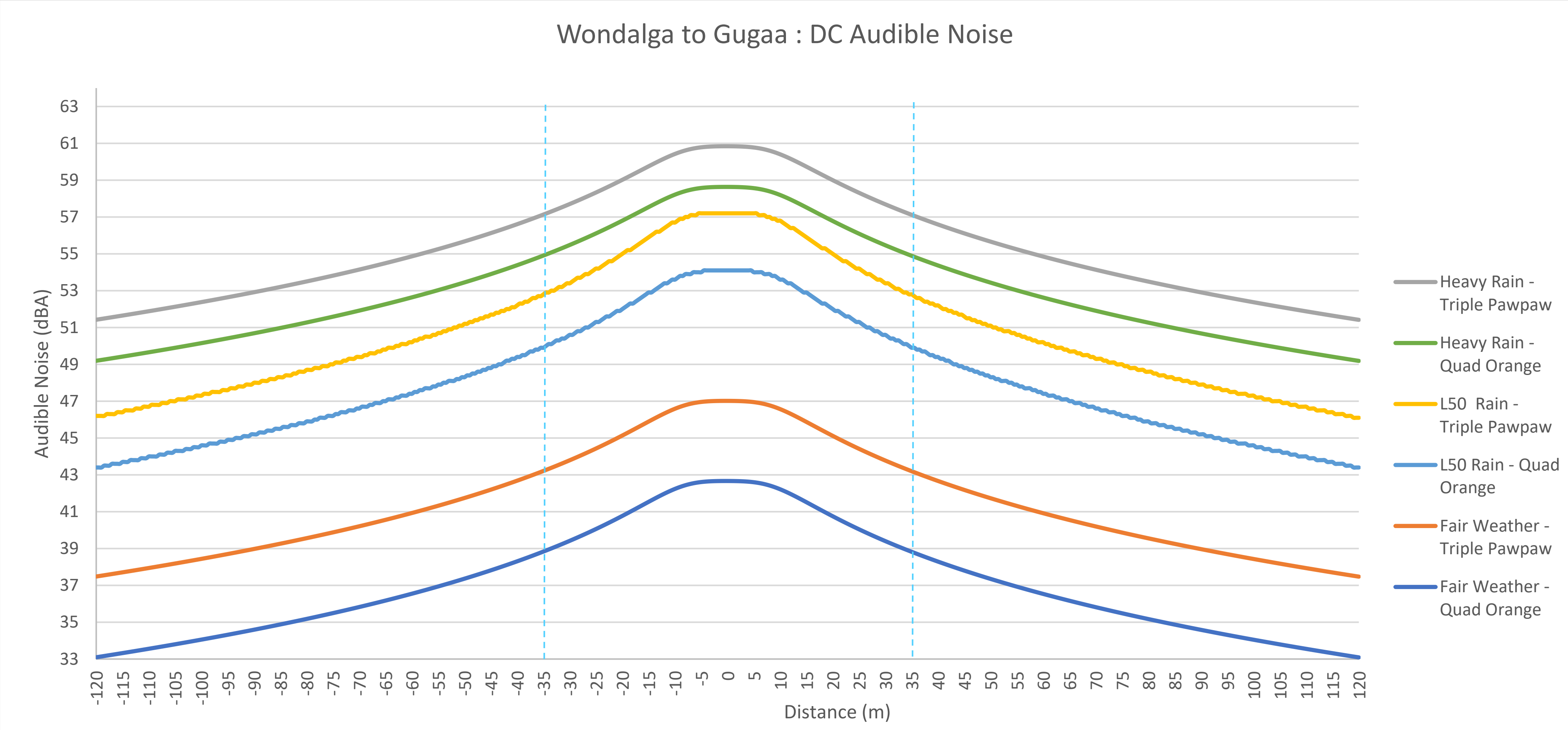


Figure 3-7: Audible Noise: Wondalga to Gugaa DC

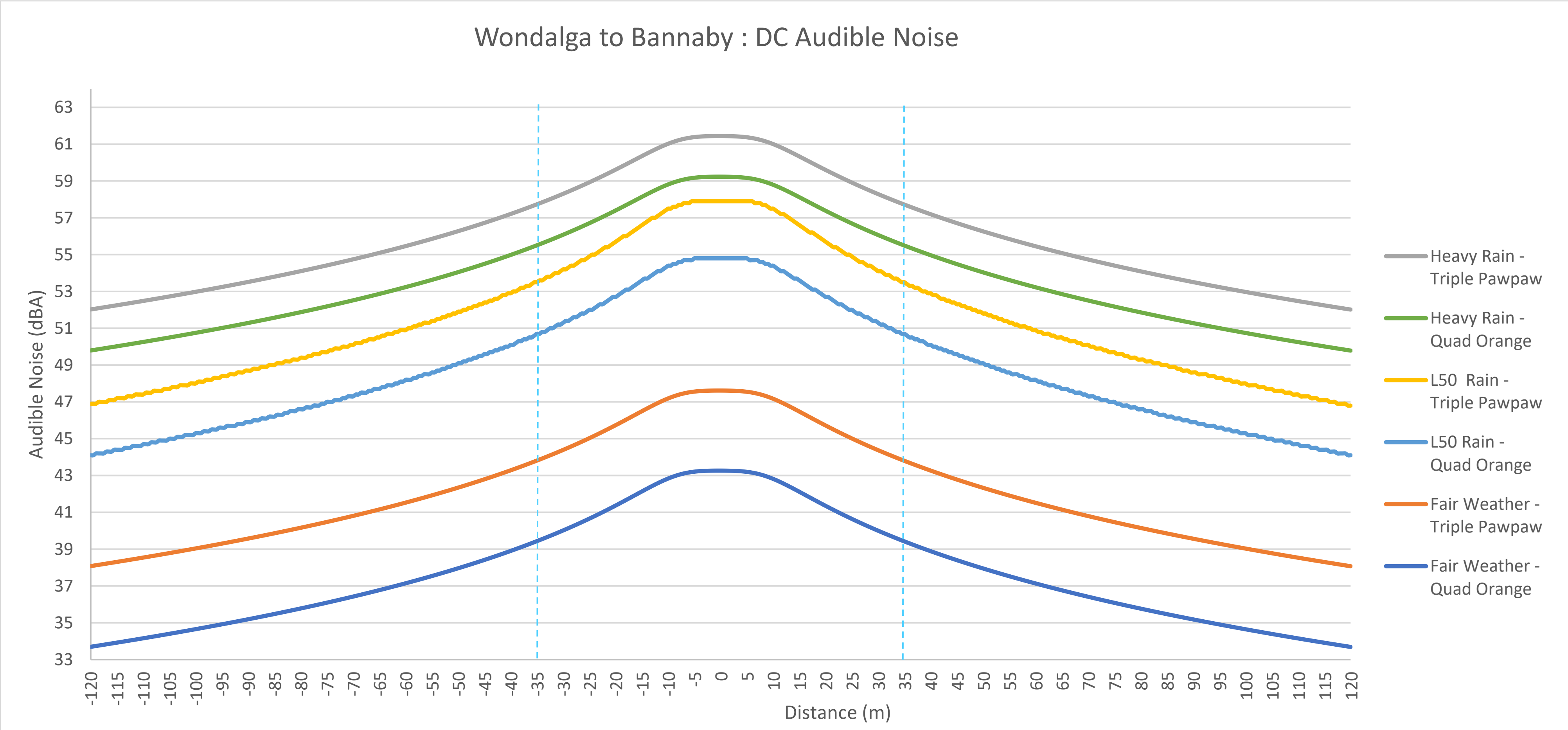


Figure 3-8: Audible Noise: Wondalga to Bannaby DC

3.4.3 Audible Noise (Gugaa to Wagga)

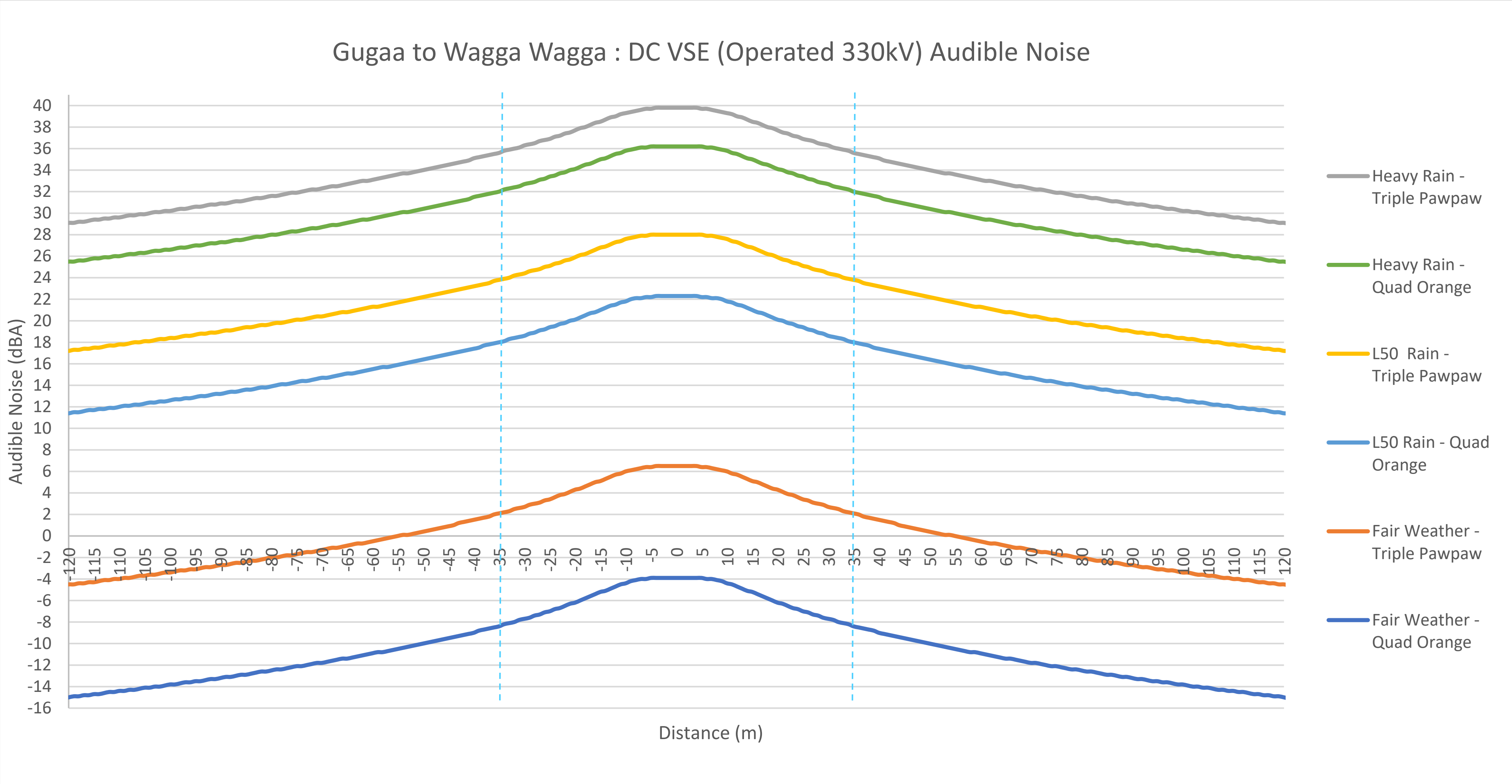


Figure 3-9: Audible Noise: Gugaa to Wagga Wagga DC VSE (Operated at 330kV)

When the 500 kV built / 330kV operating double circuit line between Gugaa and Wagga is energised in future at 500 kV as part of the proposed VNI project, the audible noise profile will be similar to the Wondalga-Gugaa section as shown in Figure 3-7 above.

3.4.4 Hum or Tonal Noise

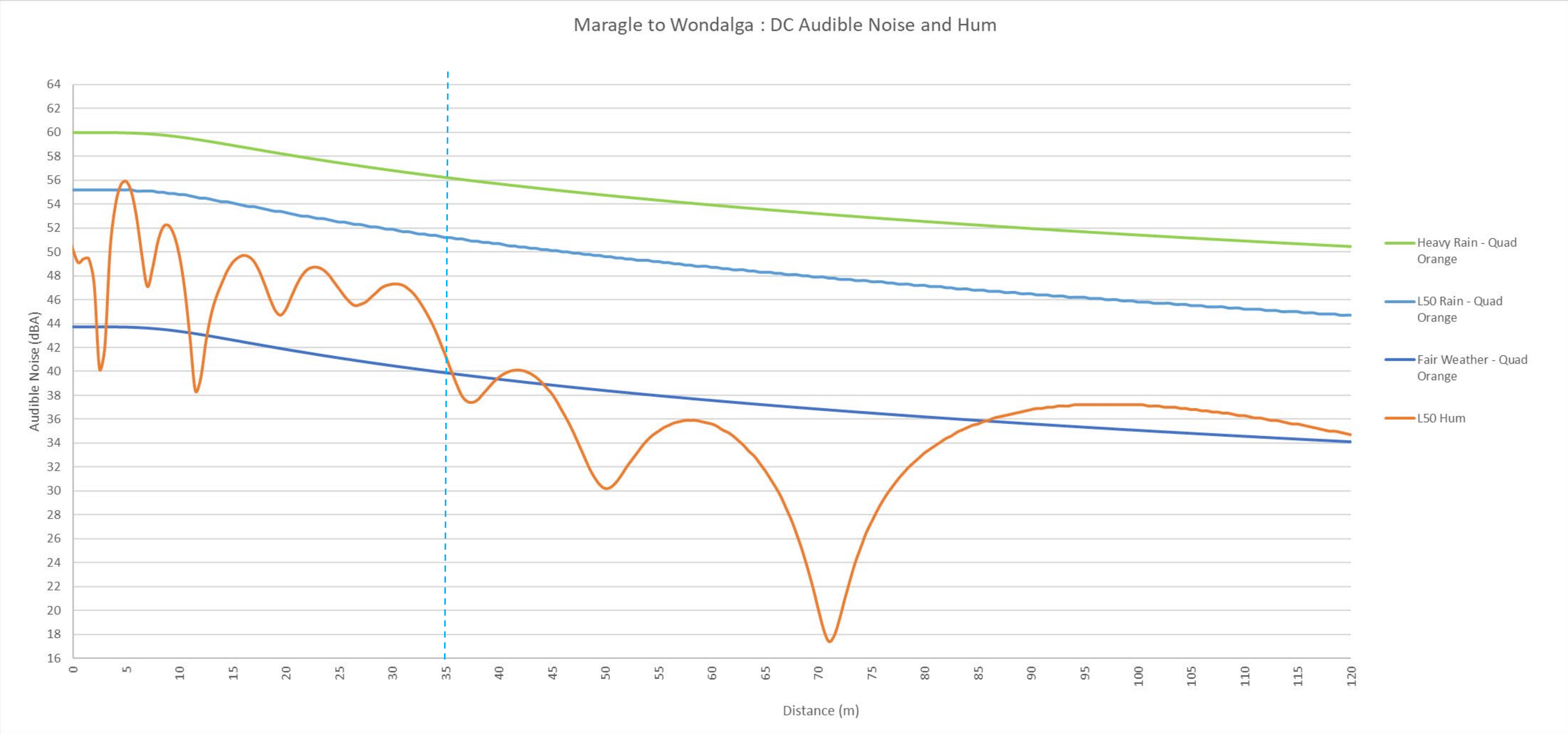


Figure 3-10: Hum: Maragle to Wondalga DC

3.4.5 Audible noise summary

The following table is a summary of the expected noise at the edge of the easement with the EPRI method.

Table 3-2: **Summary of Audible Noise at the edge of the easement**

Audible Noise at edge of easement	Fair Weather	L50 Rain	Heavy Rain	Distance from the centre line to achieve 35 dB(A) (Fair Weather)	Distance from the centre line to achieve 35 dB(A) (L50 Rain)	Distance from the centre line to achieve 35 dB(A) (L5 Rain)	Distance from the centre line to achieve 52.5 dB(A) (L50 Rain)	Distance from the centre line to achieve 52.5 dB(A) (Heavy Rain)
QUAD ORANGE								
Route 1: Maragle to Wondalga DC 4 x Orange	39.8 dBA	51.2 dBA	56.2 dBA	91.5 m	366 m	526 m	25 m	81 m
Route 2: Wondalga to Gugaa DC 4 x Orange	38.8 dBA	49.9 dBA	54.9 dBA	82.5 m	326 m	469 m	17 m	62 m
Route 3: Wondalga to Bannaby DC 4 x Orange	39.4 dBA	50.7 dBA	55.5 dBA	93 m	348 m	496 m	21.5 m	70.5 m
Route 4: Gugaa to Wagga Wagga DC 4 x Orange (330 kV)	-8.4 dBA	18.0 dBA	32.0 dBA	0 m	0 m	15 m	0 m	0 m
TRIPLE PAWPAW								
Route 1: Maragle to Wondalga DC 3 x Pawpaw	44.3 dBA	54.9 dBA	58.5 dBA	223 m	486 m	651 m	58.5 m	125.5 m
Route 2: Wondalga to Gugaa DC 3 x Pawpaw	43.2 dBA	52.8 dBA	57.1 dBA	186 m	410 m	570 m	37.5 m	97.5 m
Route 3: Wondalga to Bannaby DC 3 x Pawpaw	43.8 dBA	53.5 dBA	57.7 dBA	206 m	434 m	601 m	44 m	109.5 m
Route 4: Gugaa to Wagga Wagga DC 3 x Pawpaw (330 kV)	**2.1 dBA**	**23.8 dBA**	**35.6 dBA**	**0 m**	**0 m**	**40 m**	**0 m**	**0 m**

During 330 kV operation, noise is negligible. When the 500 kV built and 330 kV operated line is uprated to 500 kV in future, its performance will be similar to the other 500 kV lines discussed above.

3.4.6 Hum or tonal noise summary

Only the Maragle to Wondalga DC was modelled for hum. From the results in Figure 3-12: Hum: Maragle to Wondalga DC above the following can be concluded regarding hum:

- During L50 rain is the hum always lower than the wideband audible noise
- During Heavy rain is the hum slightly higher than the wideband audible noise at the centre of the line, but from the outside phase further away from the line centre, the hum is below the wideband audible noise.
- In this case hum doesn't seem to be the limiting criteria for audible noise. However, it should be kept in mind that the hum is less treatable by acoustical barriers (hedges, walls etc).

3.5 Accumulative noise

If the noise level at a reference point differs by more than 10dB between sources, the effect of the lower source is neglectable due to the log scale used for noise measurements. The following formula can be applied to calculate the accumulative noise of more than one source with similar frequencies.

$$dB_{total} = 10 \times log\left(\sum_{i=1}^{n} 10^{\left(\frac{dB_i}{10}\right)}\right)$$

The following lines run parallel to the new HumeLink lines. 132 kV lines are not expected to produce any significant noise and were therefore not considered.

3.5.1 Accumulative Noise (Alpine)

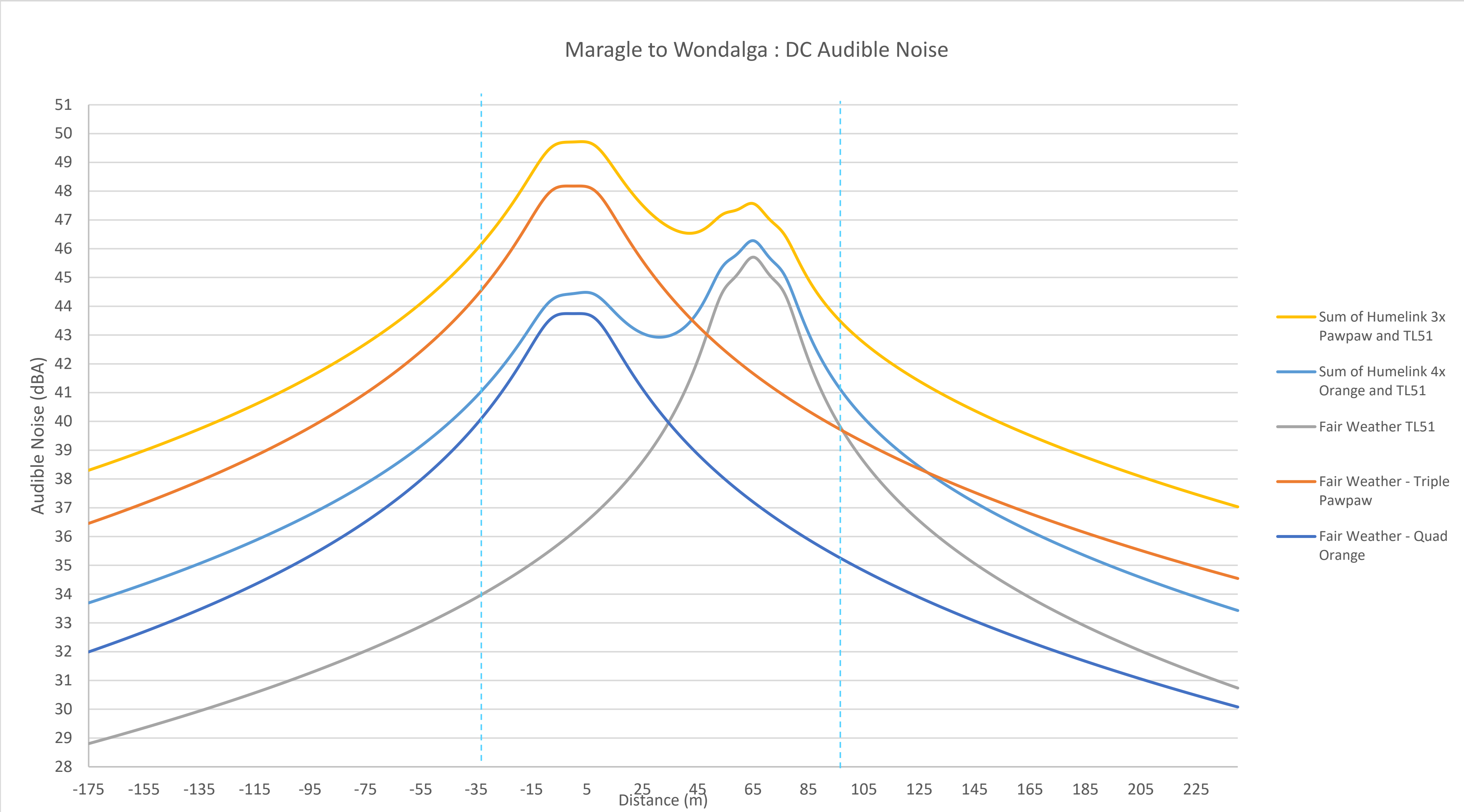


Figure 3-11: Accumulative Noise: Maragle to Wondalga DC – TL51

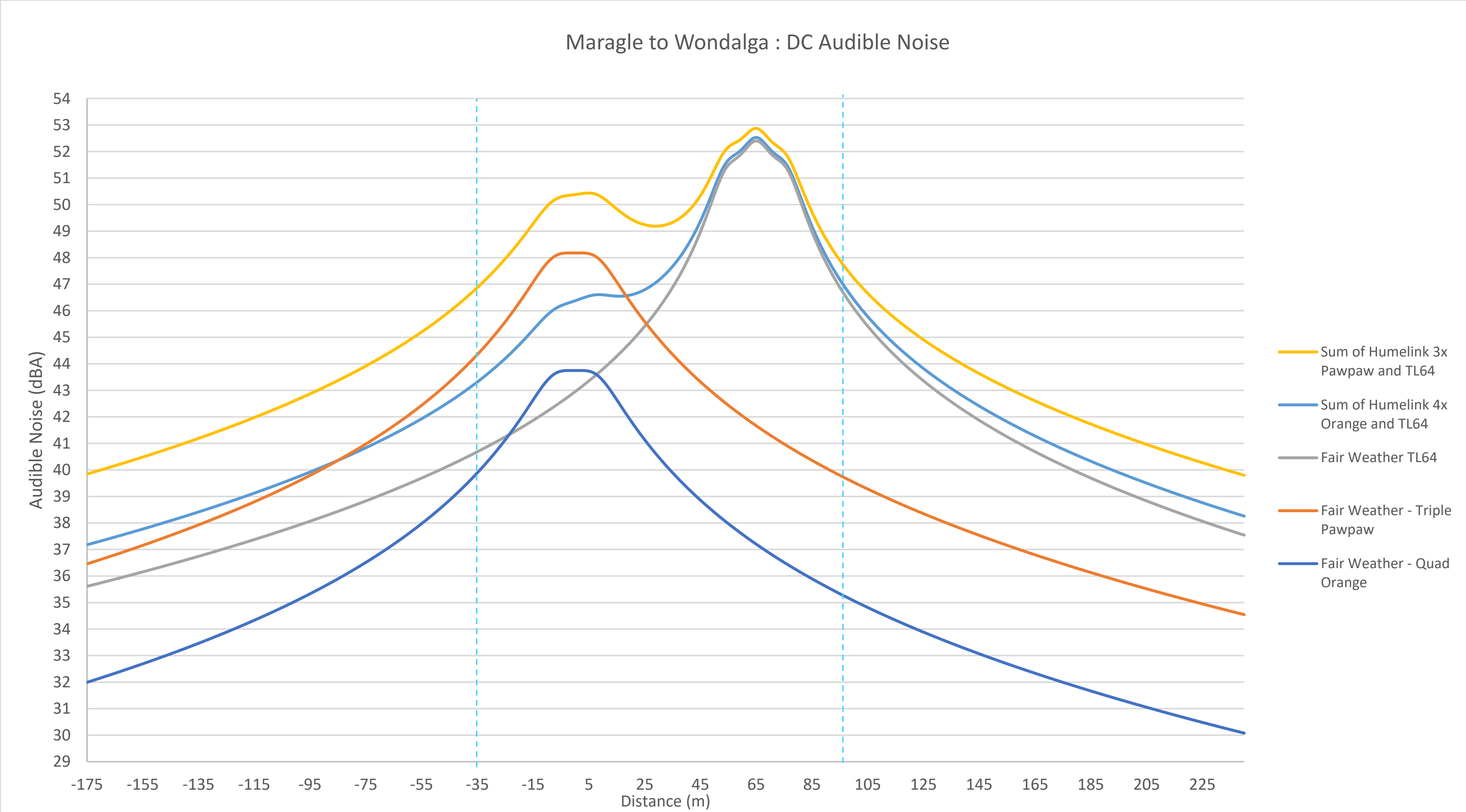


Figure 3-12: Accumulative Noise: Maragle to Wondalga DC – TL64

Figure 3-13: Accumulative Noise: Maragle to Wondalga DC – TL66

3.5.2 Accumulative Noise (Non-Alpine)

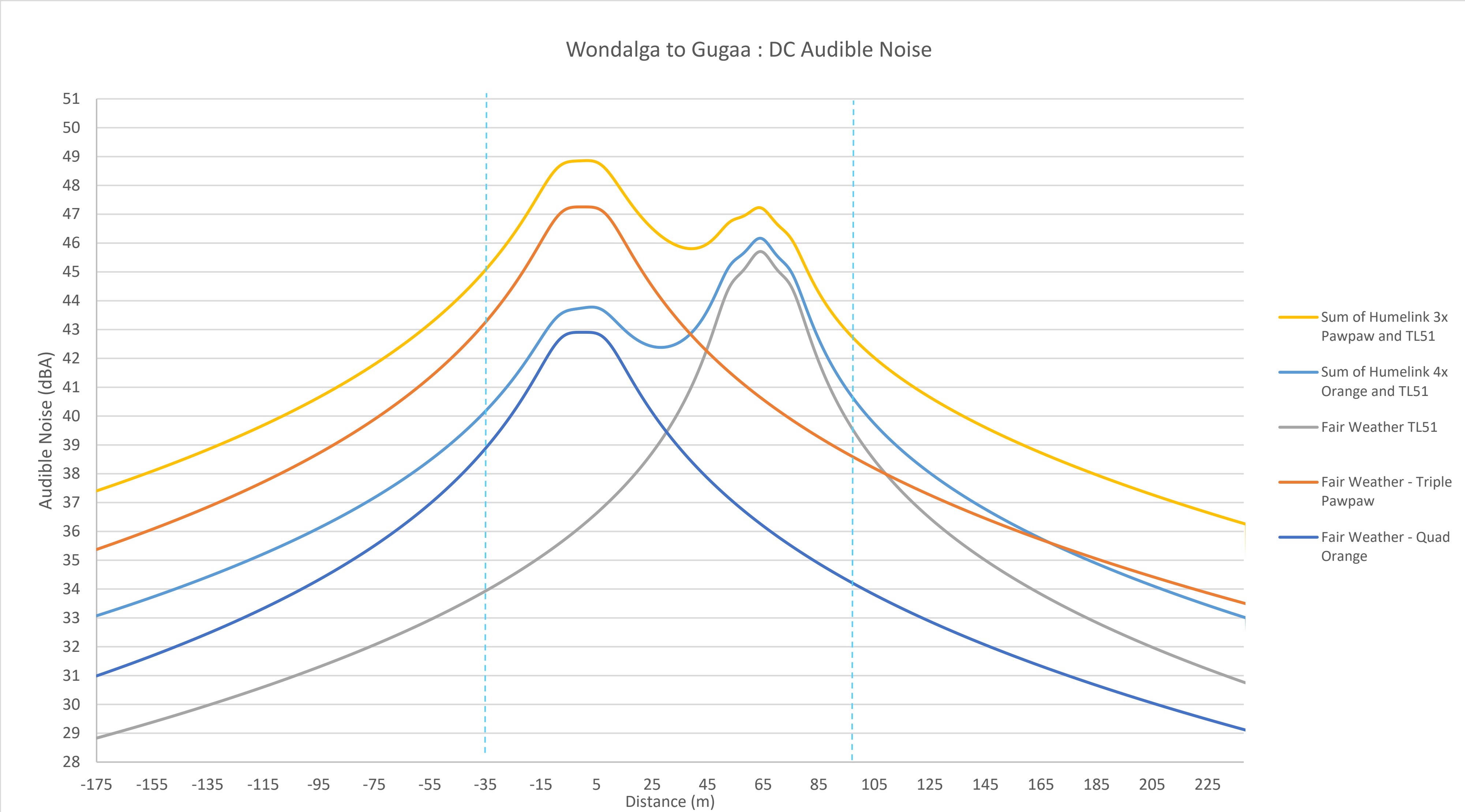


Figure 3-14: Accumulative Noise: Wondalga to Gugaa DC – TL51

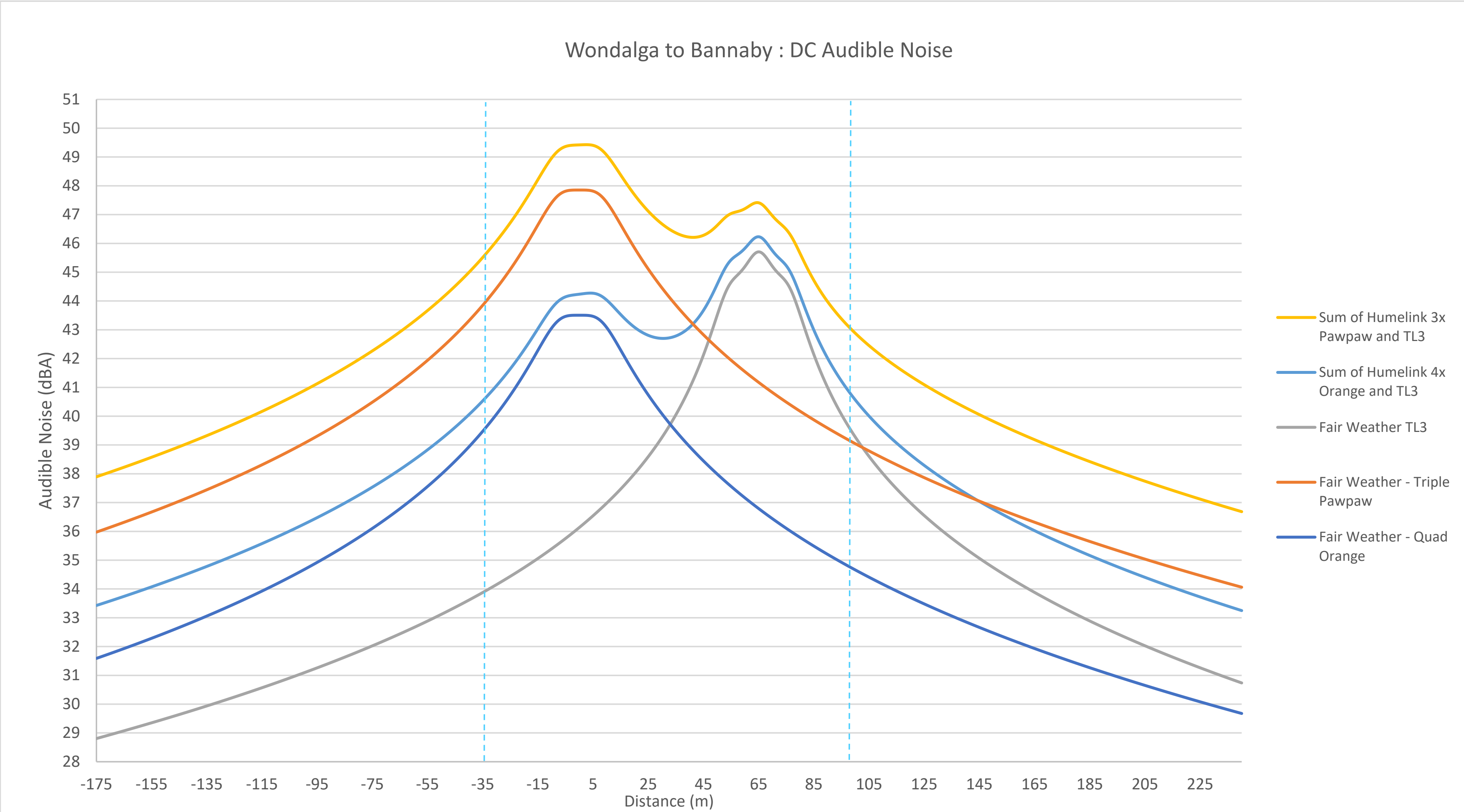


Figure 3-15: Accumulative Noise: Wondalga to Bannaby DC – TL3

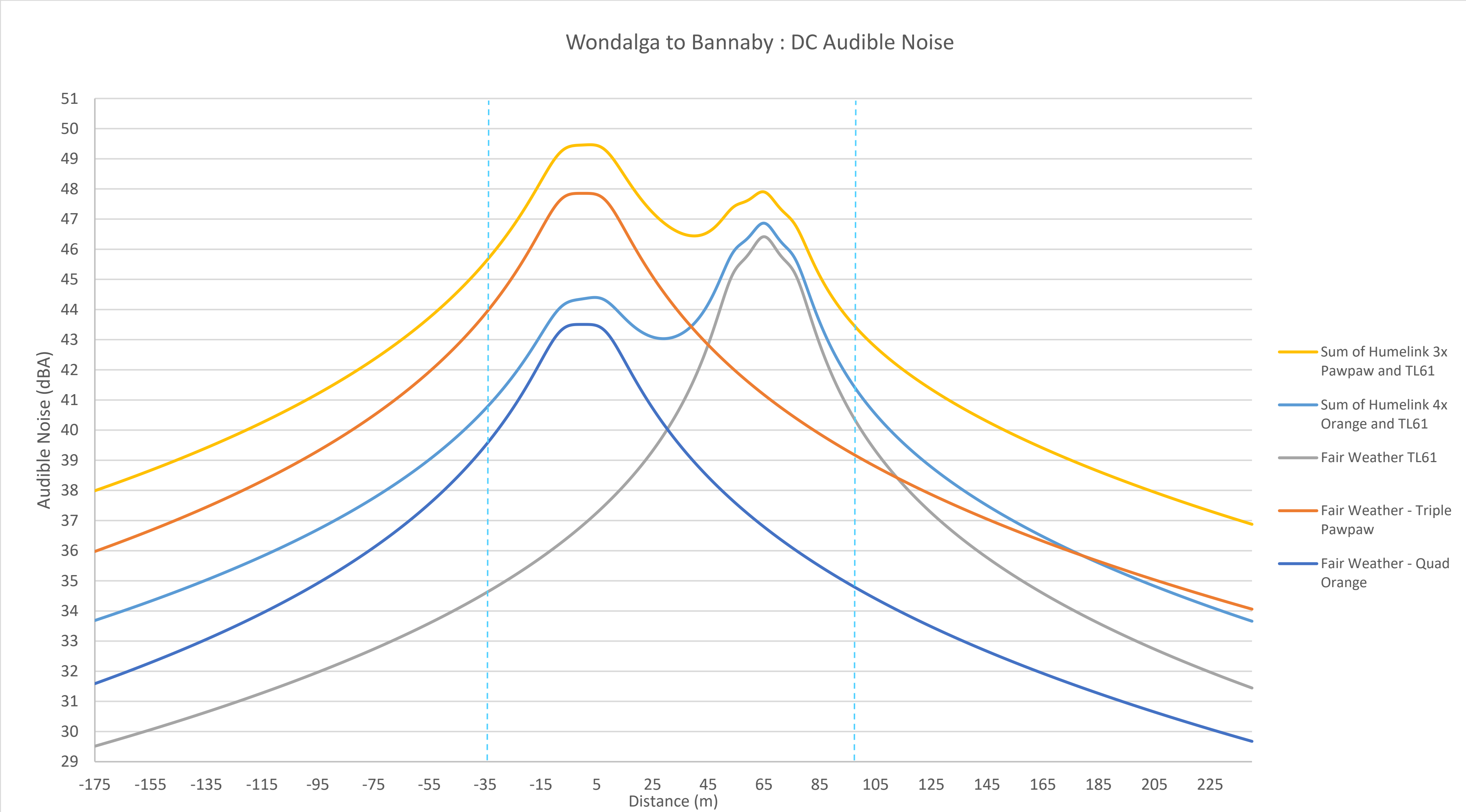


Figure 3-16: Accumulative Noise: Wondalga to Bannaby DC – TL61

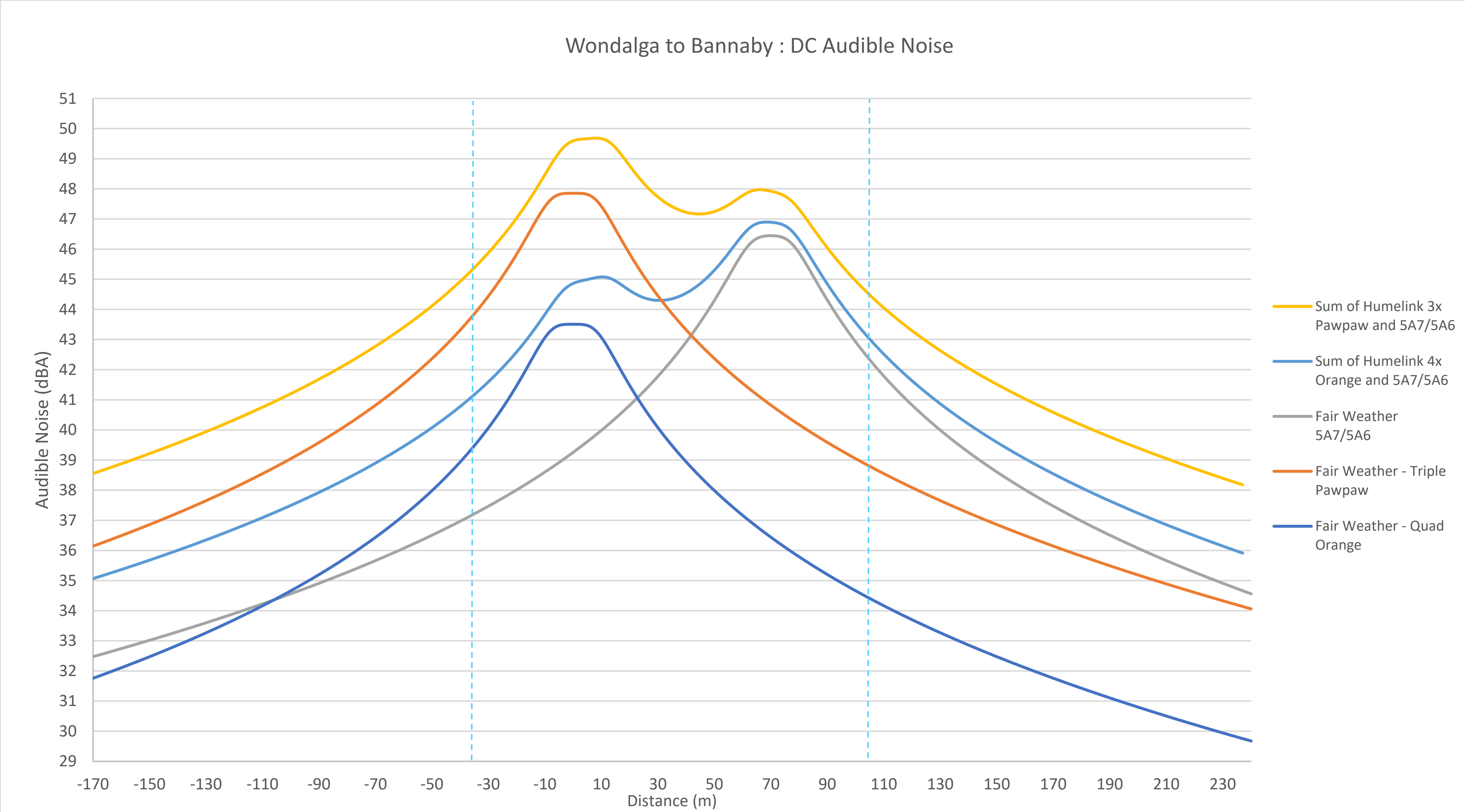


Figure 3-17: Accumulative Noise: Wondalga to Bannaby DC – 5A7/5A6

3.5.3 Accumulative Noise (Gugaa to Wagga)

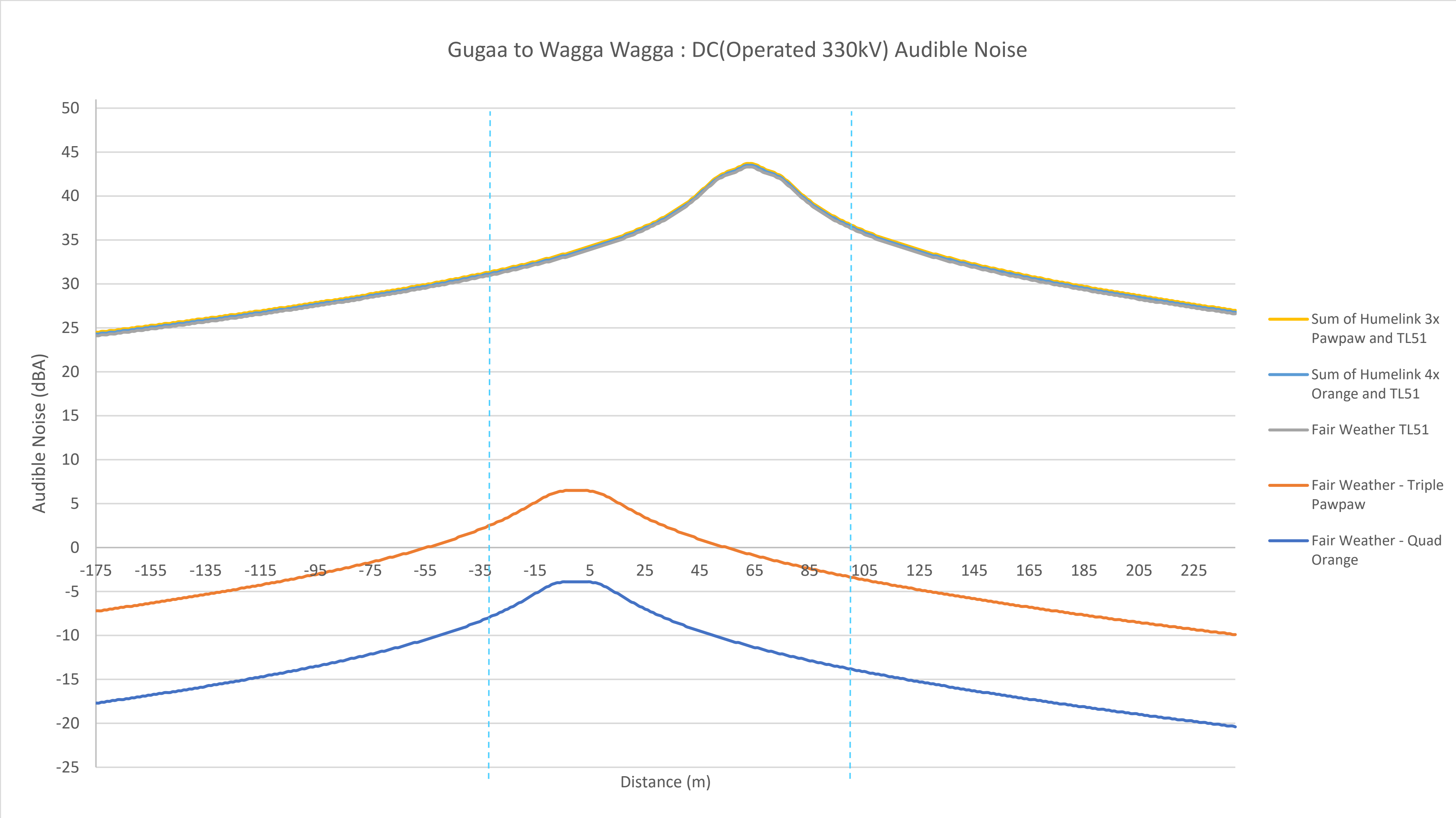


Figure 3-18: Accumulative Noise: Gugaa to Wagga Wagga DC – TL51 SC

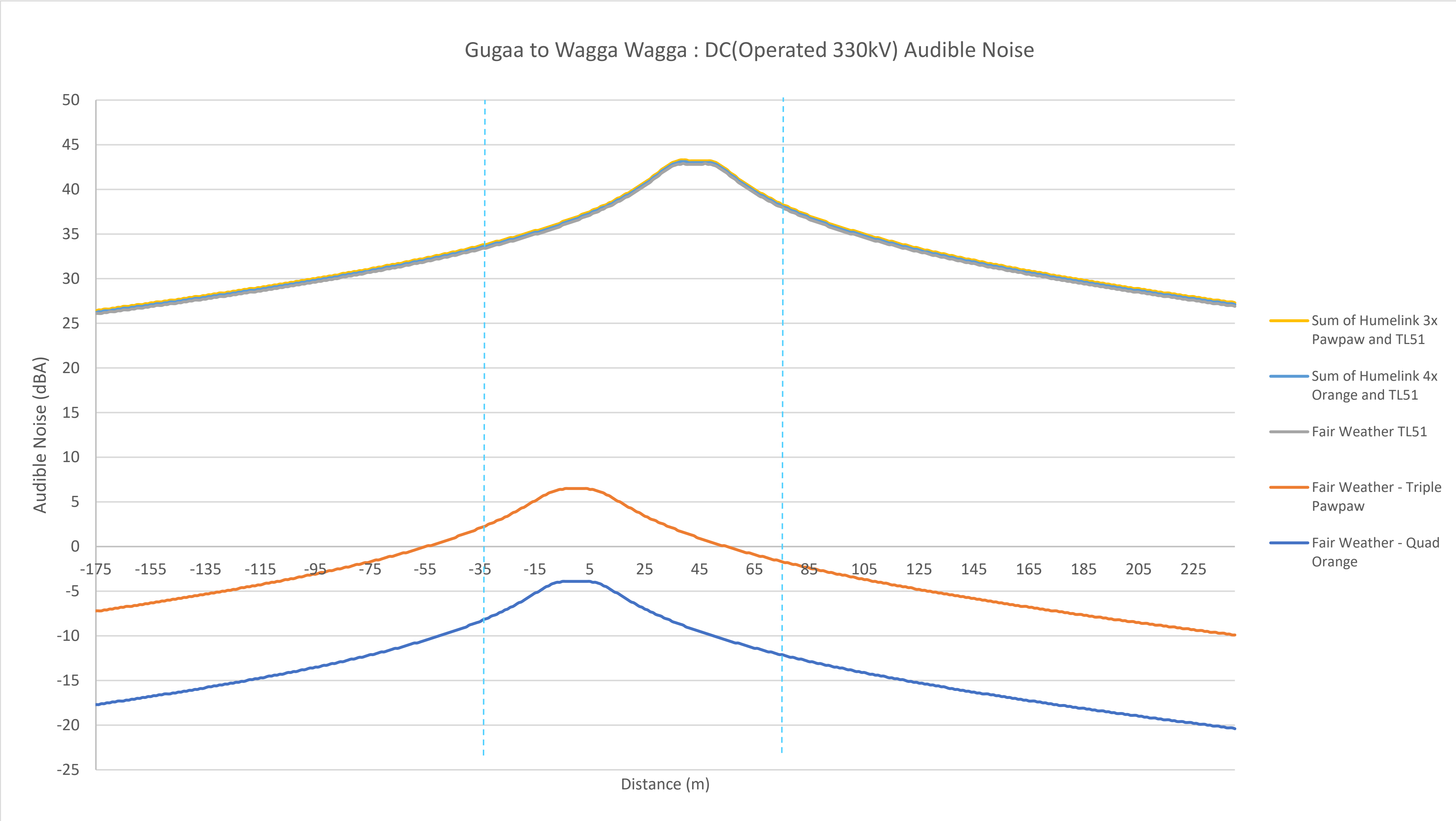


Figure 3-19: Accumulative Noise: Gugaa to Wagga Wagga DC – TL51 DC

When in future the line is uprated to 500 kV, the accumulative noise will become similar to the outcome for the Wondalga to Gugaa section interacting with line 51, as shown in Figure 3-14 above.

3.5.4 Accumulative Audible noise summary

The following table is a summary of the expected accumulative noise at the edge of the easement with the EPRI method.

Table 3-3: **Summary of Accumulative Audible Noise at the edge of the easement**

Audible Noise at edge of easement	Fair Weather	L50 Rain	Heavy Rain	Distance from the centre line to achieve 35 dB(A) (Fair Weather)	Distance from the centre line to achieve 35 dB(A) (L50 Rain)	Distance from the centre line to achieve 35 dB(A) (L5 Rain)	Distance from the centre line to achieve 52.5 dB(A) (L50 Rain)	Distance from the centre line to achieve 52.5 dB(A) (Heavy Rain)
QUAD ORANGE								
Route 1: Maragle to Wondalga DC 4 x Orange TL03, 51 & 66	40.8, 41.3dBA	51.8, 50.3dBA	57.6, 57.7dBA	136.5 m, 128 m	392 m, 362 m	608 m, 598 m	28 m, 18 m	100 m, 90 m
Route 1: Maragle to Wondalga DC 4 x Orange TL64	42.2, 45.1dBA	52.6, 53.8dBA	58.7, 61.3dBA	200 m, 223 m	440 m, 442 m	682 m, 700 m	34 m, 40 m	130 m, 148 m
Route 2: Wondalga to Gugaa DC 4 x Orange TL51	40.2, 41.1dBA	50.4, 48.3dBA	56.0, 55.5dBA	120 m, 118m	348 m, 316 m	550 m, 536 m	18 m, 10 m	76 m, 66 m
Route 3: Wondalga to Bannaby DC 4 x Orange TL03, 51 & 61	40.5, 41.2dBA	51.1, 49.5dBA	56.7, 56.8dBA	129 m, 124m	372 m, 337 m	576 m, 563 m	24 m, 13 m	86 m, 75 m
Route 3: Wondalga to Bannaby DC 4 x Orange TL5A6 & 5A7	41.2, 43.0dBA	52.4, 54.0dBA	57.5, 58.7dBA	170 m, 180 m	450 m 470 m	630 m 644 m	34 m 48 m	104 m, 118 m
Route 4A: Gugaa to Wagga Wagga DC 4 x Orange TL 51 SC	30.7, 37.4dBA	38.6, 45.3dBA	46.9, 53.5dBA	0 m, 17 m	101 m, 164 m	326 m, 387 m	0 m, 0 m	0 m, 36 m
Route 4B: Gugaa to Wagga Wagga DC 4 x Orange TL 51 DC	33.4, 38.3dBA	42.0, 47.0dBA	51.0, 55.8dBA	16 m, 59 m	172 m, 215 m	440 m, 482 m	0 m, 0 m	17 m, 59 m
TRIPLE PAWPAW								
Route 1: Maragle to Wondalga DC 3 x Pawpaw TL03, 51 & 66	45.9, 43.6dBA	55.1, 52.1dBA	59.5, 58.3dBA	214 m, 238 m	498 m, 451 m	670 m, 643 m	60 m, 25 m	132 m, 107 m
Route 1: Maragle to Wondalga DC 3 x Pawpaw TL64	46.9, 47.9dBA	55.4, 54.5dBA	60.2, 61.5dBA	238 m, 292 m	525 m, 500 m	724 m, 726 m	67 m, 49 m	157 m, 162 m
Route 2: Wondalga to Gugaa DC 3 x Pawpaw TL51	45.0, 42.9dBA	53.8, 50.6dBA	58.0, 56.8dBA	182 m, 206 m	450 m, 401 m	612 m, 581m	46 m, 15 m	104 m, 79 m
Route 3: Wondalga to Bannaby DC 3 x Pawpaw TL03, 51 & 61	45.5, 43.7dBA	54.5, 51.3dBA	58.7, 57.5dBA	200 m, 222 m	476 m, 427 m	638 m, 609 m	24 m, 52 m	91 m, 116 m
Route 3: Wondalga to Bannaby DC 3 x Pawpaw TL5A6 & 5A7	45.0, 44.5dBA	55.1, 54.6dBA	59.2, 59.1dBA	218 m, 270 m	451 m, 522 m	611 m, 678 m	62 m, 58 m	132 m, 130 m

Audible Noise at edge of easement	Fair Weather	L50 Rain	Heavy Rain	Distance from the centre line to achieve 35 dB(A) (Fair Weather)	Distance from the centre line to achieve 35 dB(A) (L50 Rain)	Distance from the centre line to achieve 35 dB(A) (L5 Rain)	Distance from the centre line to achieve 52.5 dB(A) (L50 Rain)	Distance from the centre line to achieve 52.5 dB(A) (Heavy Rain)
Route 4A: Gugaa to Wagga Wagga DC 3 x Pawpaw TL 51 SC	30.8, 37.4 dBA	45.3, 38.7 dBA	53.5, 47.1 dBA	0 m, 47 m	102 m, 165 m	329 m, 389 m	0 m, 0 m	0 m, 37 m
Route 4B: Gugaa to Wagga Wagga DC 3 x Pawpaw TL 51 DC	32.8, 37.7 dBA	41.7, 46.5 dBA	50.6, 55.4 dBA	9 m, 52 m	160 m, 202 m	425 m, 467 m	0 m, 0 m	13 m, 55 m

From the above results can be seen that the new HumeLink 500 kV lines with quad Orange conductor have lower noise levels than the existing 330 kV lines. This is mainly due to the quad bundle and tower geometry. Accumulative noise is not significant but is evaluated in more detail at specific sensitive receivers along the route in the table above.

The 500 kV line operated at 330 kV contributes negligible noise in combination with nearby 330 kV line 51. In future when it is operated at 500 kV as part of the proposed VNI project, the accumulative noise is expected to be similar to other combinations of 500 kV double circuit alongside 330 kV lines.

3.6 Surface gradient voltage

The following table is a summary of the maximum surface gradient voltages calculated using CDEGS as part of the noise simulation.

Table 3-4: Summary of maximum surface gradient voltages

Line	Voltage	Conductor	Bundle	Surface Gradient Voltage
HumeLink DC VSE	540 kV	Orange	4x	16.4 kV/cm
HumeLink DC VSE	540 kV	Pawpaw	3x	17.5 kV/cm
HumeLink DC VSE	354 kV	Orange	4x	10.7 kV/cm
HumeLink DC VSE	354 kV	Pawpaw	3x	11.4 kV/cm
HumeLink DC VSL	540 kV	Orange	4x	16.0 kV/cm
HumeLink DC VSL	540 kV	Pawpaw	3x	17.1 kV/cm
TL3, TL51, TL61 &TL 66 SC	354 kV	Bison	2x	17.2 kV/cm
TL64 SC	354 kV	Jarrah	1x	15.8 kV/cm
5A7/5A6 DC	540 kV	Orange	4x	17.1 kV/cm
TL51 DC	354 kV	Olive	2x	15.8 kV/cm

The surface gradient voltage recommendation from AS/NZS 7000:2016 is 16.0 kV/cm. For 500 kV operation, this is met with quad Orange for the VSL tower and slightly exceeded with the VSE tower. With triple Pawpaw it is exceeded by at least 1 kV/cm. Various parameters influence the surface gradient voltage, the main parameters are number of sub conductors, sub conductor diameter and bundle spacing. These parameters have been considered in the Humelink Preliminary Conductor Selection and Structure Selection report TL-799007. Higher surface gradient voltage causes higher corona losses and higher noise levels. While the recommended 16.0 kV/cm limit is exceeded, we note that the calculated corona inception voltage of each the above conductors is not exceeded, which indicates that problems with corona (such as noise levels and losses) are not expected.

For the 500 kV line operating at 330 kV, surface voltage gradient is very low, which is consistent with the low audible noise findings in the modelling discussed above.

3.7 Corona Losses

Different methods for fair weather and rain exists. From the EPRI applets the following summary of corona losses can be obtained. Corona losses are typically limited to 1% of the line capacity.

Table 3-5: Summary of Corona Loss for the VSE tower at 935m

	Fair Weather Corona Loss		Heavy Rain Corona Loss				
Bundle	**EdF(W/m)**	**BPA(W/m)**	**EdF(W/m)**	**BPA(W/m)**	**IREQ(W/m)**	**EPRI(W/m)**	**Project EHV (W/m)**
1A	0.2 to 3.3	0.2	36.8	25.7	20.7	41.4	24.2
1B	0.1 to 2.0	0.1	26.7	18.5	14.7	30.1	18.8
1C	0.1 to 2.4	0.1	30.7	21.3	17.0	34.5	20.9
2C	0.1 to 2.4	0.1	30.7	21.3	17.0	34.5	20.9
2B	0.1 to 2.0	0.1	26.7	18.5	14.7	30.1	18.8
2A	0.2 to 3.3	0.2	36.8	25.7	20.7	41.4	24.2
Total	**0.8 to 15.4**	**0.9**	**188.4**	**131.1**	**104.7**	**211.9**	**127.6**

Table 3-6: Summary of Corona Loss for the VSL tower at 1250m

	Fair Weather Corona Loss		Heavy Rain Corona Loss				
Bundle	**EdF(W/m)**	**BPA(W/m)**	**EdF(W/m)**	**BPA(W/m)**	**IREQ(W/m)**	**EPRI(W/m)**	**Project EHV (W/m)**
1A	0.2 to 4.6	0.2	43.2	30.1	24.1	48.6	22.6
1B	0.1 to 3.5	0.2	36.1	25.1	19.9	40.7	19.7
1C	0.2 to 3.4	0.2	35.4	24.6	19.5	39.9	19.3
2C	0.2 to 3.4	0.2	35.4	24.6	19.5	39.9	19.3
2B	0.1 to 3.5	0.2	36.1	25.1	19.9	40.7	19.7
2A	0.2 to 4.6	0.2	43.2	30.1	24.1	48.6	22.6
Total	**0.9 to 23.2**	**1.0**	**229.5**	**159.5**	**127.0**	**258.2**	**123.3**

The longest section of line is 235 km, one circuit is rated for a maximum of 3,239 MVA.

If we use the VSL tower and EPRI as worst case 258.2 W/m divided by two for one circuit is 129.1 W/m.

- 129.1 x 235,000 = 30,338,500 W/m, 0.93% of 3,239 MVA.

This is lower than 1% of 3,239 MVA.

From the above it can be seen that corona losses under worst case will be less than 1% of the capacity of the line.

3.8 Risks

According to EPRI research, additional noise of up to 8 dB [4], can be expected post energization due to the following reasons

- Oil on the new conductor surface due to the manufacturing process creates a hydrophobic surface. Small beads of water form all over a hydrophobic surface.
- Significant 100 Hz hum due to the water beads.
- Dust, insects, etc accumulate on the surface of new conductors after installation and before energization.
- Aluminium burrs due to the manufacturing and installation process.

Noise levels should reduce with time and normalize after approximately 1 year.

4 Radio Interference

Electromagnetic interference (EMI) from overhead power lines can be classified as follows:

- Corona, from
  - Conductors
  - Insulators and hardware.
- Gap discharges, from
  - Loose or floating hardware
  - Dissimilar dielectrics
  - Insulator dry-band arcing.
- Passive interference, including
  - Reradiation of broadcast signals
  - Ghosting
  - Blocking.

Radio Interference will decrease as the distance from the source increases. Receivers outside the easement might experience interference if the current signal to noise ratio at the receiver is low. If the easement is between the sender and receiver any additional noise introduced by the overhead line might increase the signal to noise level above an acceptable level.

4.1 Method selection

In the project Preliminary Conductor Selection and Structure Report (refer Table 1-1), the CIGRE method was used to calculate Radio Interference. The CIGRE method produced good average results amongst other methods available.

In this study various methods were compared by comparing the difference in calculated value and actual measured value. The data was obtained from the IEEE ‘Comparison of several methods for calculating power line electromagnetic interference levels and calibration with long term data’ document. The table below represents the difference in dB/μV/m.

[44] EPRI Red Book 3rd Edition:10-22

Table 4-1: Difference between calculated and measured values in dB/µV/m

L #	Measured	EdF	EdF (n=1)	HVRAIN	WETCON	IREQ	IREQ (n=1)	CIGRE	BPA
1	74	74.0	79.0	79.3	70.7	74.4	80.4	71.7	72.8
2	73	74.1	74.1	71.4	64.2	73.0	73.0	66.6	65.6
3	66	61.5	65.6	64.9	56.3	61.6	65.6	57.0	59.0
4	73	74.4	80.3	76.5	69.6	71.7	77.7	70.7	72.1
5	58	55.0	61.5	62.1	50.8	56.1	61.9	53.6	55.1
6	70.5	74.1	80.3	73.6	68.5	70.0	76.0	73.2	72.6
7	74	77.3	81.1	76.3	70.2	74.0	78.0	72.0	72.4
8	68	70.2	70.5	69.1	64.1	71.5	71.6	70.4	65.1
9	68	69.1	75.3	69.7	63.9	65.5	71.5	66.9	67.3
RMS difference		2.6	5.8	3.0	5.7	2.2	4.1	4.4	3.8

Table I: Predictions of EMI using WBNOISE with different generation functions. Predictions are compared to long term average stable foul weather data. Numerical values are given in dB/ $\mu V/m$ as would be measured with a CISPR quasi-peak receiver having a horizontally oriented loop antenna. In this case, the horizontal magnetic field is converted to an "equivalent" vertical electric field by multiplying by 120π, the impedance of free space. The program also allows calculation of any rectangular component of electric or magnetic field. All ANSI measurements have been converted to CISPR by subtracting 2 dB.

From the above comparison the IREQ method is the most accurate across a wide variety of methods, in the next table the methods have been optimized and compared.

Table 4-2: Difference between calculated and measured values in dB/µV/m for optimized functions.

L #	Measured	EdF	EdF (n=1)	HVRAIN	WETCON	IREQ	IREQ (n=1)	CIGRE	BPA
1	74	73.4	74.2	77.3	75.8	75.1	76.9	74.2	75.3
2	73	73.5	69.3	69.4	69.3	73.7	69.5	69.1	68.1
3	66	60.9	60.8	62.9	61.4	62.3	62.1	59.5	61.5
4	73	73.8	75.5	74.5	74.7	72.4	74.2	73.2	74.6
5	58	54.4	56.7	60.1	55.9	56.8	58.4	56.1	57.6
6	70.5	73.5	75.5	71.6	73.6	70.7	72.5	75.7	75.1
7	74	76.7	76.3	74.3	75.3	74.7	74.5	74.5	74.9
8	68	69.6	65.7	67.1	69.2	72.2	68.1	72.9	67.6
9	68	68.5	70.5	67.7	69.0	66.2	68.0	69.4	69.8
A in eq. (8)		-.58	4.80	-2.04	5.13	.74	-3.47	2.49	2.50
RMS difference		2.6	3.2	2.2	2.6	2.1	2.2	3.6	2.9

Table II: Comparison of measured long term data to data predicted by WBNOISE with optimized generation functions. Numerical values are in dB/ $\mu V/m$ for a CISPR receiver in average stable foul weather.

The IREQ remains the most accurate method. The CIGRE method was used on other Transgrid projects and therefore it would be beneficial for comparison reasons to use both the IREQ and CIGRE methods.

4.2 Modelling

The CDEGS, SESEnviroPlus module version 16.2 was used to simulate the noise.

The following inputs were used:

- Air Resistivity: 1 x 10^{18} Ω.m
- Soil Resistivity: 100 Ω.m
- Conductor Bundle: 4 x Orange or 3 x Pawpaw
- Phase Energization: 540 kV and 354 kV(Gugaa to Wagga Wagga) at 3464 A
- Observation Profile Height: 1.8m
- Radio Noise Method: Semi-Empirical CIGRE and IREQ
- Altitude: As per Table 2-1: Weather cases for noise
- Temperature: As per Table 2-1: Weather cases for noise
- Weather: Heavy Rain (18 mm/h) and Fair Weather.

4.3 Results

4.3.1 Radio Noise (Alpine)

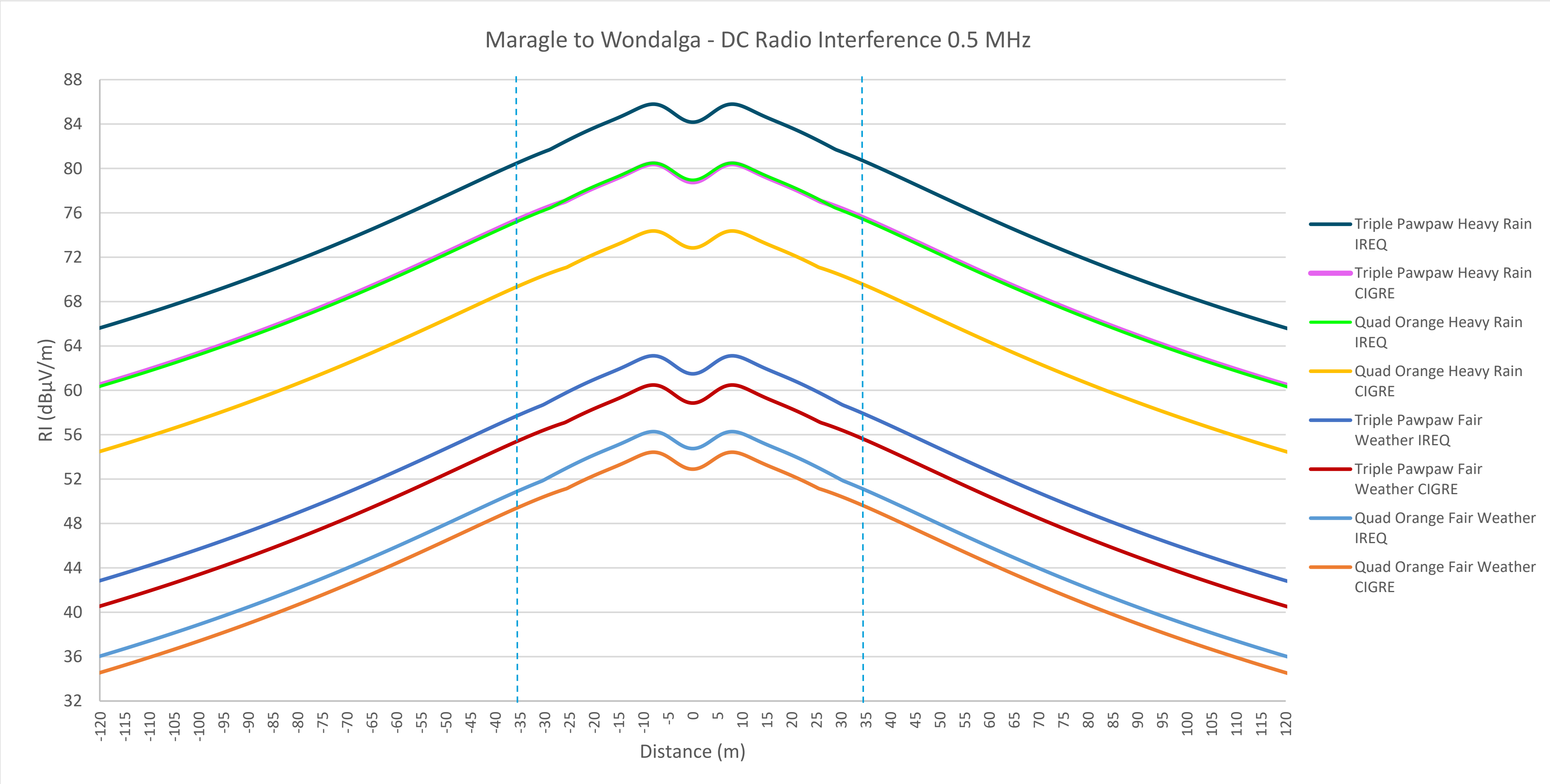


Figure 4-1: Radio Interference: Maragle to Wondalga DC

4.3.2 Radio Noise (Non-alpine)

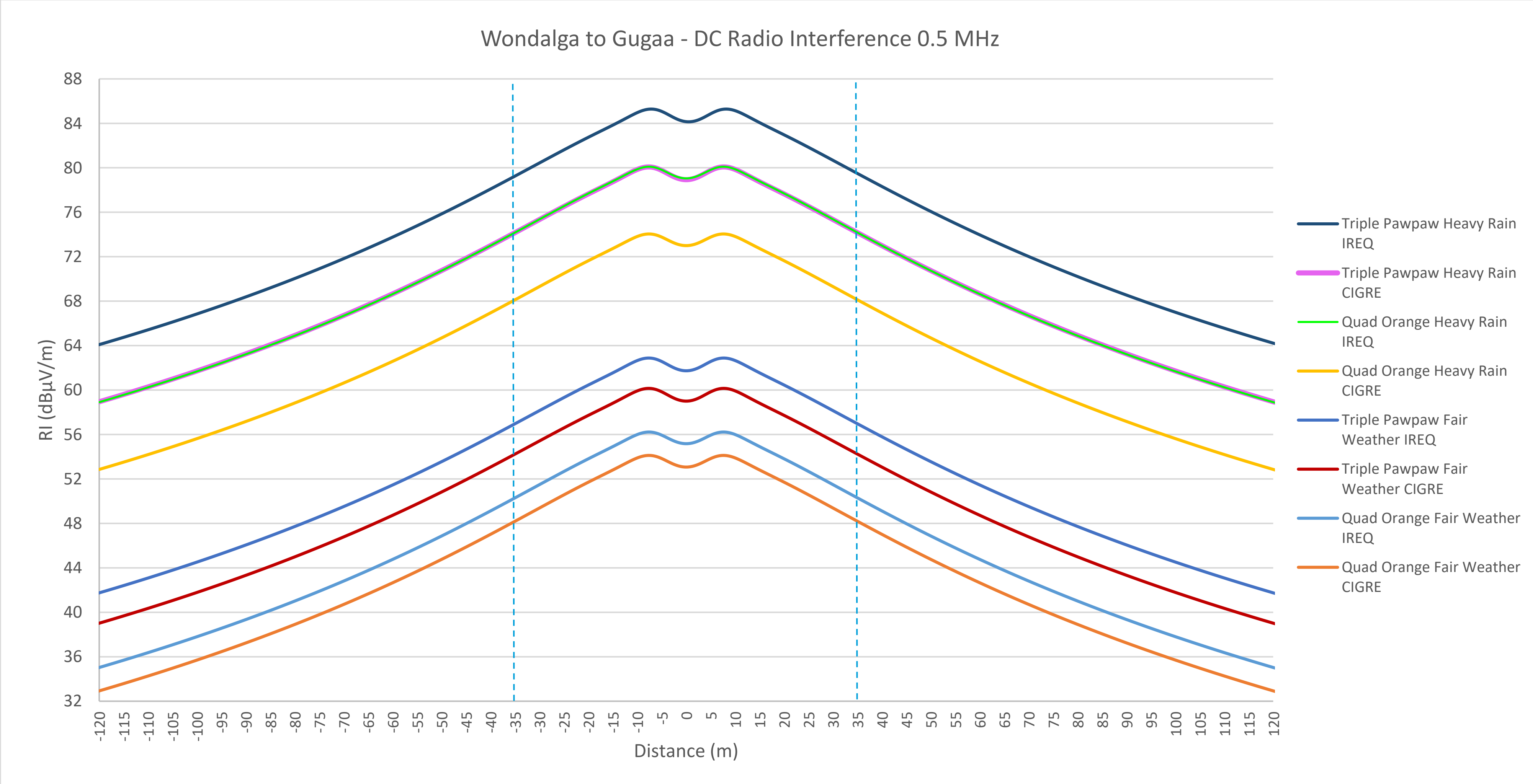


Figure 4-2: Radio Interference: Wondalga to Gugaa DC

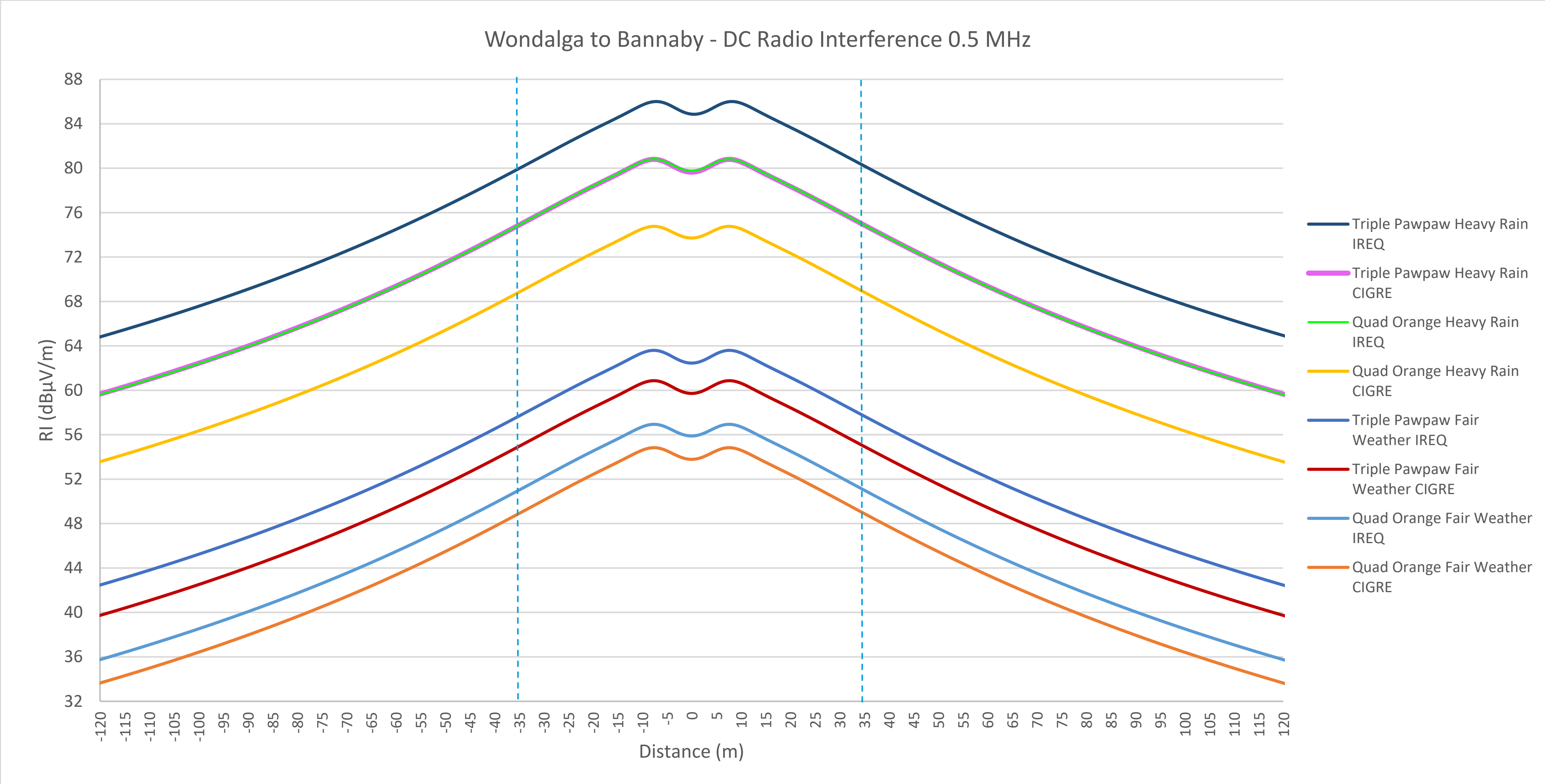


Figure 4-3: Radio Interference: Wondalga to Bannaby DC

4.3.3 Radio Noise (Gugaa to Wagga)

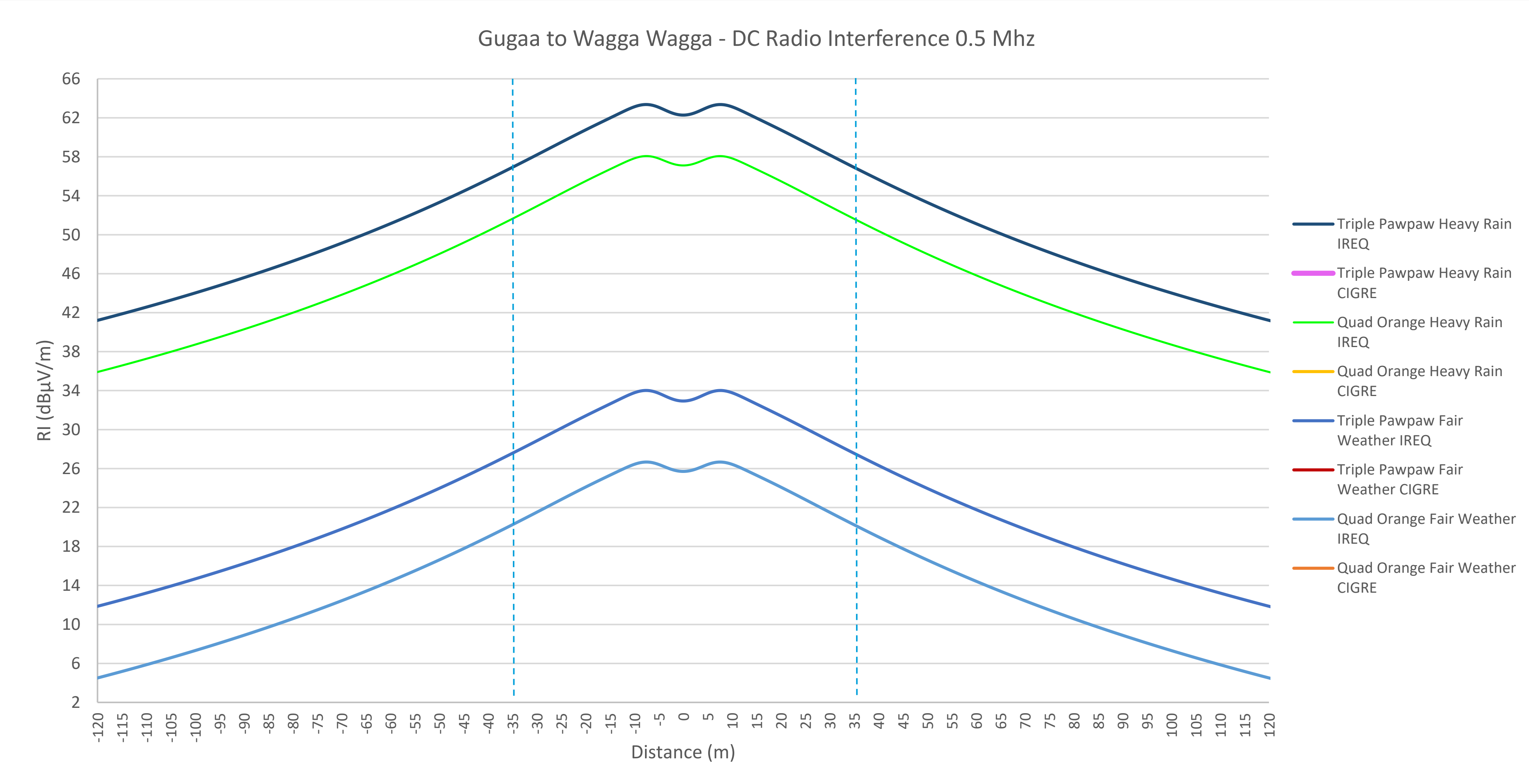


Figure 4-4: Radio Interference: Gugaa to Wagga Wagga DC

CIGRE methods are not valid for surface gradient voltage below 12 kV/cm, therefore no results are shown in the graph above.

4.3.4 Radio noise summary

Table 4-3: Summary of Radio Interference at the edge of the easement

Radio Interference at edge of easement	Fair Weather IREQ	Fair Weather CIGRE	Heavy Rain IREQ	Heavy Rain CIGRE
ALPINE				
Route 1: Maragle to Wondalga DC (4 x Orange)	51.0 dBµV/m	49.5 dBµV/m	75.3 dBµV/m	69.5 dBµV/m
Route 1: Maragle to Wondalga DC (3 x Pawpaw)	57.8 dBµV/m	55.5 dBµV/m	80.6 dBµV/m	75.5 dBµV/m
NON-ALPINE				
Route 2: Wondalga to Gugaa DC (4 x Orange)	50.3 dBµV/m	48.2 dBµV/m	74.2 dBµV/m	68.1 dBµV/m
Route 2: Wondalga to Gugaa DC (3 x Pawpaw)	57.0 dBµV/m	54.2 dBµV/m	79.4 dBµV/m	74.2 dBµV/m
Route 3: Wondalga to Bannaby DC (4 x Orange)	51.0 dBµV/m	48.9 dBµV/m	74.9 dBµV/m	68.8 dBµV/m
Route 3: Wondalga to Bannaby DC (3 x Pawpaw)	57.7 dBµV/m	54.9 dBµV/m	80.1 dBµV/m	74.9 dBµV/m
Route 4: Gugaa to Wagga Wagga DC (4 x Orange)	20.2 dBµV/m	N/A*	51.6 dBµV/m	N/A*
Route 4: Gugaa to Wagga Wagga DC (3 x Pawpaw)	27.5 dBµV/m	N/A*	56.9 dBµV/m	N/A*

**CIGRE method is not valid for surface gradient voltage below 12 kV/cm*

4.4 RI at higher frequencies

Corona can be a source of severe EMI on the AM Broadcast band, especially during foul weather. However very few complaints over the recent years have been received in this frequency band due to corona. This trend is mainly due to the popularity of the FM Broadcast band (87-108 MHz) which is not affected so much by overhead line EMI.

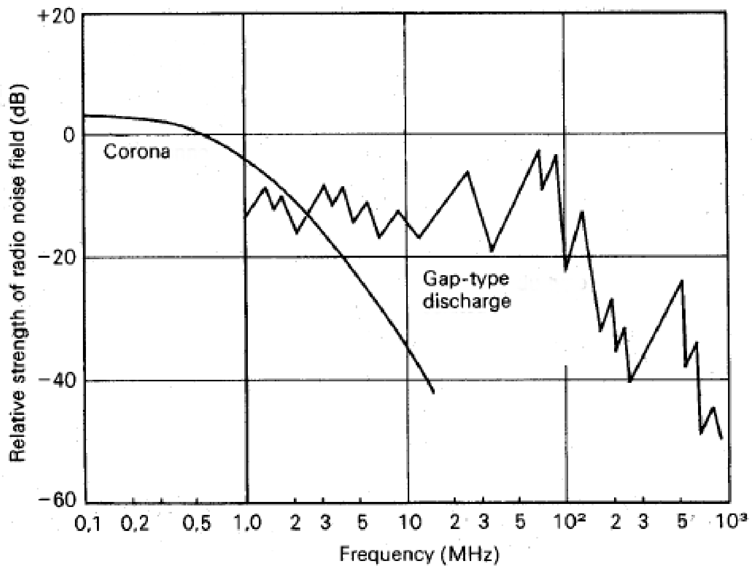


Figure 4-5: EPRI: Relative strength of corona and gap-type discharges as a function of frequency

As can be seen from the figure above, RI due to corona rapidly decreases at frequencies above 3.0 MHz.

Current methods do not support accurate predictions above 30 Mhz.

As can be seen from the figures below, AS 2344 Limits for RI increases at frequencies above 30 MHz (the limit being 23 dBuV/m at 30 MHz, 30 dBuV/m between 30 and 230 MHz, and 37 dBuV/m between 230 and

1000 MHz). Meanwhile, noise produced by the line decreases with frequency. Accordingly, frequencies above 30 MHz are not expected to present any radio interference problems.

GPS devices typically used in agricultural vehicles operates in UHF bands above 1000 MHz. Since the line noise decreases rapidly above 30 MHz this shouldn't be of any concern.

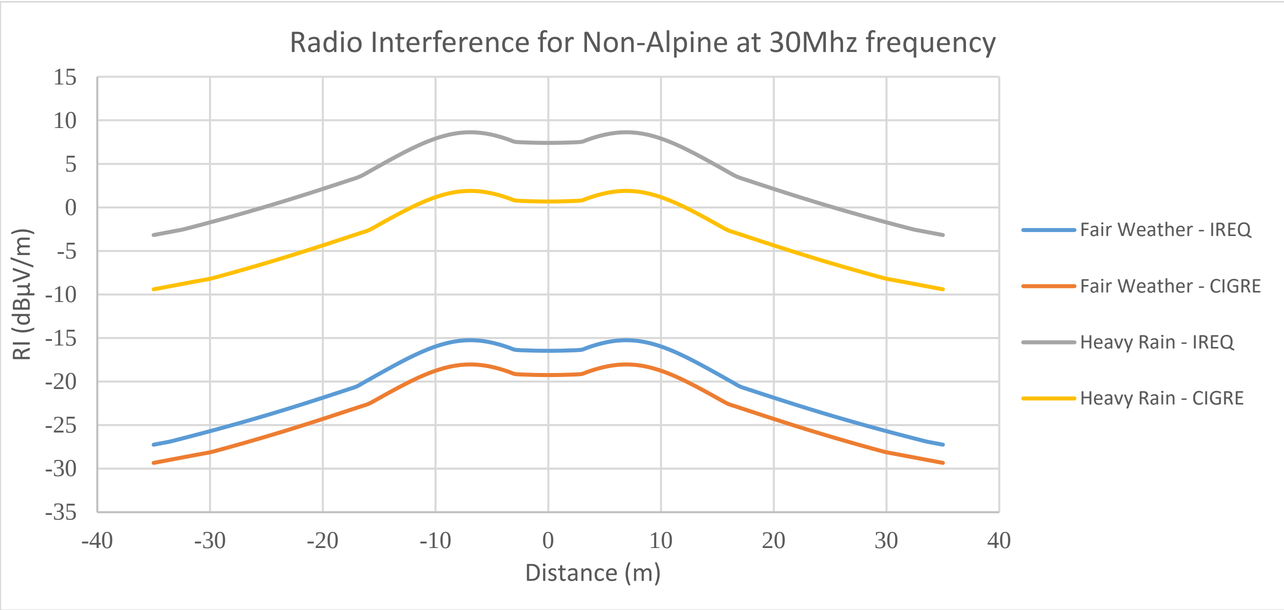


Figure 4-6: Radio Interference at 30 MHz for Typical 500 kV DC VSE HumeLink line

Gap discharge phenomenon is not expected at 500 kV, since it is caused typically by a small air gap opening up between two cap-and-pin insulators which are lightly mechanically loaded. But for our purposes, the insulator strings are always supporting considerable weight spans.

Agricultural machinery might experience interference if the radios operate in the lower band frequencies, especially inside the easement. GPS receivers operate in frequencies bands above 1000 MHz and shouldn't be affected.

4.5 Risks

According to CIGRE 22/33/36-09 research, additional noise of up to 12 dB can be expected at the edge of the easement post energization due to the following reasons:

- Oil on the new conductor surface due to the manufacturing process creates a hydrophobic surface. Small beads of water form all over a hydrophobic surface.
- Dust, insects, etc accumulate on the surface of new conductors after installation and before energization.
- Aluminium burrs due to the manufacturing and installation process.

Noise levels should reduce with time and normalize after approximately 1 year.

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F +61 2 9465 5598
E sydney@aurecongroup.com
W aurecongroup.com

ATTACHMENT F

Ambient noise monitoring results

Noise Monitoring Location	L.02
Noise Monitoring Address	**1070 Livingstone Gully Road, Gregadoo**

Logger Device Type: Svantek 957, Logger Serial No: 23245
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3005904

Ambient noise logger deployed at 1070 Livingstone Gully Road, Gregadoo. Logger located in house yard, surrounded by open terrain around 2 km south of Gregadoo E Road and 3 km west of Tumbarumba Road.

Attended noise measurements indicate the ambient noise environment at this location is influenced by road traffic noise and wildlife noise.

Recorded Noise Levels (LAmax) 03/05/2022:

Road traffic noise: 36-47 dBA
Birds: 40-68 dBA
Livestock: 40-45 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	29	52	44	54
Evening	<25	41	38	43
Night-time	<25	42	29	36

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	51	49
Night-time (10pm-7am)	42	38

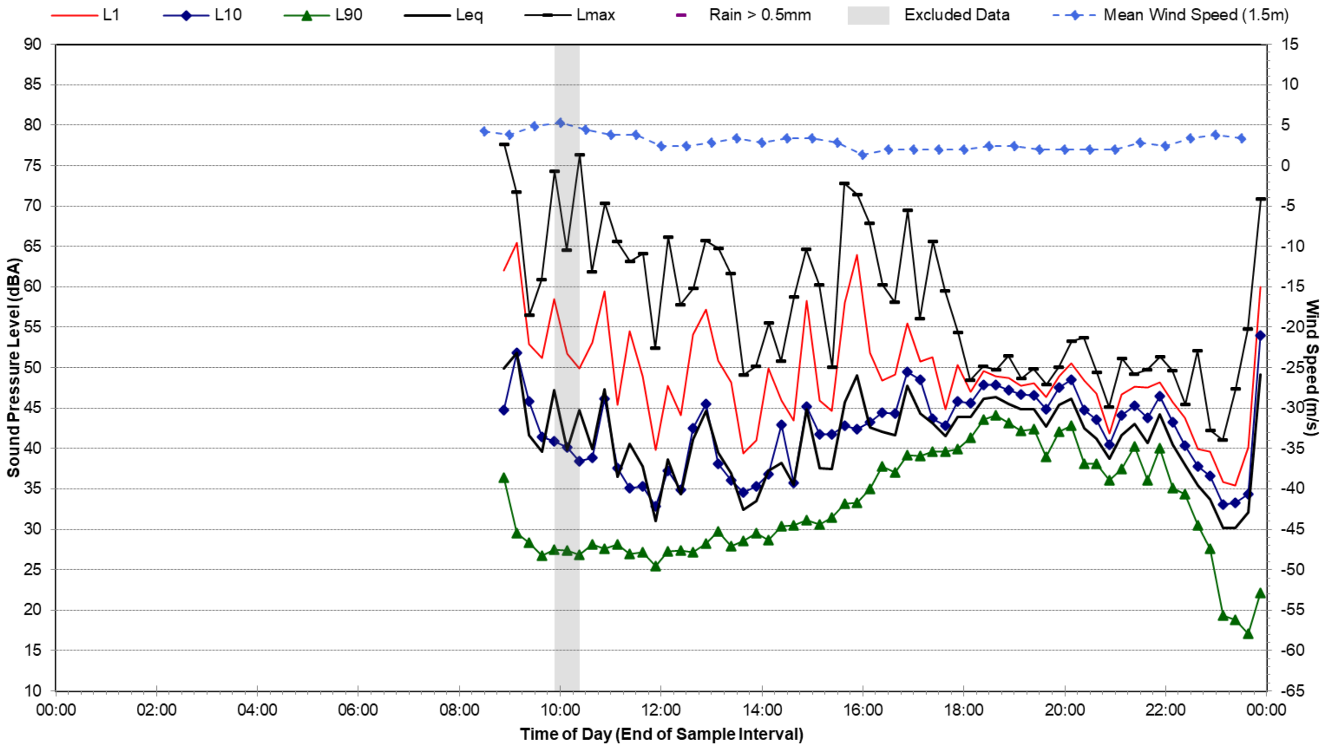
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
03/05/2022	8:38	33	50	70

Photo of Noise Monitoring Location

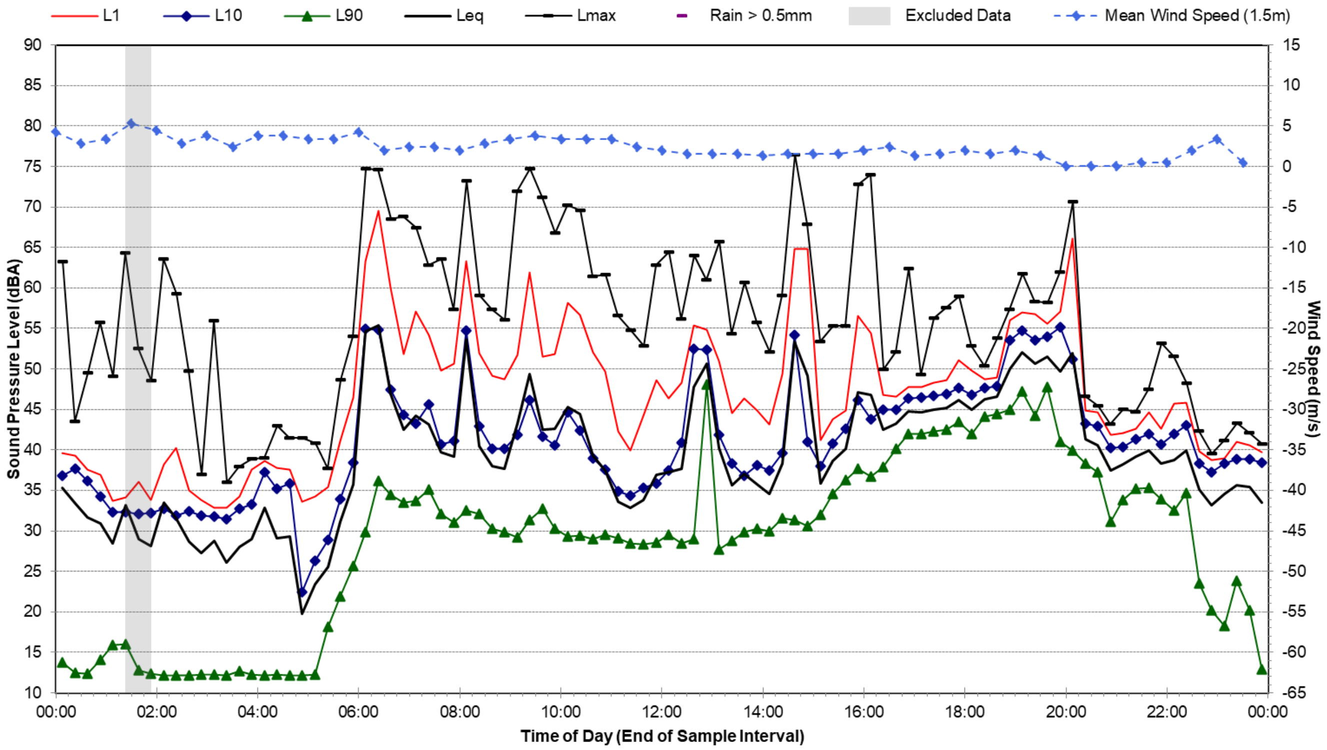
Statistical Ambient Noise Levels

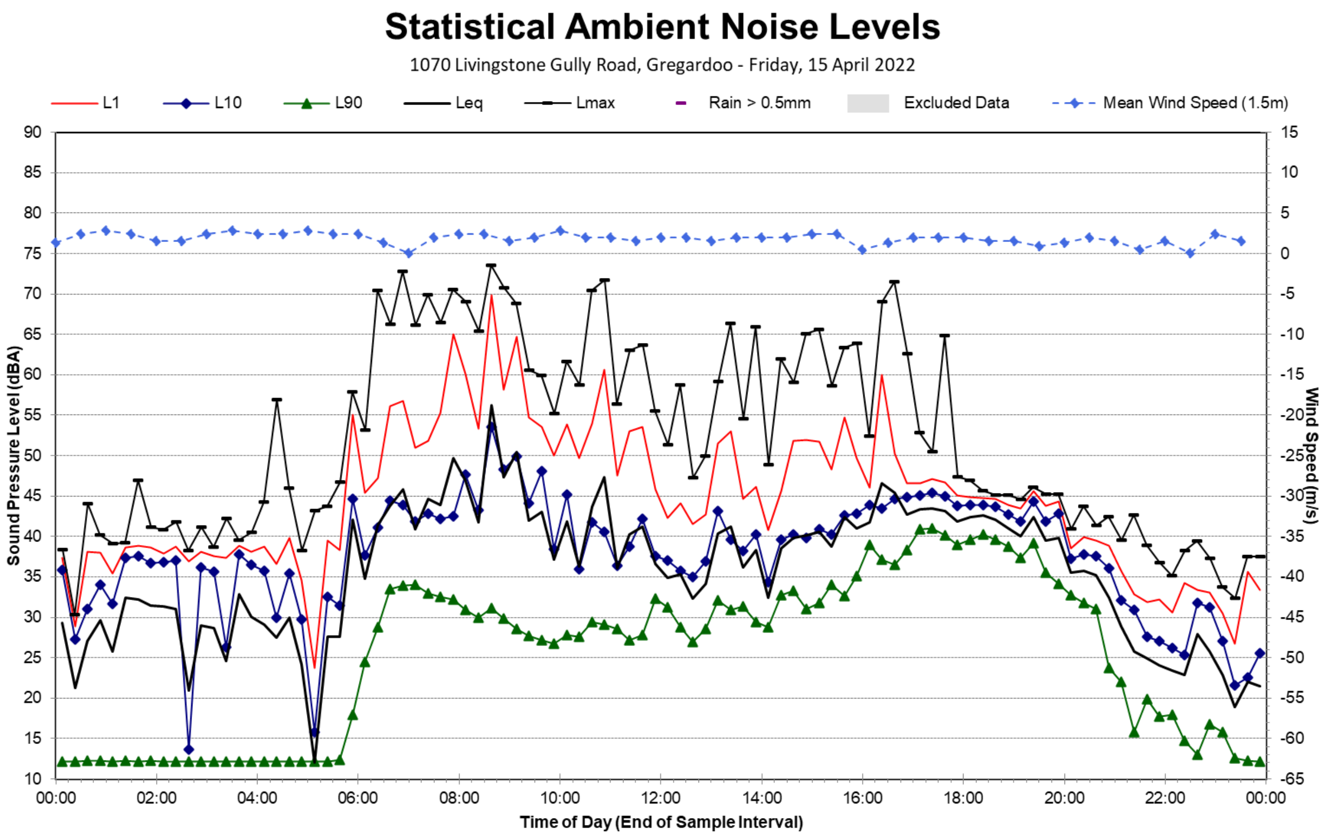
1070 Livingstone Gully Road, Gregardoo - Wednesday, 13 April 2022



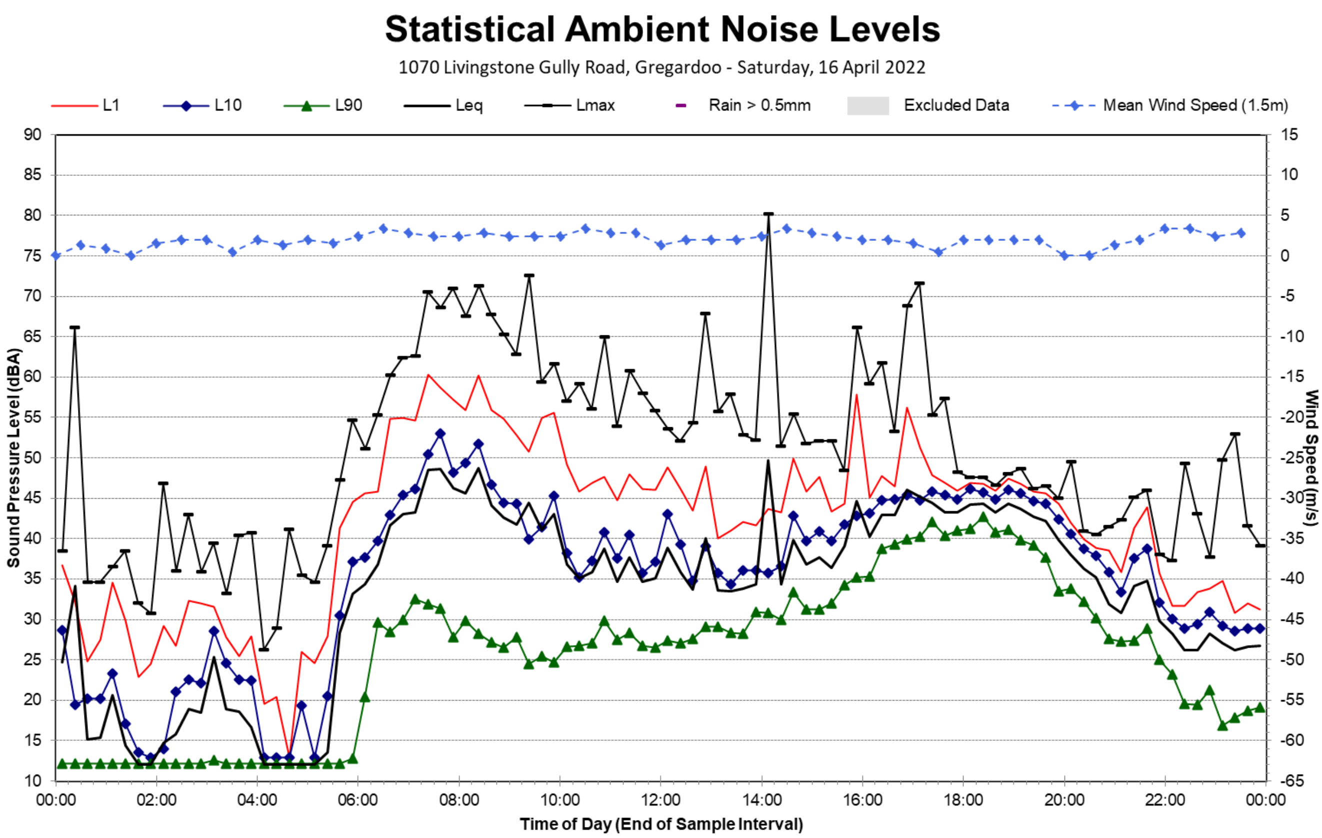
Statistical Ambient Noise Levels

1070 Livingstone Gully Road, Gregardoo - Thursday, 14 April 2022

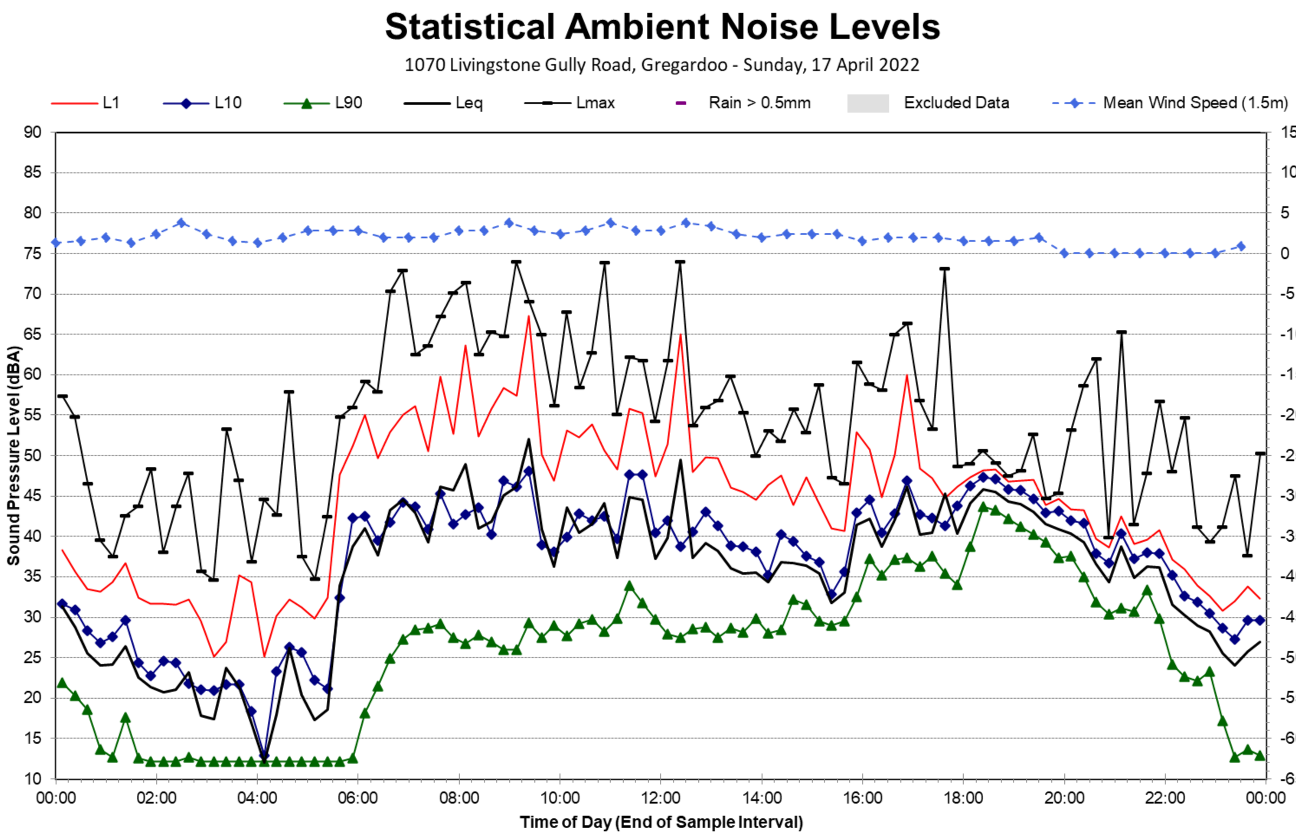


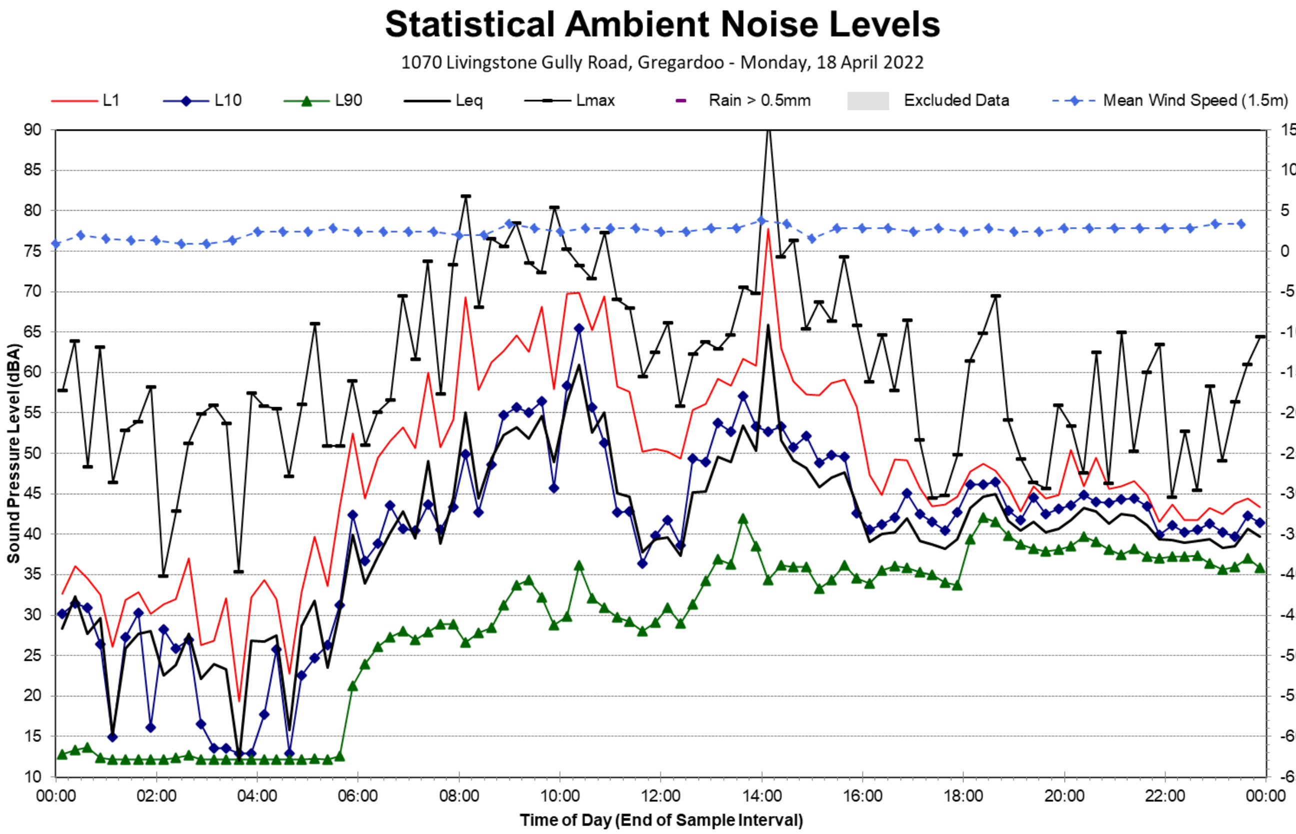


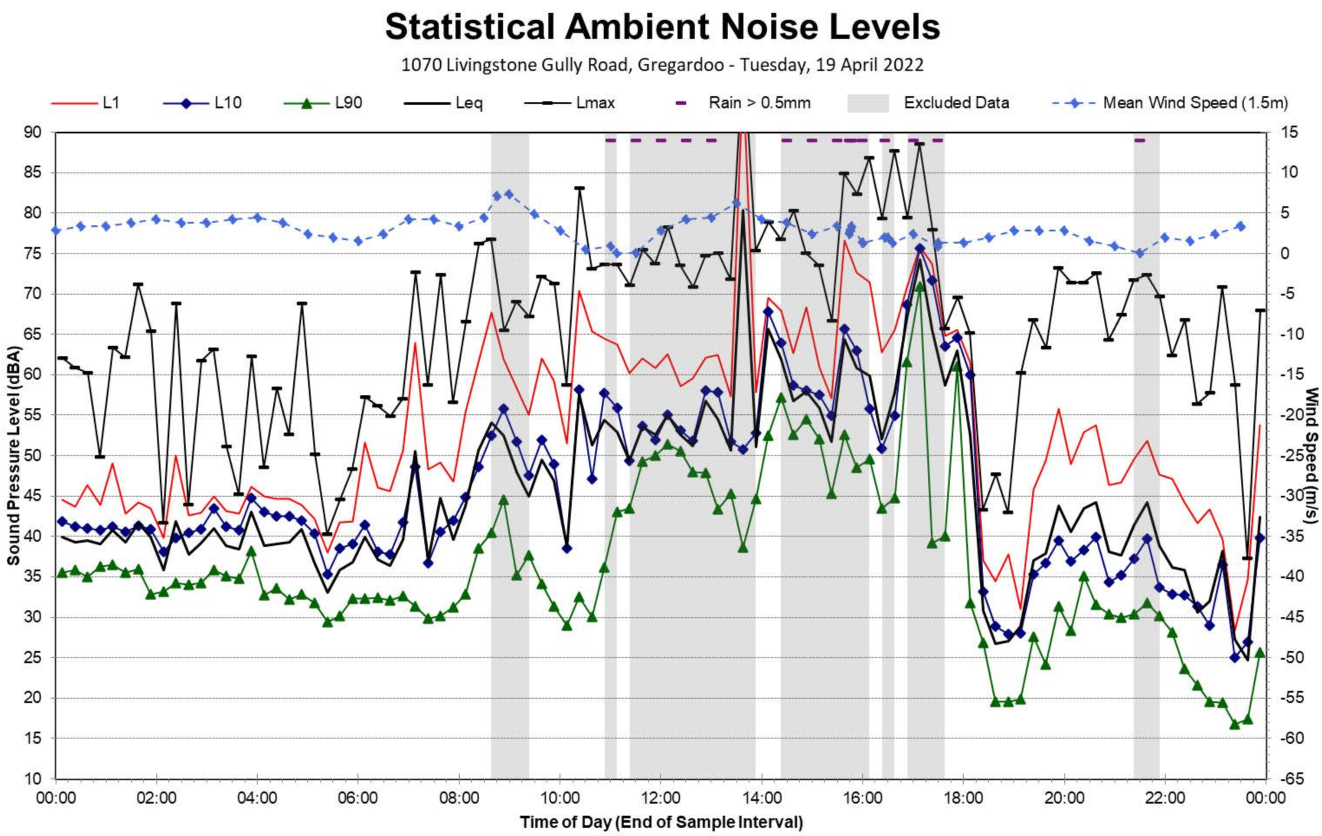
Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Friday, 15 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

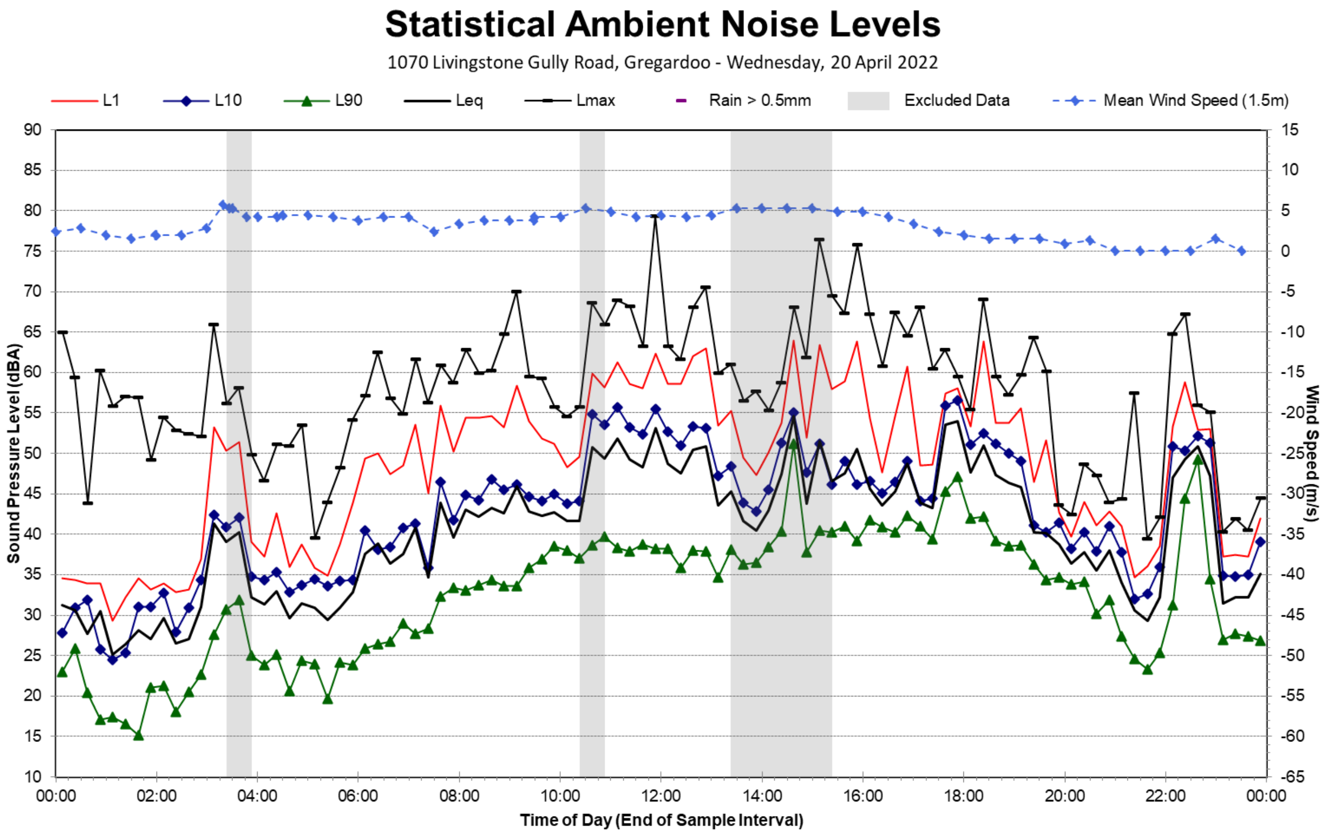


Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Saturday, 16 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Sunday, 17 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

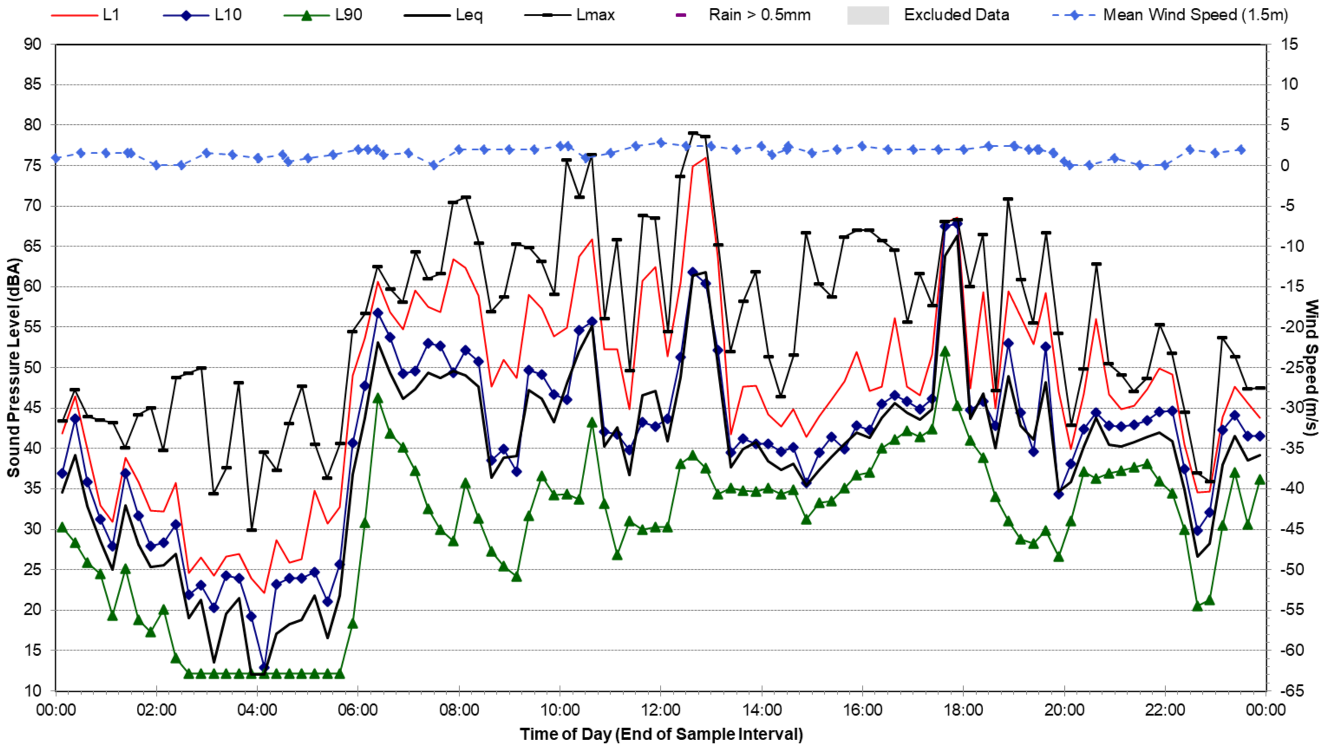

Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Monday, 18 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Tuesday, 19 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Wednesday, 20 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

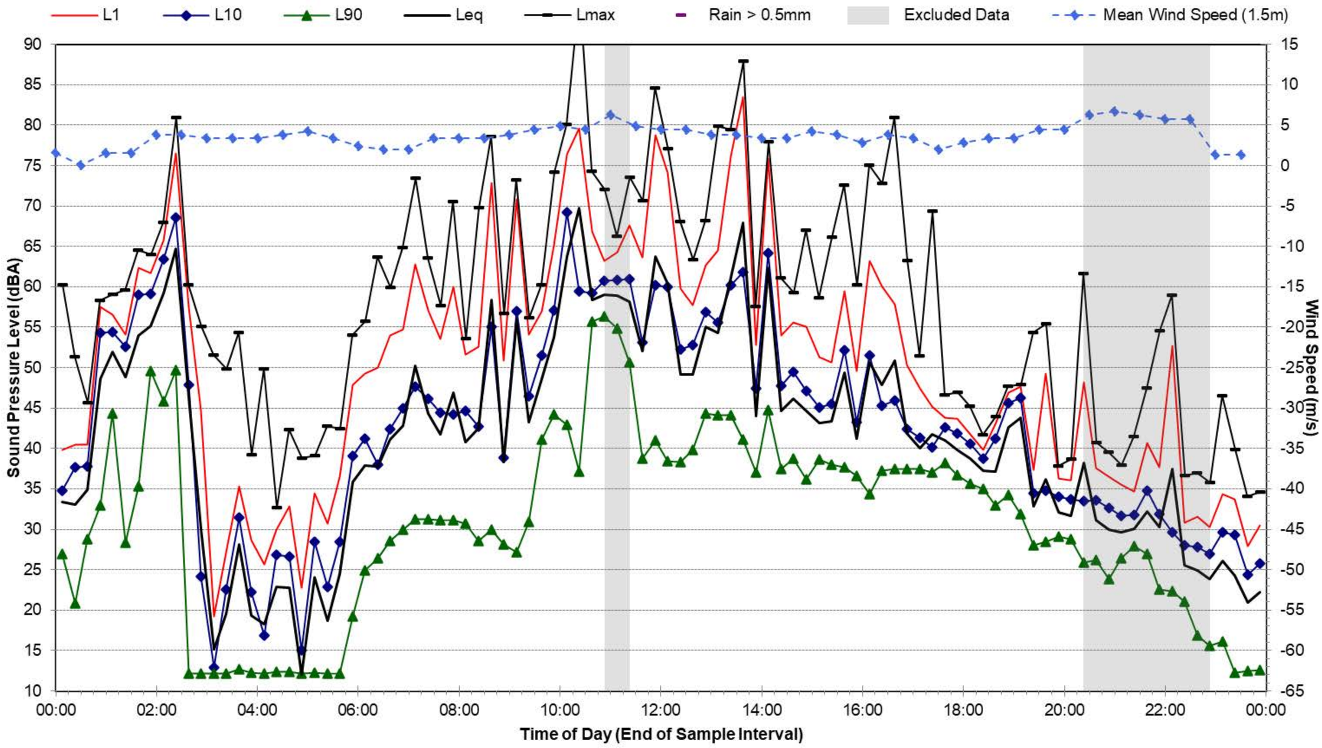
Statistical Ambient Noise Levels

1070 Livingstone Gully Road, Gregardoo - Thursday, 21 April 2022



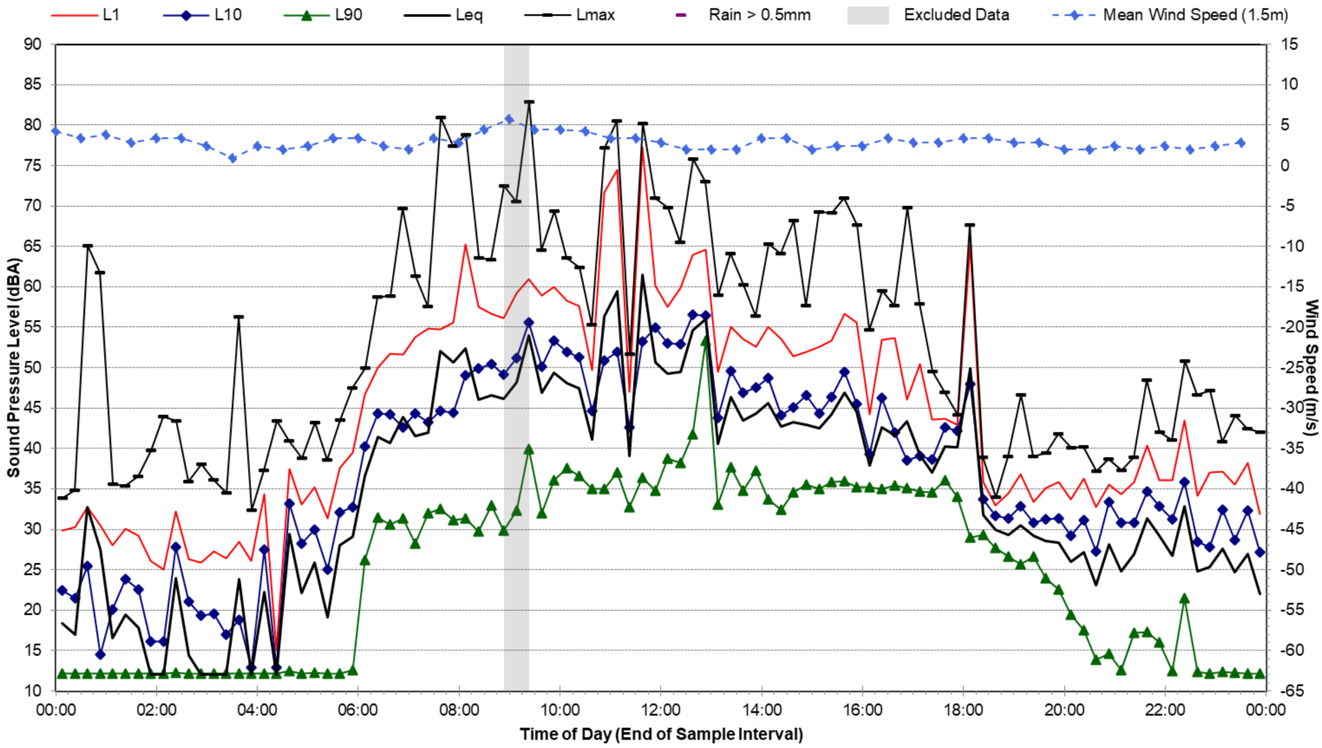
Statistical Ambient Noise Levels

1070 Livingstone Gully Road, Gregardoo - Friday, 22 April 2022



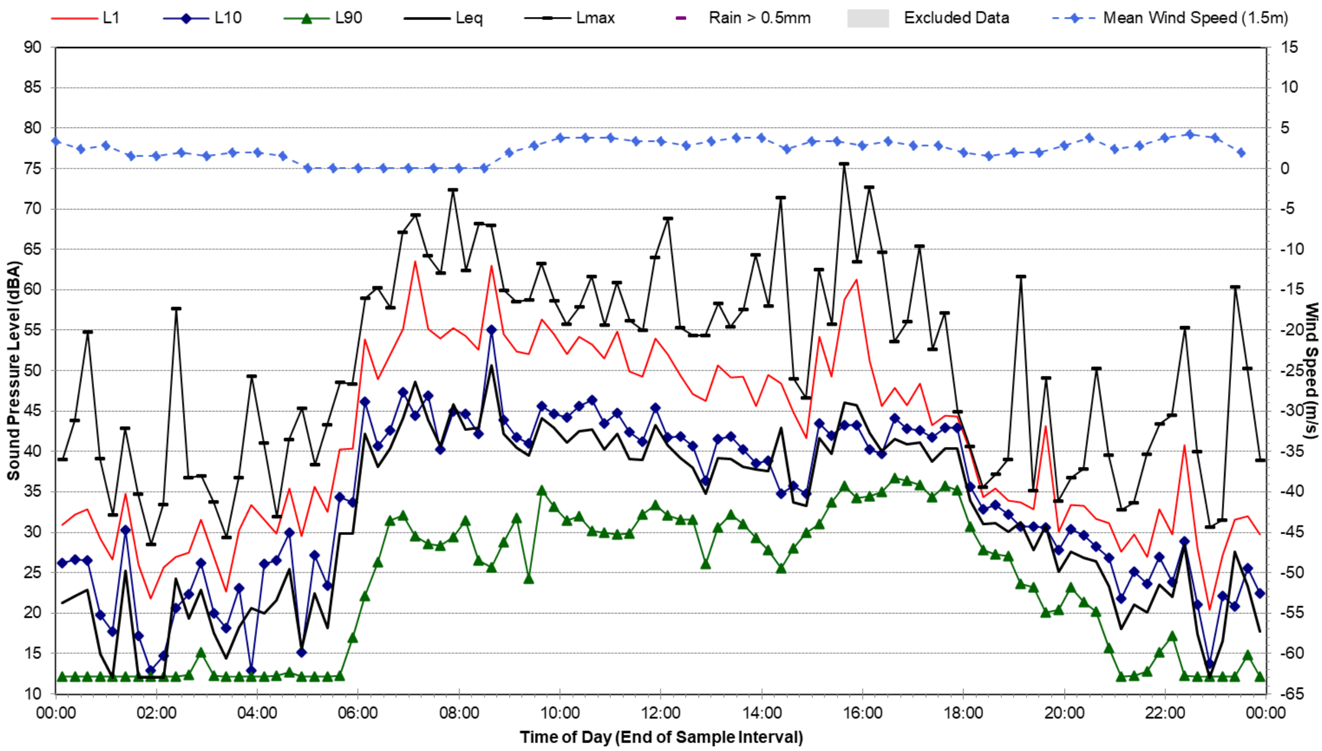
Statistical Ambient Noise Levels

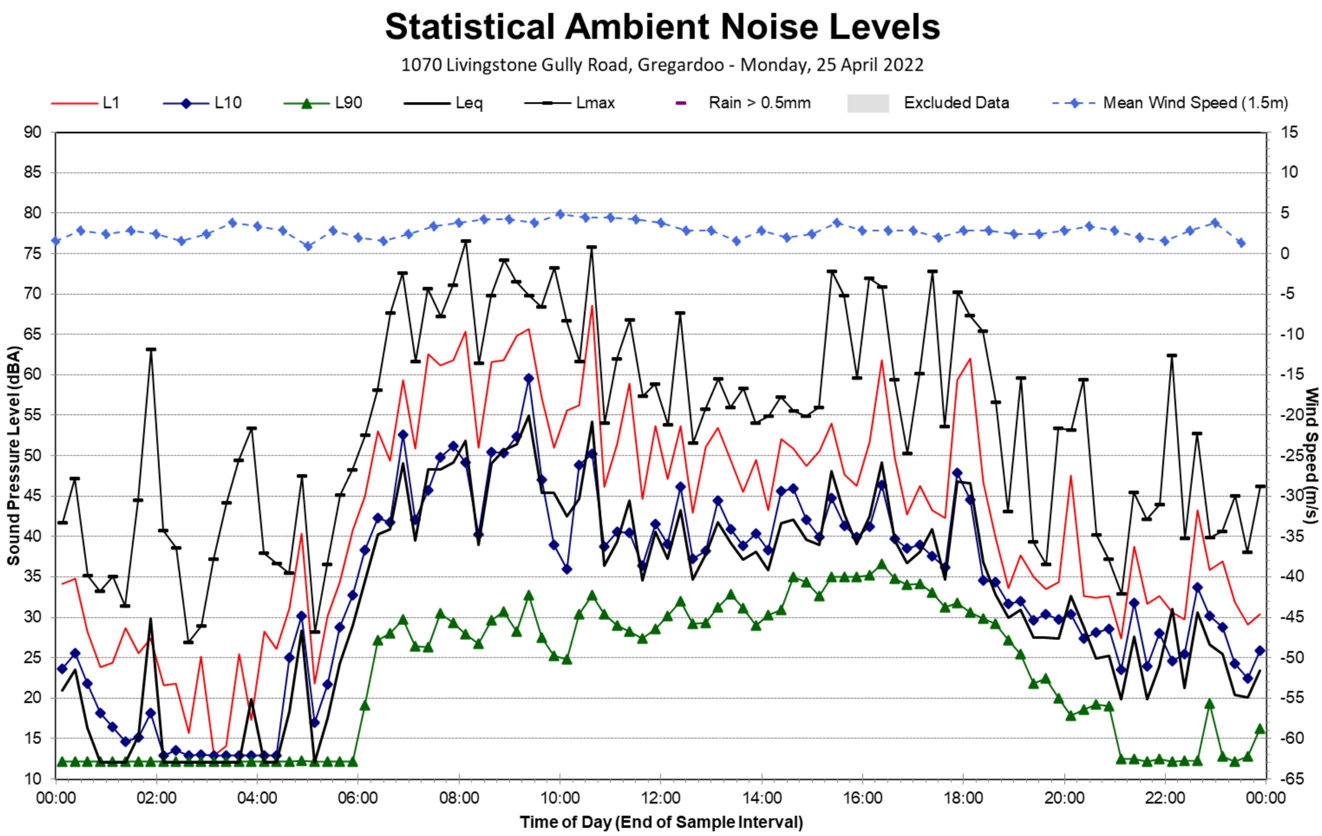
1070 Livingstone Gully Road, Gregardoo - Saturday, 23 April 2022

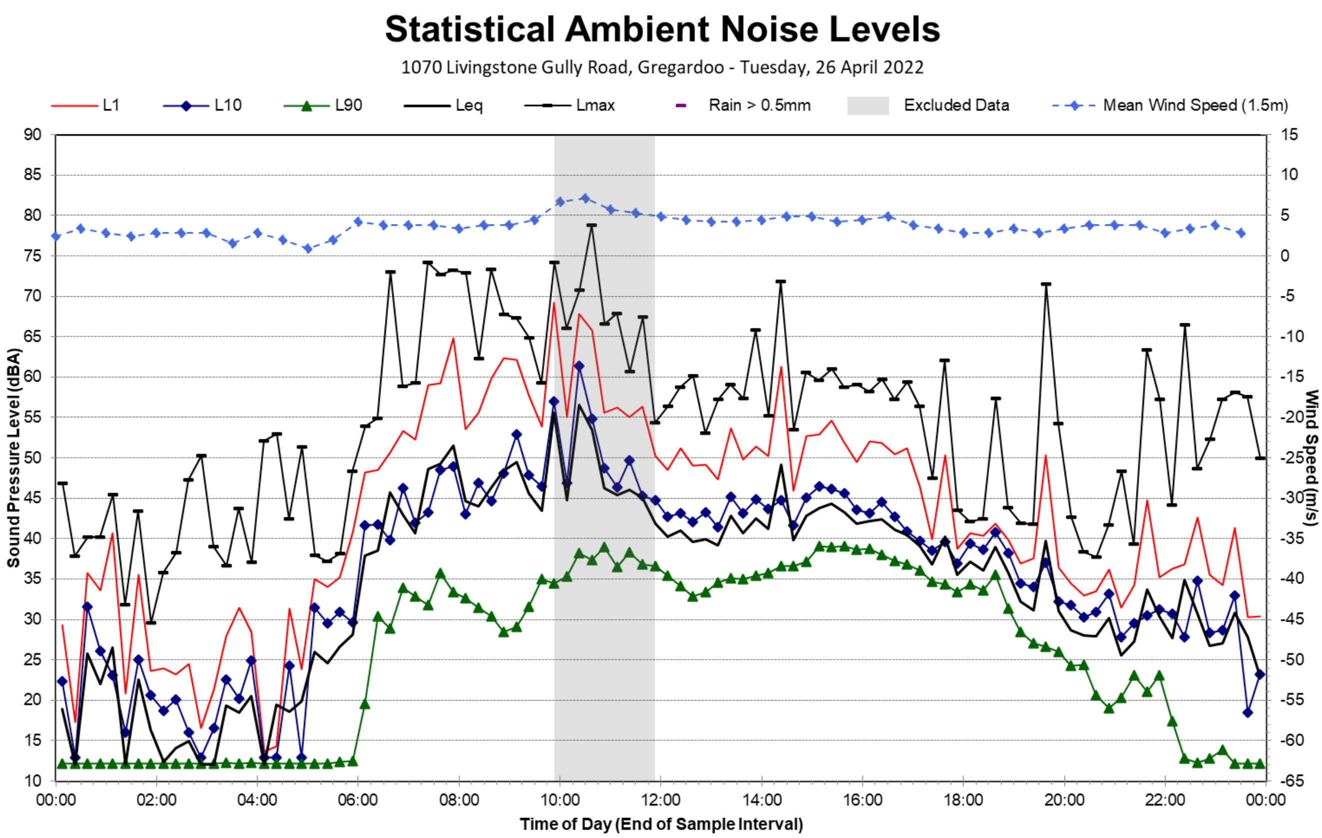


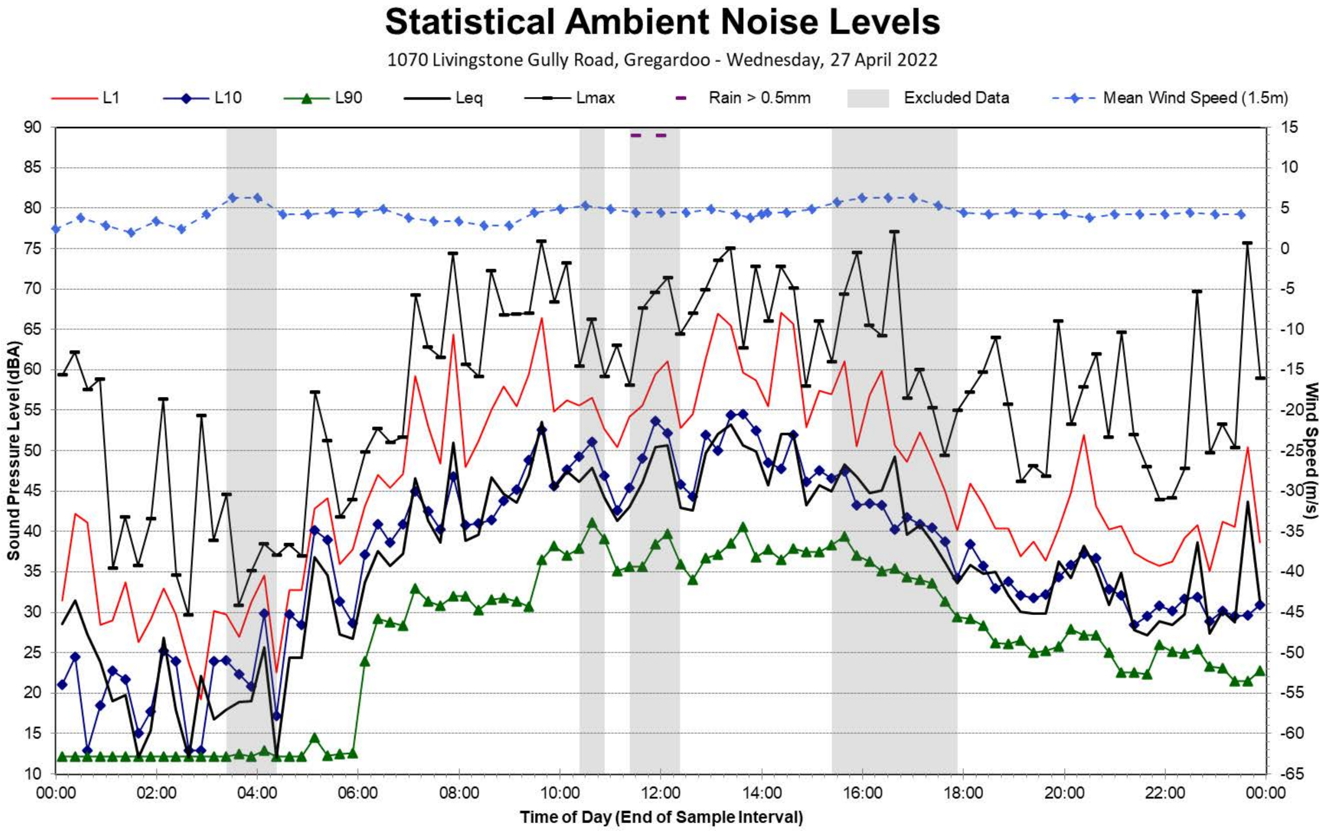
Statistical Ambient Noise Levels

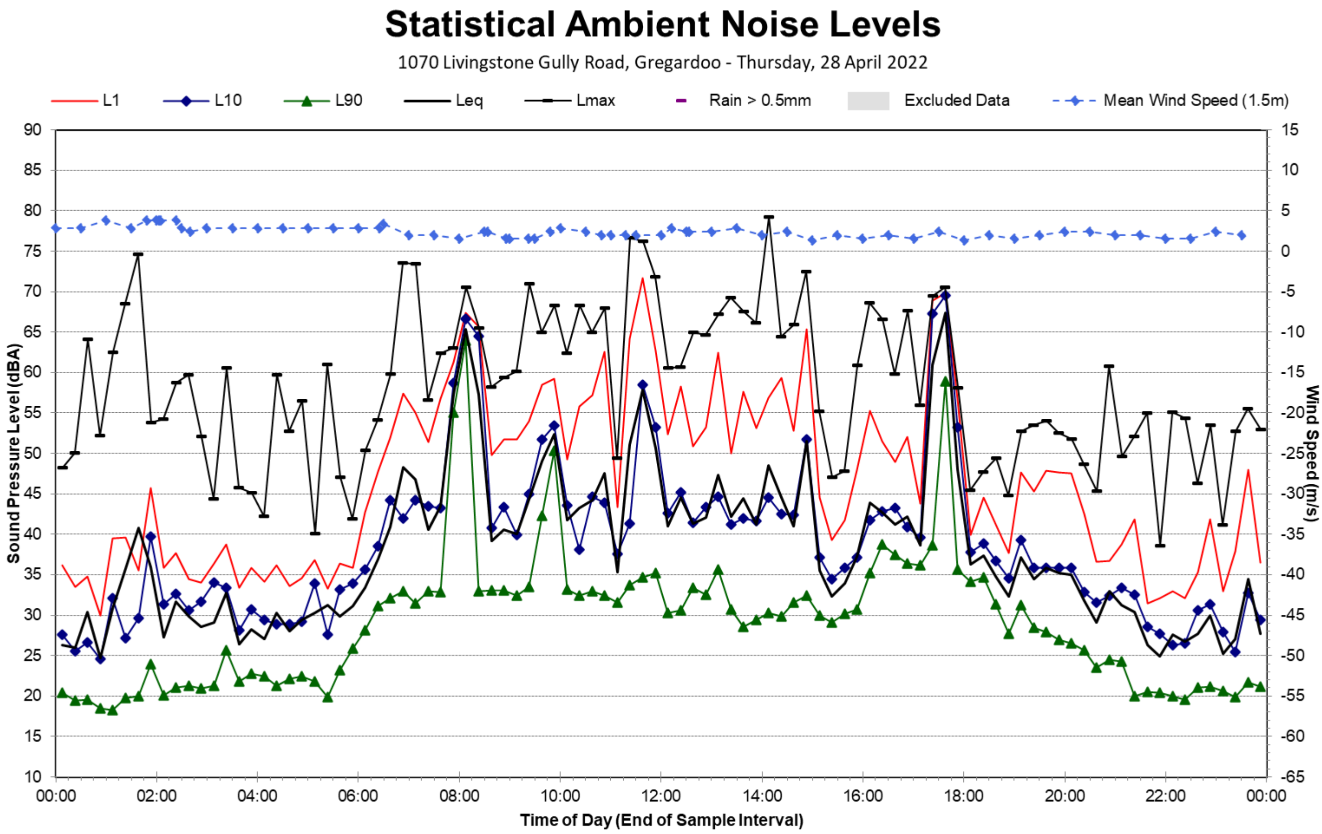
1070 Livingstone Gully Road, Gregardoo - Sunday, 24 April 2022

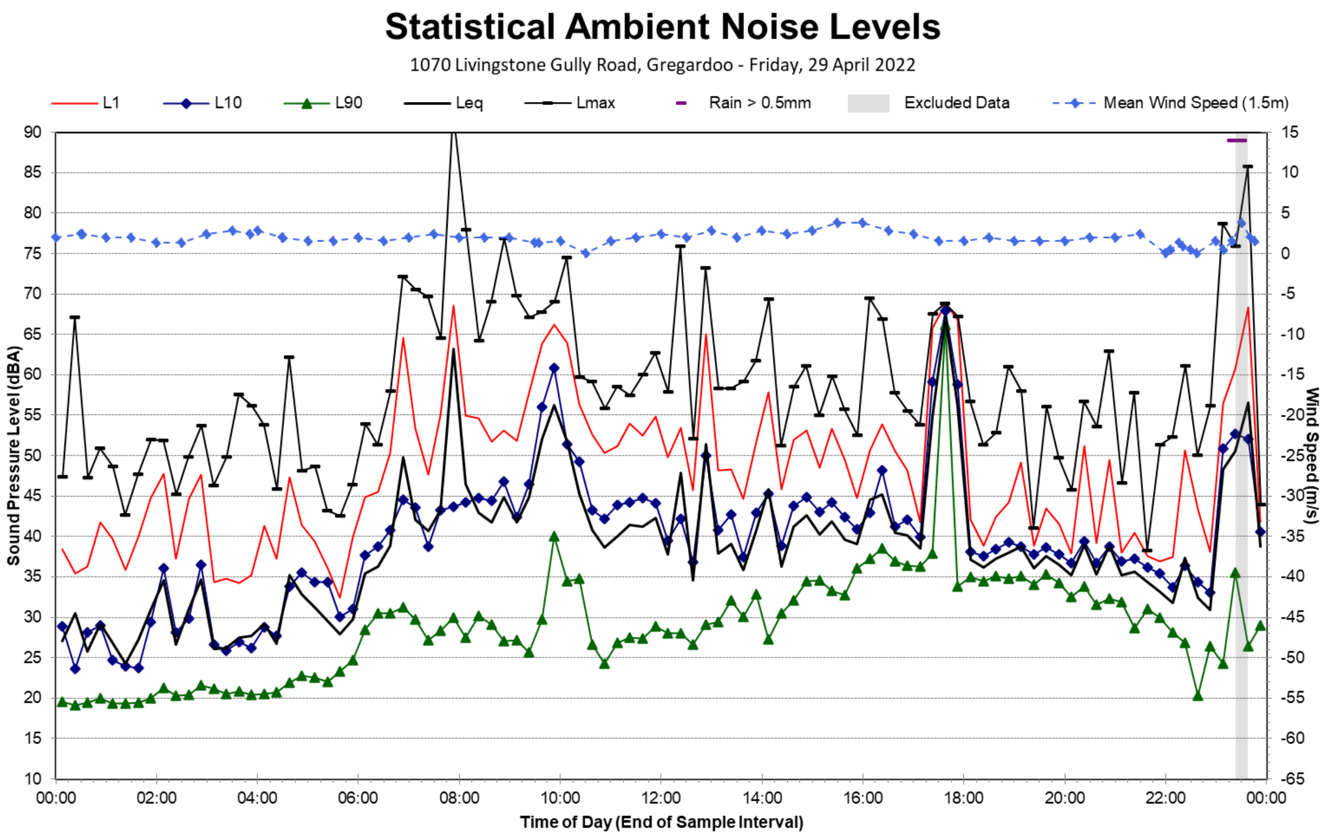


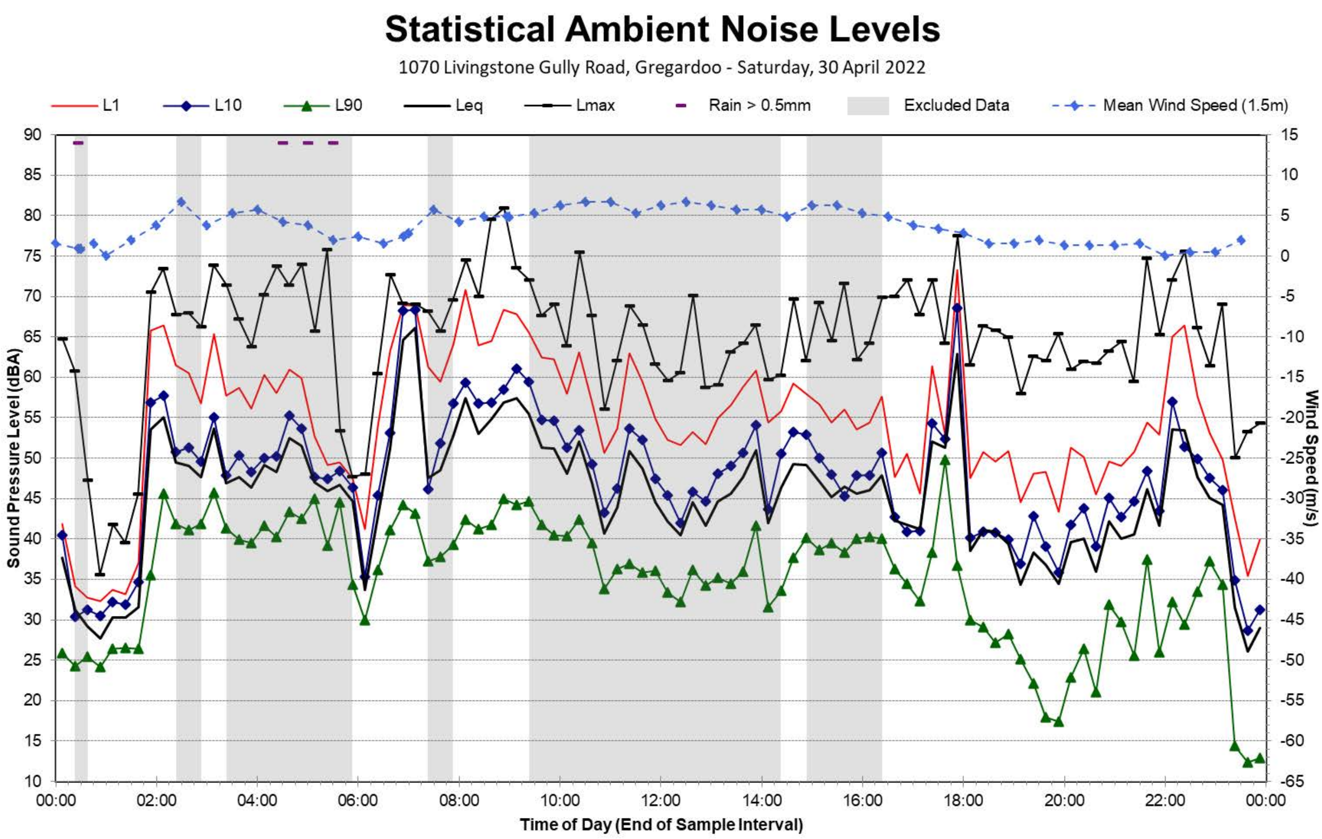

Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Monday, 25 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

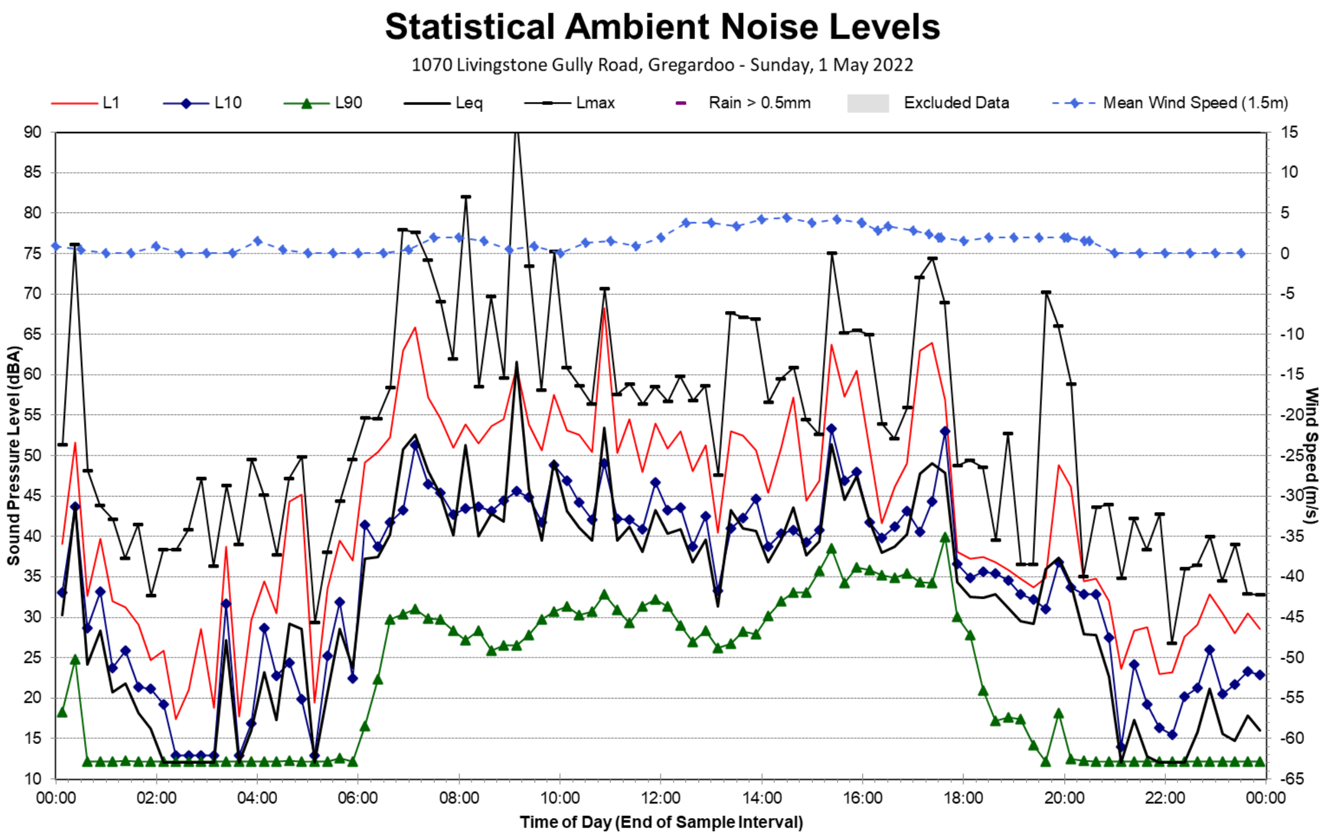

Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Tuesday, 26 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

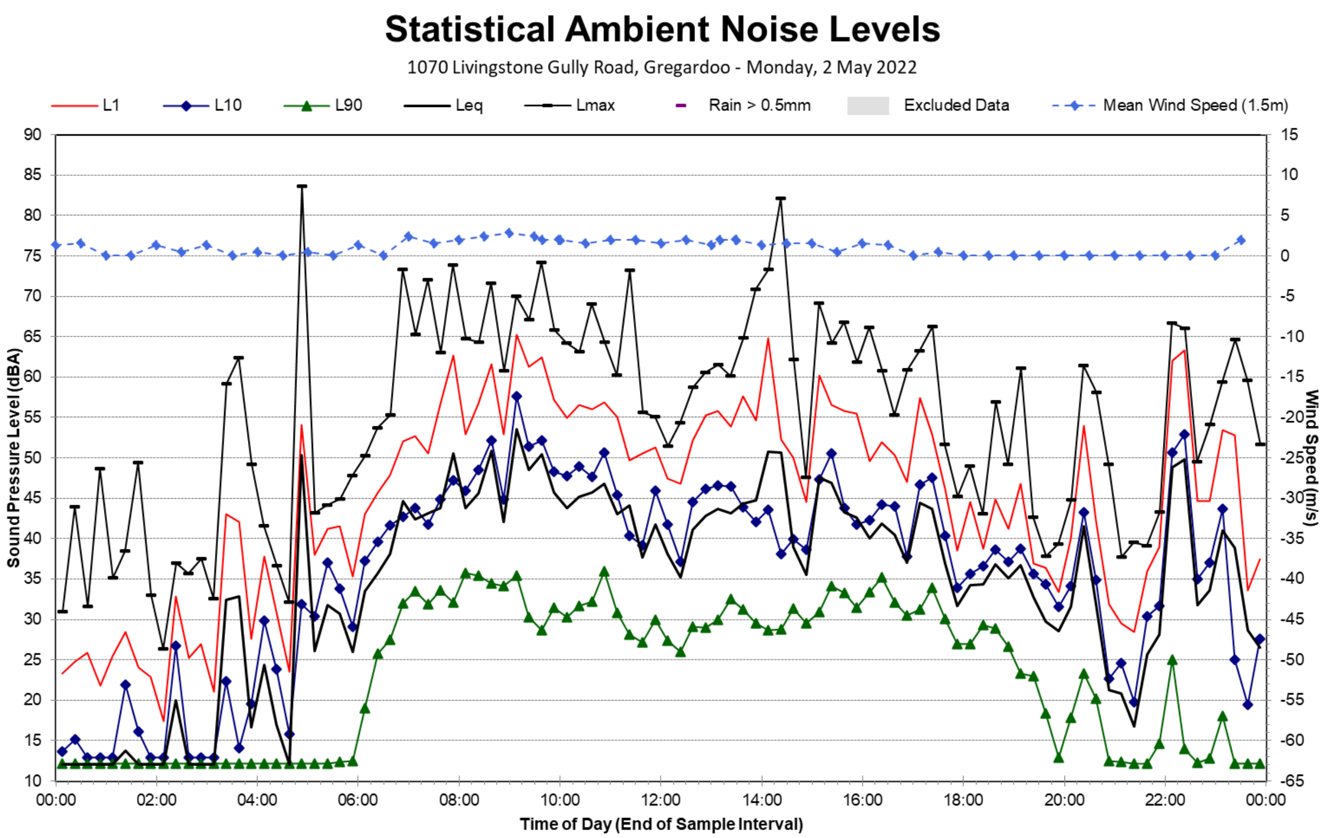

Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Wednesday, 27 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

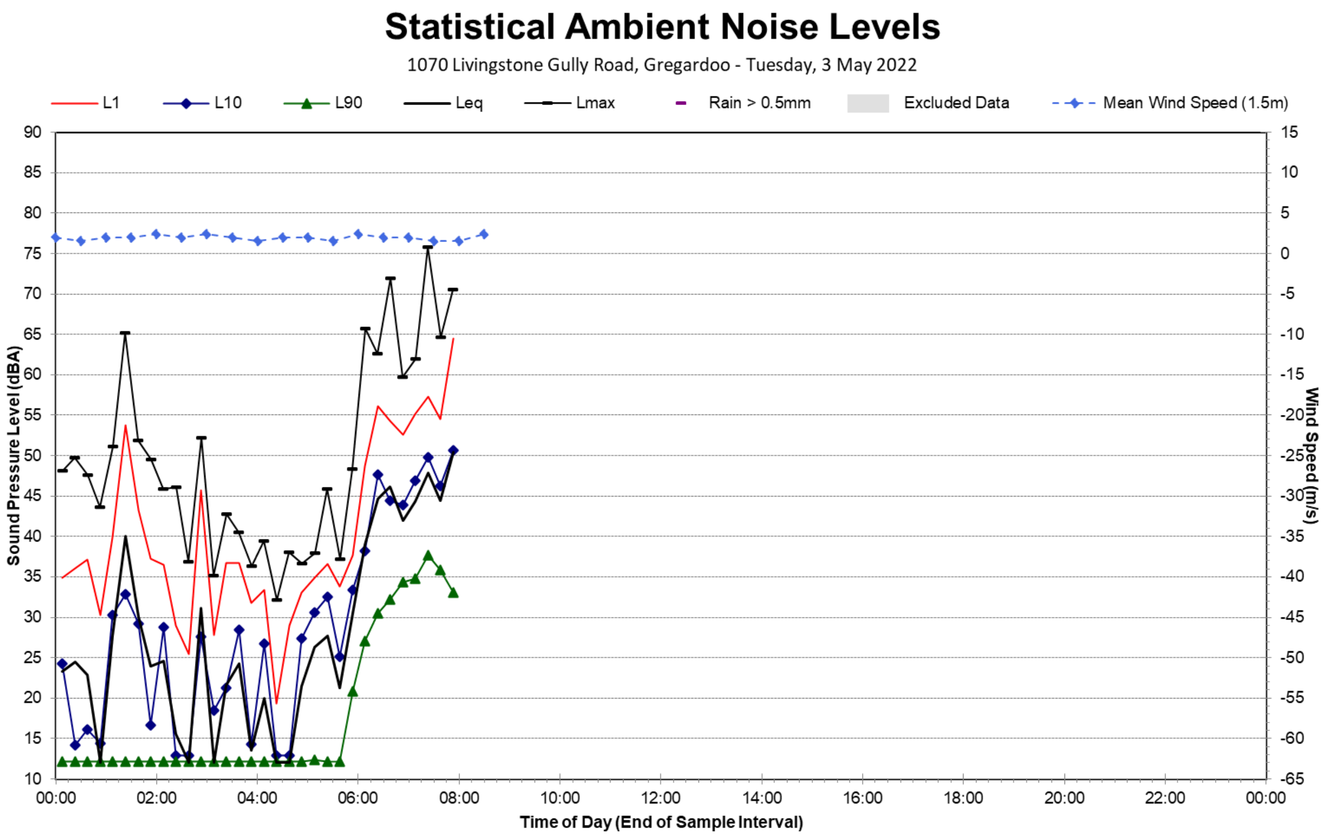

Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Thursday, 28 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Friday, 29 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Saturday, 30 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Sunday, 1 May 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Monday, 2 May 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
1070 Livingstone Gully Road, Gregardoo - Tuesday, 3 May 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.03
Noise Monitoring Address	**Snowy Mountains Highway, Gilmore**

Logger Device Type: Svantek 957, Logger Serial No: 20677
Sound Level Meter Device Type: Brüel and Kjær 2270, Sound Level Meter Serial No: 2679354

Ambient noise logger deployed east of the Snowy Mountains Highway, opposite Gilmore Mill Road. Logger located with view of Snowy Mountains Highway to the west.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from the Snowy Mountains Highway. Industrial noise from the sawmill to the northwest also contributes to the LAeq at this location.

Recorded Noise Levels (LAmax) 13/04/2022:

Road traffic noise: 57-72 dBA
Sawmill: 47-56 dBA
Birds: 50-66 dBA
Insects: 40-43 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	45	58	60	67
Evening	43	56	59	66
Night-time	41	55	56	67

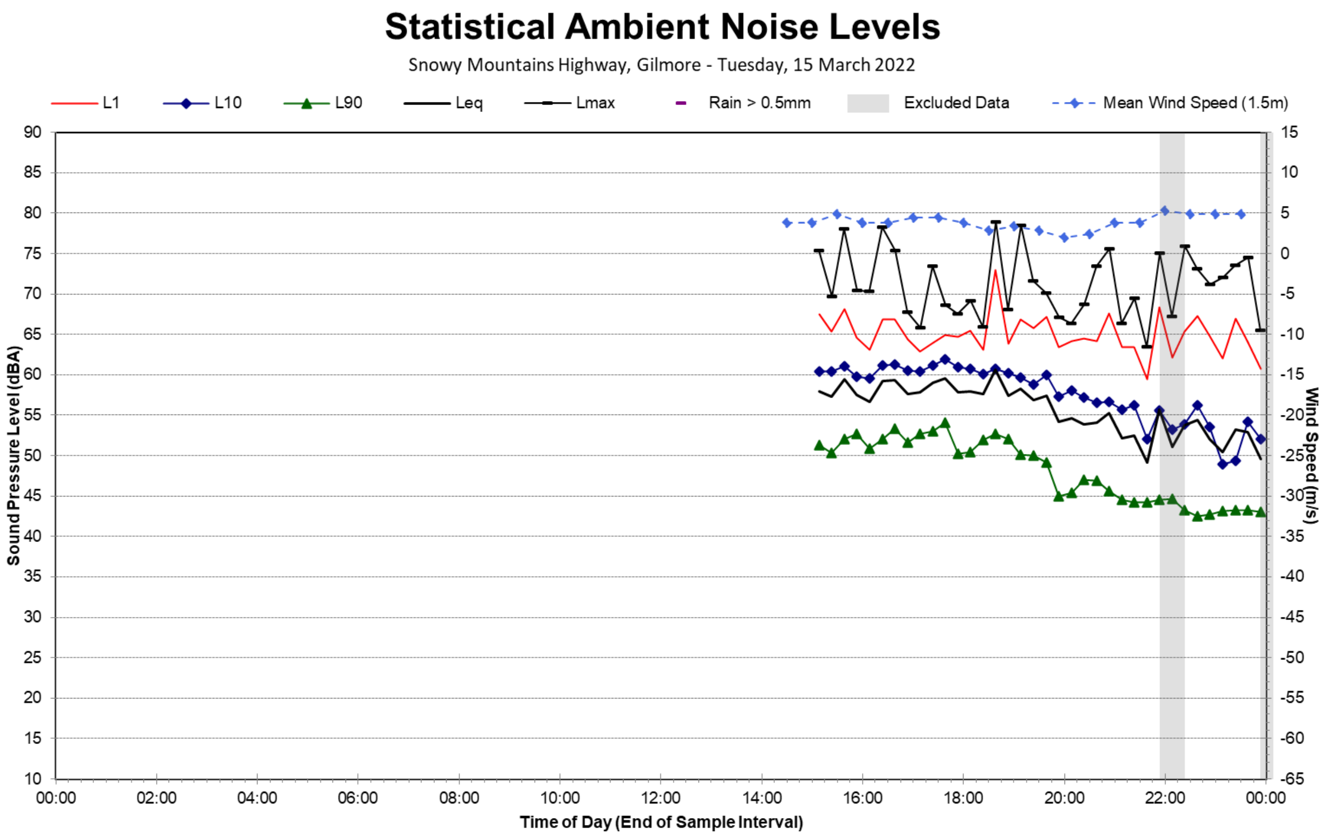
Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	57	60
Night-time (10pm-7am)	55	59

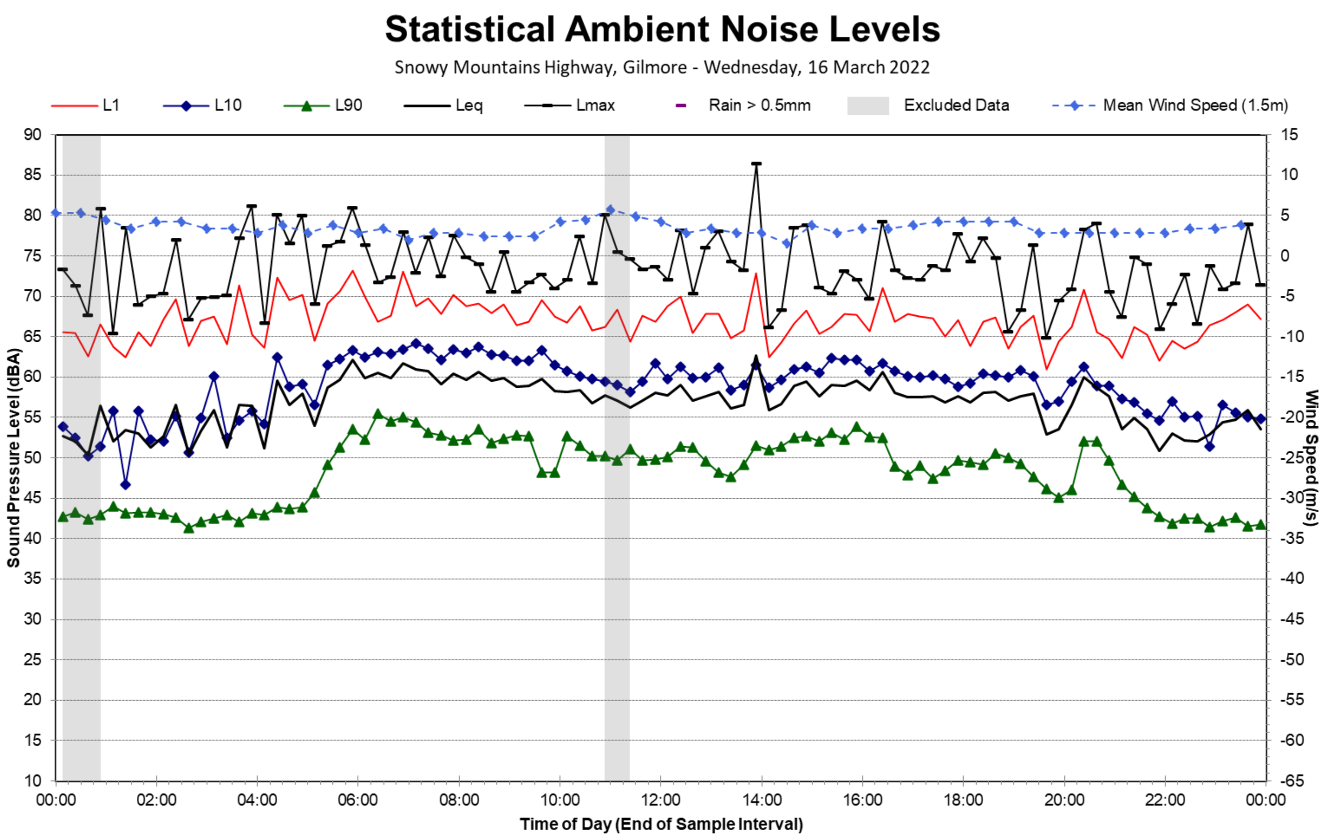
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
13/04/2022	11:00	50	58	75

Photo of Noise Monitoring Location



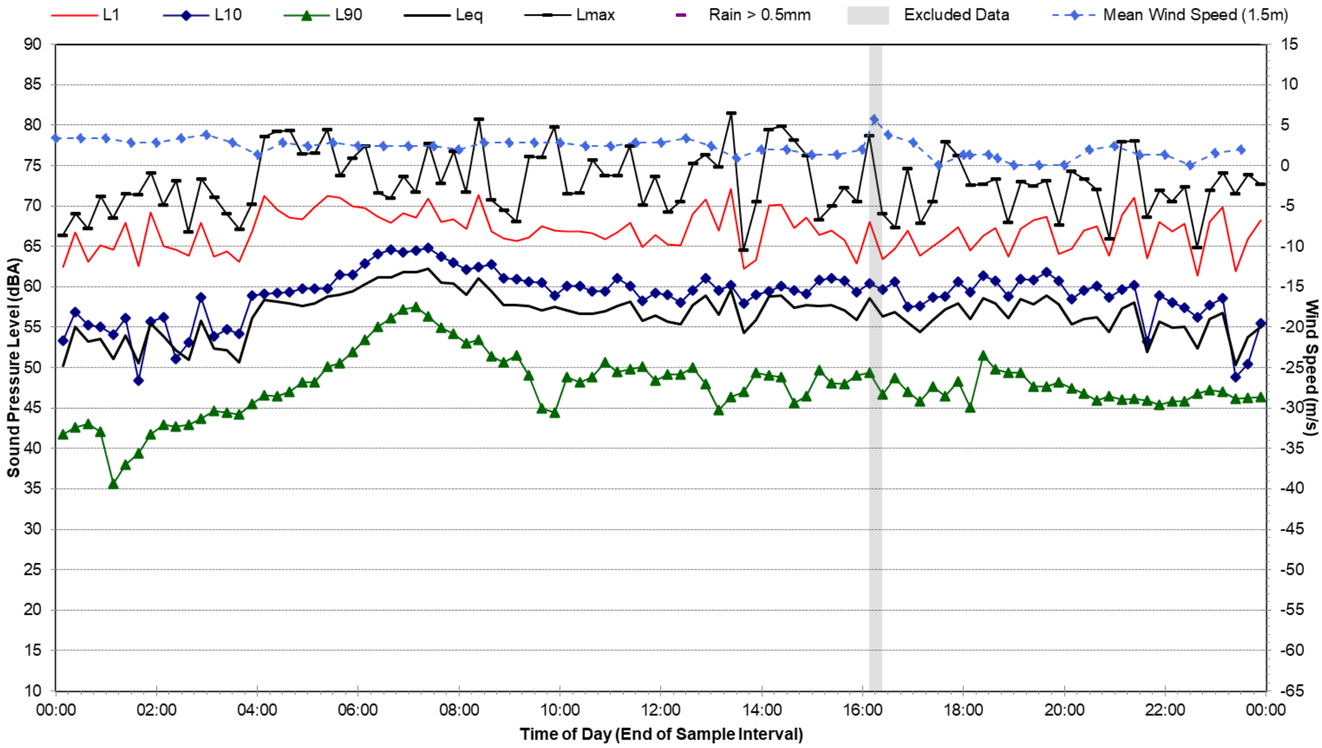
Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Tuesday, 15 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Wednesday, 16 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

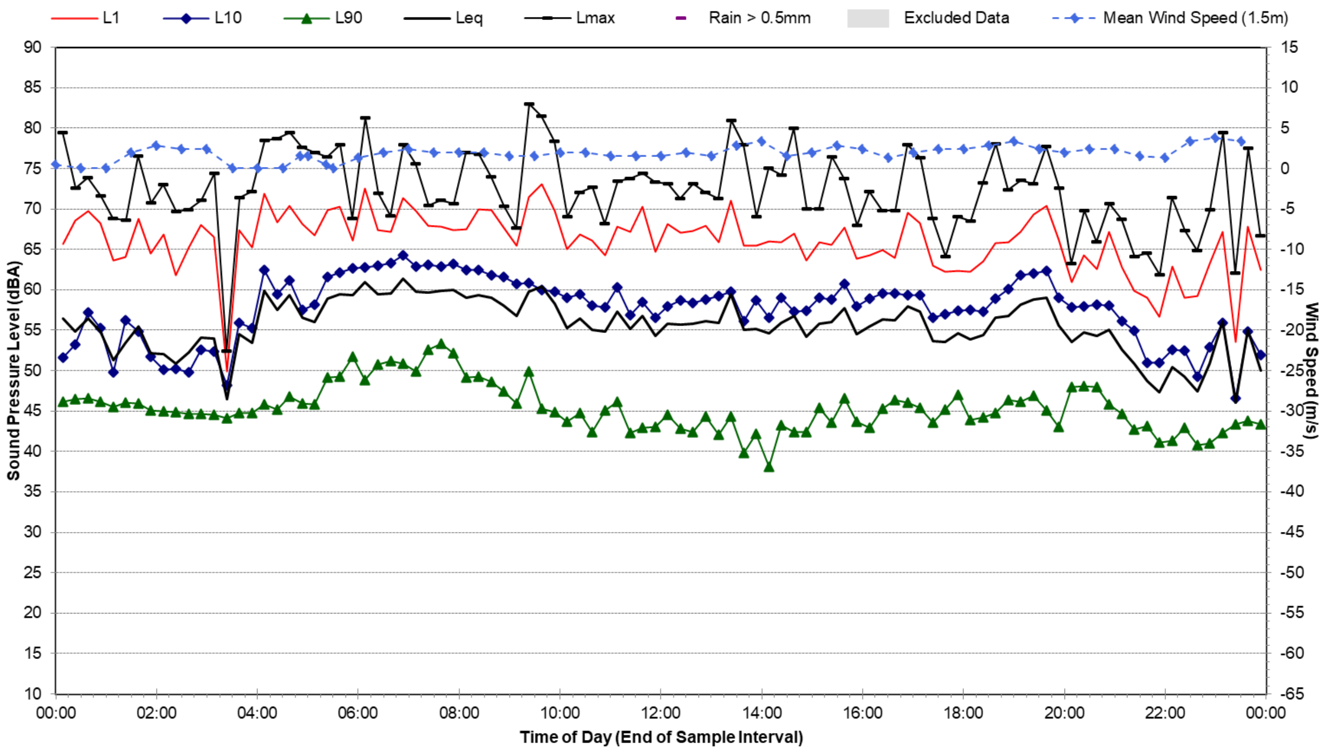
Statistical Ambient Noise Levels

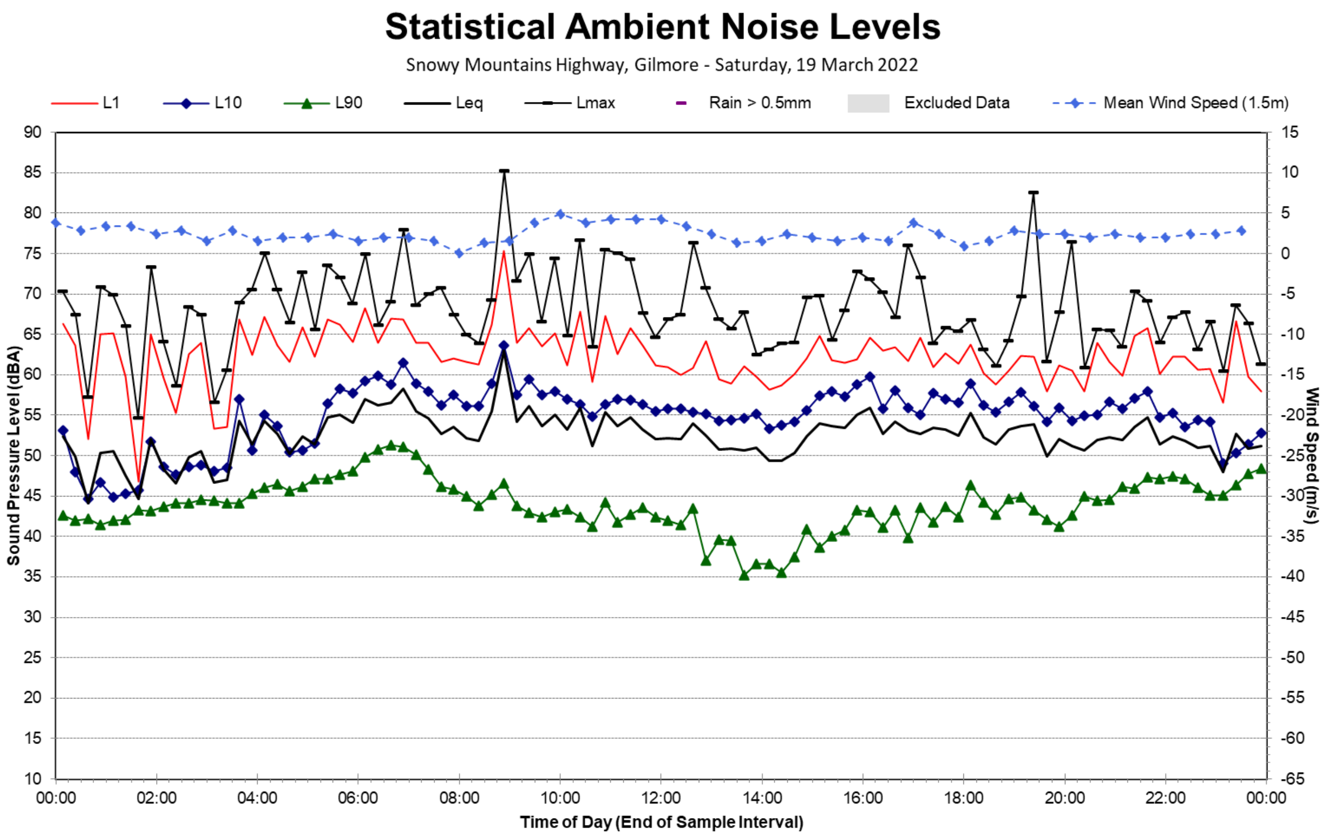
Snowy Mountains Highway, Gilmore - Thursday, 17 March 2022

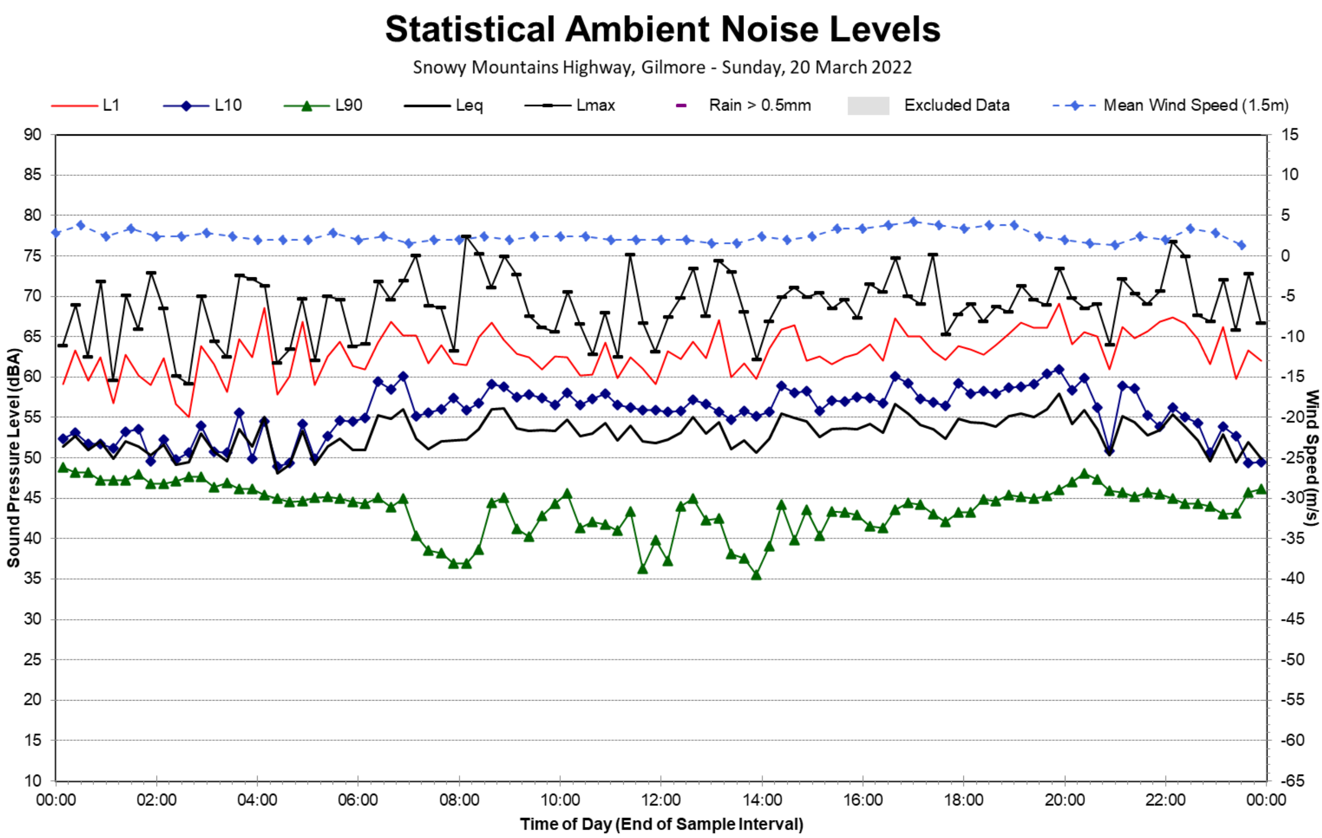


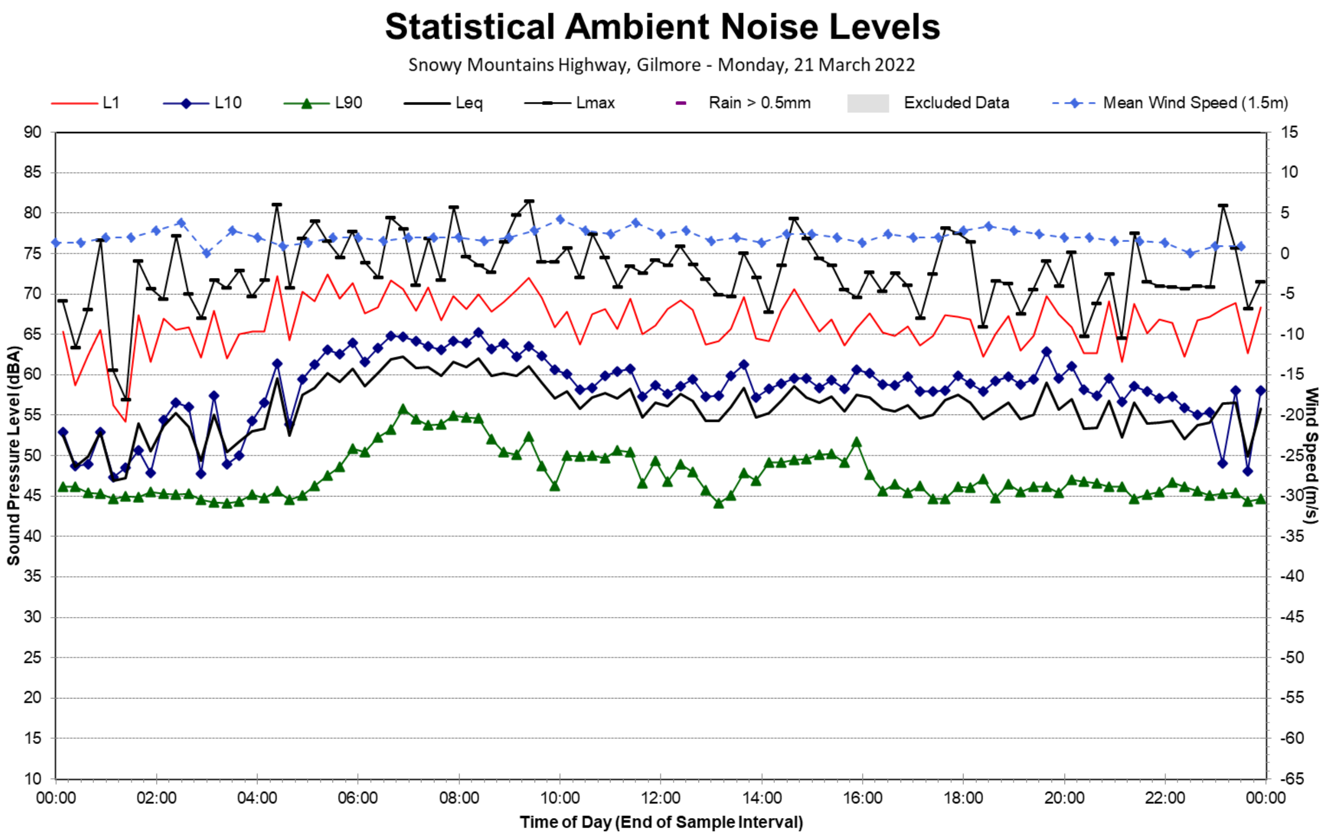
Statistical Ambient Noise Levels

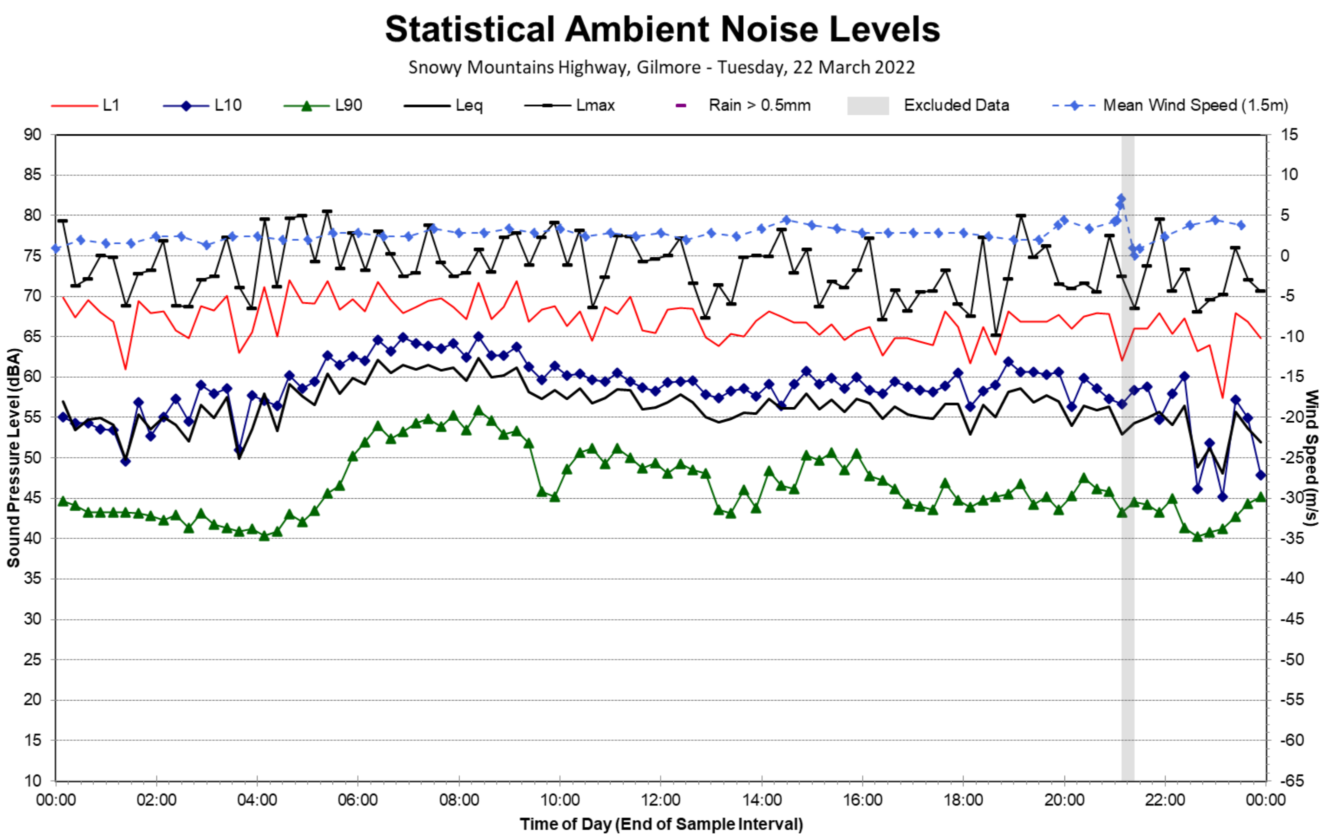
Snowy Mountains Highway, Gilmore - Friday, 18 March 2022

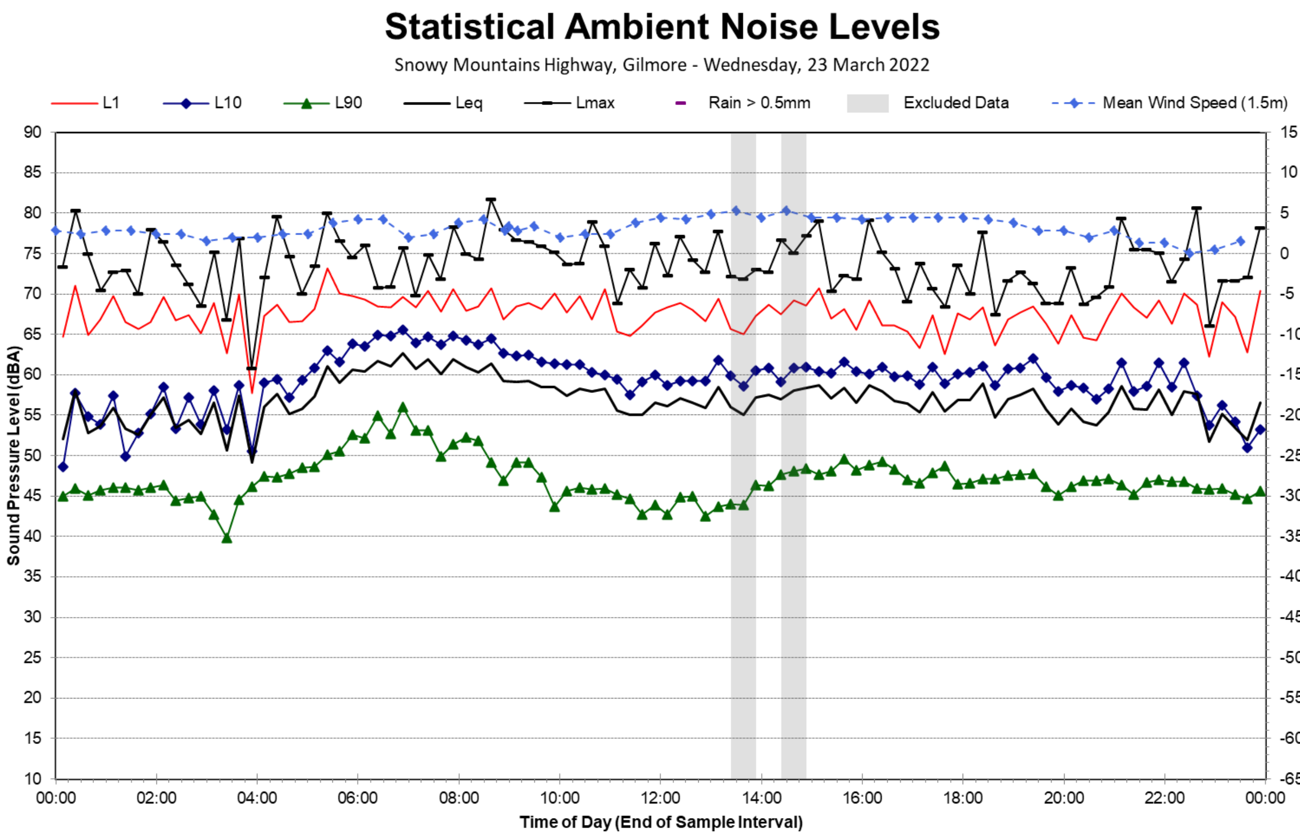


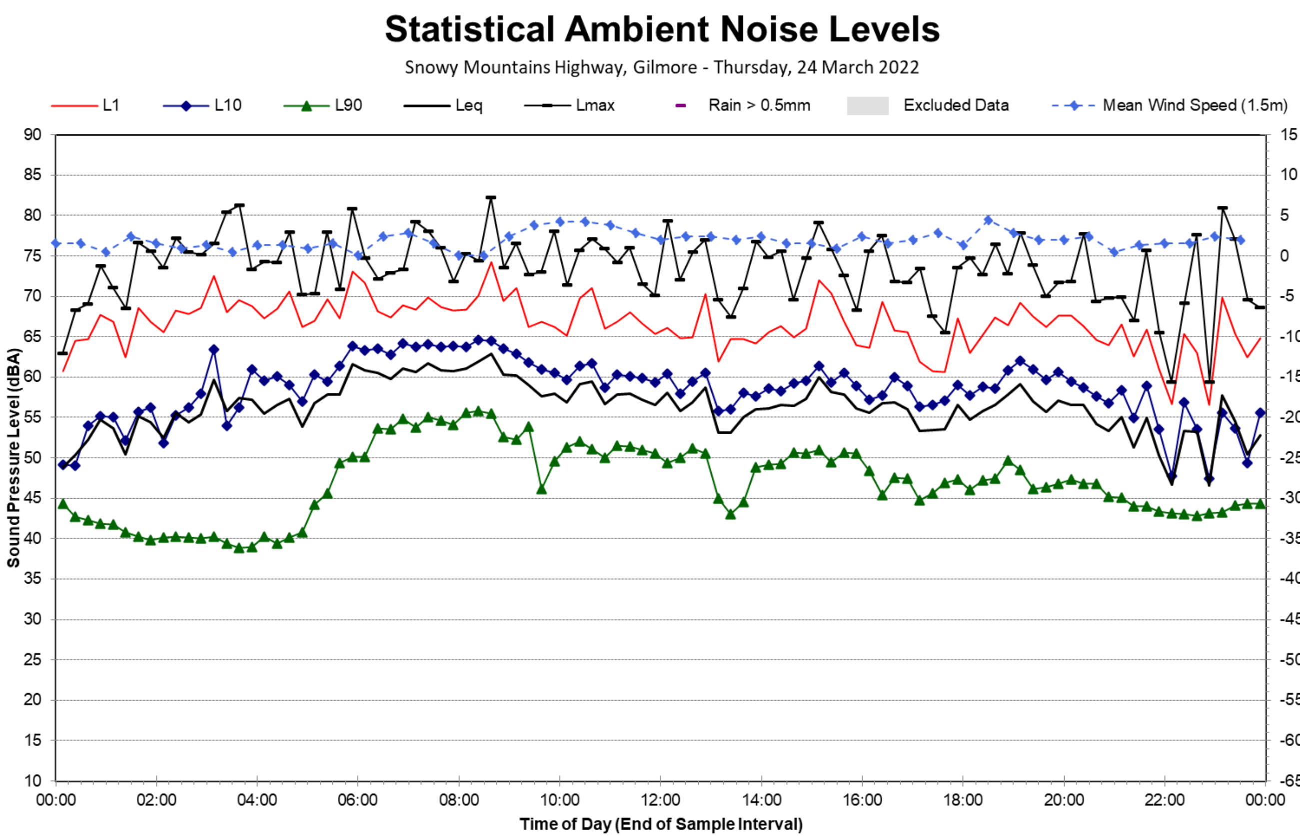

Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Saturday, 19 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

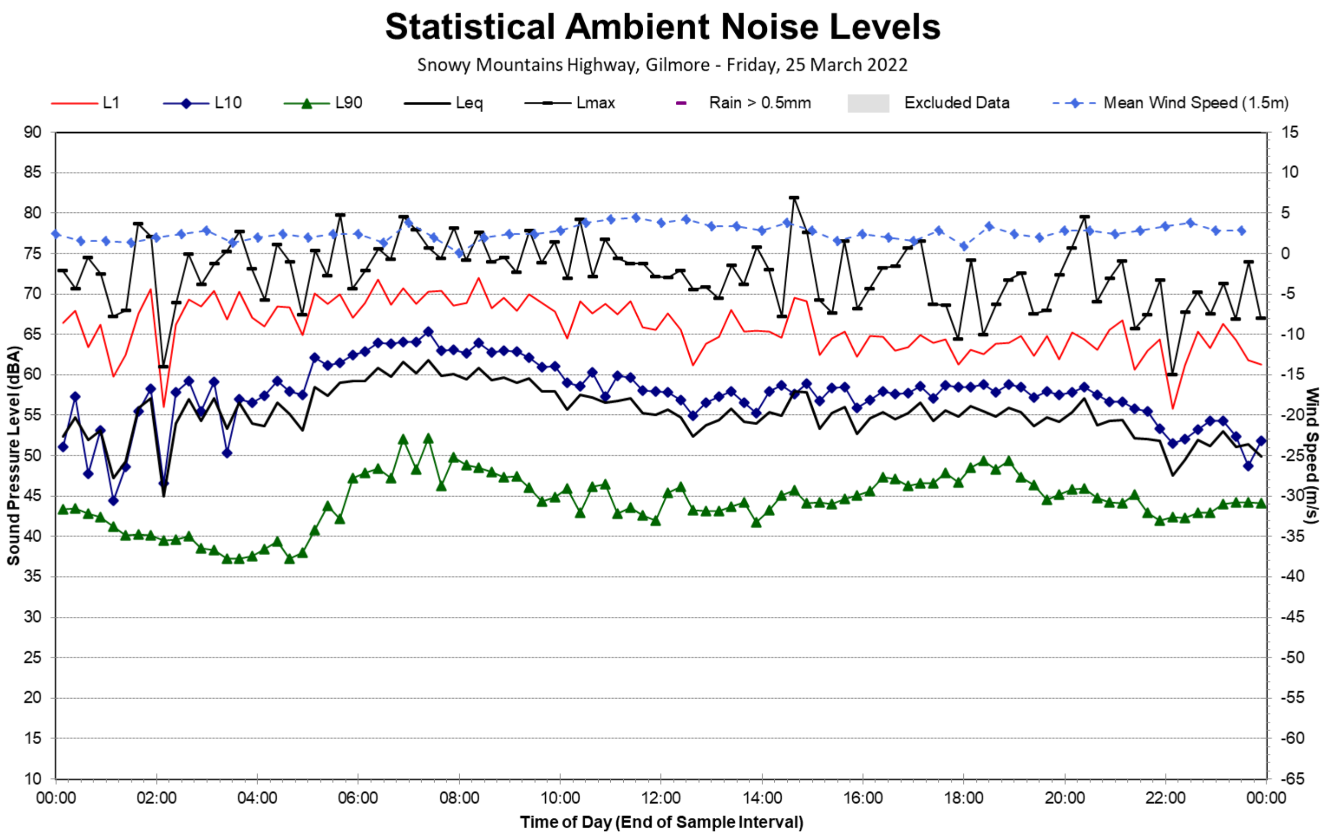

Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Sunday, 20 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

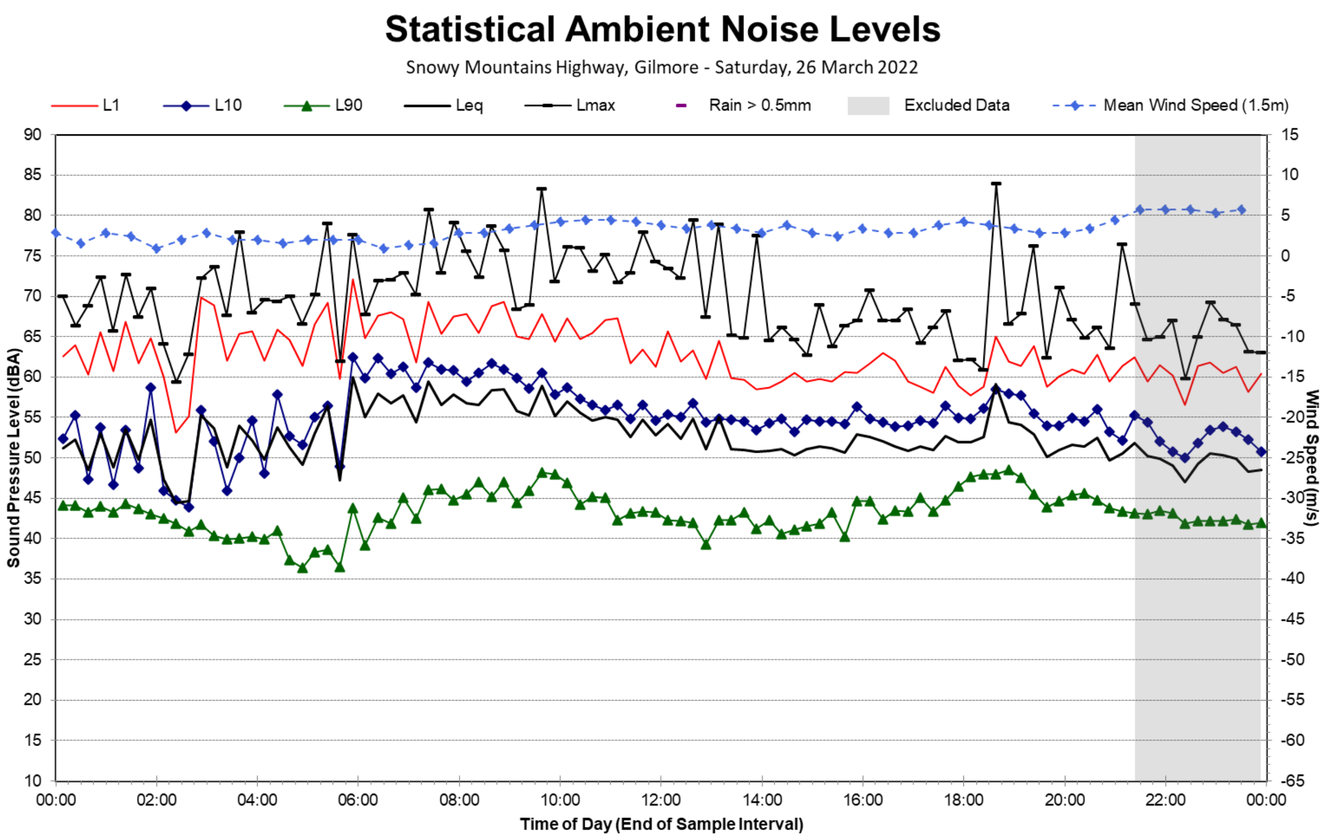

Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Monday, 21 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

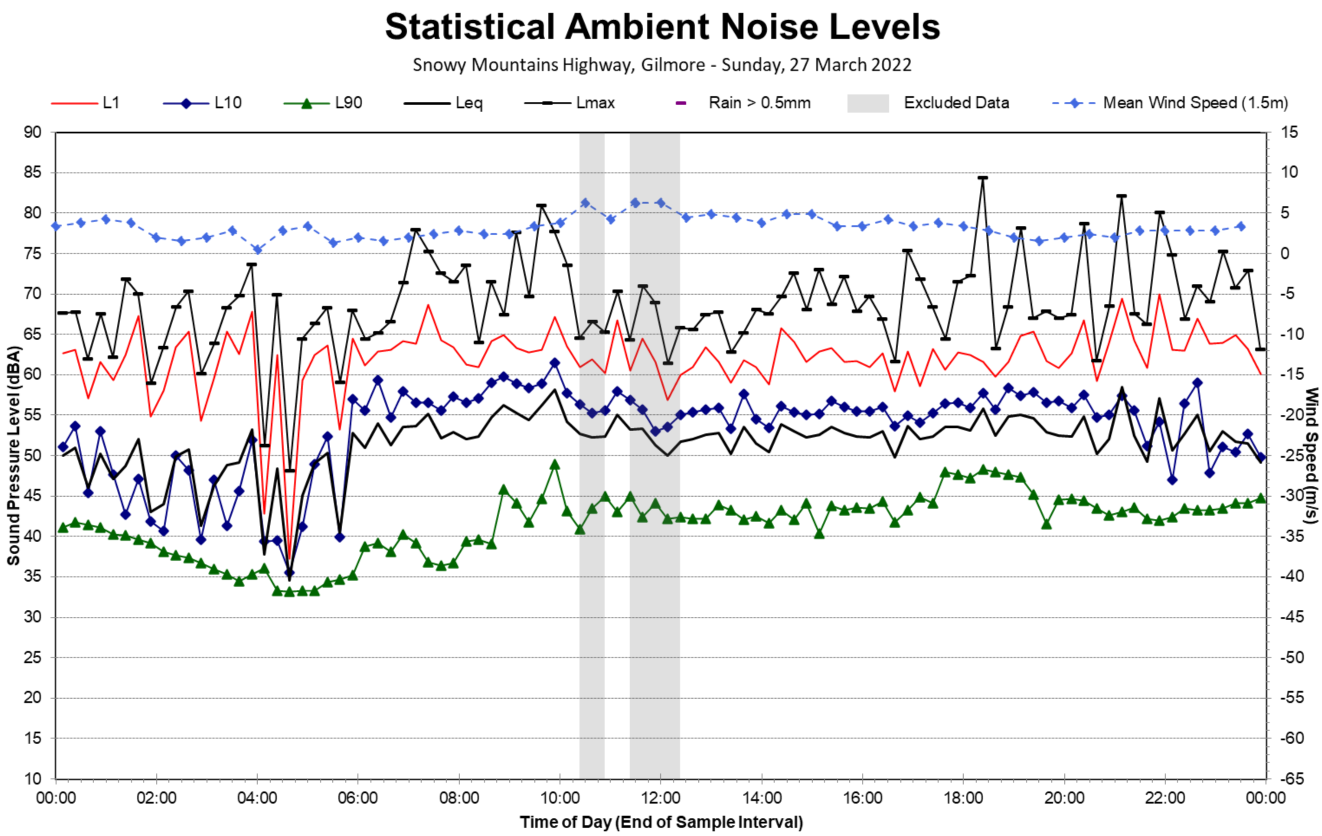

Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Tuesday, 22 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

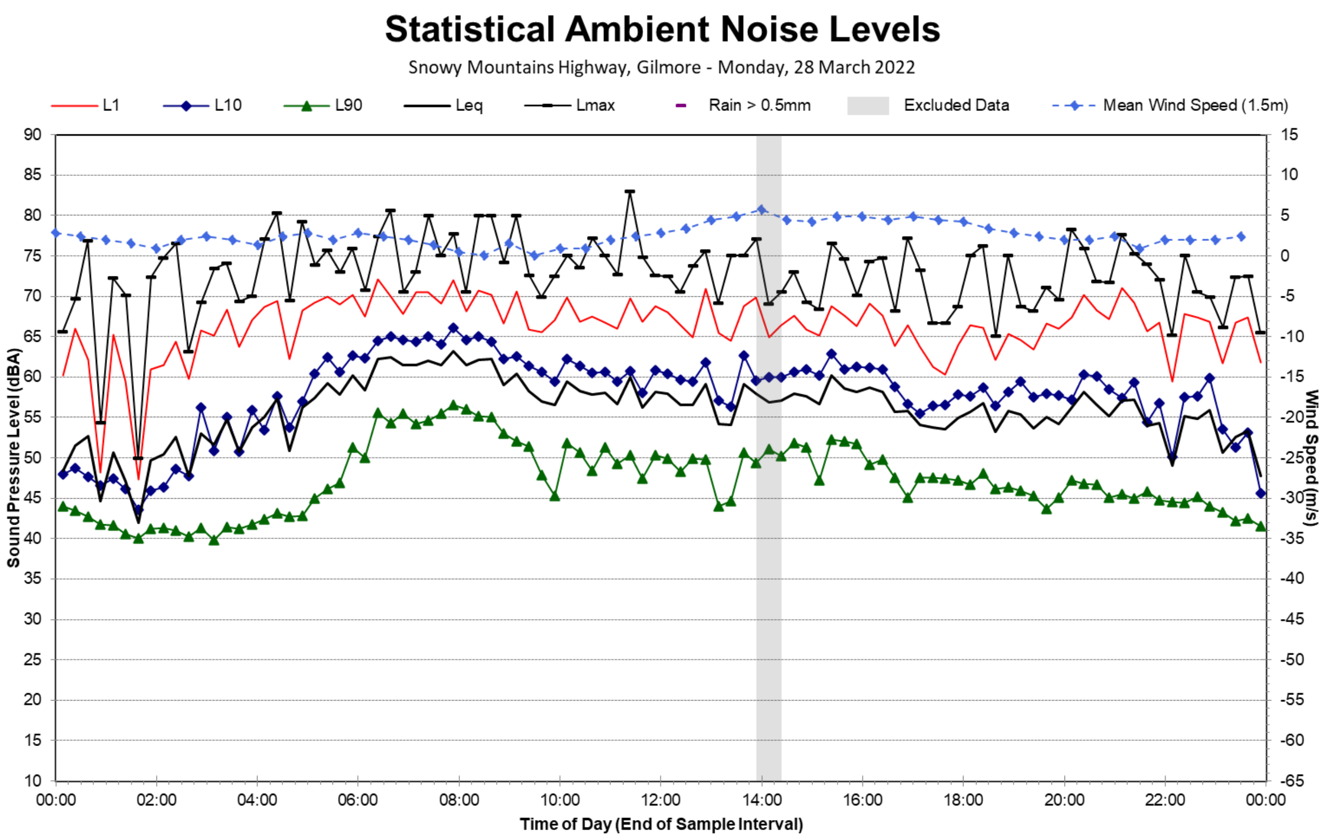

Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Wednesday, 23 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

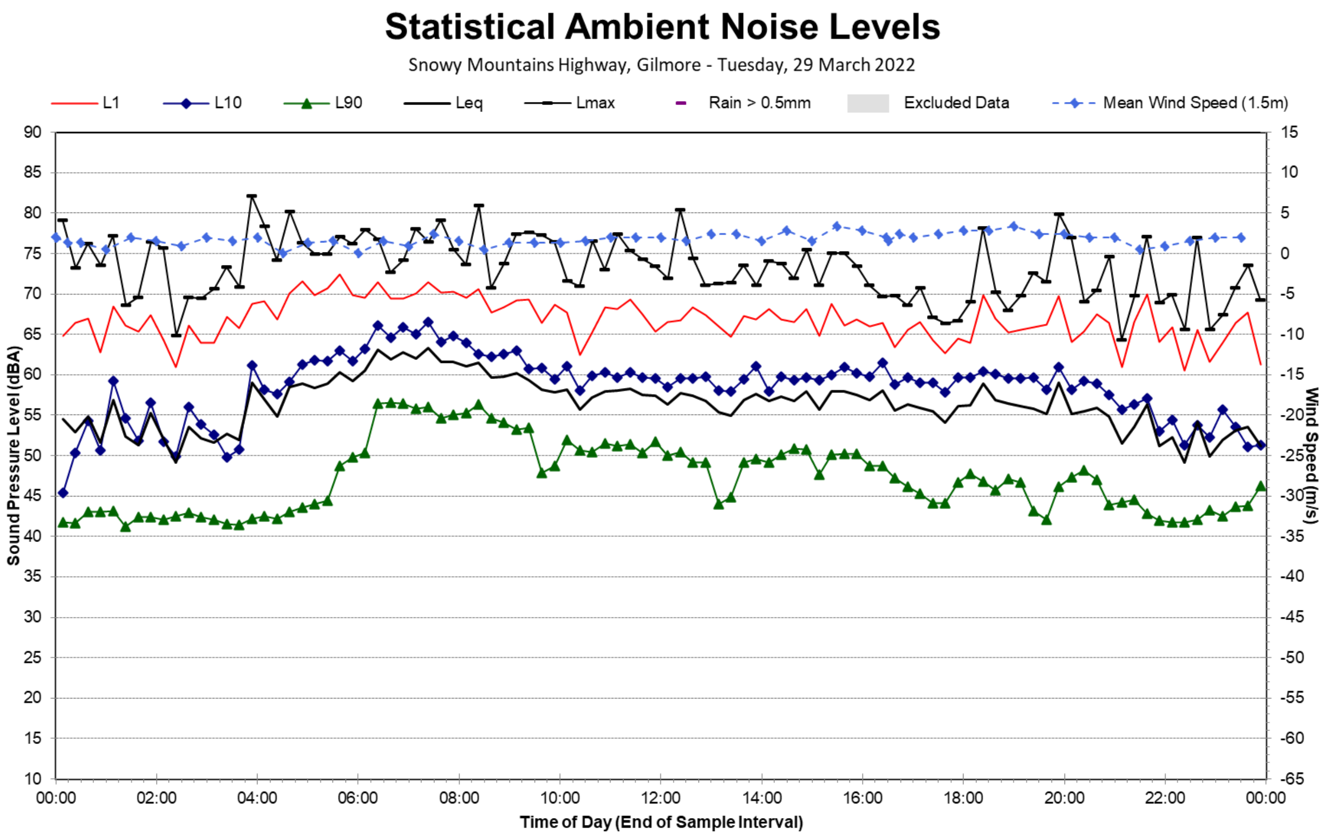

Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Thursday, 24 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Friday, 25 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

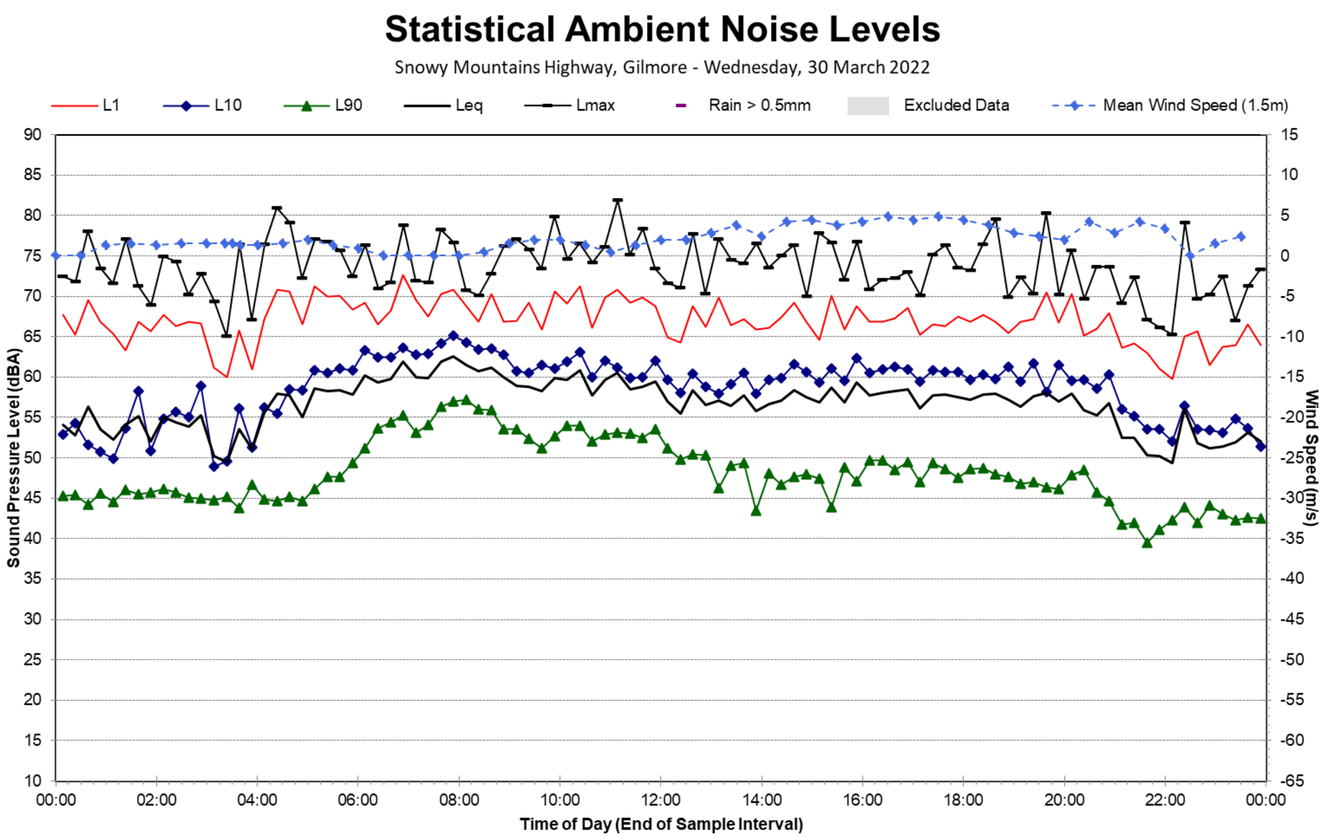

Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Saturday, 26 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Sunday, 27 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

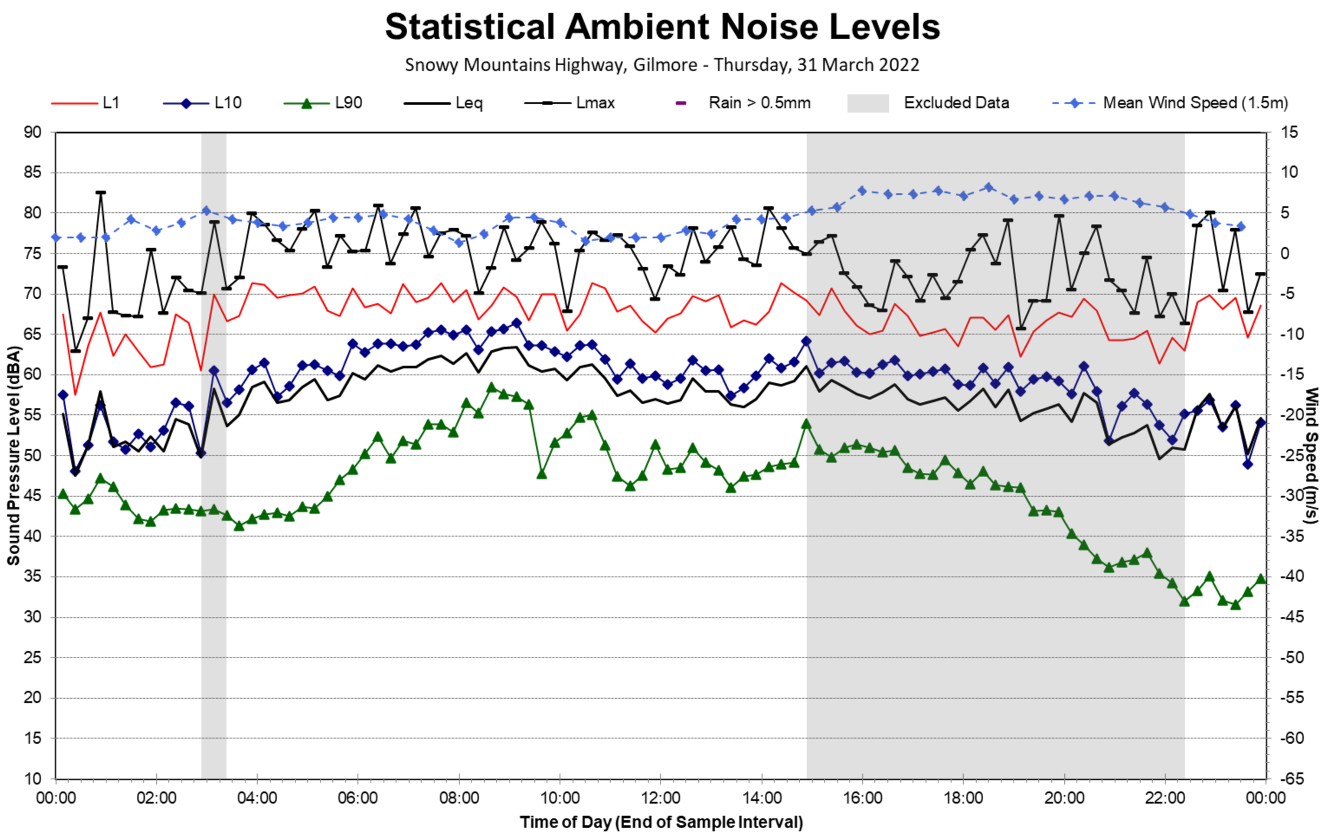

Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Monday, 28 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



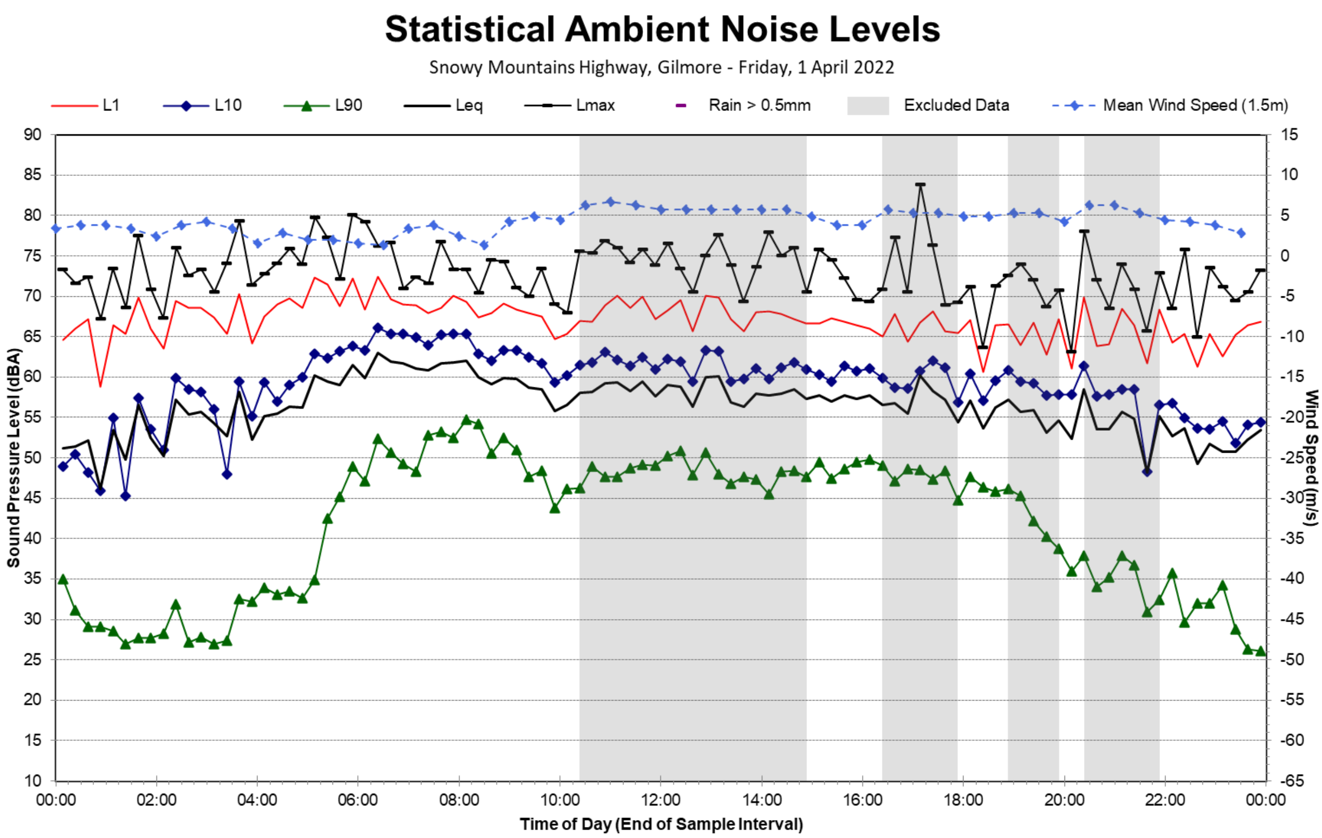
Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Tuesday, 29 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



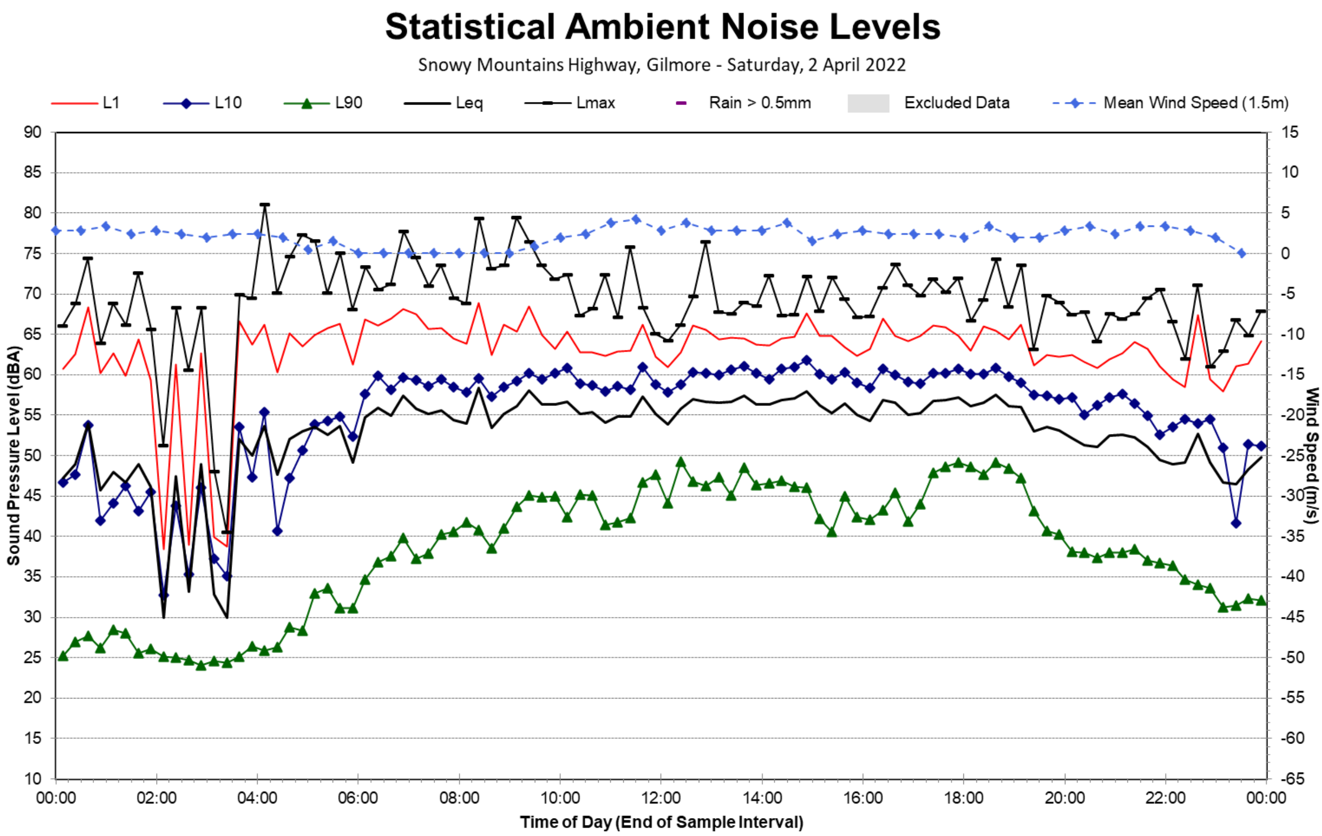
Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Wednesday, 30 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

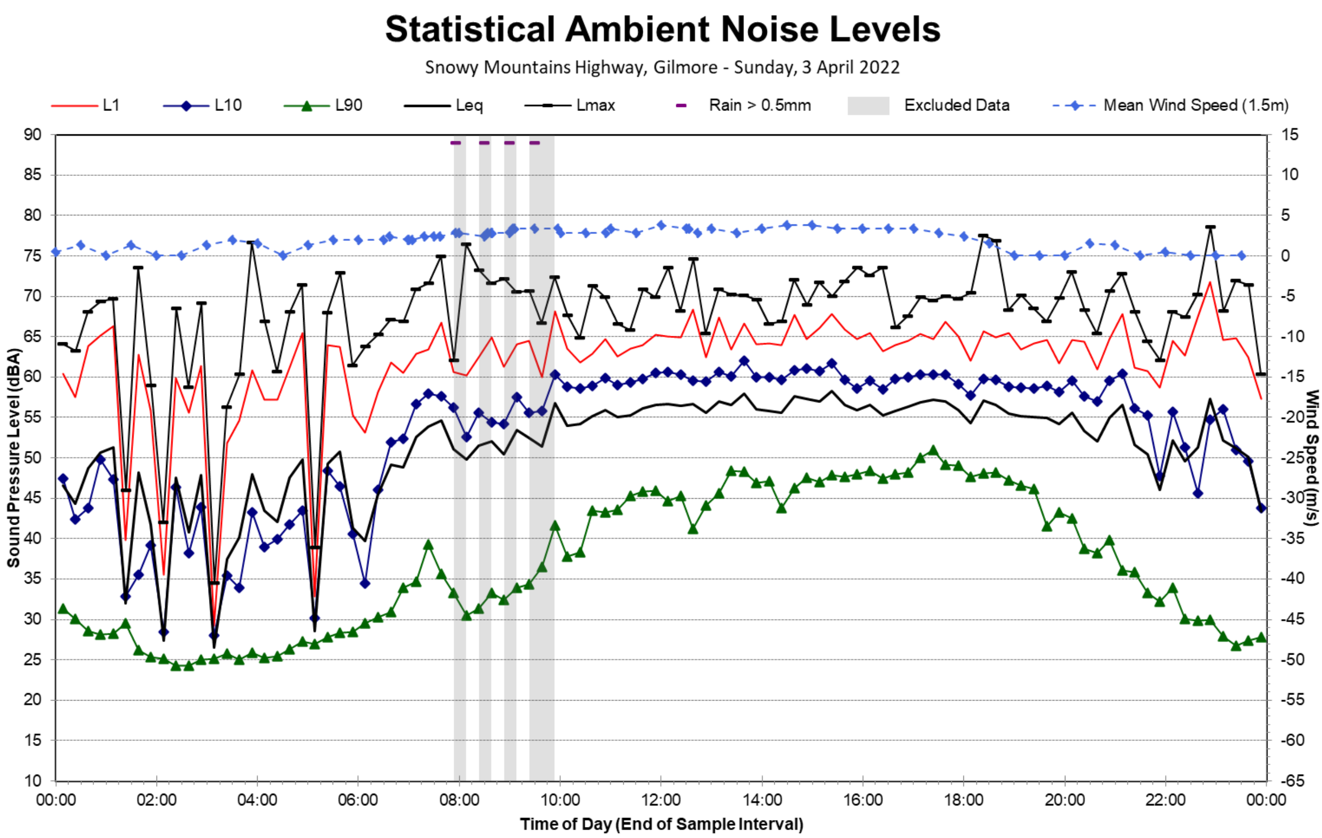


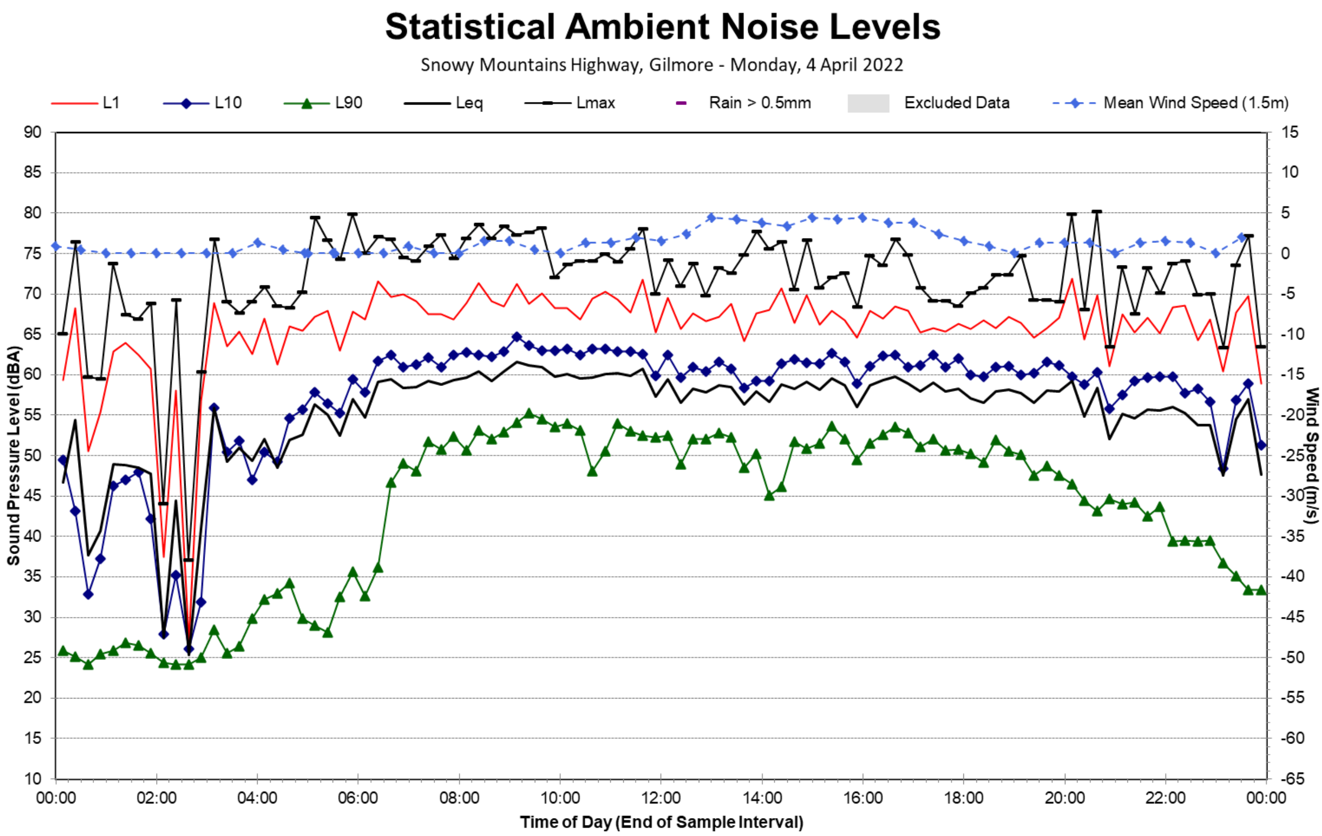
Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Thursday, 31 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

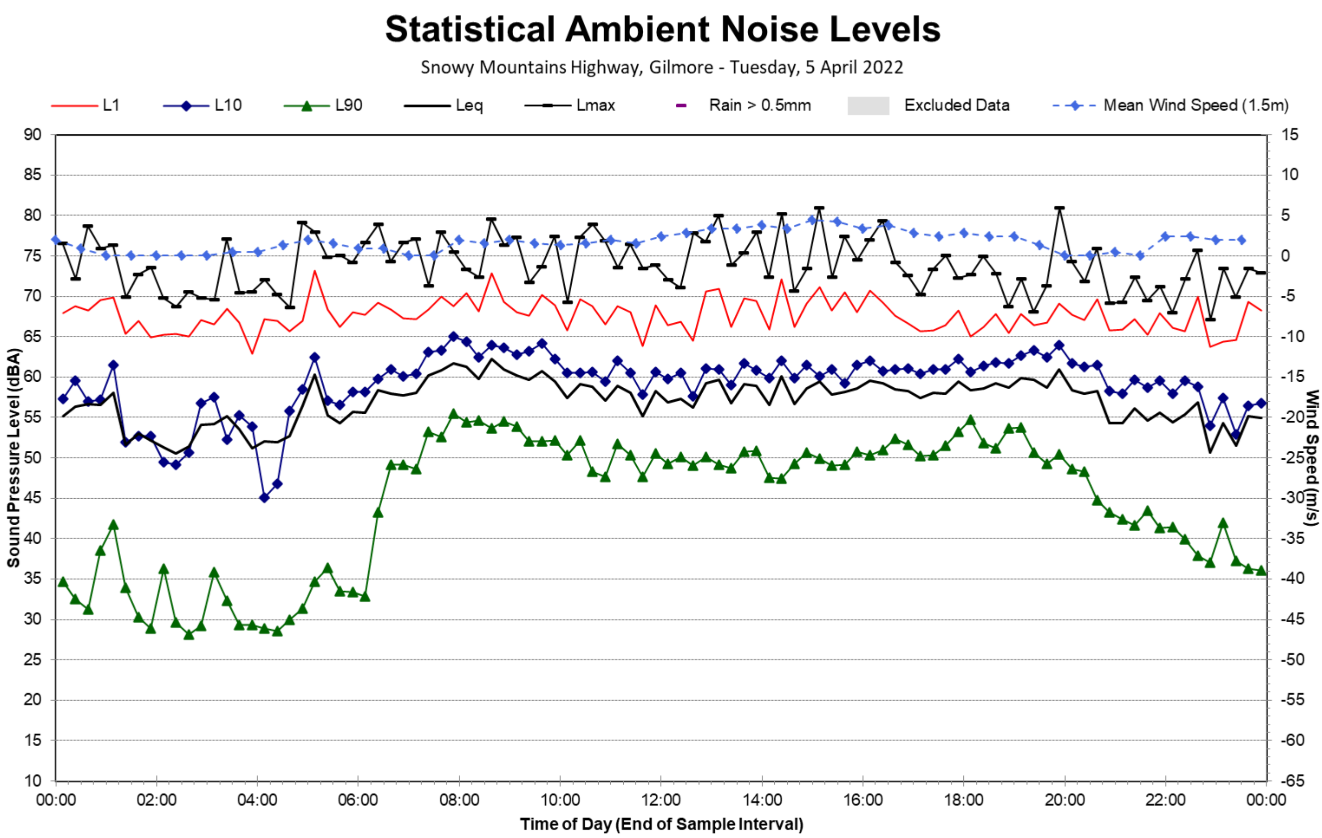


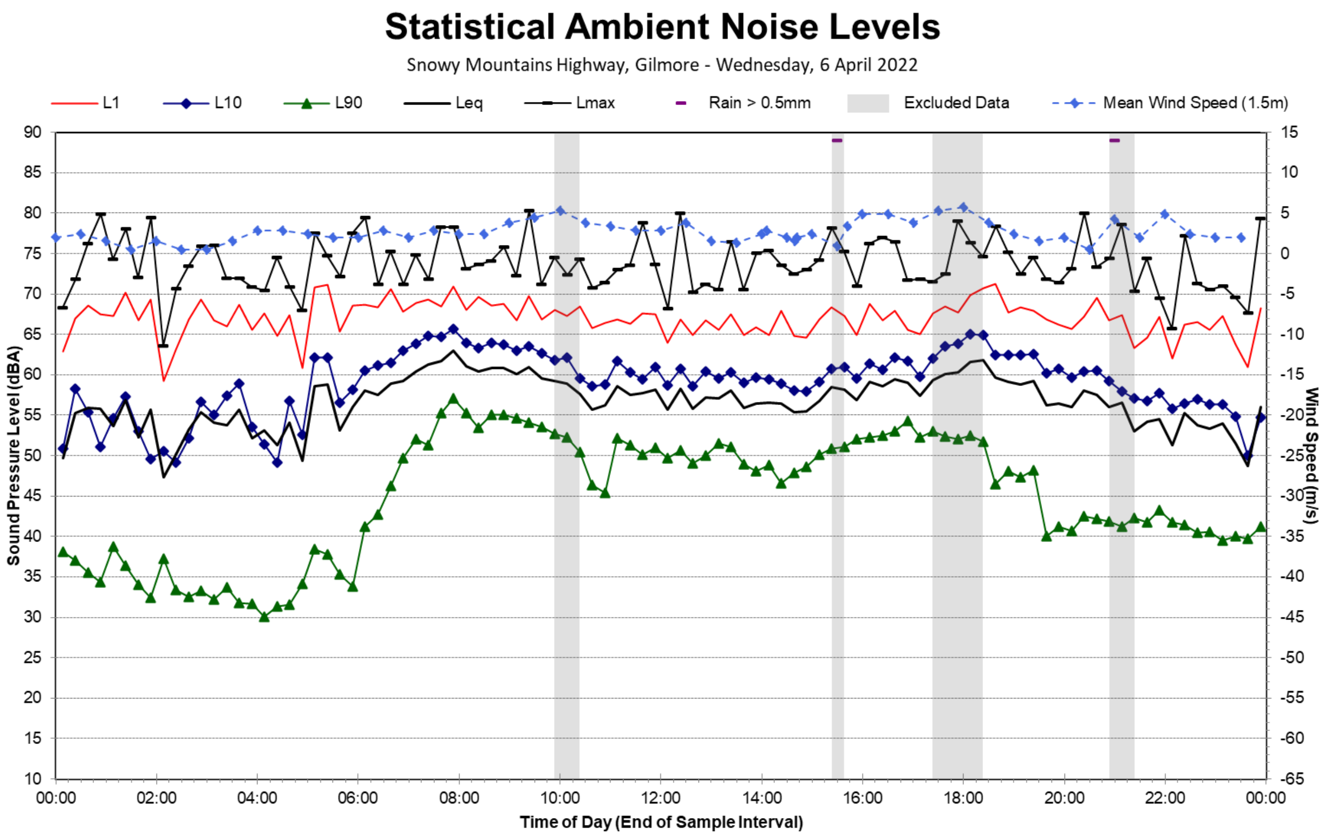
Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Friday, 1 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

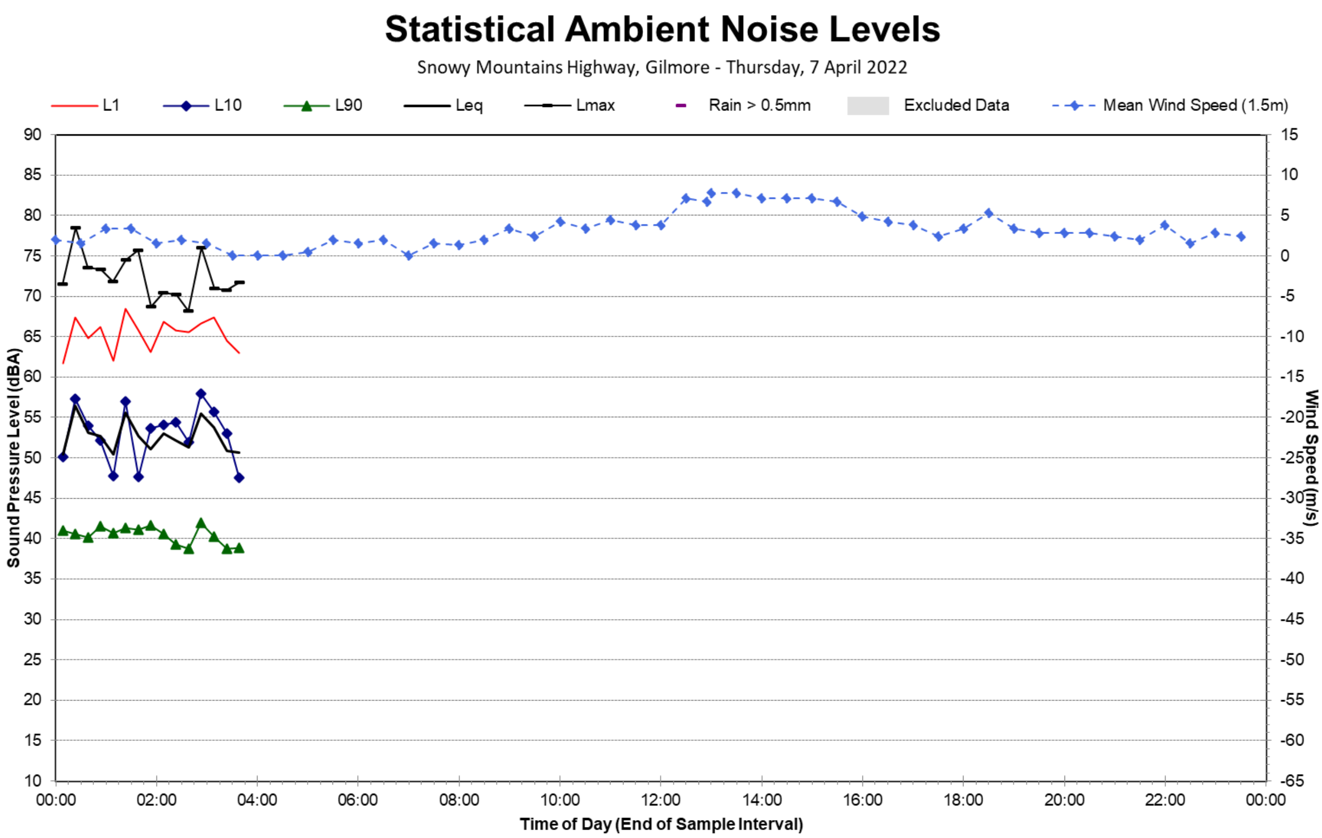

Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Saturday, 2 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Sunday, 3 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Monday, 4 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Tuesday, 5 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Wednesday, 6 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Snowy Mountains Highway, Gilmore - Thursday, 7 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.04
Noise Monitoring Address	**1428 Adjungbilly Road, Adjungbilly**

Logger Device Type: Svantek 957, Logger Serial No: 20667
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3005904

Ambient noise logger deployed at residential address 1428 Adjungbilly Road, Adjungbilly. Logger located in properties house yard with view of Adjungbilly Road to the north.

Attended noise measurements indicate the ambient noise environment at this location is influenced by wildlife noise, such as birds and insects, and by occasional aircraft noise.

Recorded Noise Levels (LAmax) 28/03/2022:

Aircraft: 45-62 dBA
Insects: 41-51
Birds: 42-55 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	41	53	54	56
Evening	47	56	58	61
Night-time	38	51	50	54

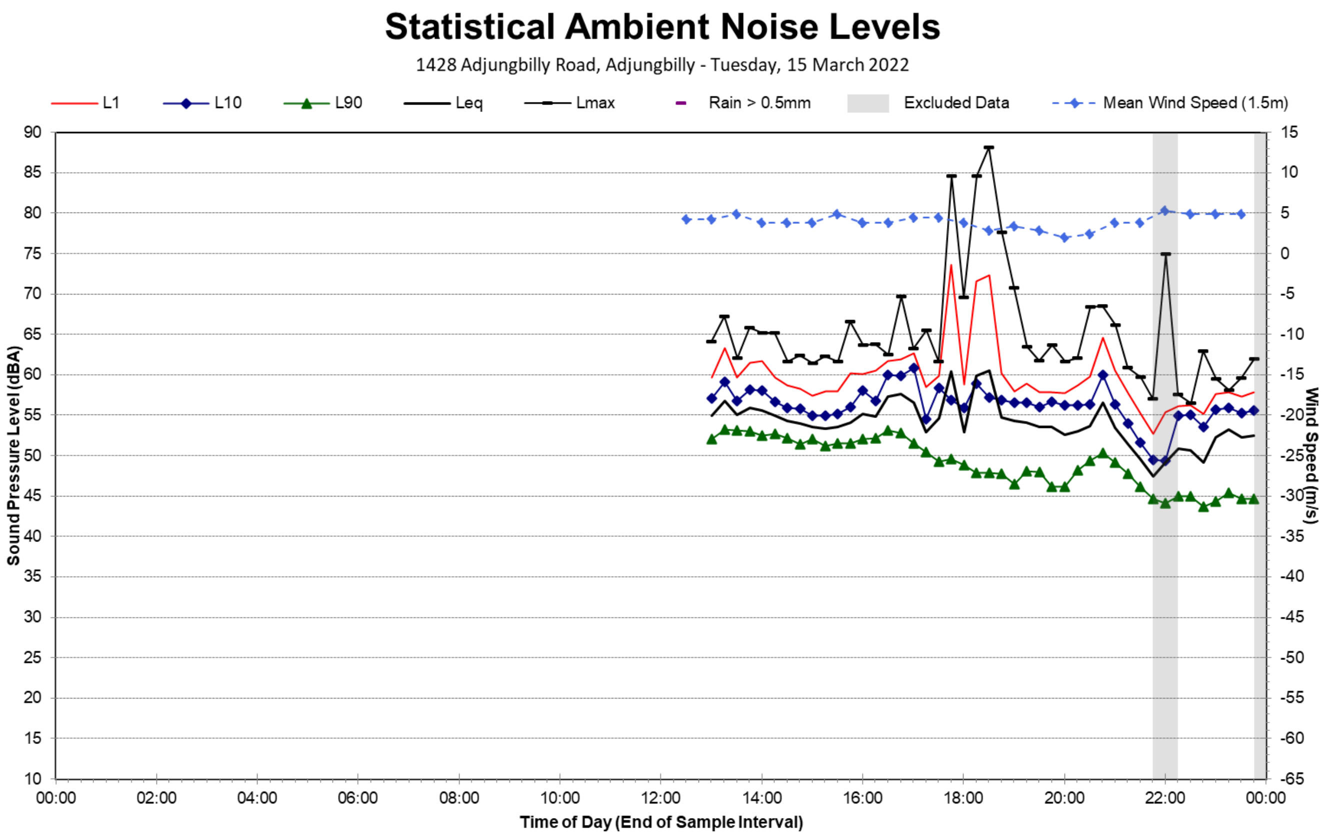
Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	54	57
Night-time (10pm-7am)	51	50

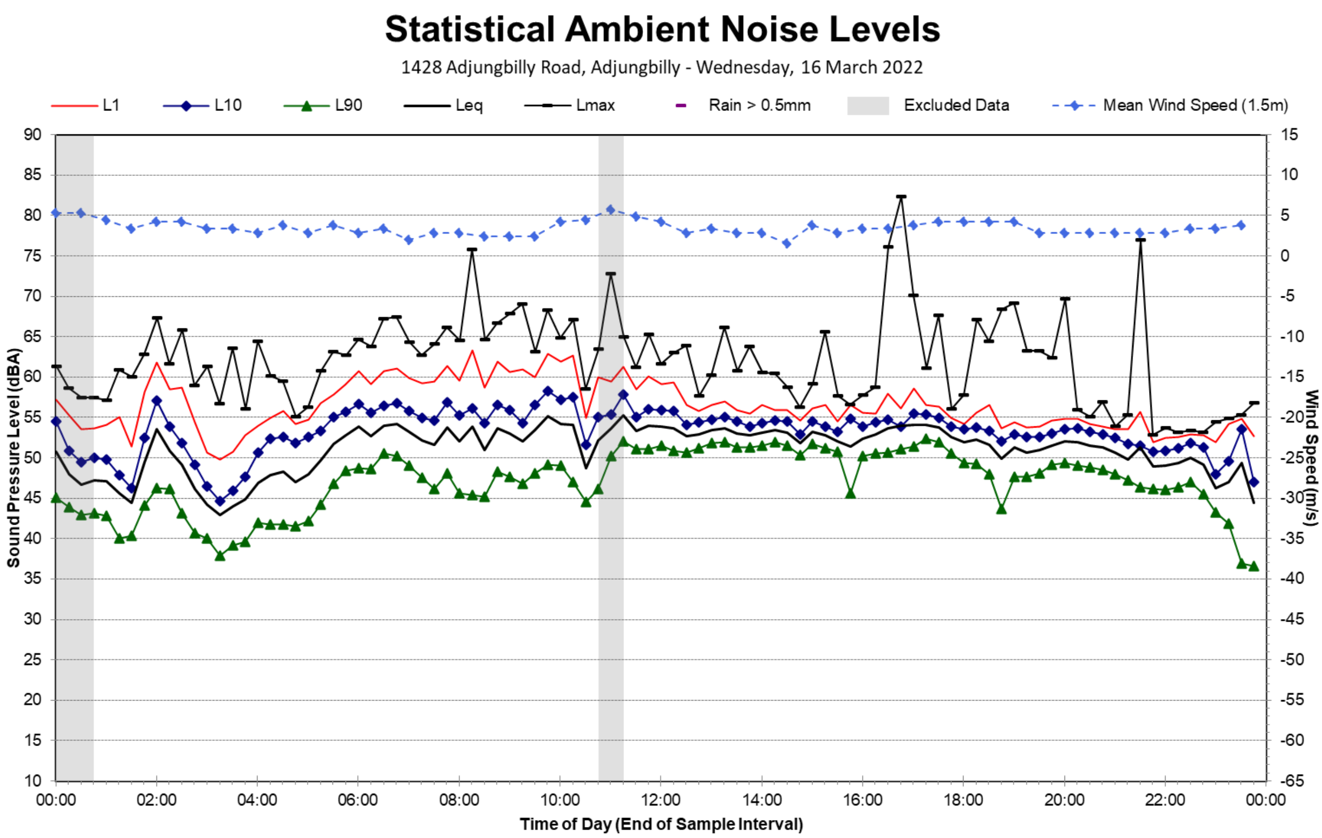
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
28/03/2022	13:13	43	46	62

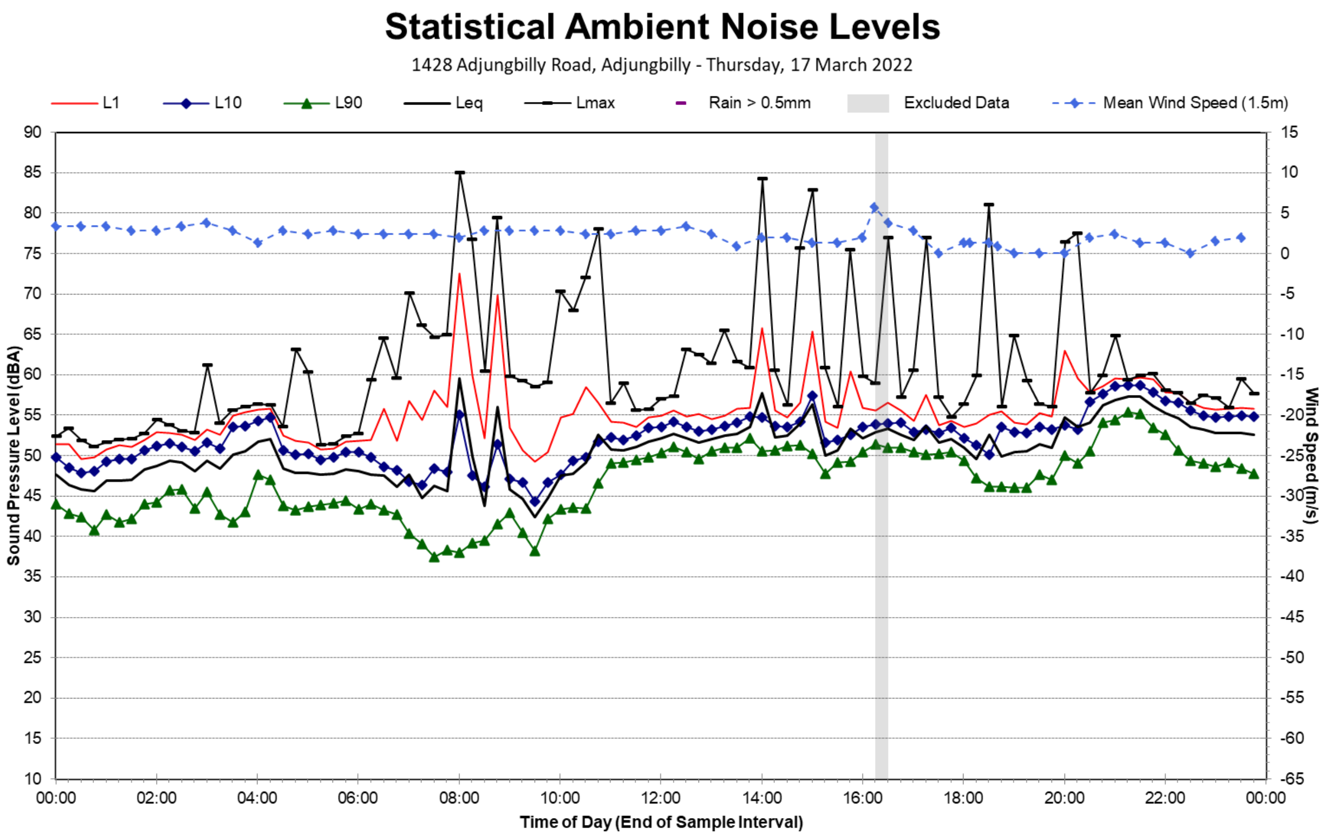
Photo of Noise Monitoring Location

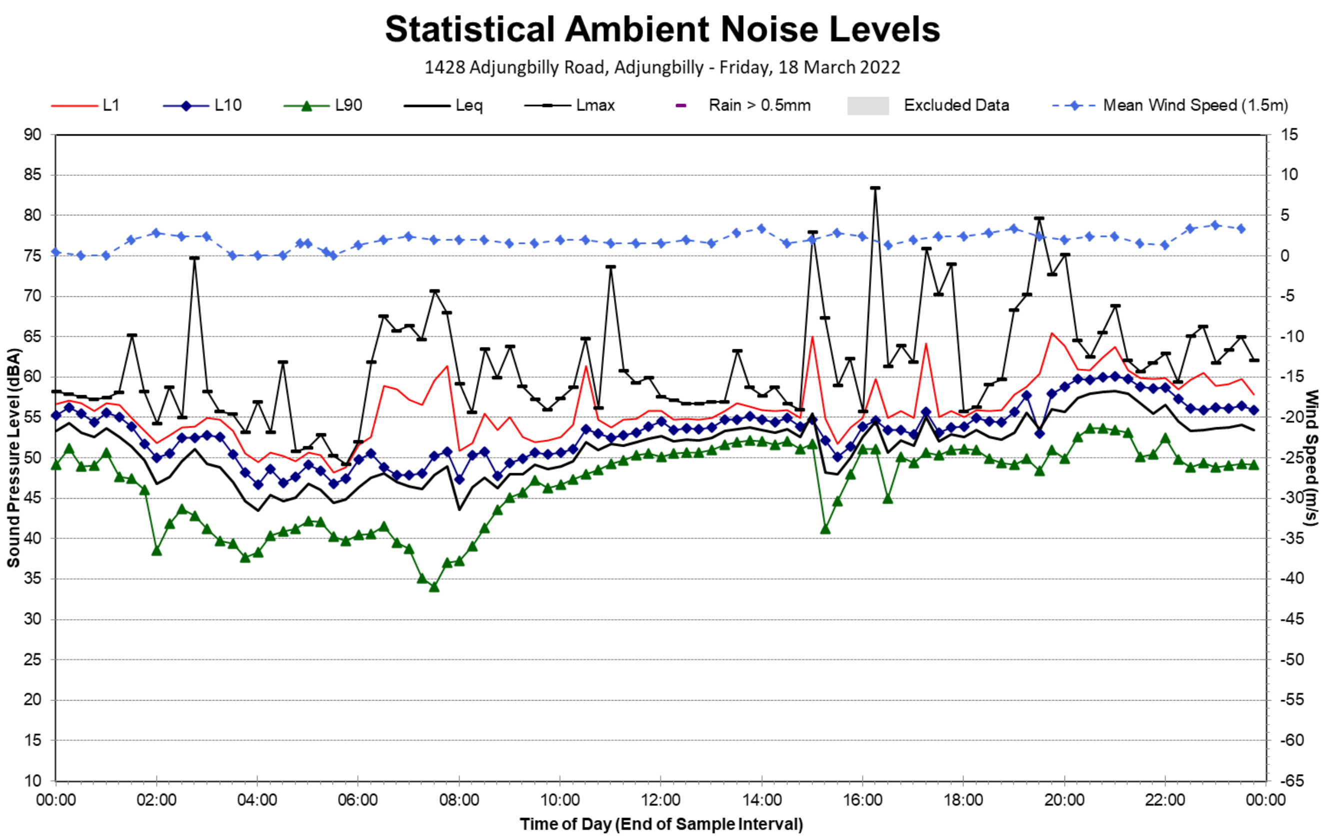


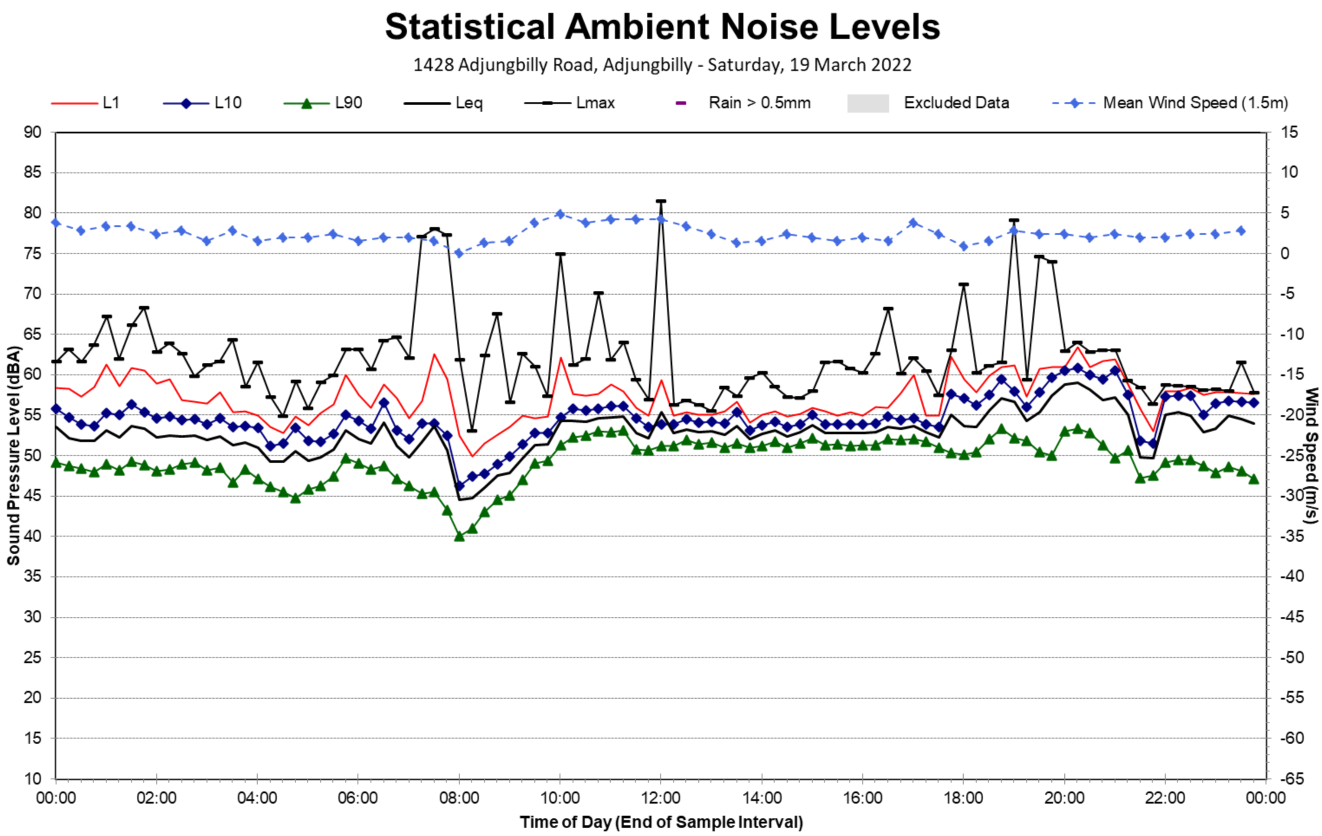
Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Tuesday, 15 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



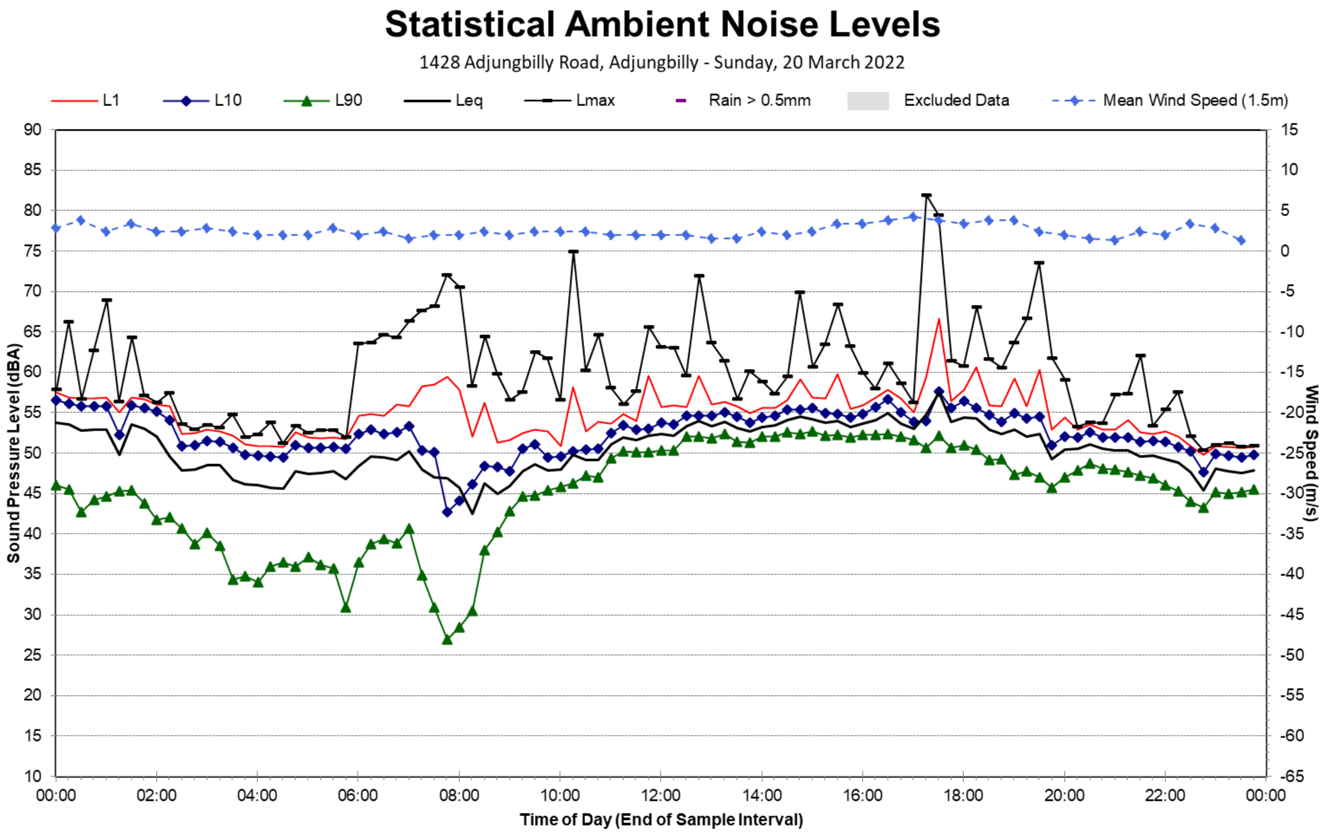
Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Wednesday, 16 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Thursday, 17 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

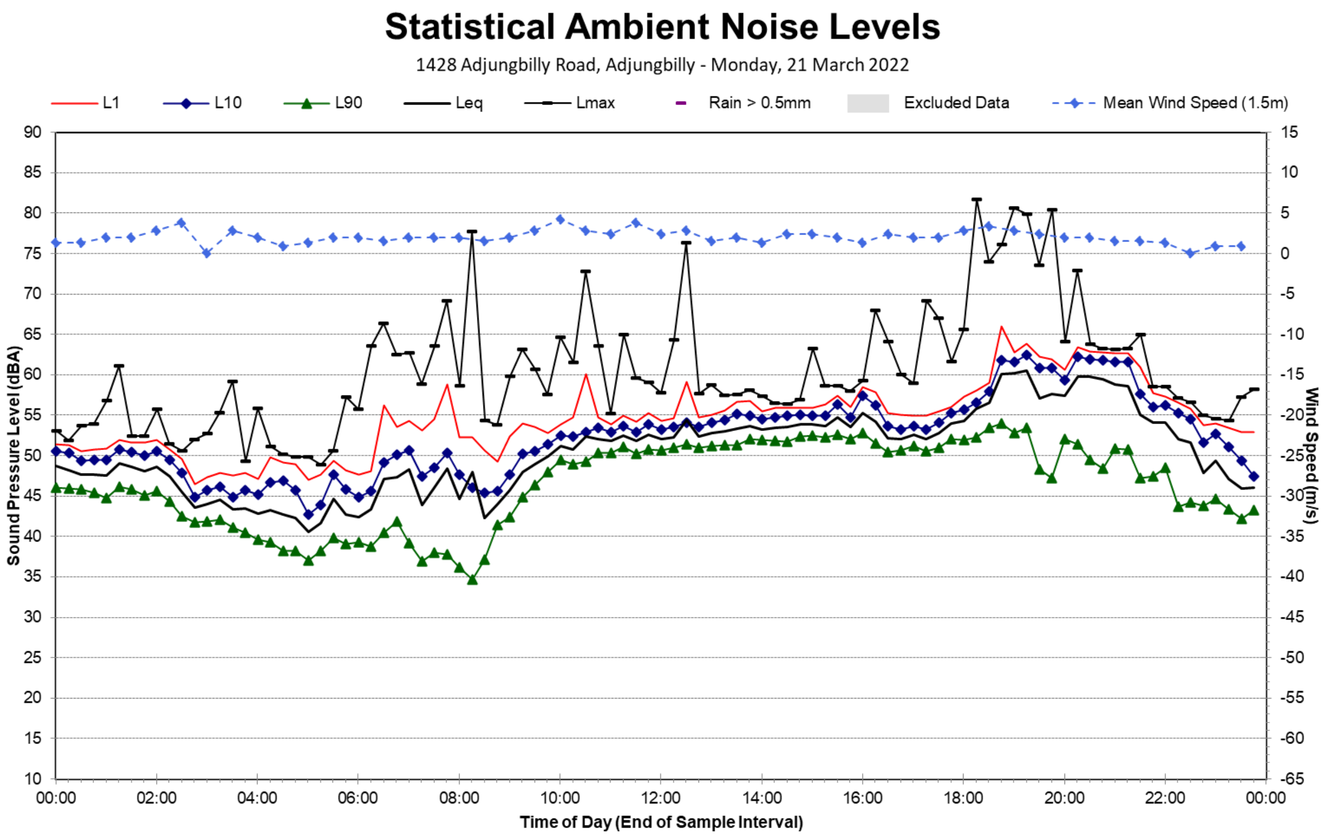

Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Friday, 18 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

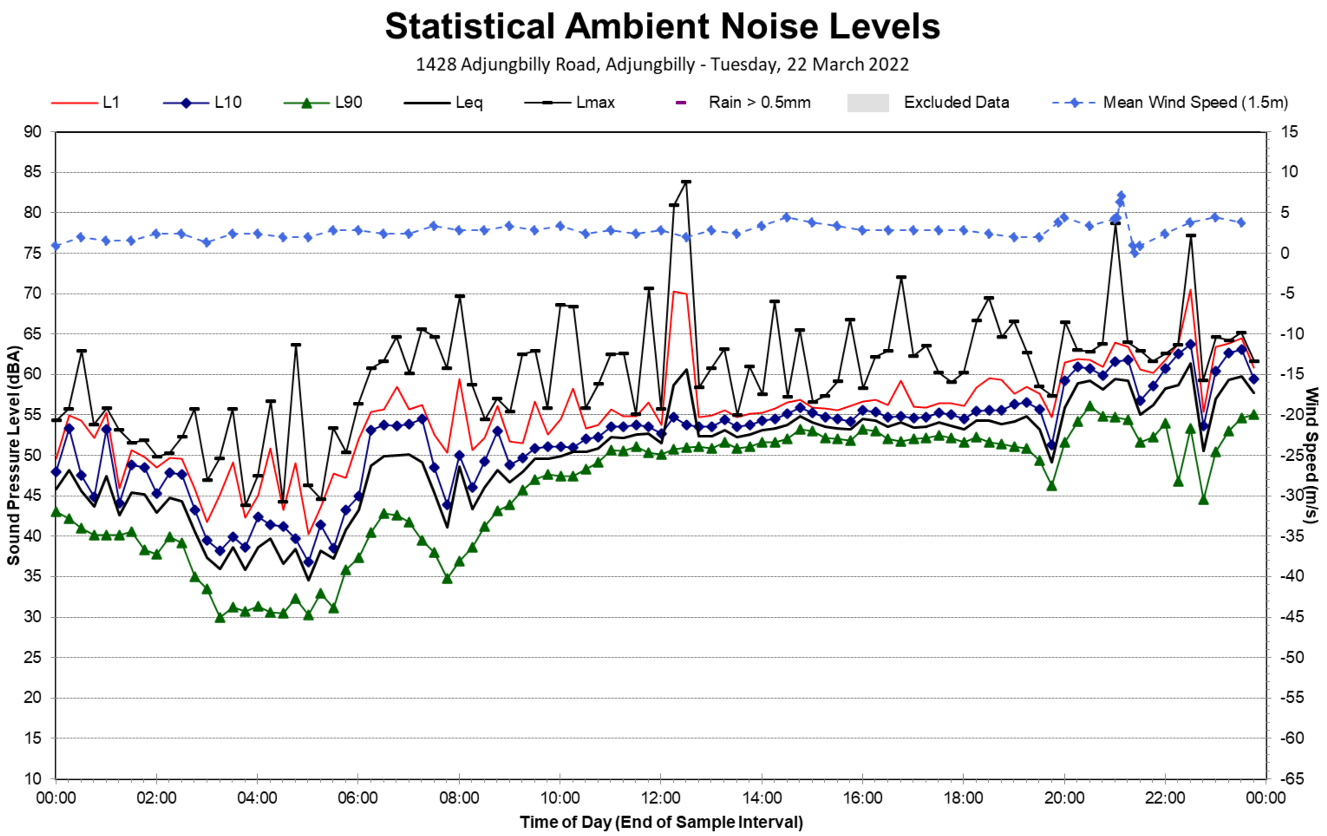


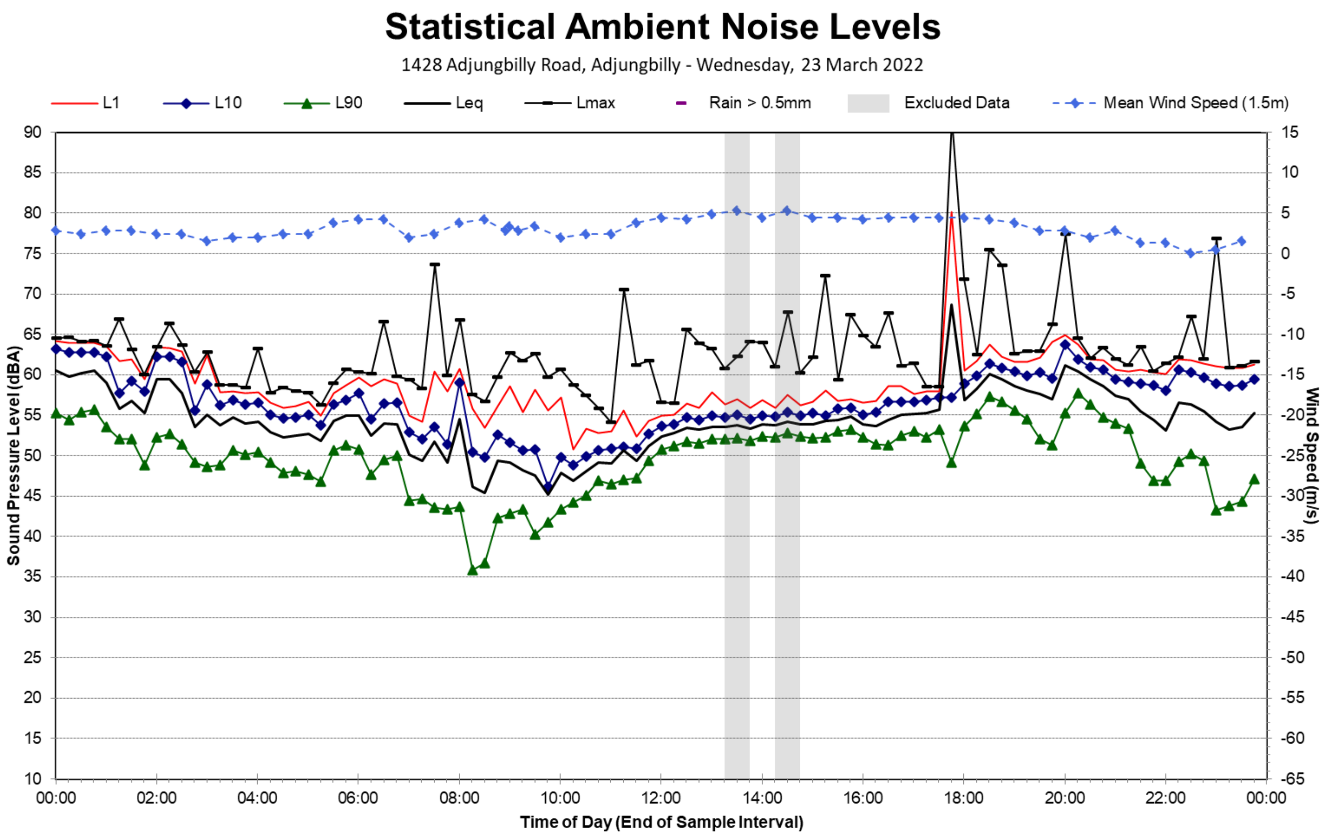
Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Saturday, 19 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

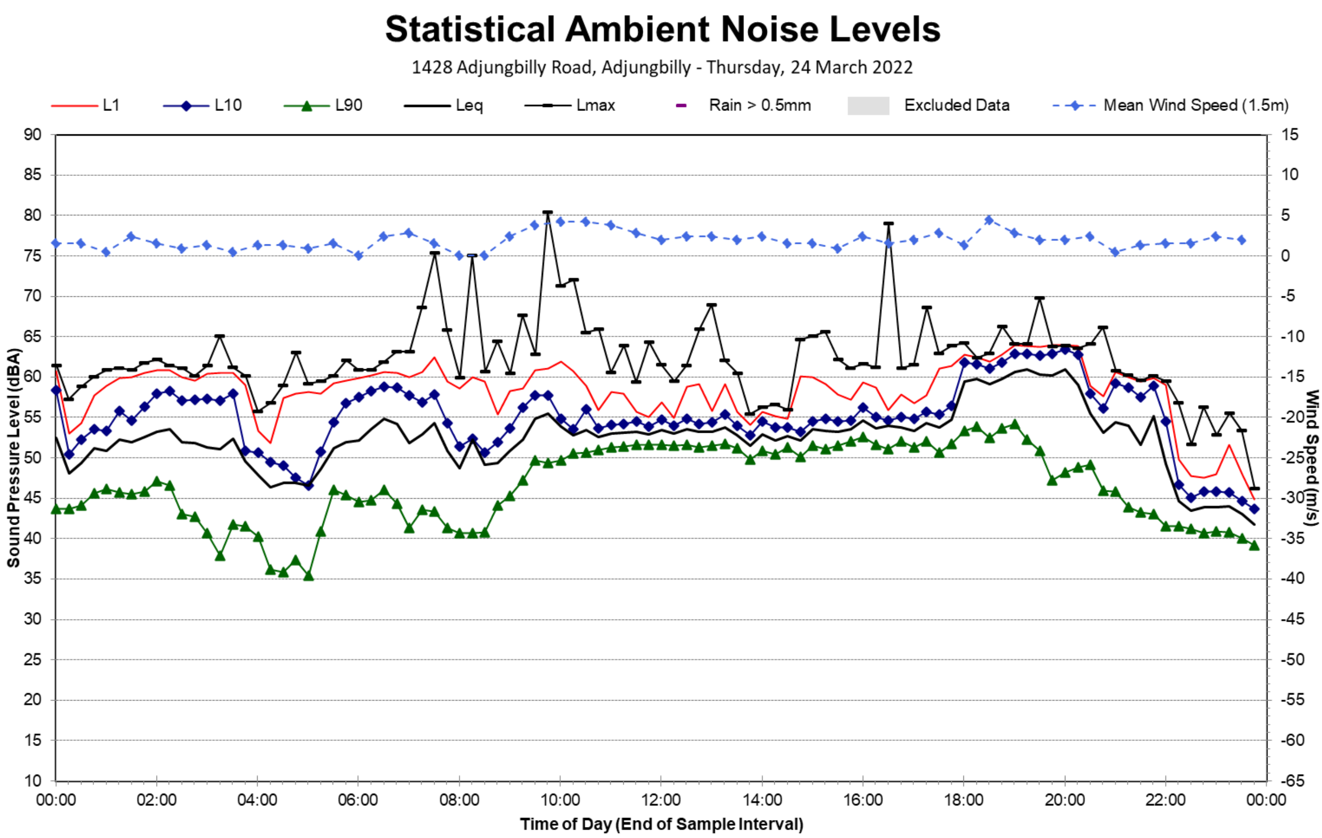


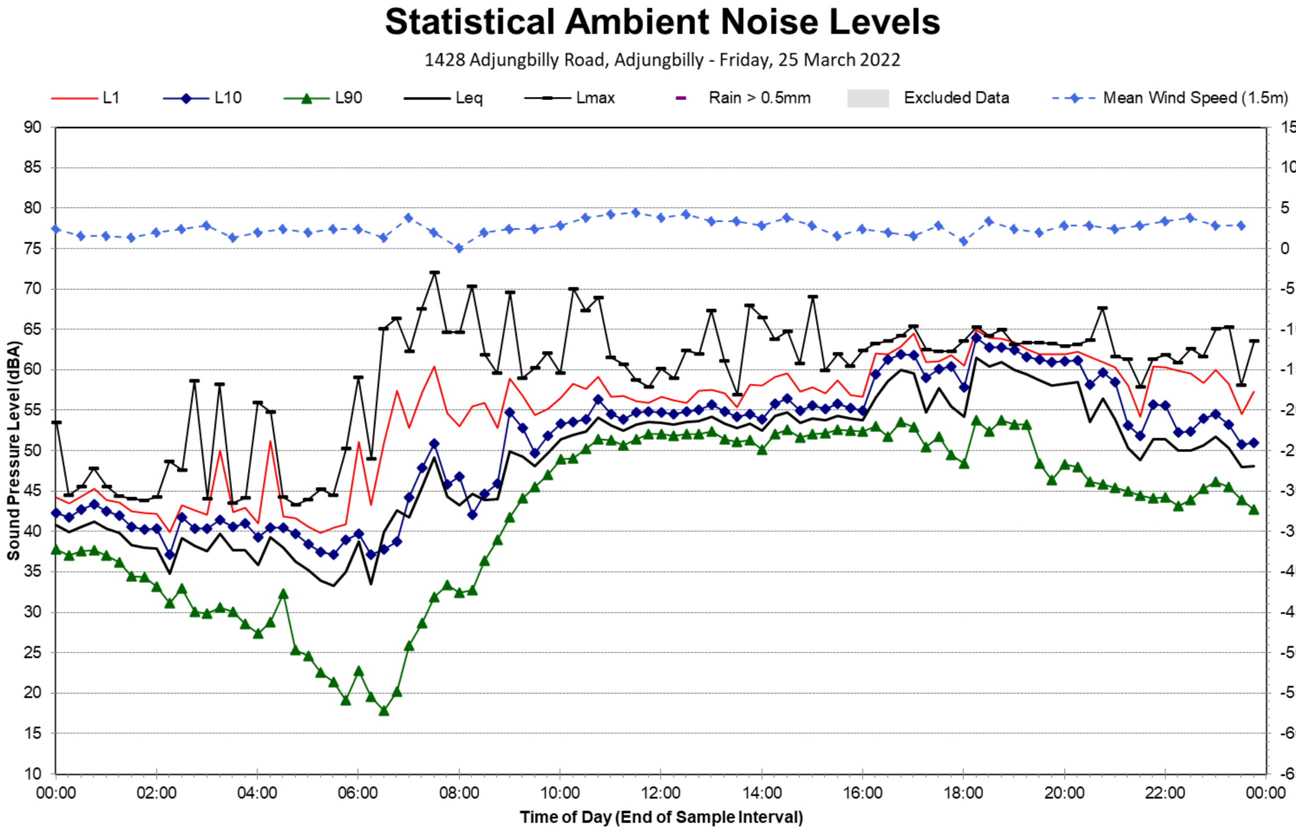
Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Sunday, 20 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

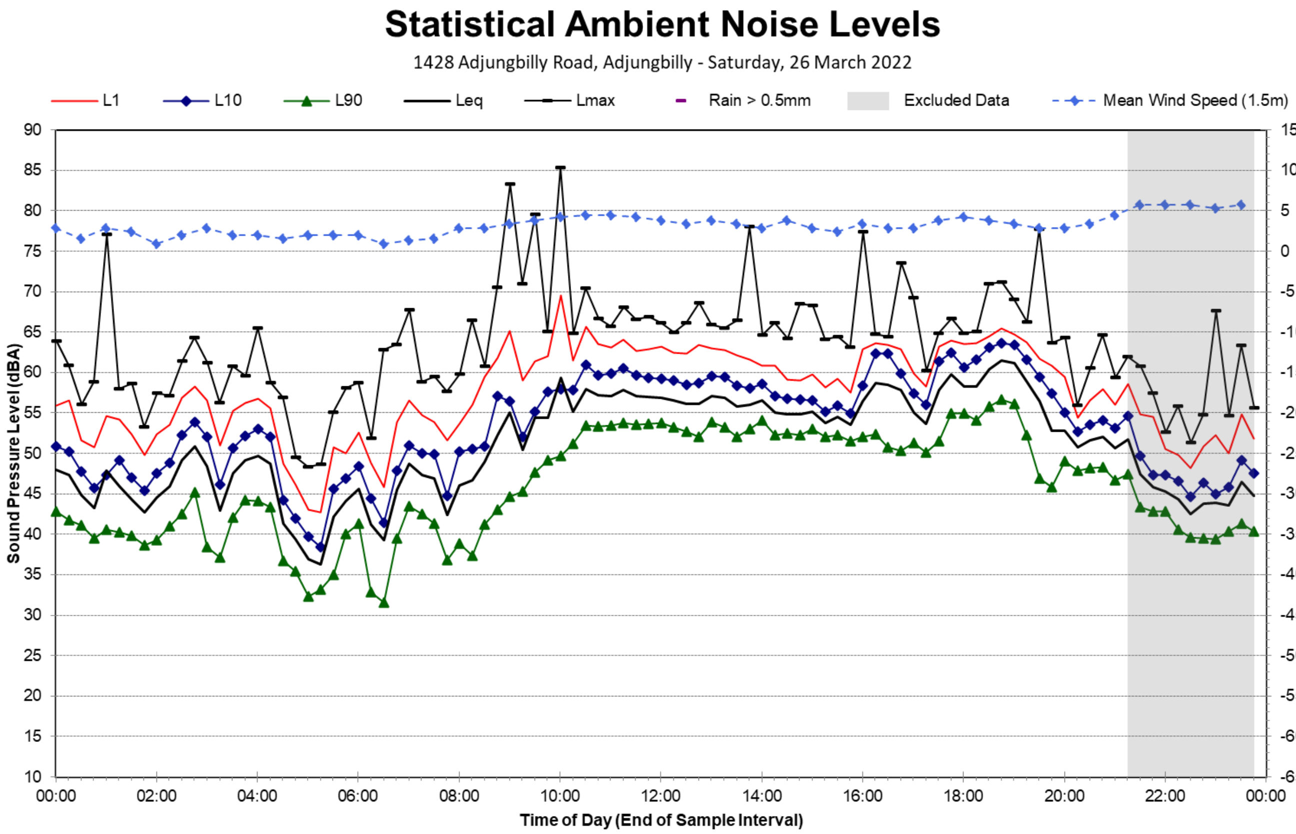

Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Monday, 21 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

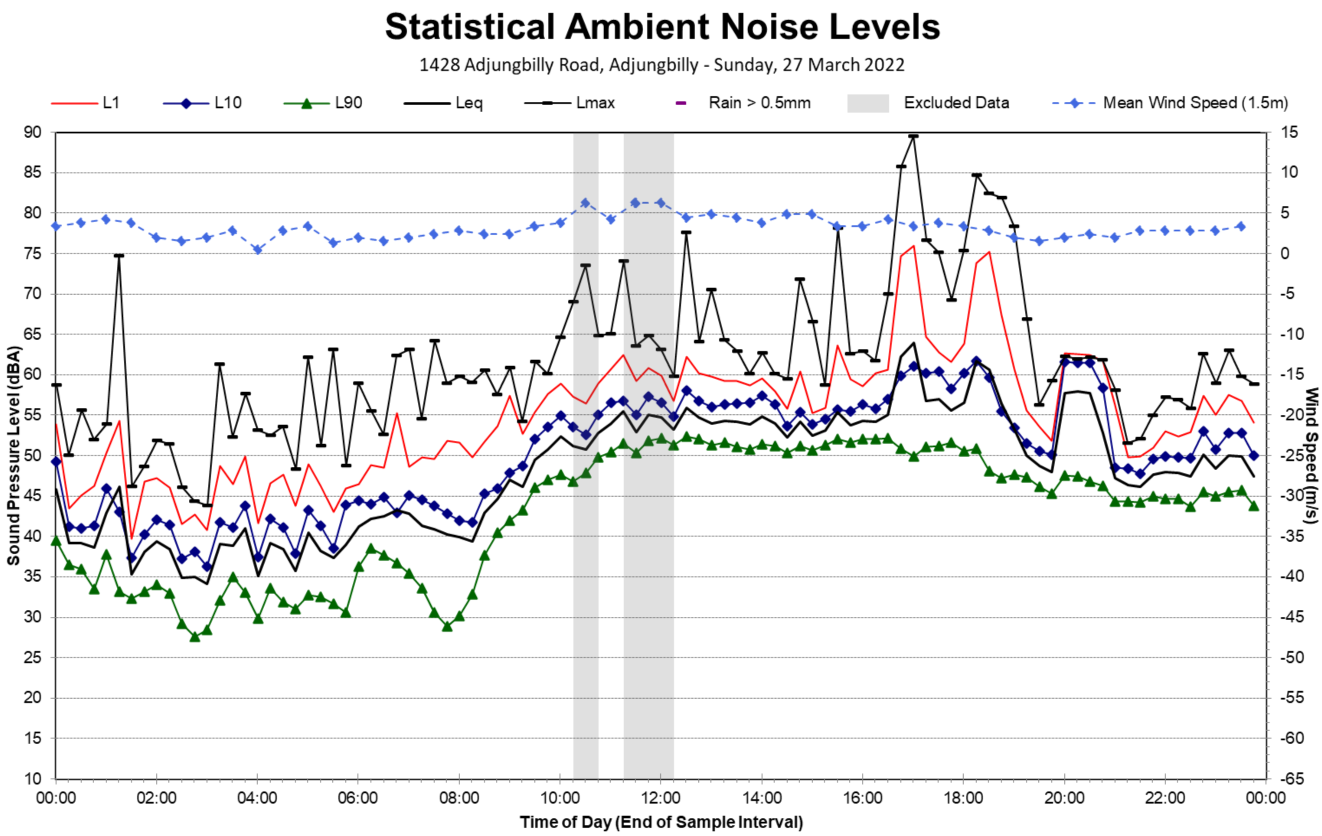

Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Tuesday, 22 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

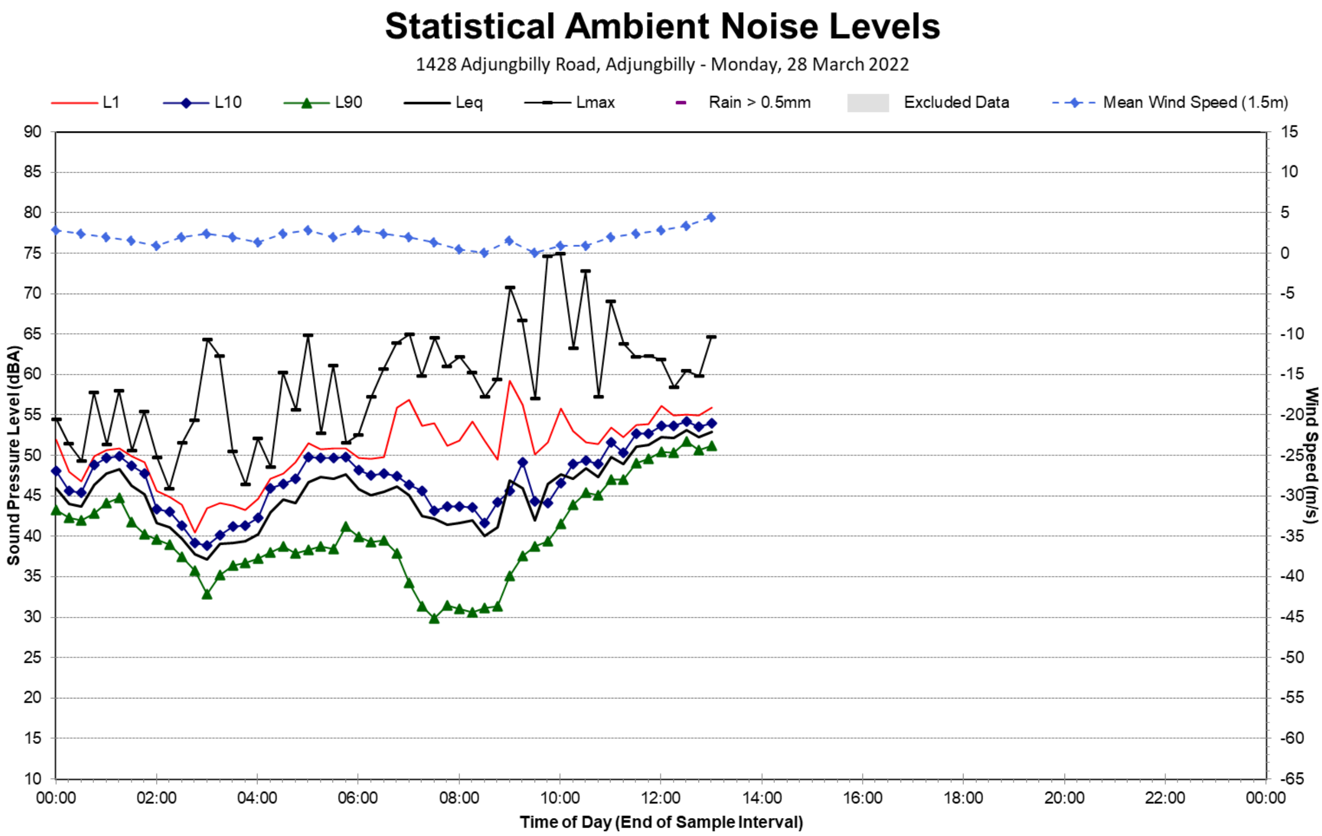

Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Wednesday, 23 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Thursday, 24 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Friday, 25 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Saturday, 26 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Sunday, 27 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
1428 Adjungbilly Road, Adjungbilly - Monday, 28 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.05
Noise Monitoring Address	**Hanworth Road, Bannaby**

Logger Device Type: Svantek 957, Logger Serial No: 23241
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3005904

Ambient noise logger deployed south of Hanworth Road, Bannaby, around 2 km northwest of the existing Bannaby 500 kV substation. Logger located with view of Hanworth Road to the north.

Attended noise measurements indicate the ambient noise environment at this location is influenced by wildlife noise, such as birds and insects, and by occasional aircraft noise.

Recorded Noise Levels (LAmax) 28/03/2022:

Aircraft: 35-45 dBA
Wind: 30-35 dBA
Birds: 30-41 dBA
Insects: 30-35 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	**LAeq**	**L10**	**L1**
Daytime	26	44	42	45
Evening	27	39	41	46
Night-time	20	46	39	43

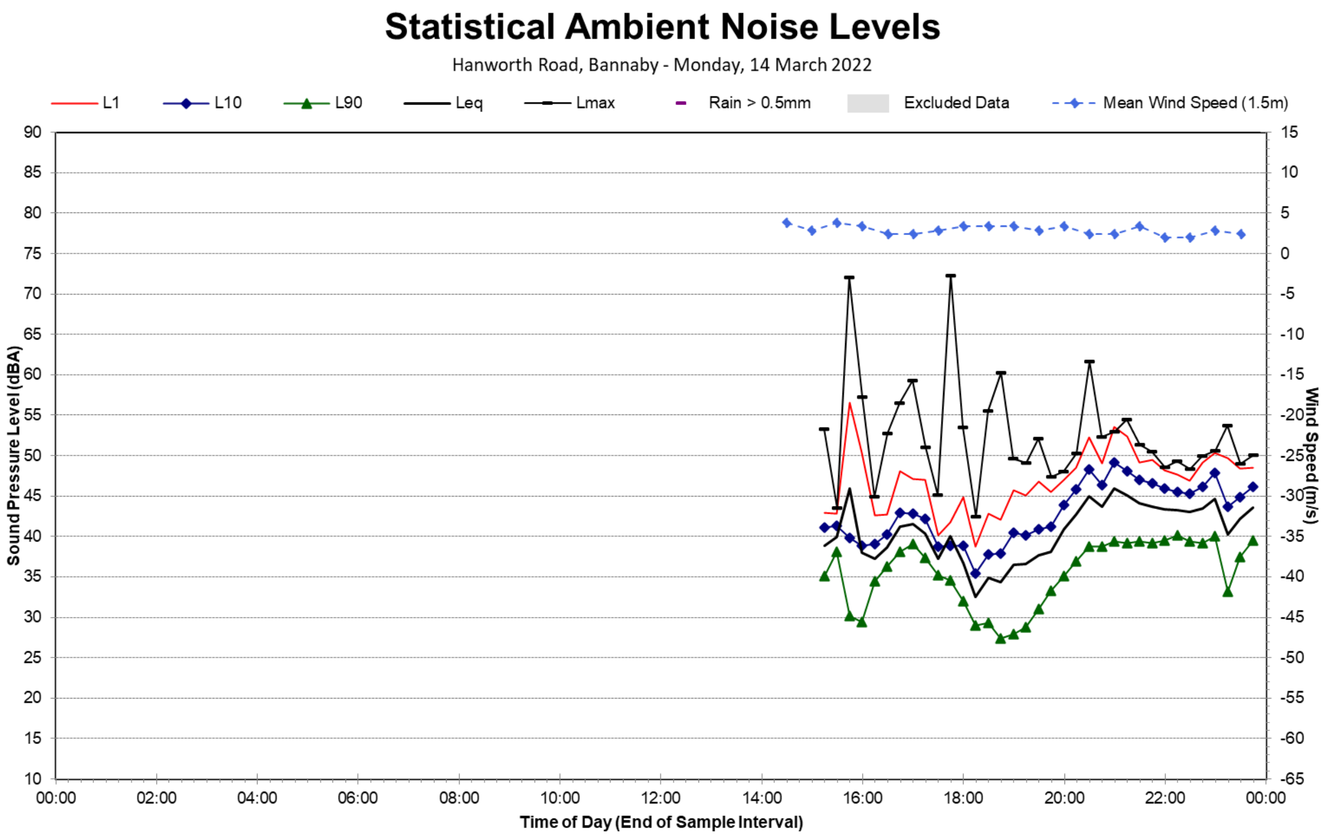
Ambient Noise Logging Results – RNP Defined Time Periods

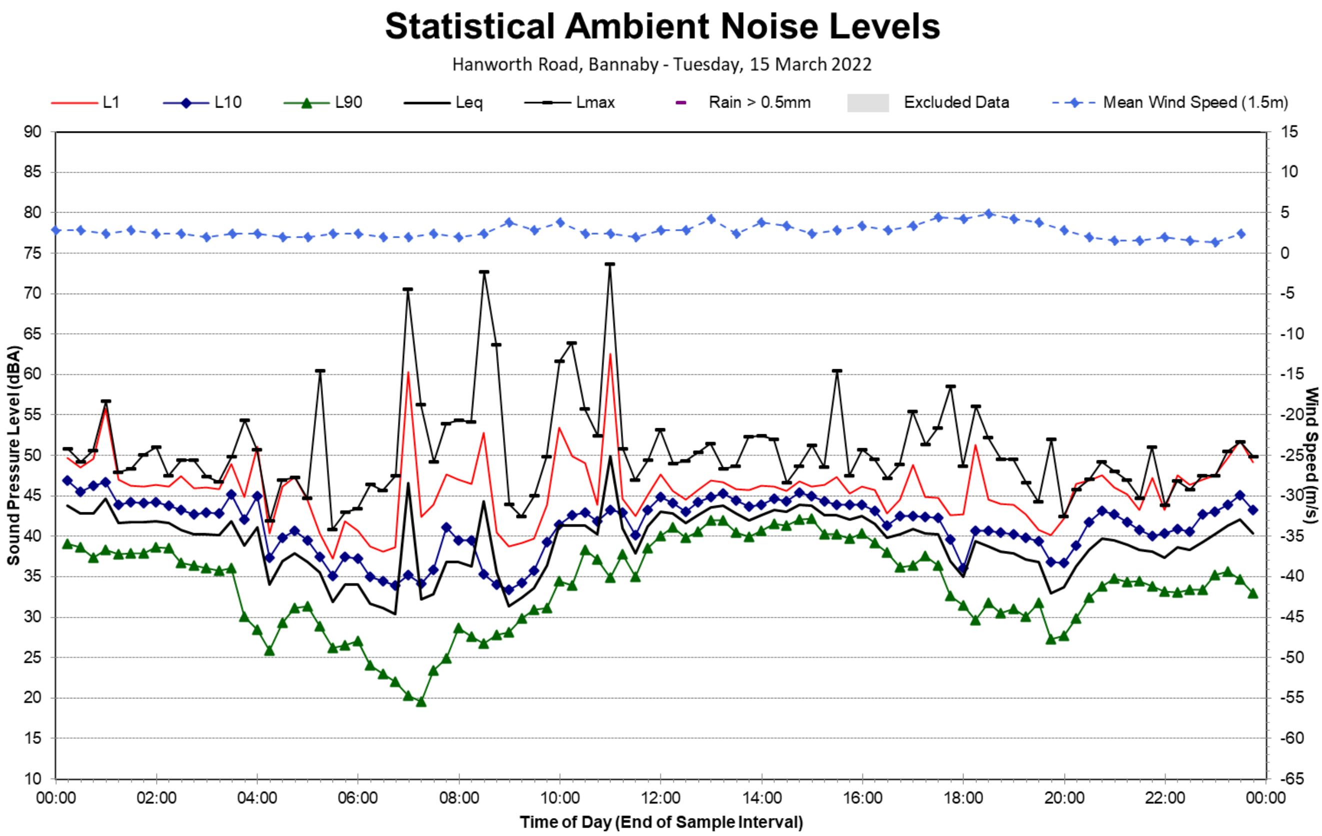
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	**LAeq(1hour)**
Daytime (7am-10pm)	43	43
Night-time (10pm-7am)	46	39

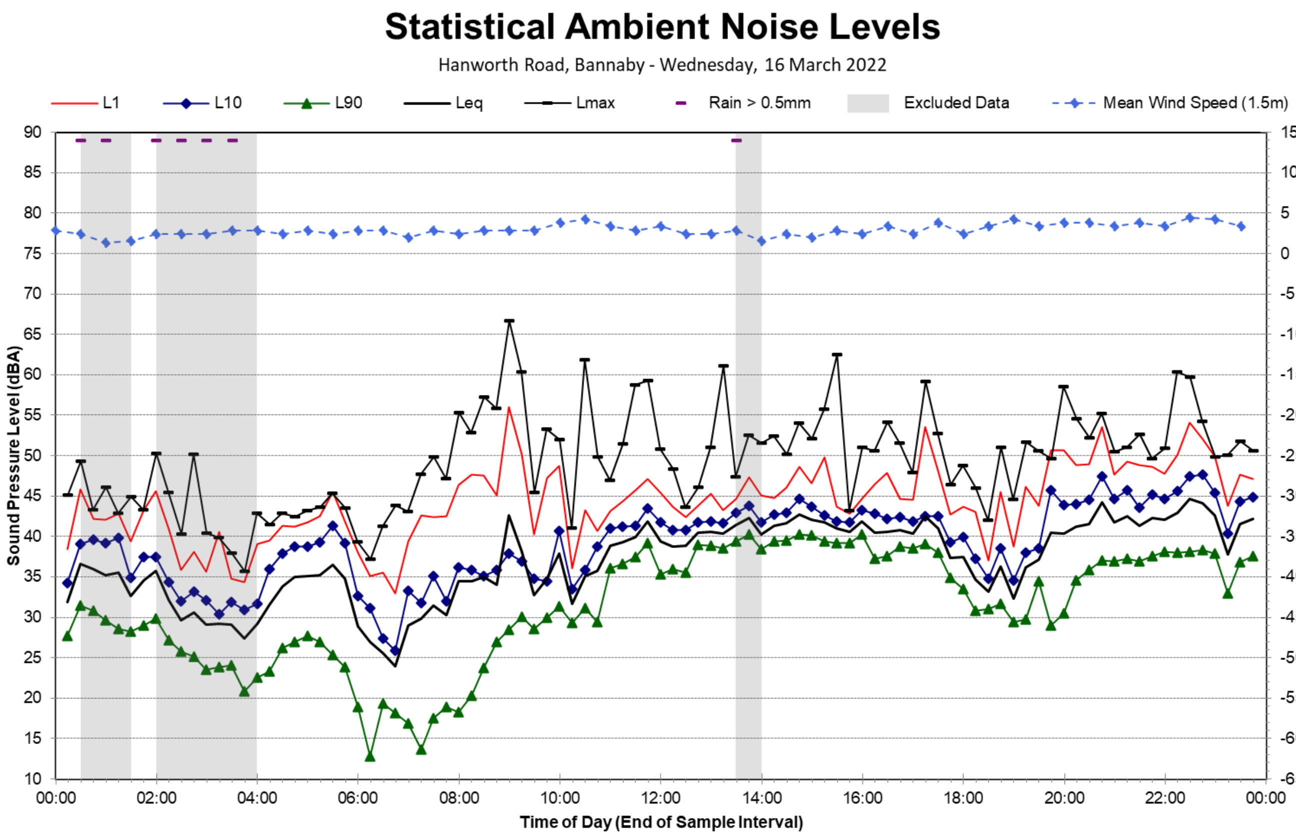
Attended Noise Measurement Results

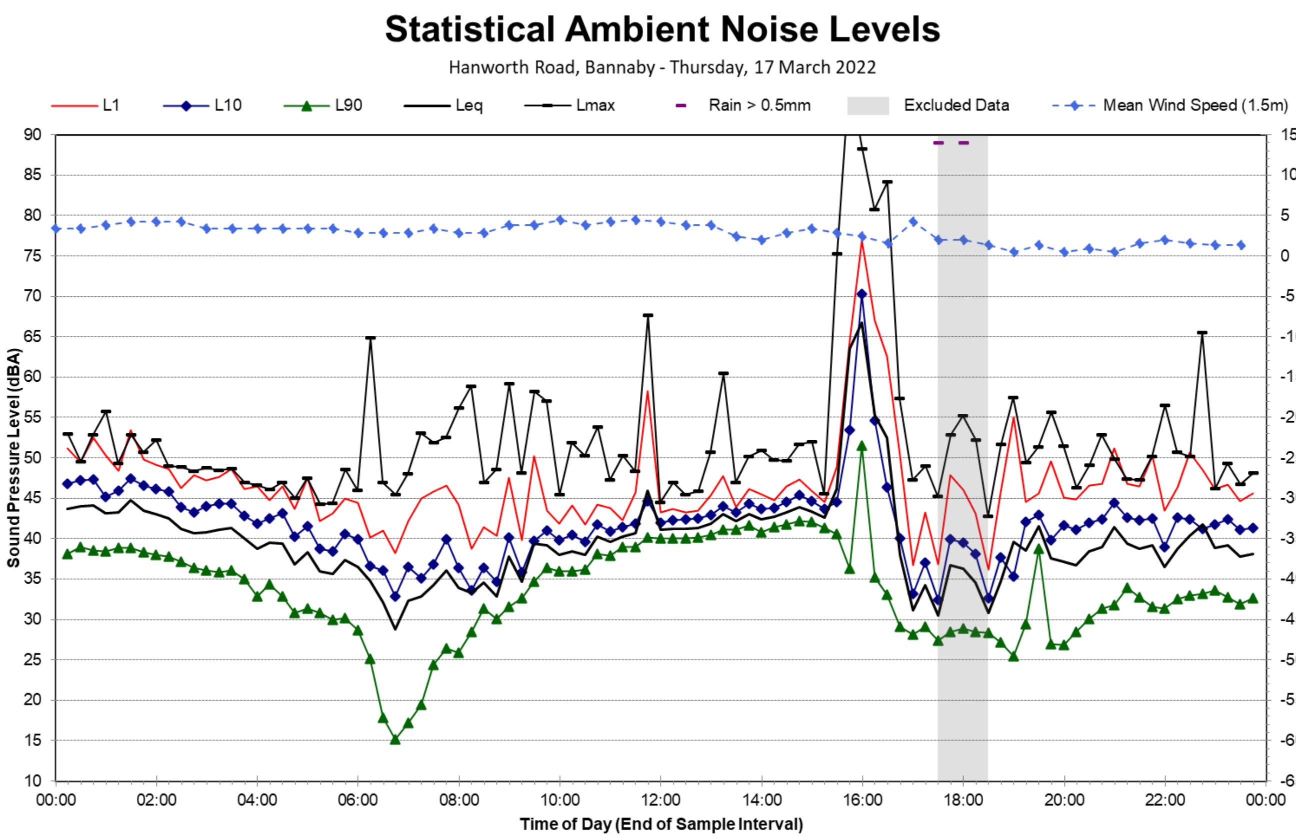
Date	Start Time	Measured Noise Level (dBA)		
		LA90	**LAeq**	**LAmax**
28/03/2022	09:29	31	35	67

Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Monday, 14 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

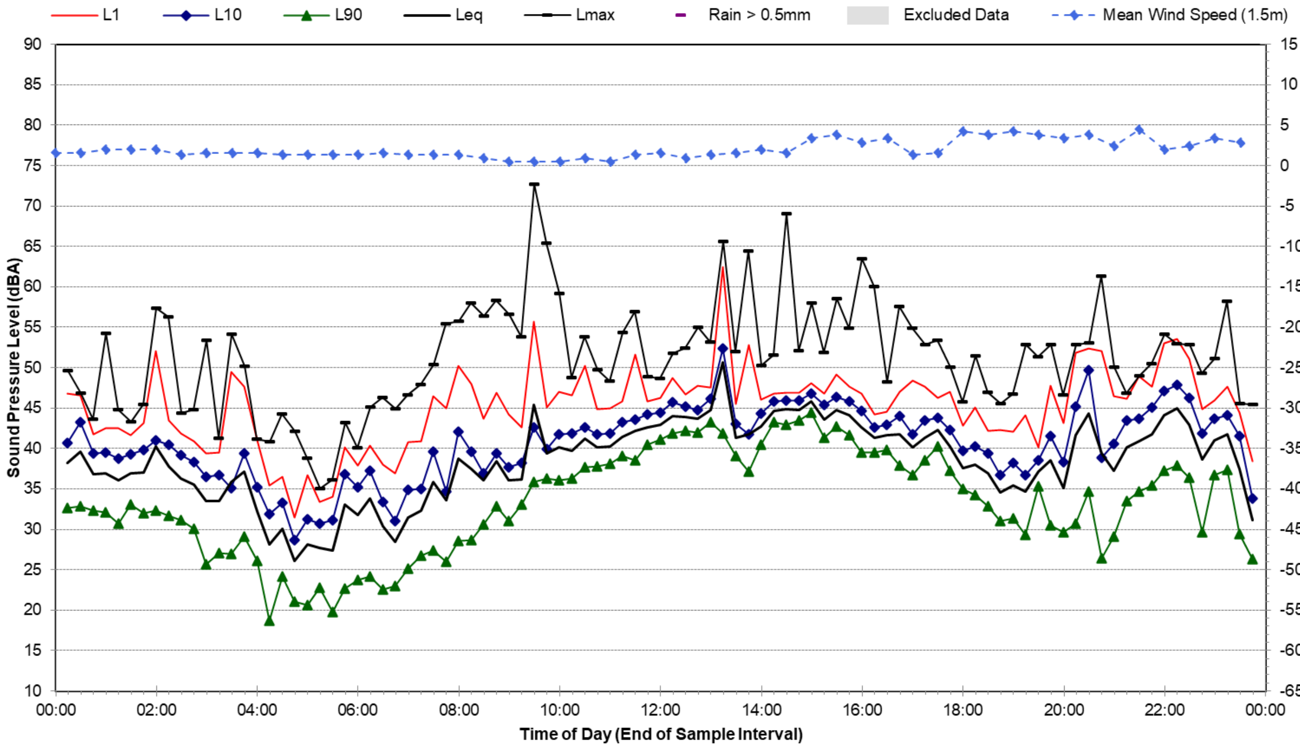

Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Tuesday, 15 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Wednesday, 16 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Thursday, 17 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

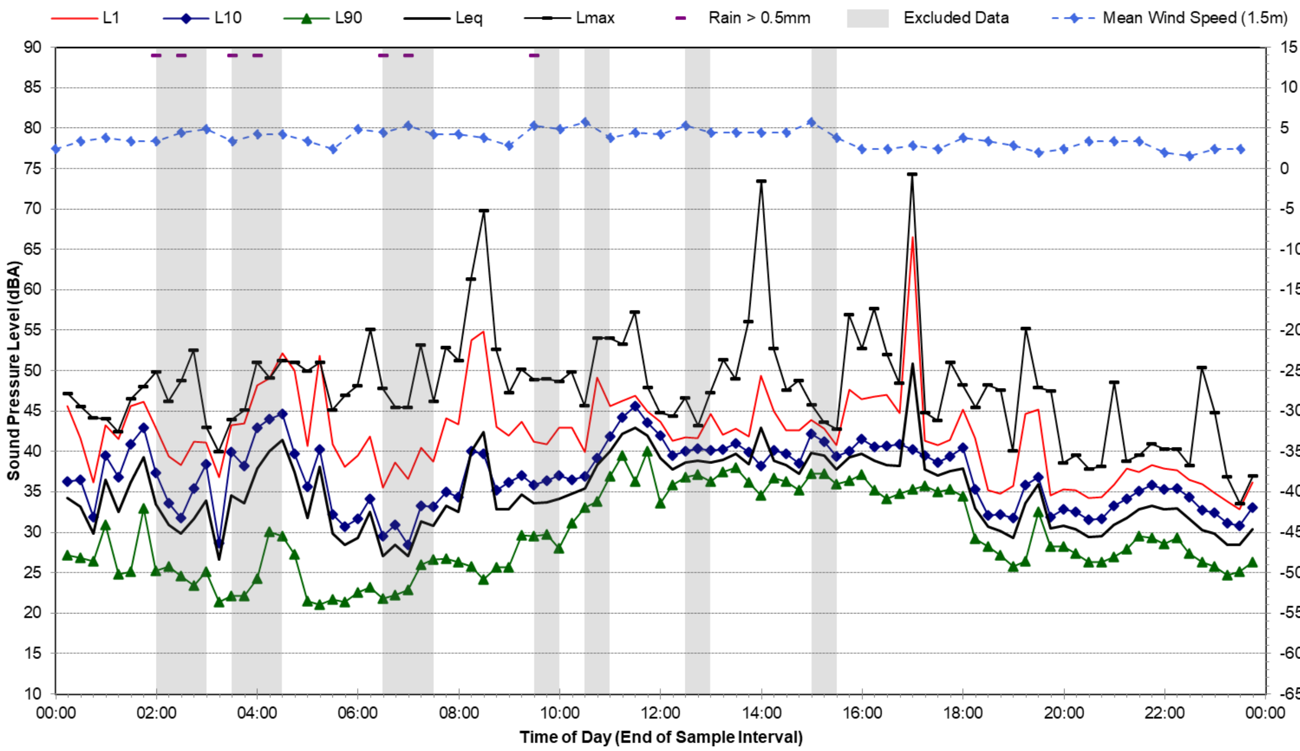
Statistical Ambient Noise Levels

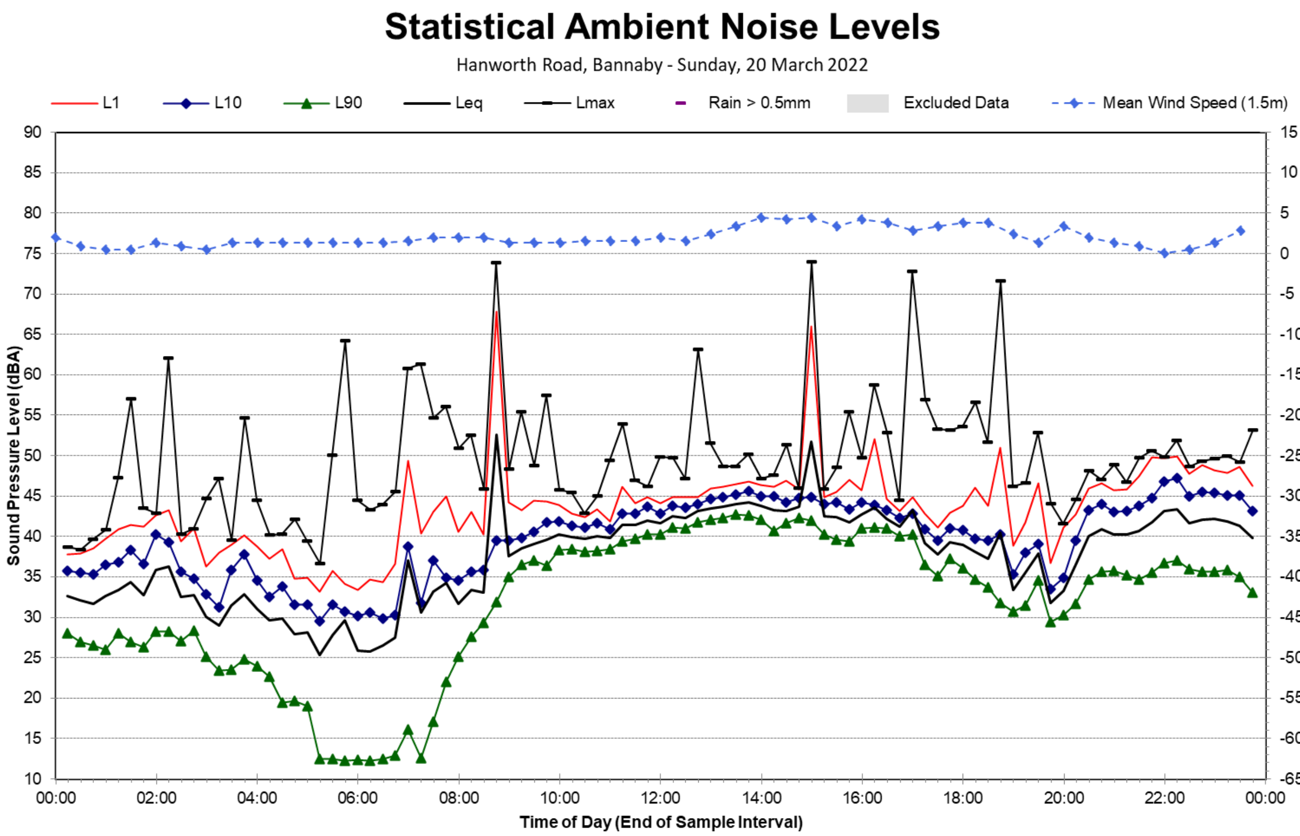
Hanworth Road, Bannaby - Friday, 18 March 2022

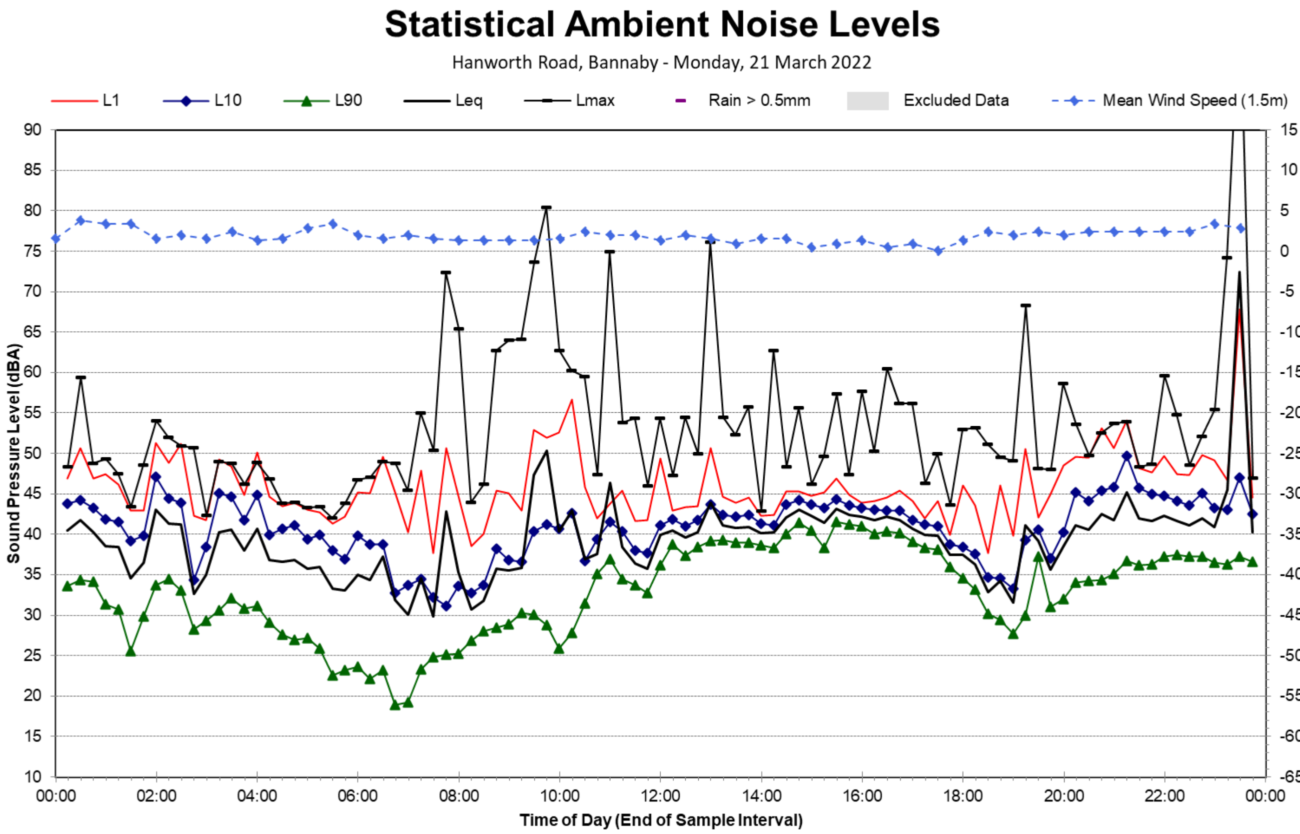


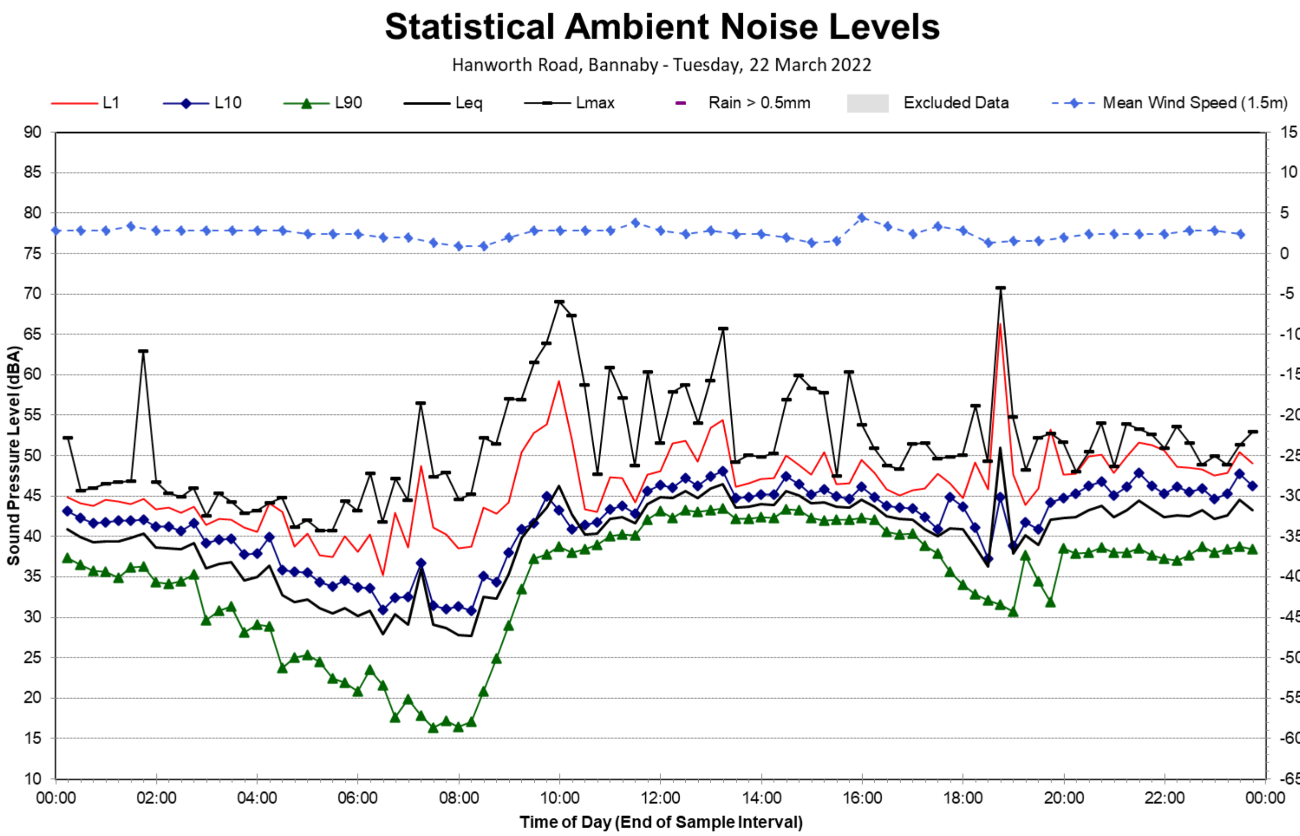
Statistical Ambient Noise Levels

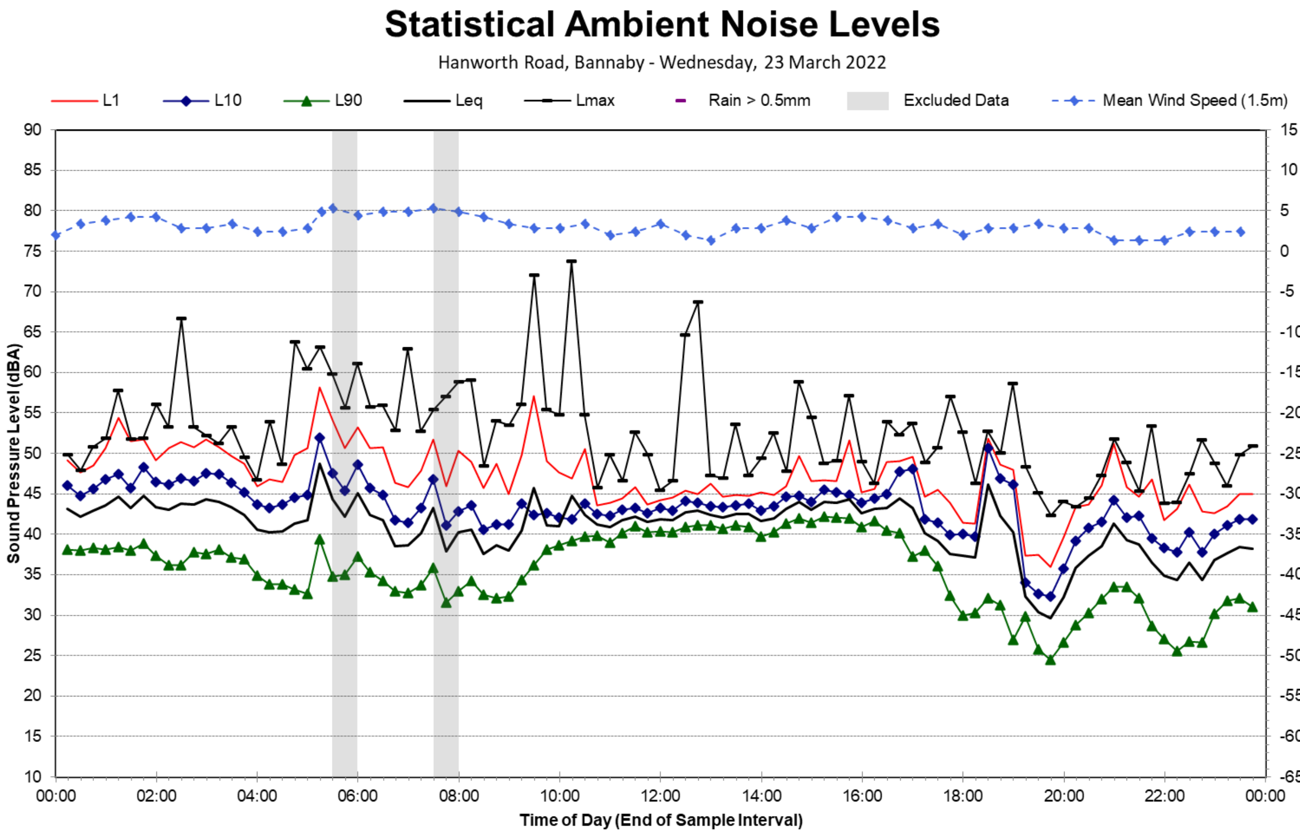
Hanworth Road, Bannaby - Saturday, 19 March 2022

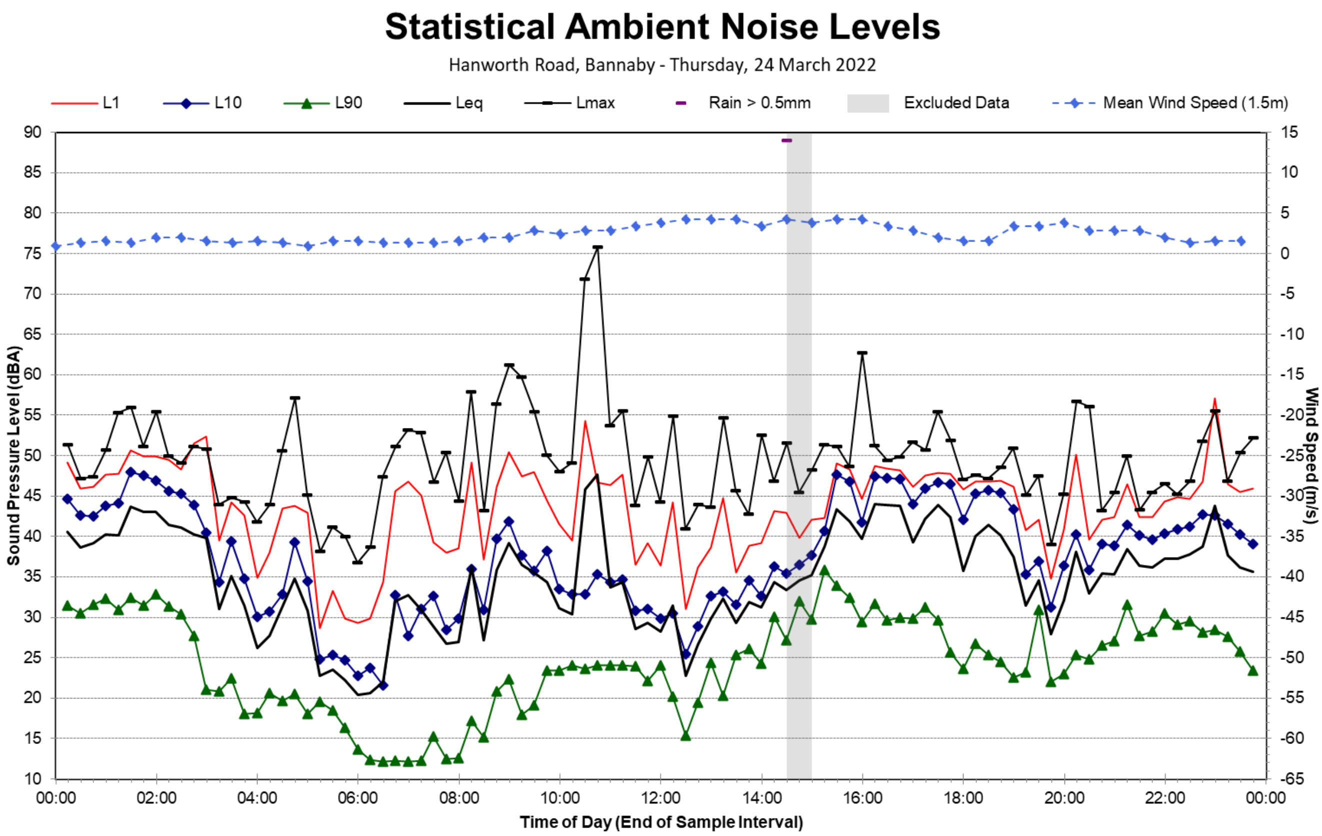



Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Sunday, 20 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

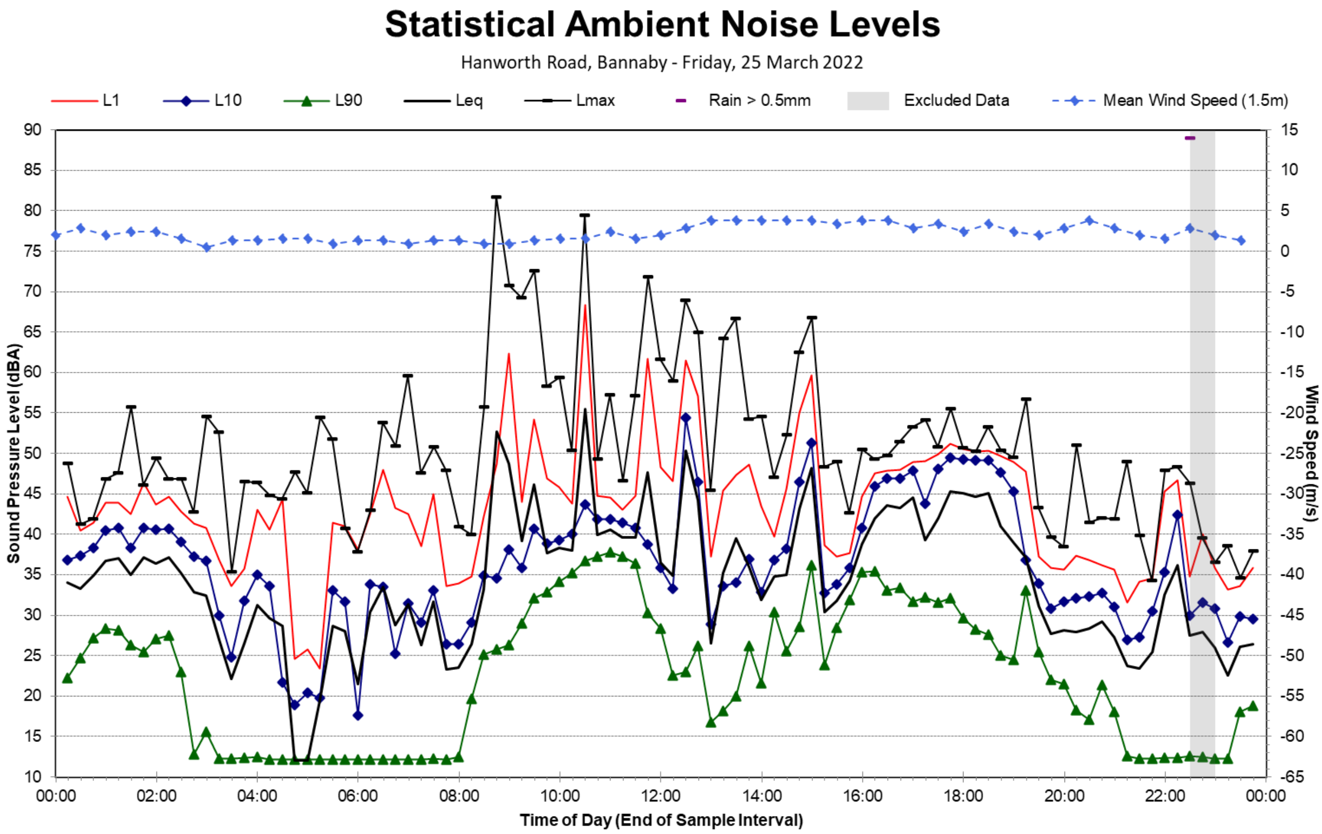

Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Monday, 21 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Tuesday, 22 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Wednesday, 23 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



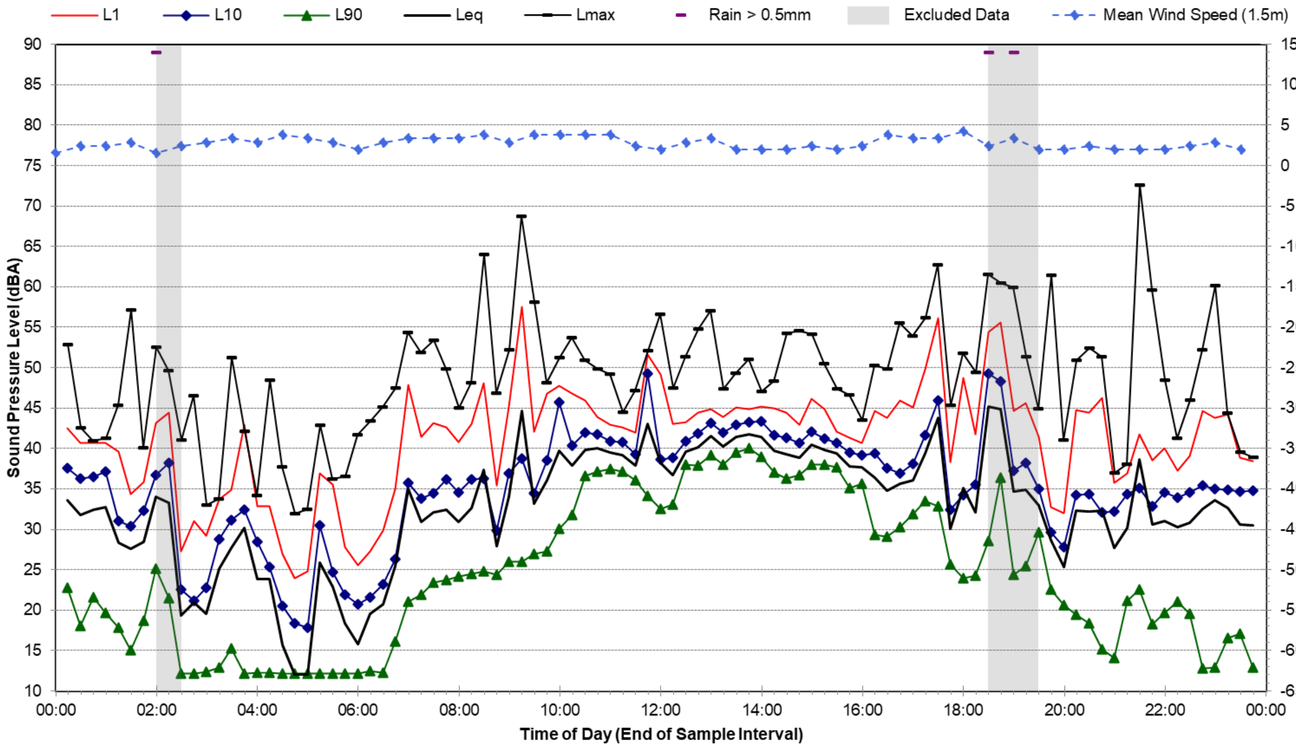
Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Thursday, 24 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Friday, 25 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

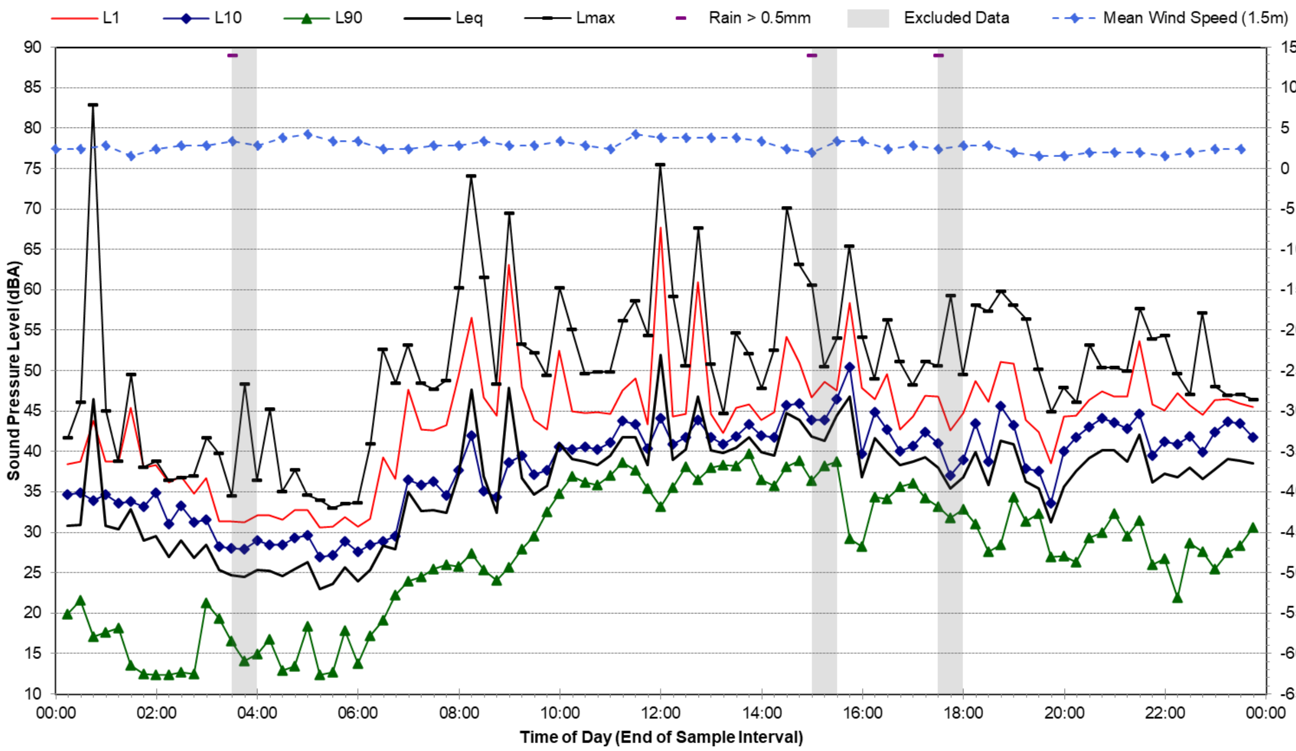
Statistical Ambient Noise Levels

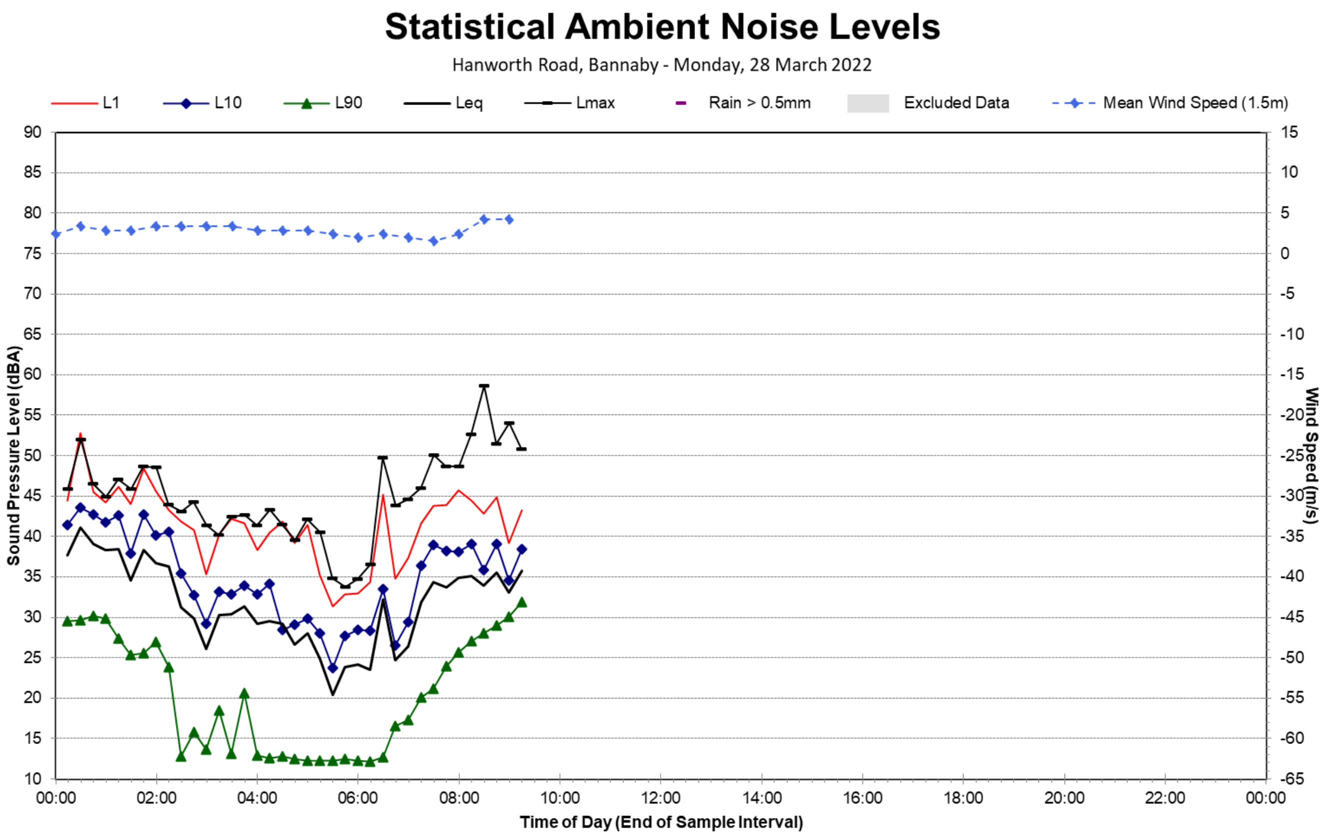
Hanworth Road, Bannaby - Saturday, 26 March 2022



Statistical Ambient Noise Levels

Hanworth Road, Bannaby - Sunday, 27 March 2022





Statistical Ambient Noise Levels
Hanworth Road, Bannaby - Monday, 28 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.06
Noise Monitoring Address	**14 Memorial Avenue, Batlow**

Logger Device Type: Svantek 957, Logger Serial No: 27578
Sound Level Meter Device Type: Rion NA-28, Sound Level Meter Serial No: 106005

Ambient noise logger deployed at 14 Memorial Avenue, Batlow. Logger located with view of Memorial Avenue to the north.

Attended noise measurements indicate the ambient noise environment at this location is influenced by road traffic noise and wildlife noise.

Recorded Noise Levels (LAmax) 16/08/2022:

Road traffic noise: 43-46 dBA
Insects: 40 dBA
Birds: 40-47 dBA
Distant construction: 38 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	35	60	46	52
Evening	35	53	43	46
Night-time	32	49	38	43

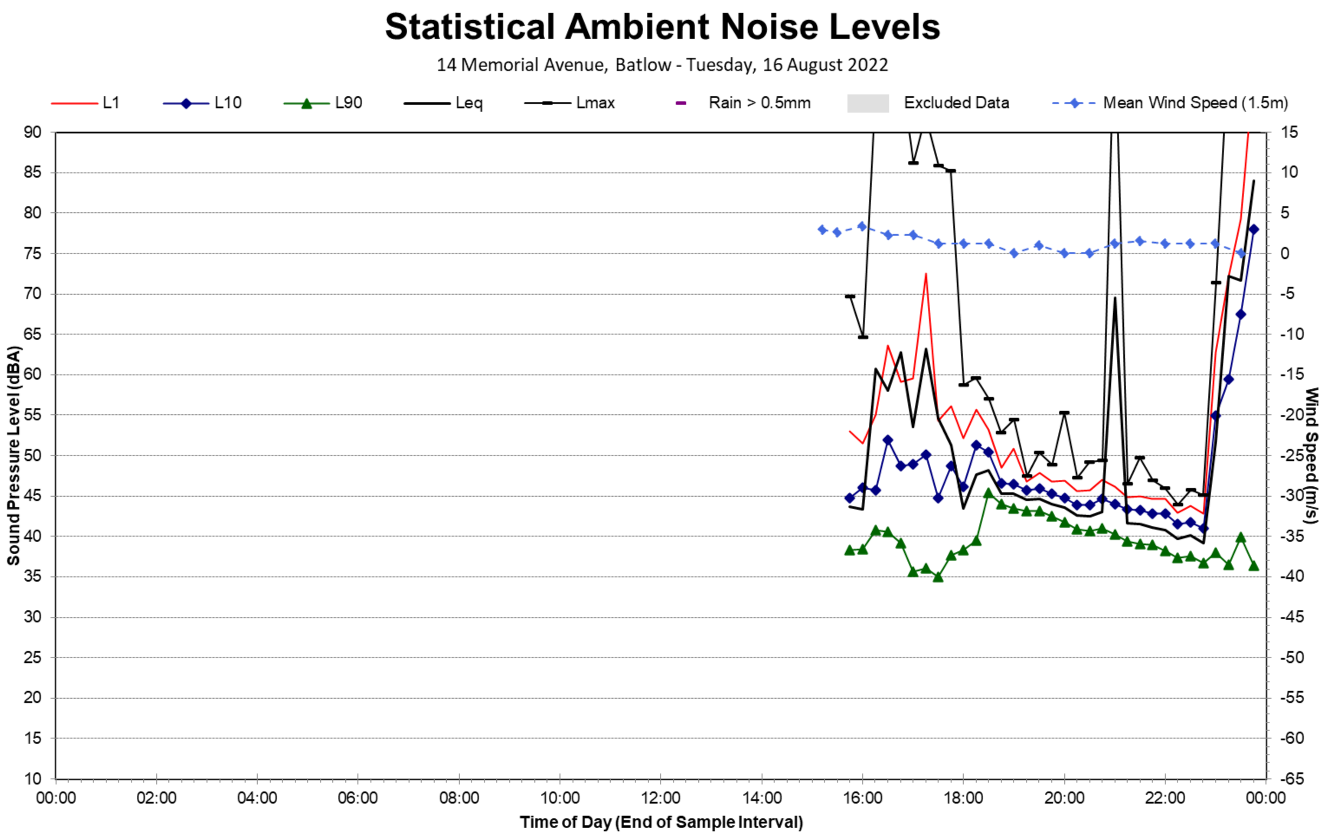
Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	59	51
Night-time (10pm-7am)	59	46

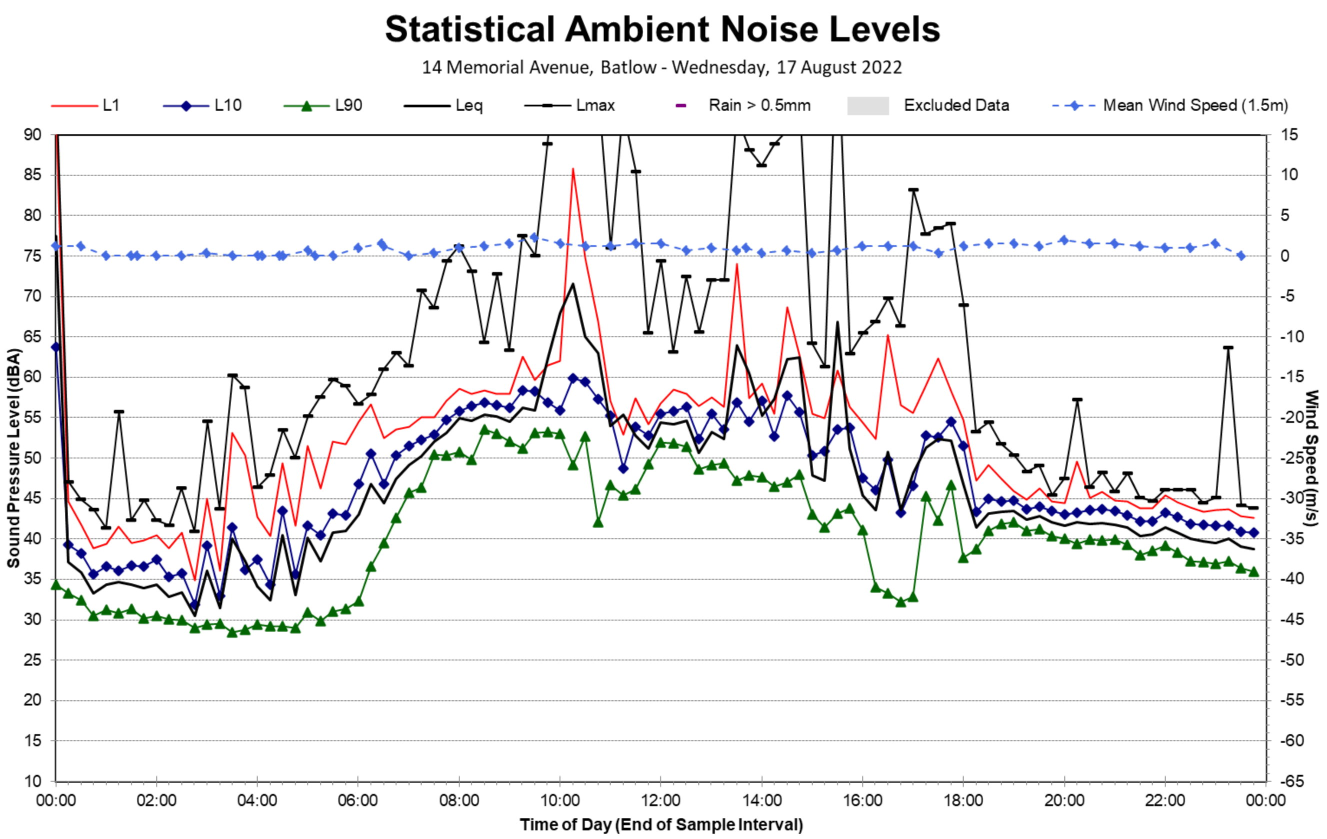
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
16/08/2022	15:02	37	44	66

Photo of Noise Monitoring Location



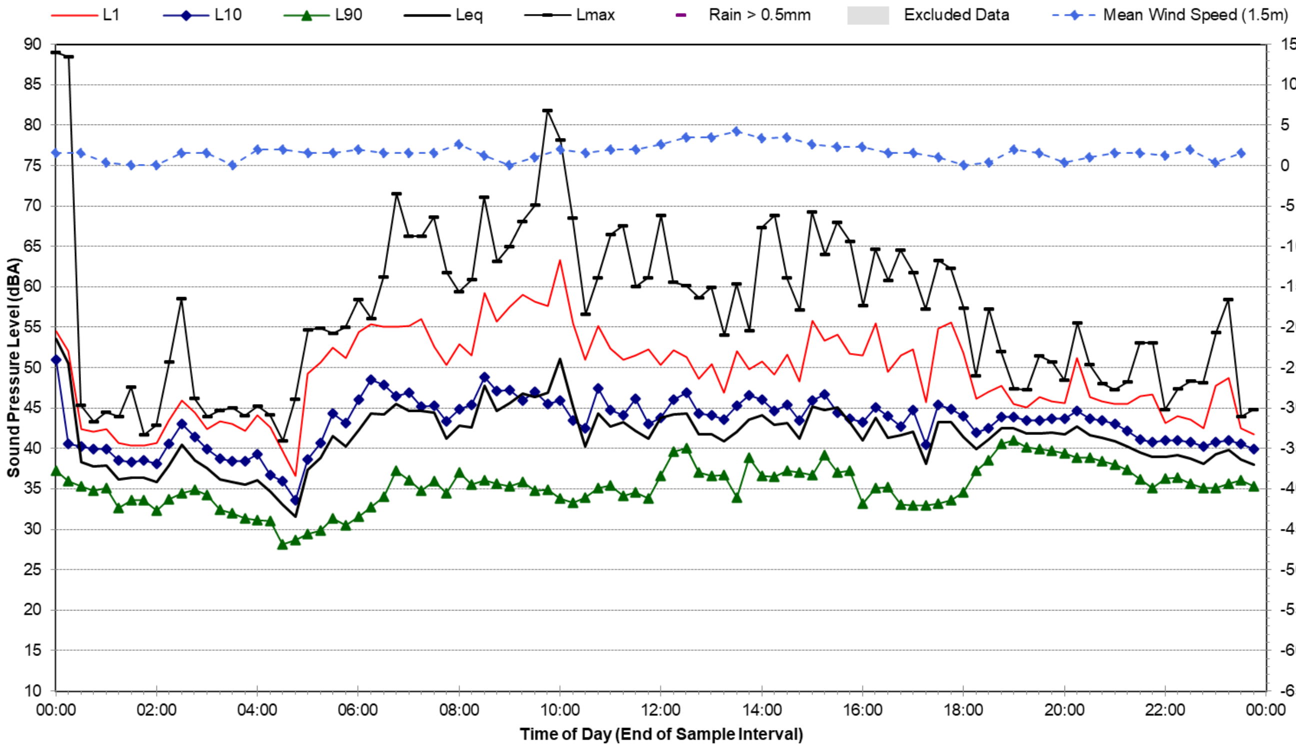
Statistical Ambient Noise Levels
14 Memorial Avenue, Batlow - Tuesday, 16 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
14 Memorial Avenue, Batlow - Wednesday, 17 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

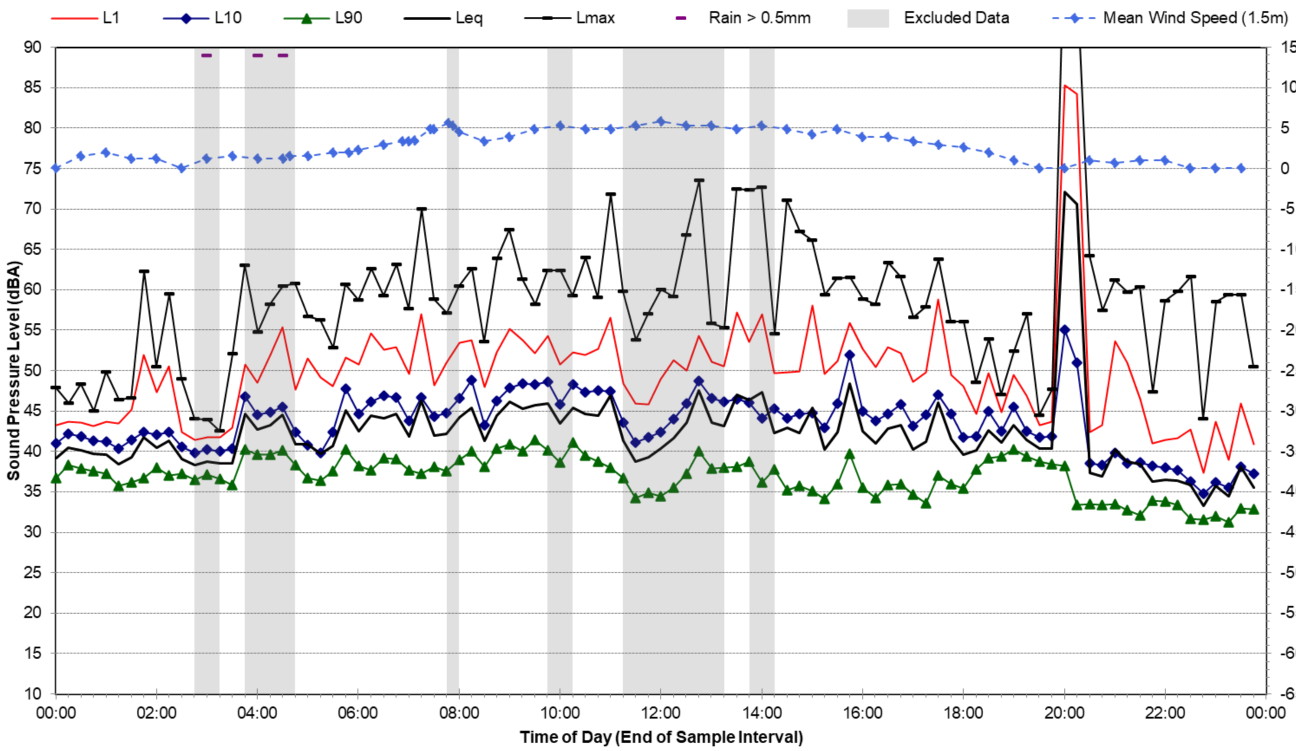
Statistical Ambient Noise Levels

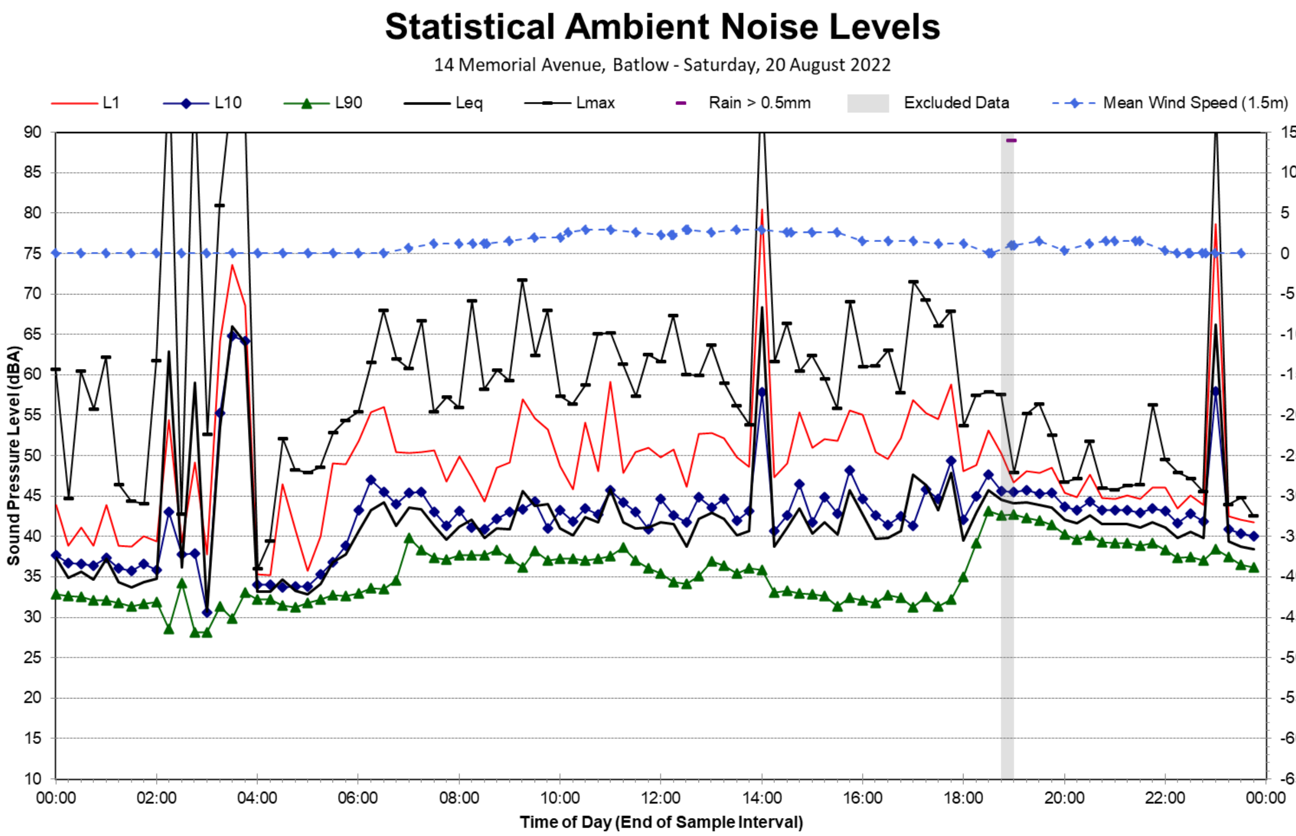
14 Memorial Avenue, Batlow - Thursday, 18 August 2022

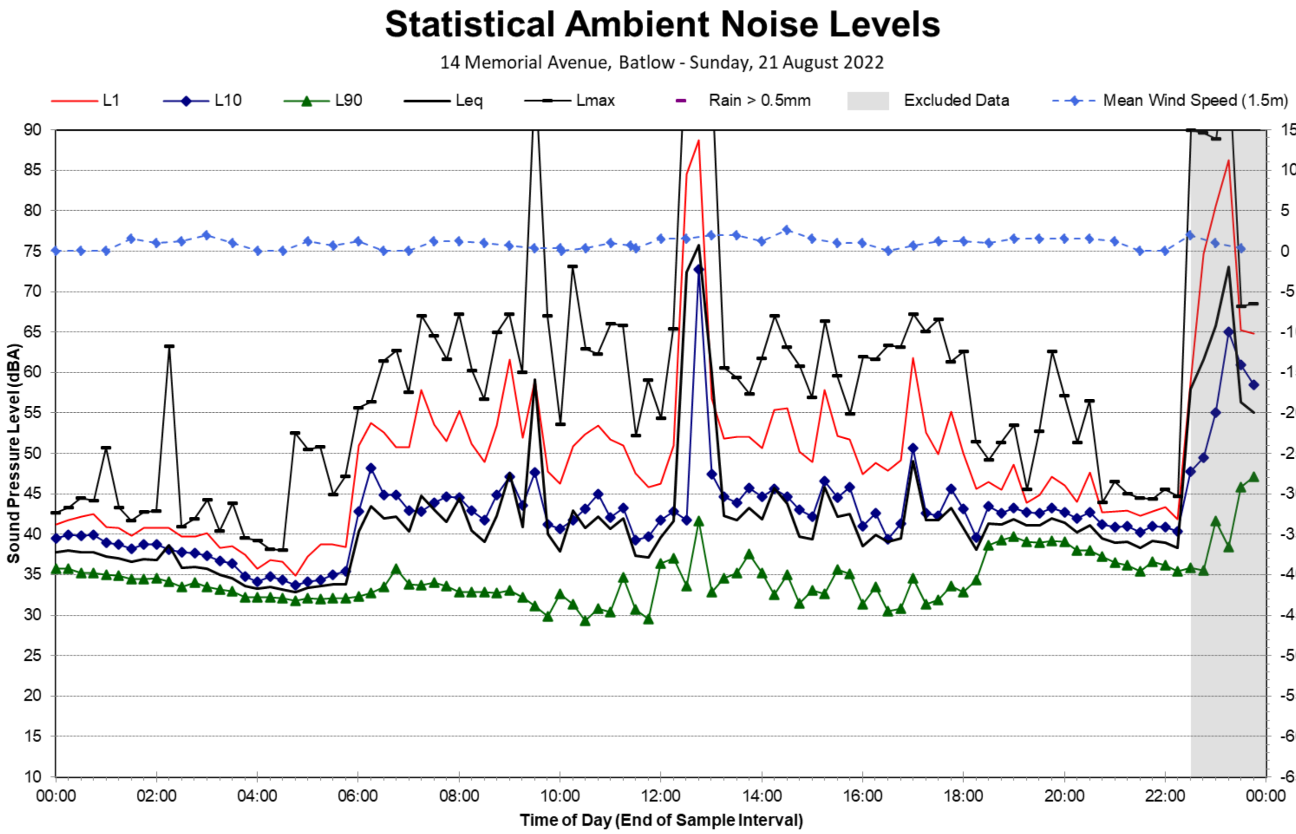


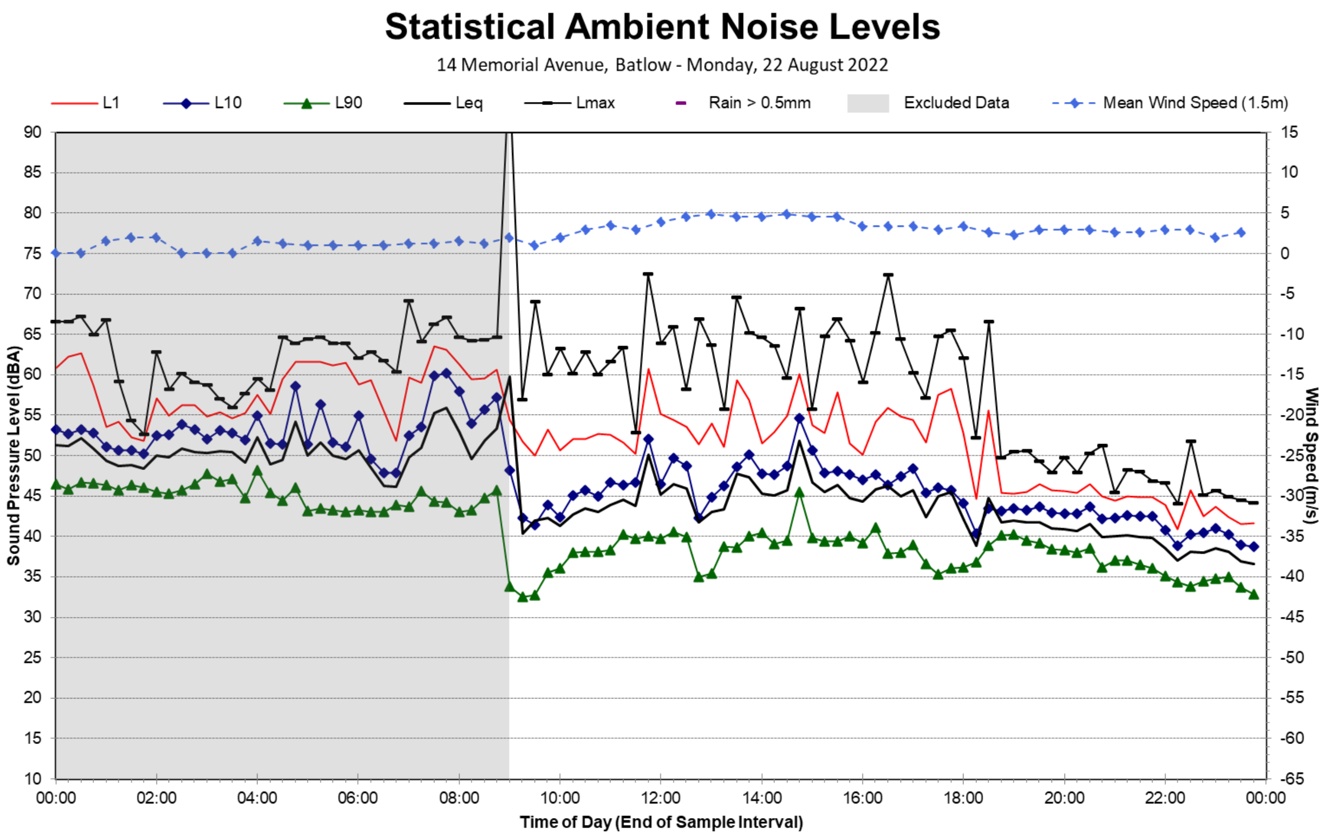
Statistical Ambient Noise Levels

14 Memorial Avenue, Batlow - Friday, 19 August 2022

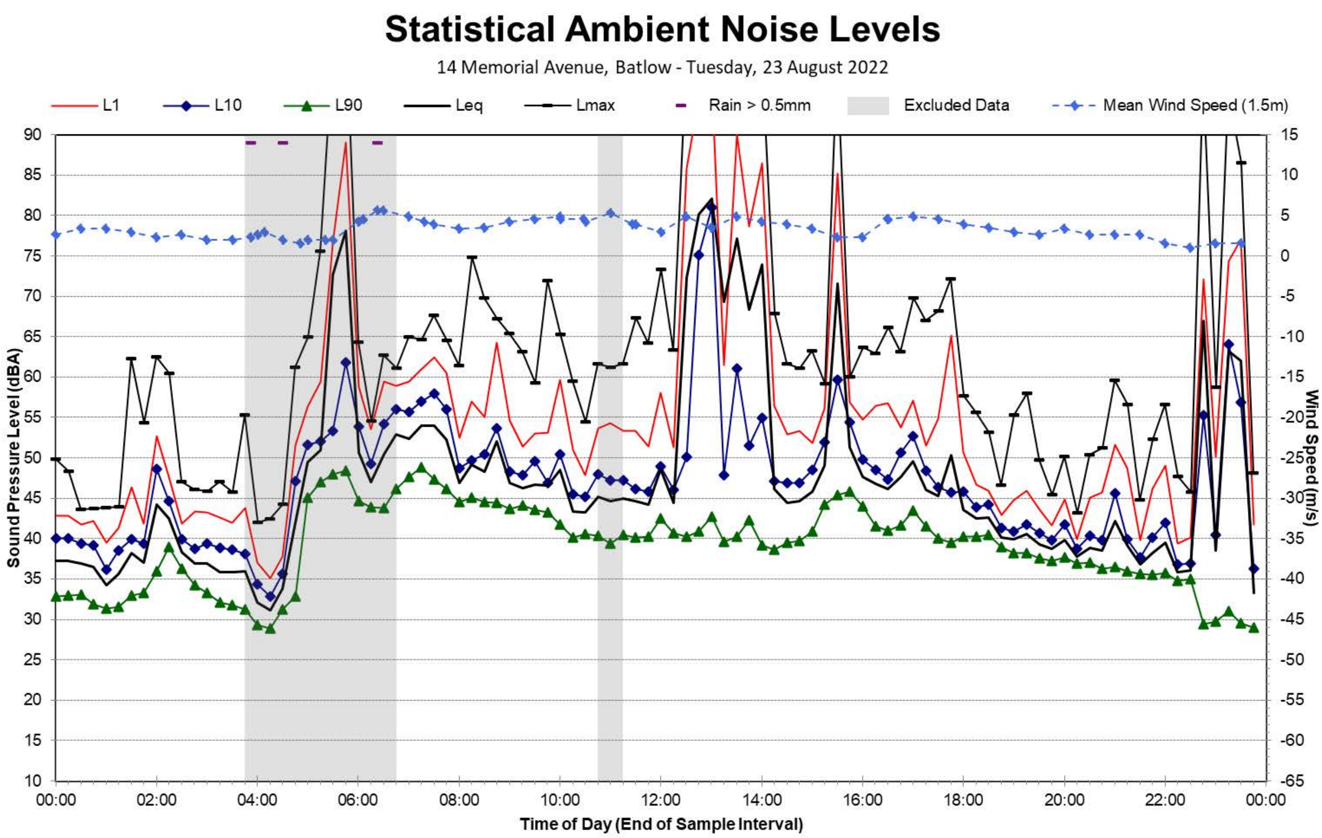



Statistical Ambient Noise Levels
14 Memorial Avenue, Batlow - Saturday, 20 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
14 Memorial Avenue, Batlow - Sunday, 21 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



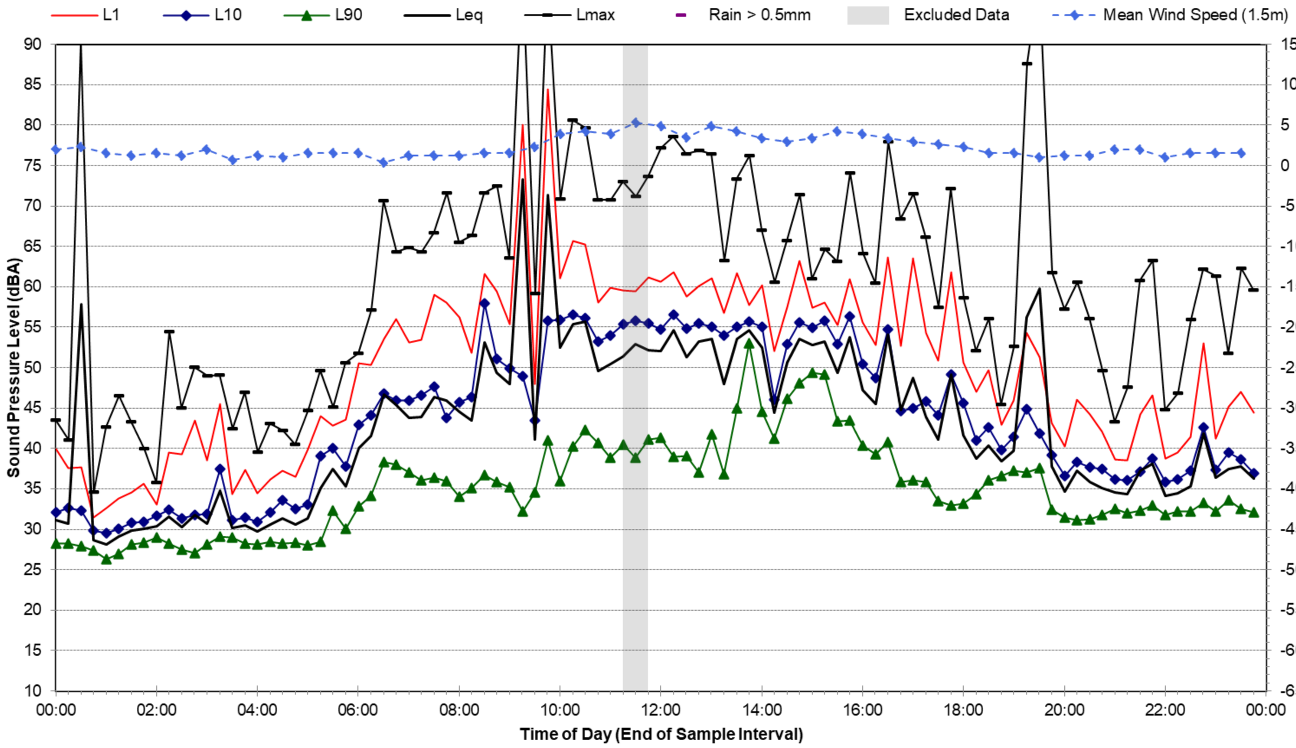
Statistical Ambient Noise Levels
14 Memorial Avenue, Batlow - Monday, 22 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
14 Memorial Avenue, Batlow - Tuesday, 23 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

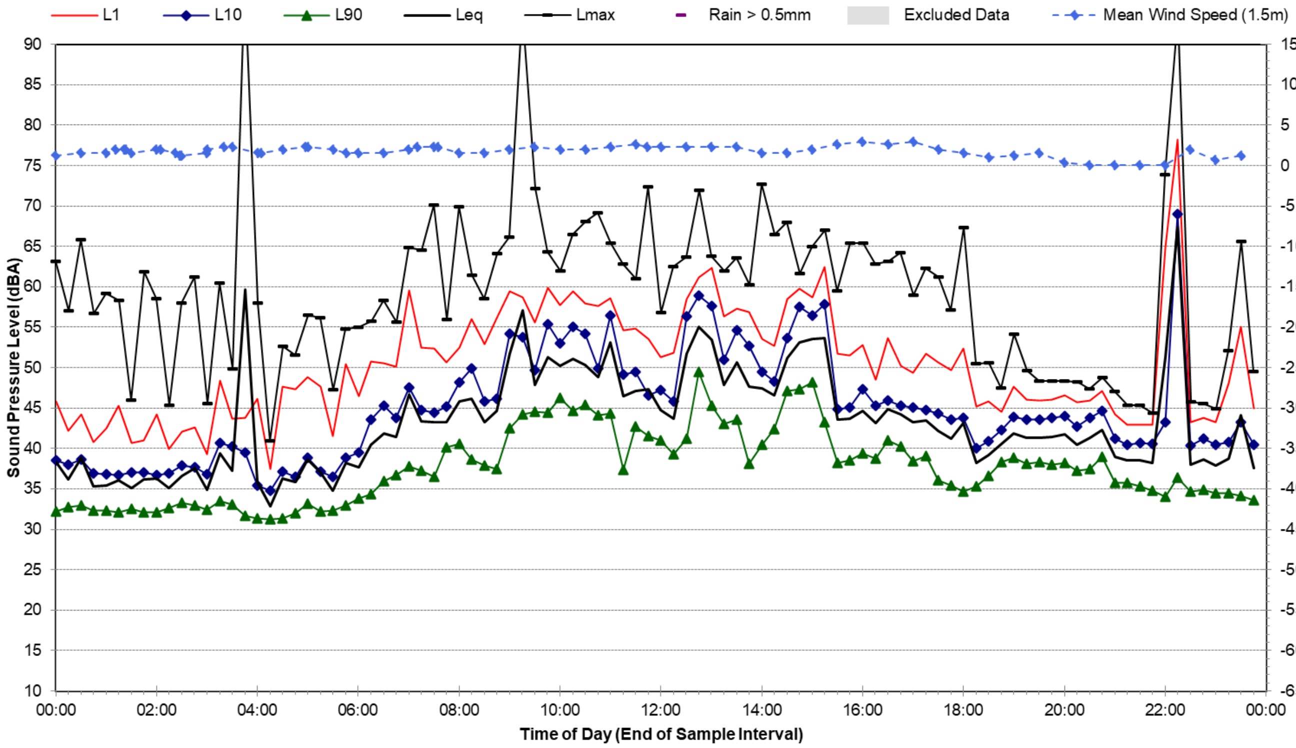
Statistical Ambient Noise Levels

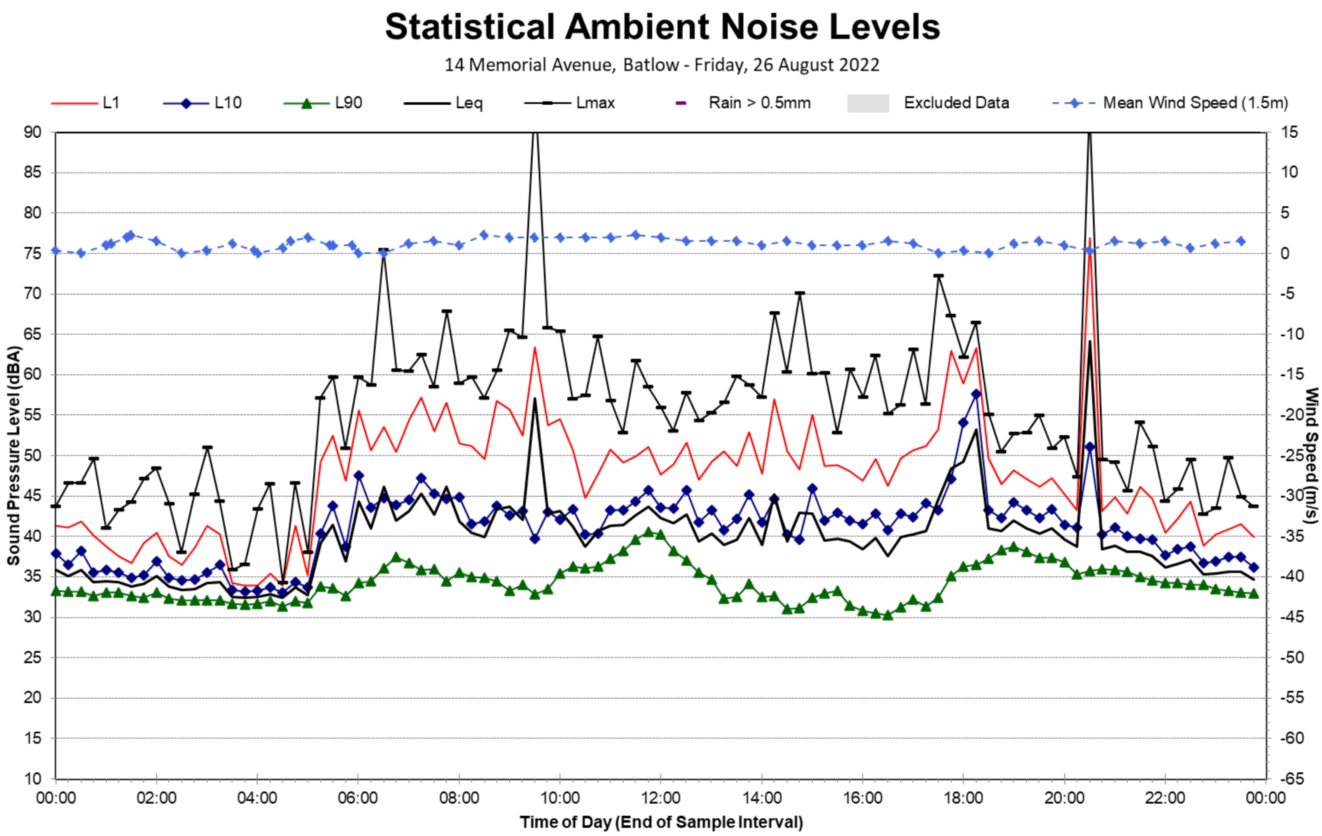
14 Memorial Avenue, Batlow - Wednesday, 24 August 2022

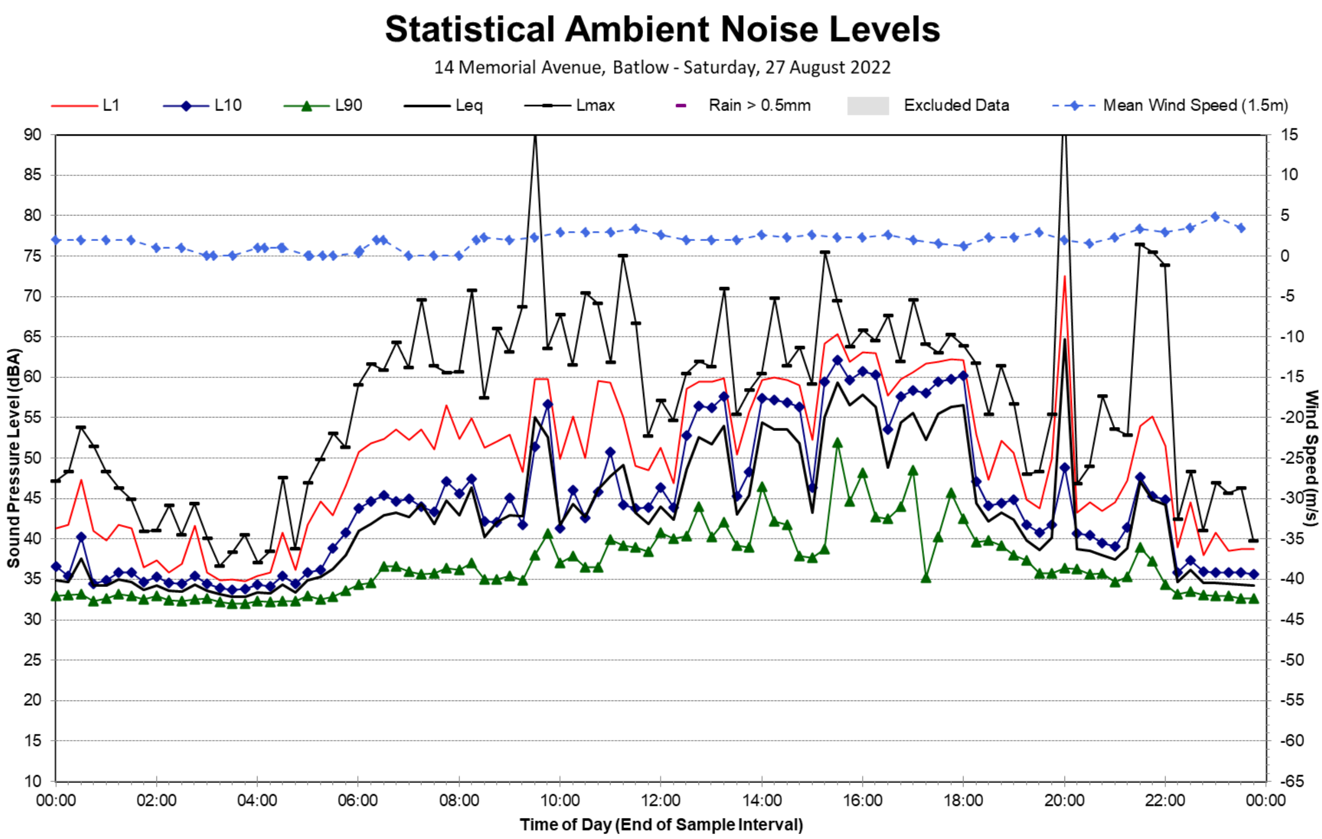


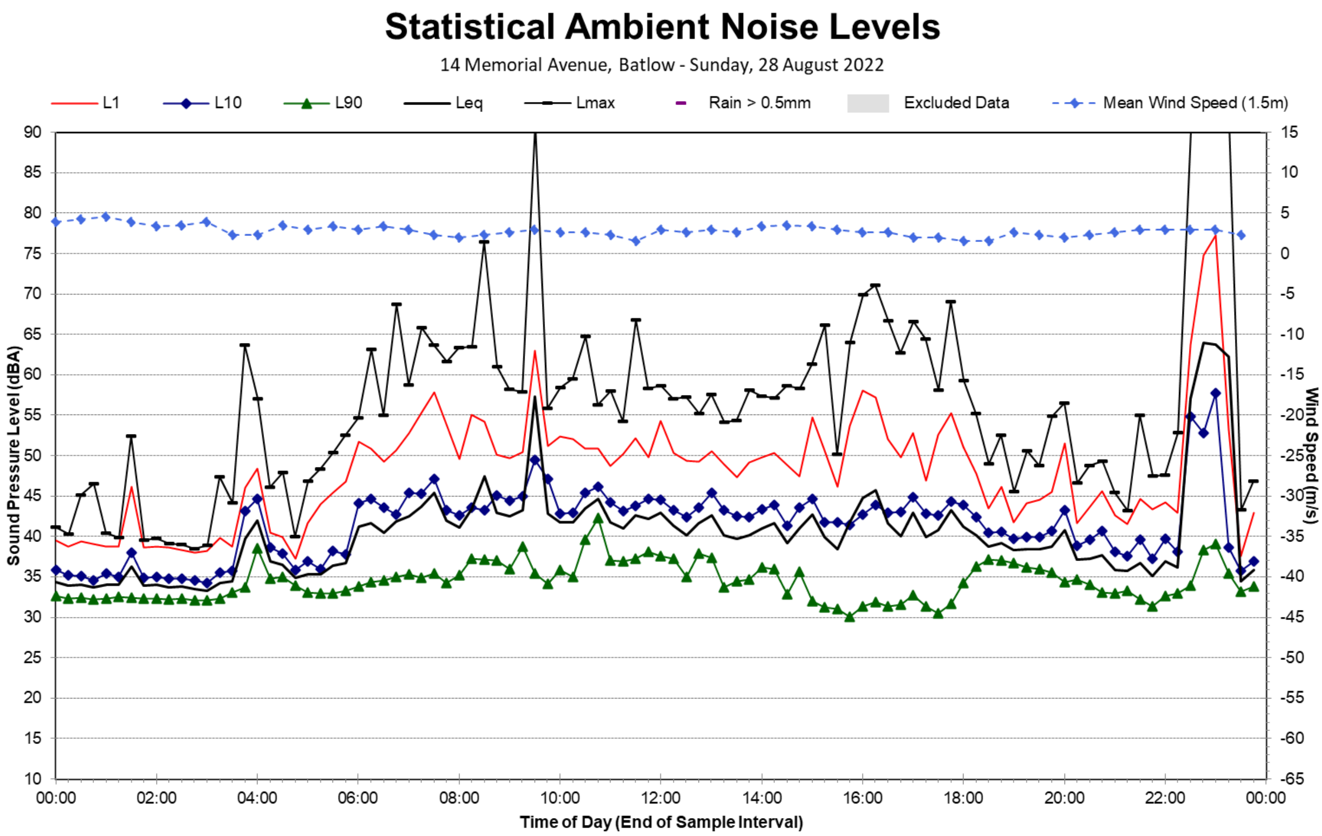
Statistical Ambient Noise Levels

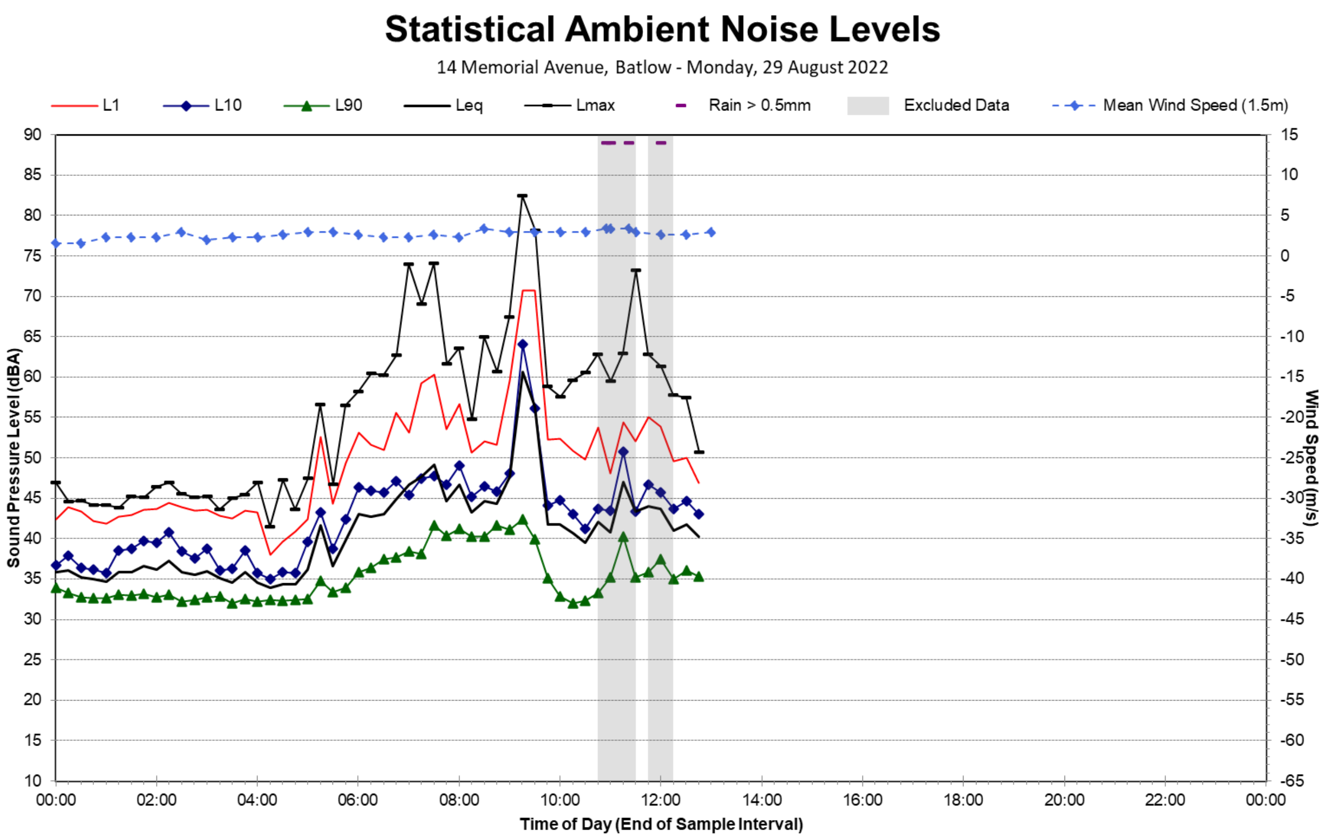
14 Memorial Avenue, Batlow - Thursday, 25 August 2022




Statistical Ambient Noise Levels
14 Memorial Avenue, Batlow - Friday, 26 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
14 Memorial Avenue, Batlow - Saturday, 27 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
14 Memorial Avenue, Batlow - Sunday, 28 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
14 Memorial Avenue, Batlow - Monday, 29 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.07
Noise Monitoring Address	**Bowmans Lane, Batlow**

Logger Device Type: Svantek 957, Logger Serial No: 21423
Sound Level Meter Device Type: Rion NA-28, Sound Level Meter Serial No: 106005

Ambient noise logger deployed at Bowmans Lane, Batlow. Logger located at northeast corner of council yard, with earth berm partially obstructing industrial activity.

Attended noise measurements indicate the ambient noise environment at this location is influenced by industrial noise, such as chainsaws and excavators, at the time of the attended measurement.

Recorded Noise Levels (LAmax) 16/08/2022:

Cutting logs: 45 dBA
Excavator/loader: 48 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	29	46	43	54
Evening	30	43	38	43
Night-time	30	43	37	39

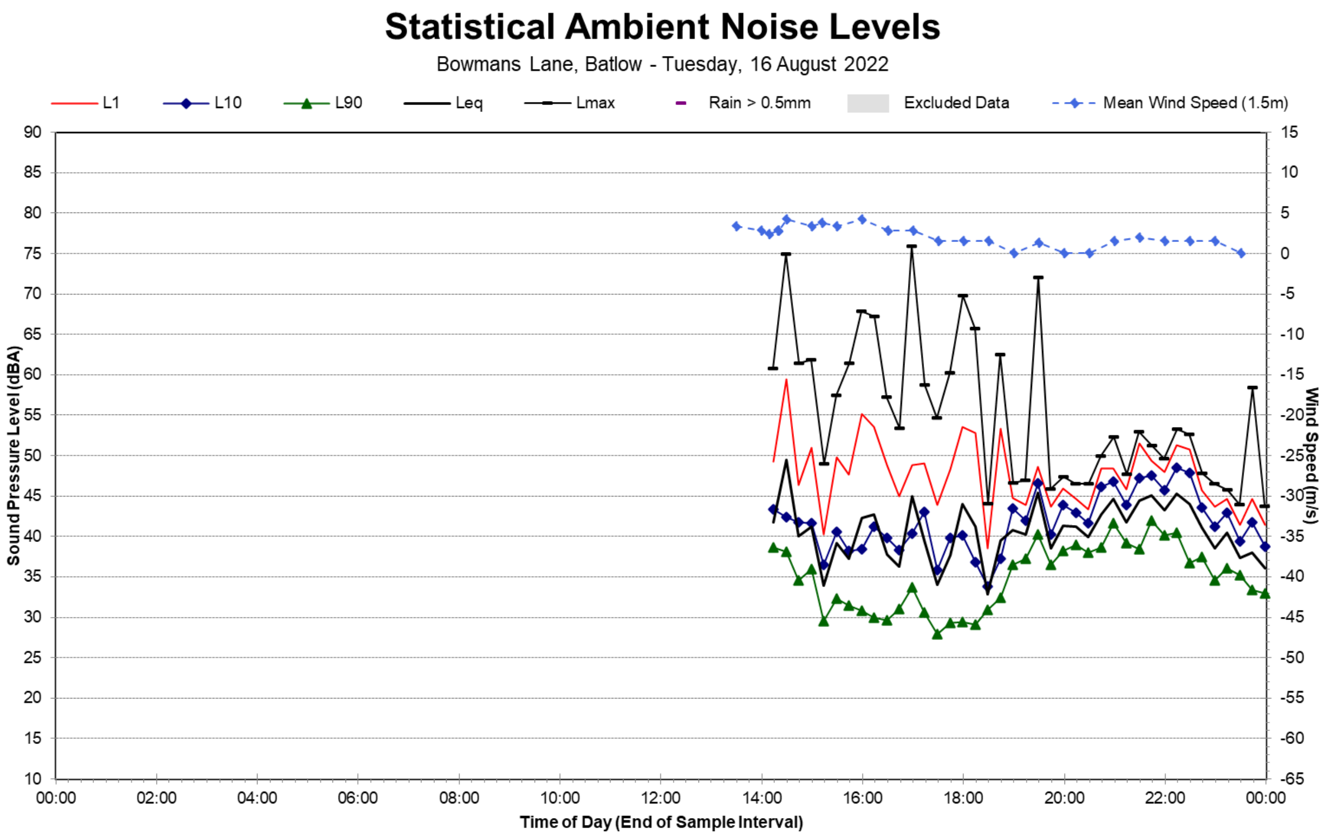
Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	46	49
Night-time (10pm-7am)	43	46

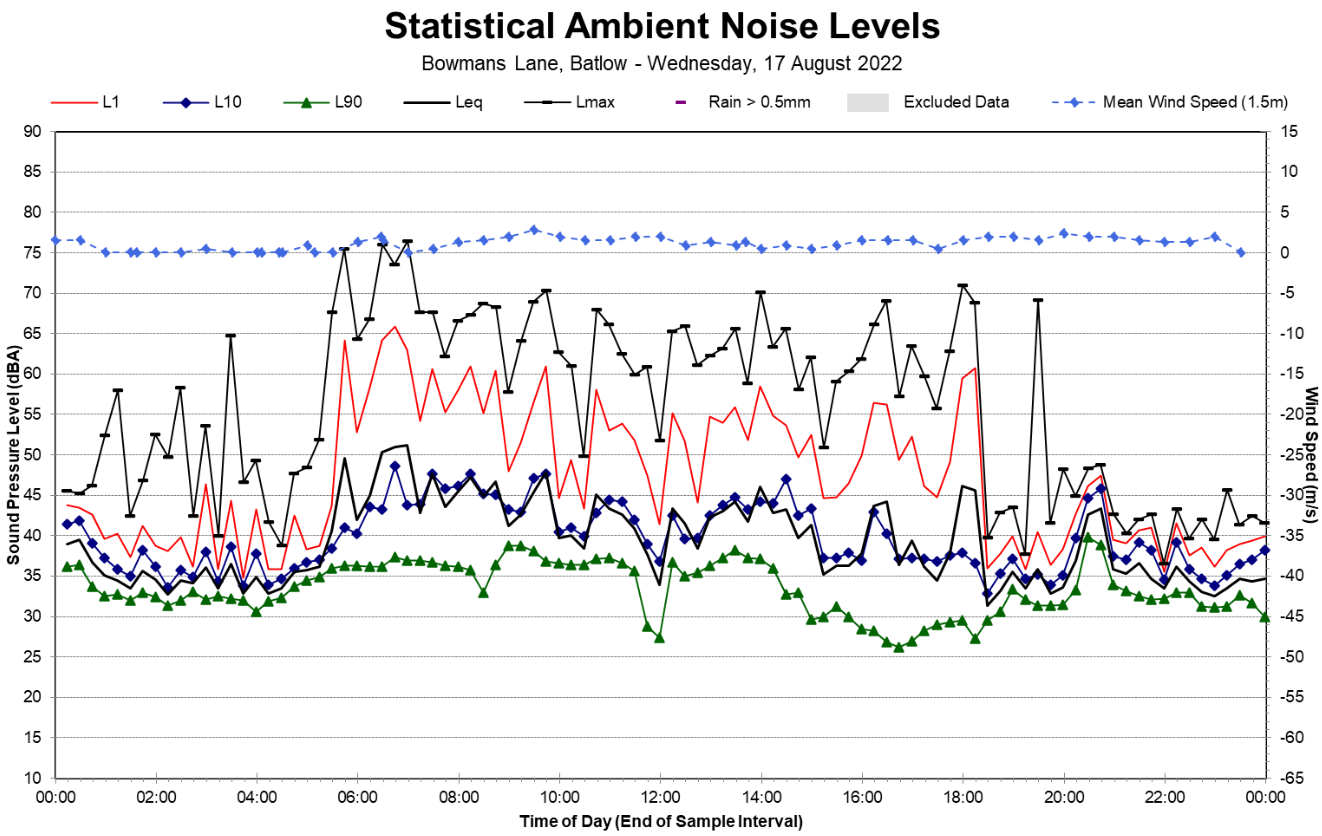
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
16/08/2022	14:10	39	42	60

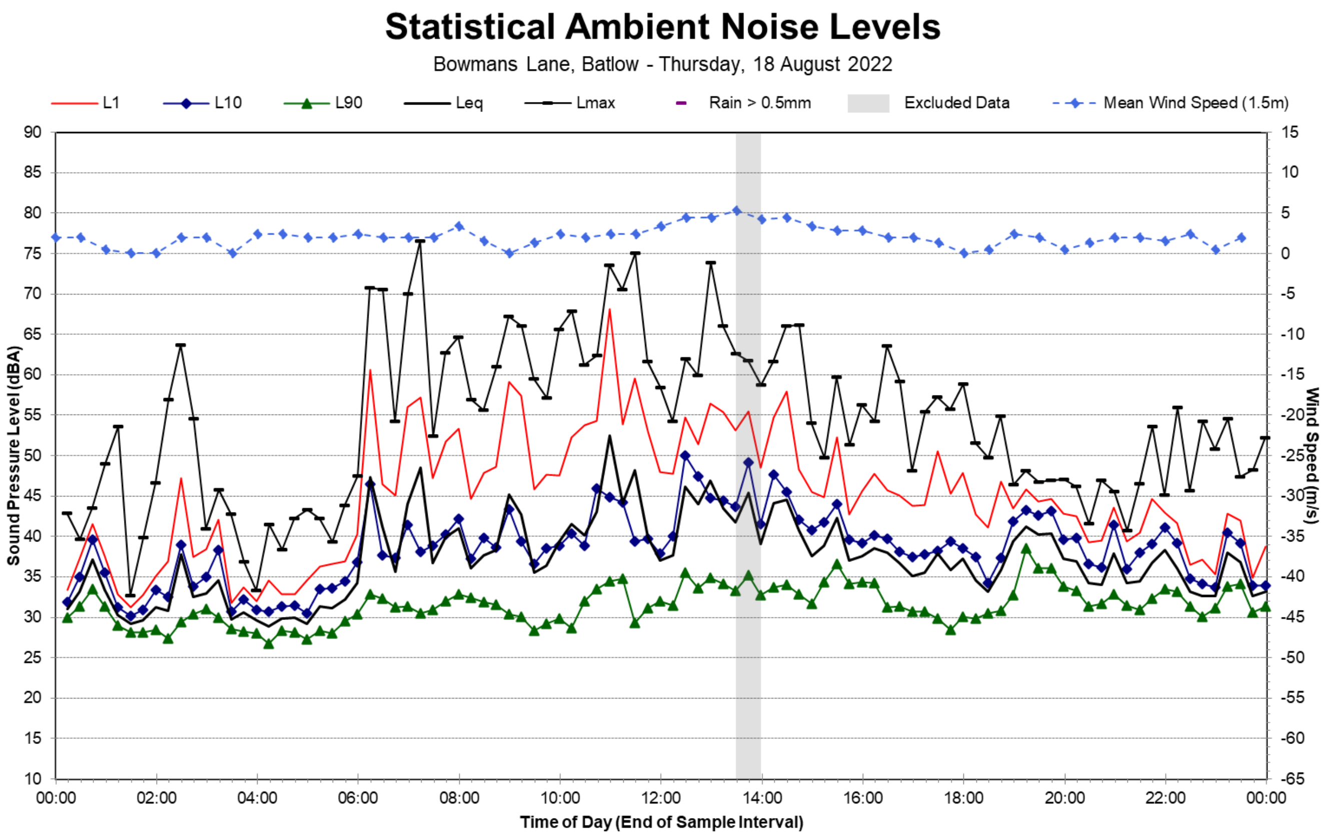
Photo of Noise Monitoring Location

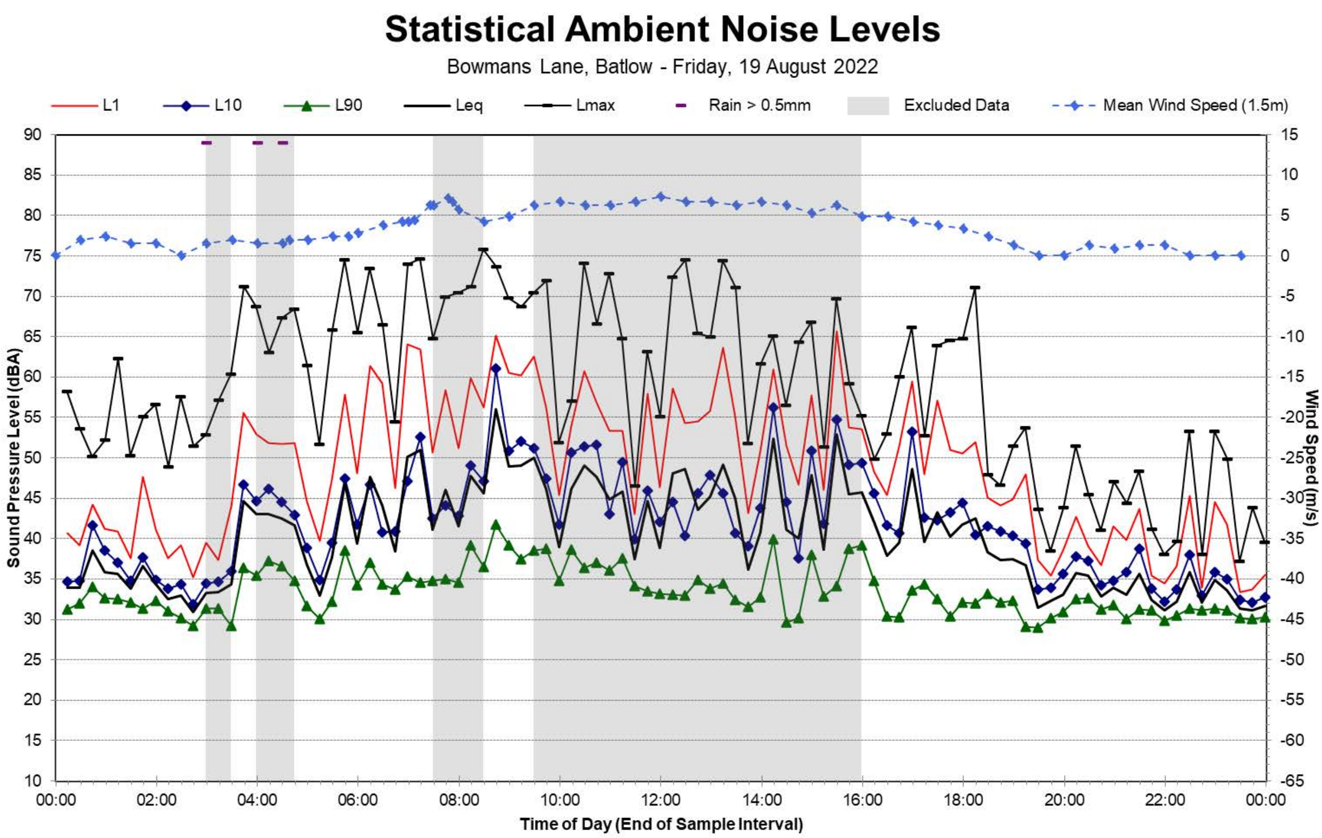


Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Tuesday, 16 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



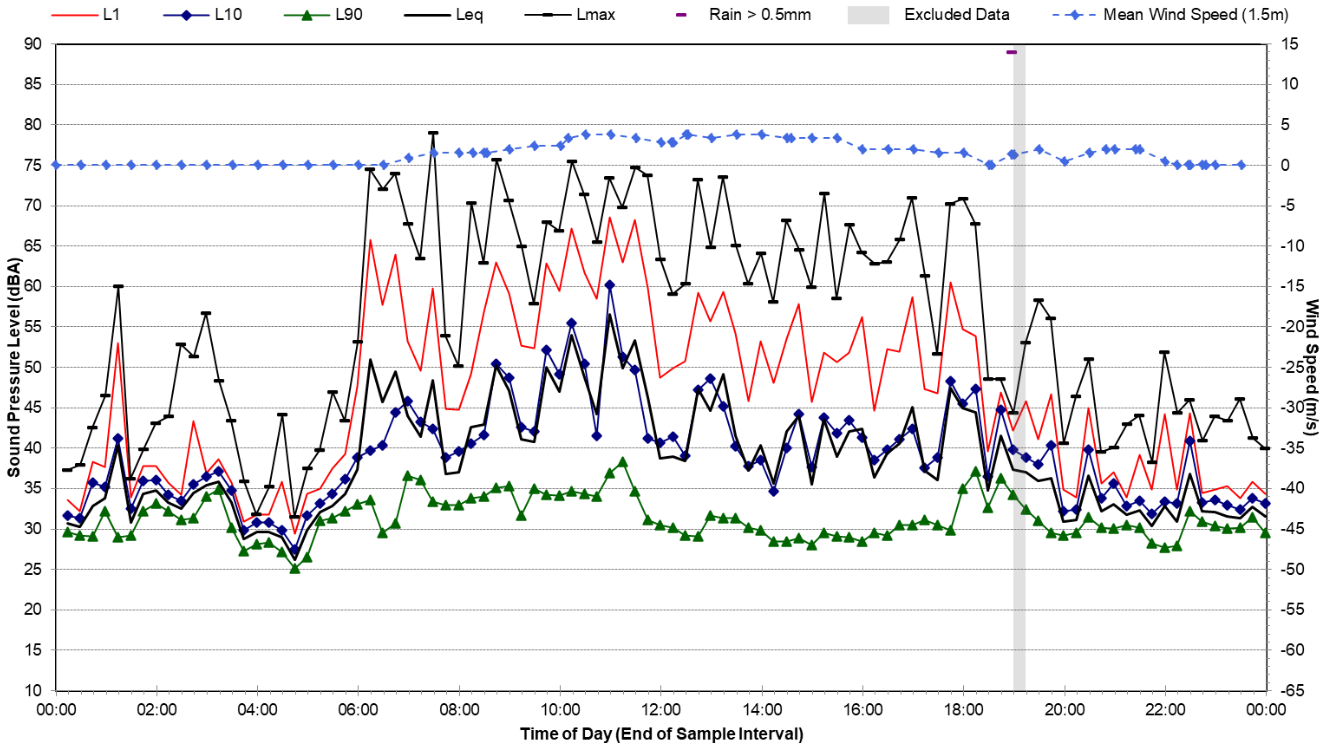
Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Wednesday, 17 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Thursday, 18 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Friday, 19 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

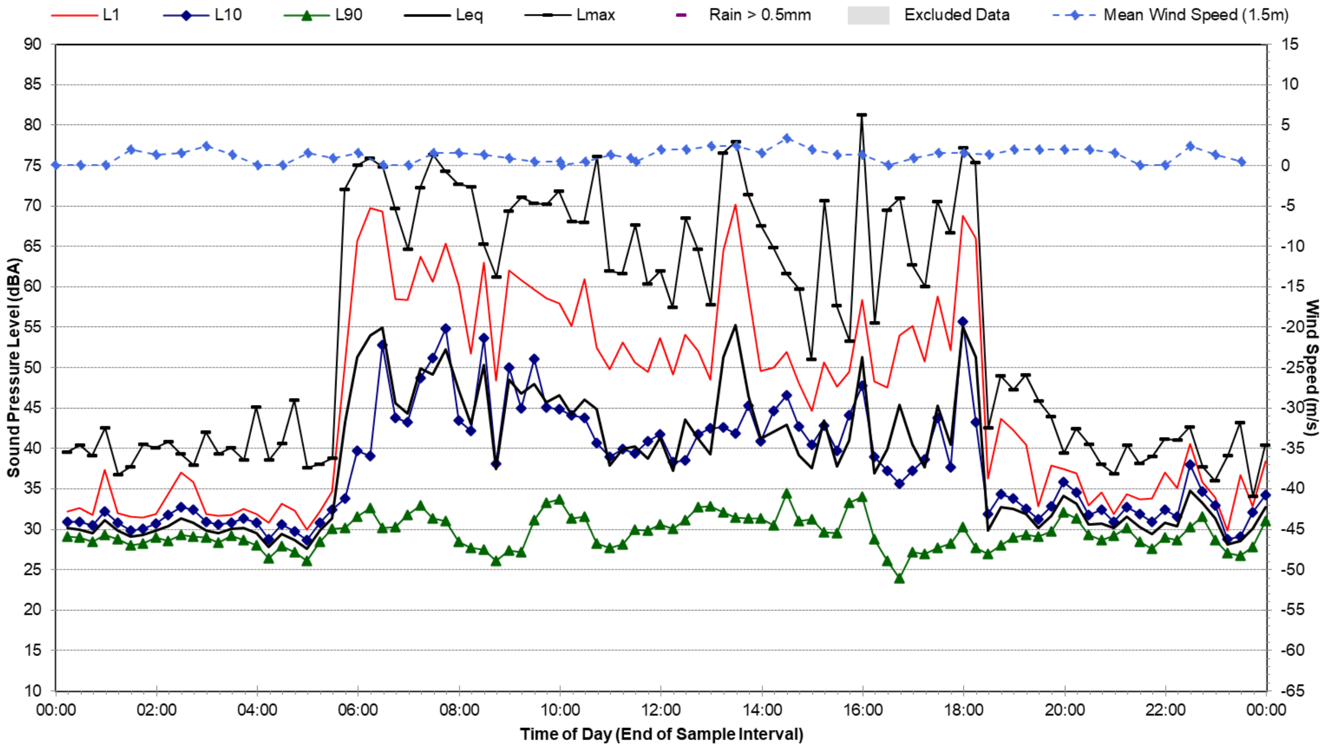
Statistical Ambient Noise Levels

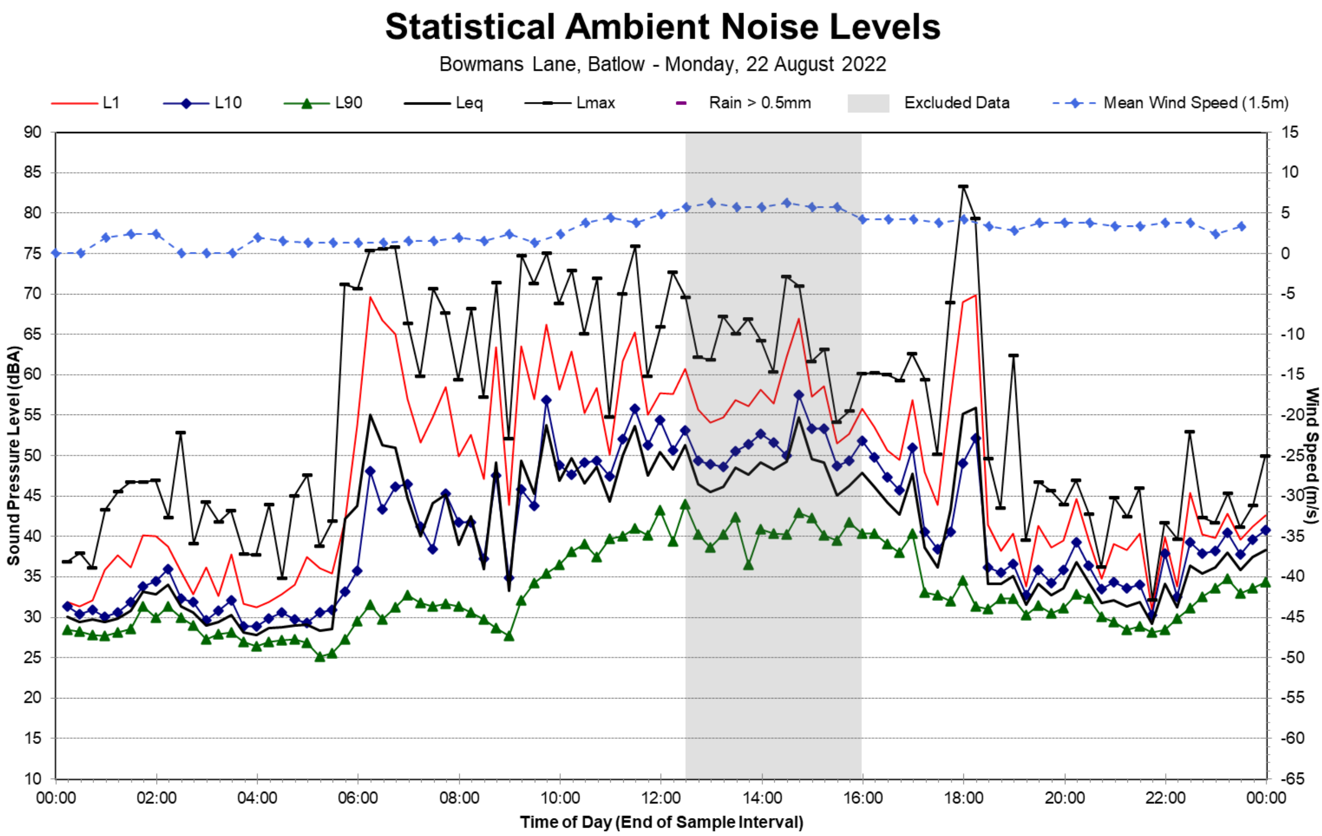
Bowmans Lane, Batlow - Saturday, 20 August 2022



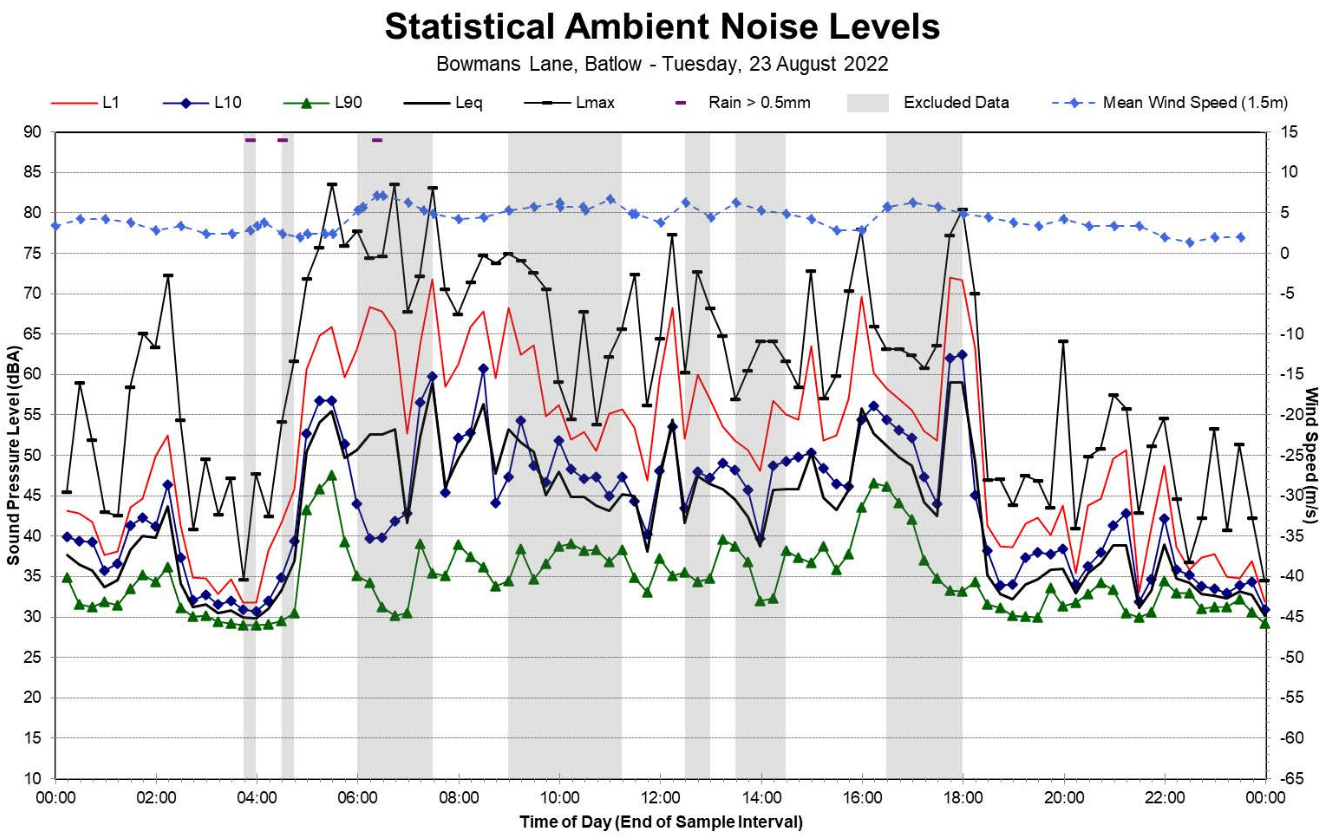
Statistical Ambient Noise Levels

Bowmans Lane, Batlow - Sunday, 21 August 2022

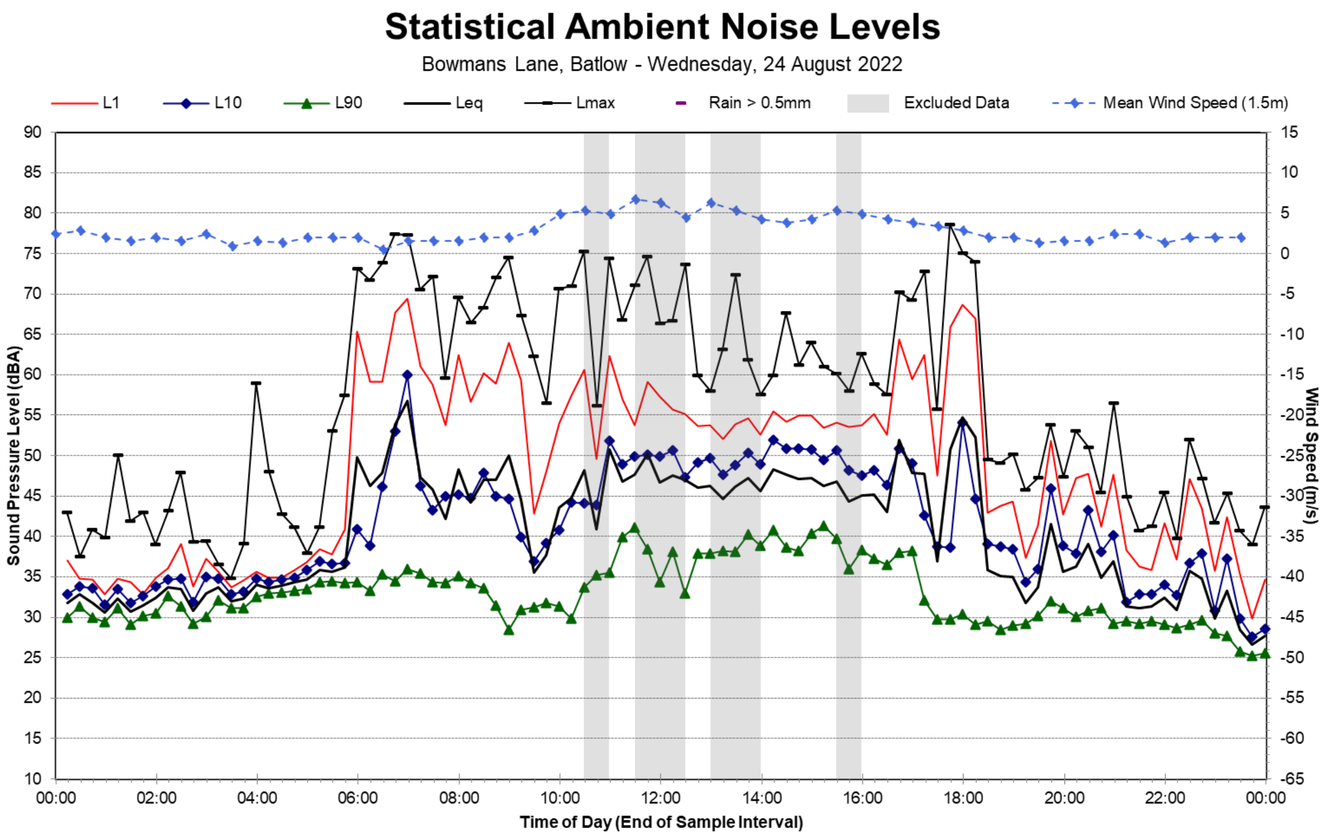


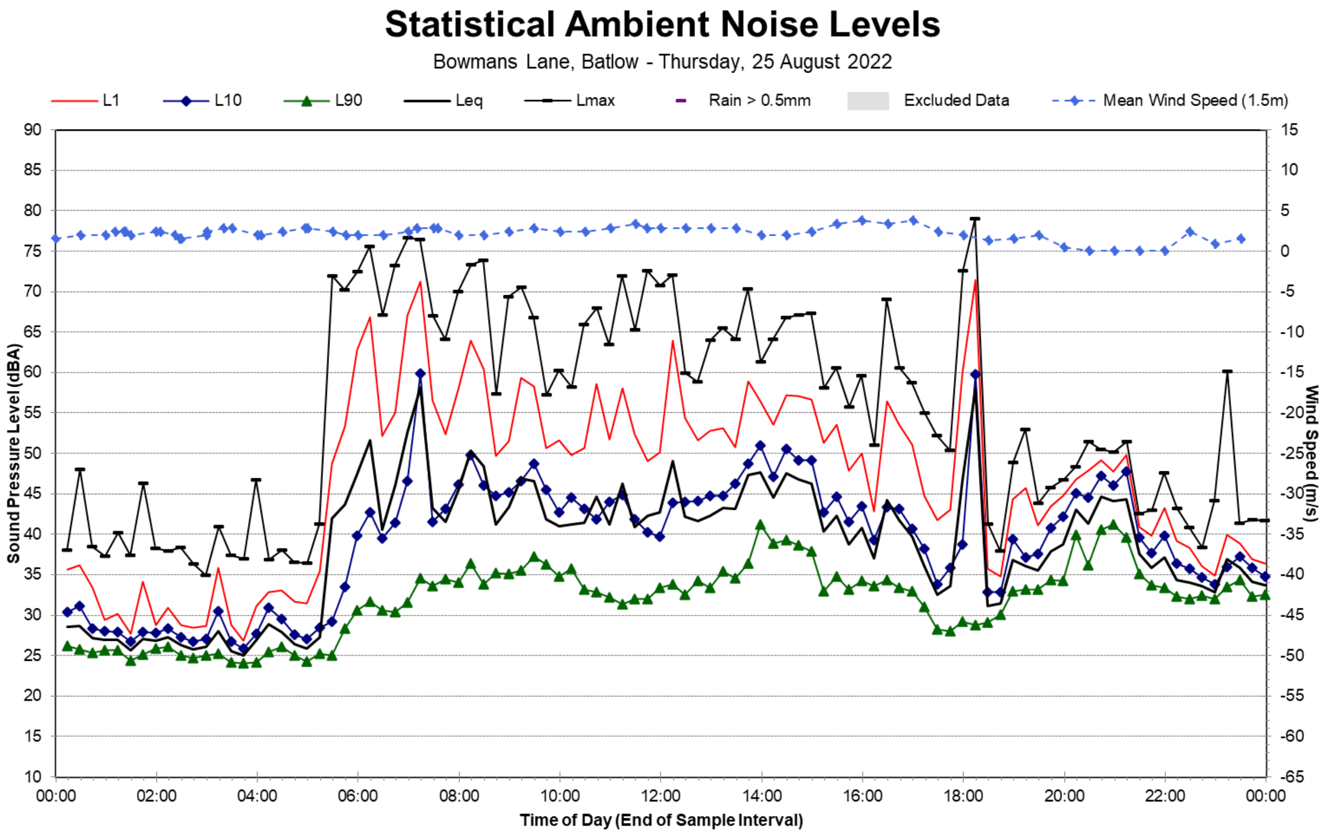


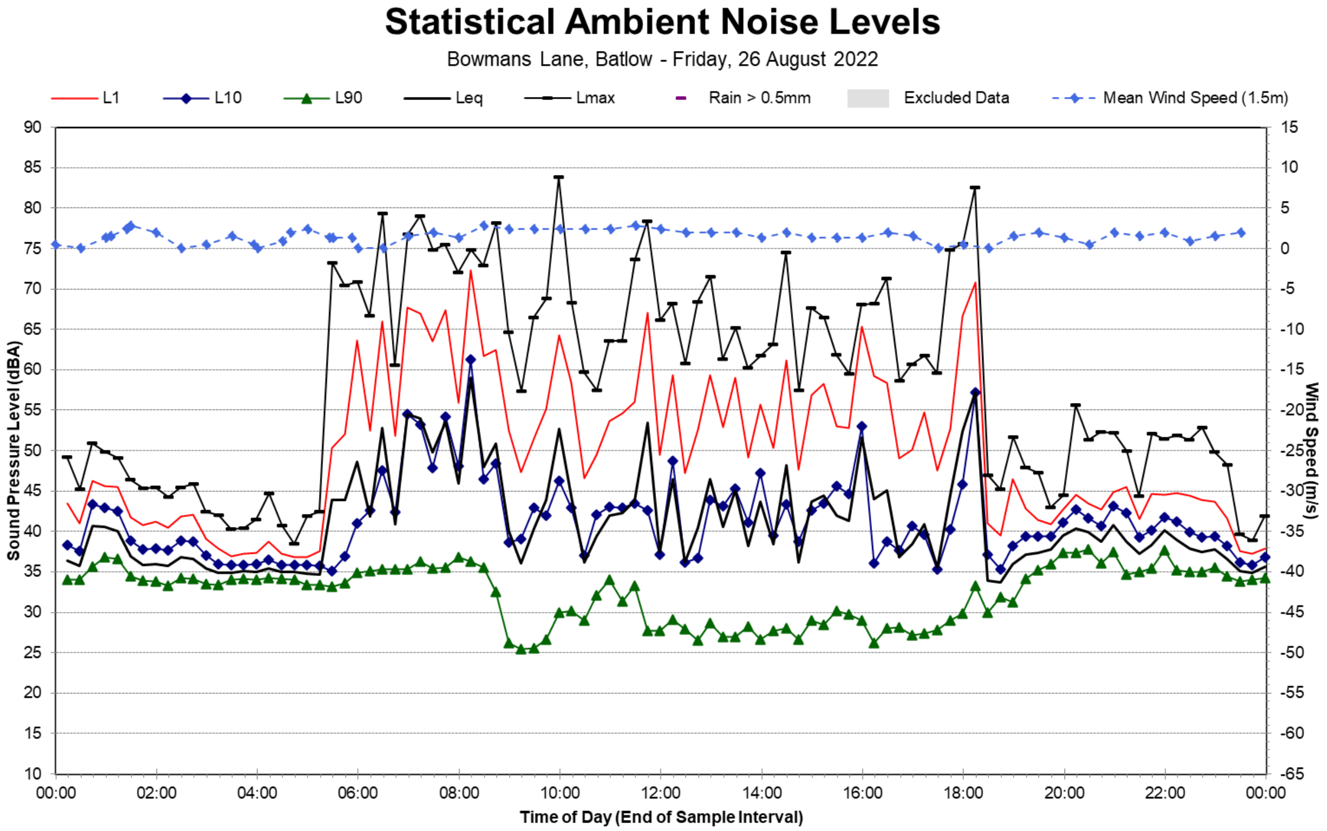
Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Monday, 22 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

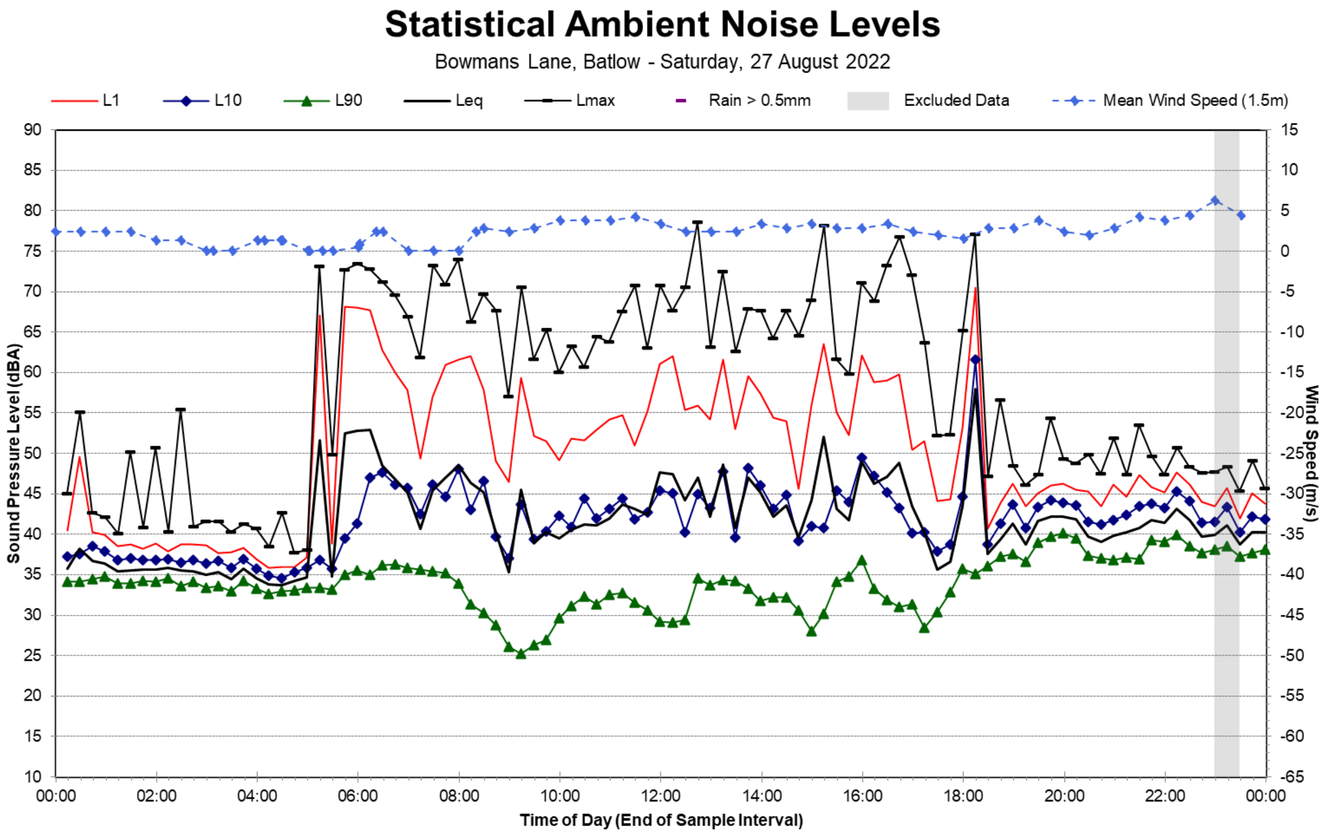


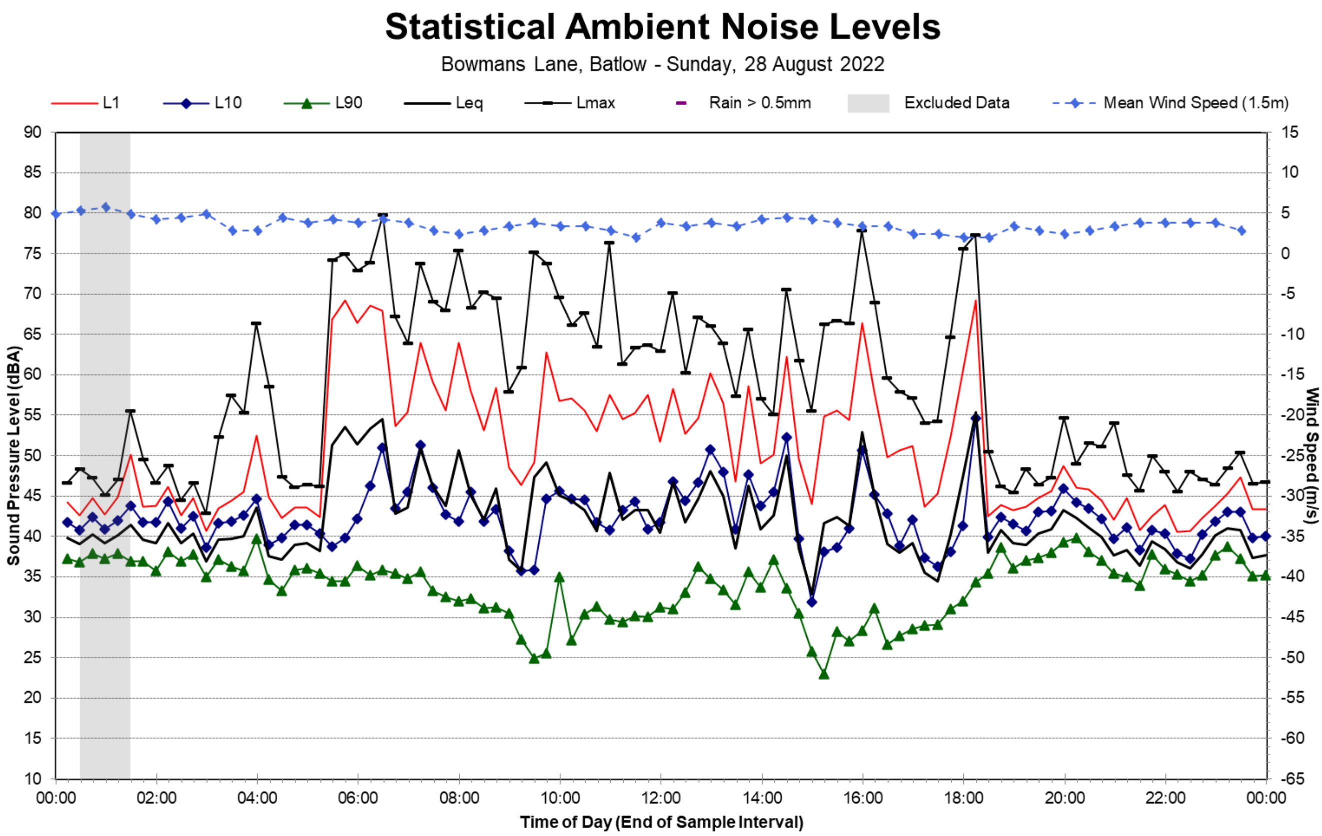
Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Tuesday, 23 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

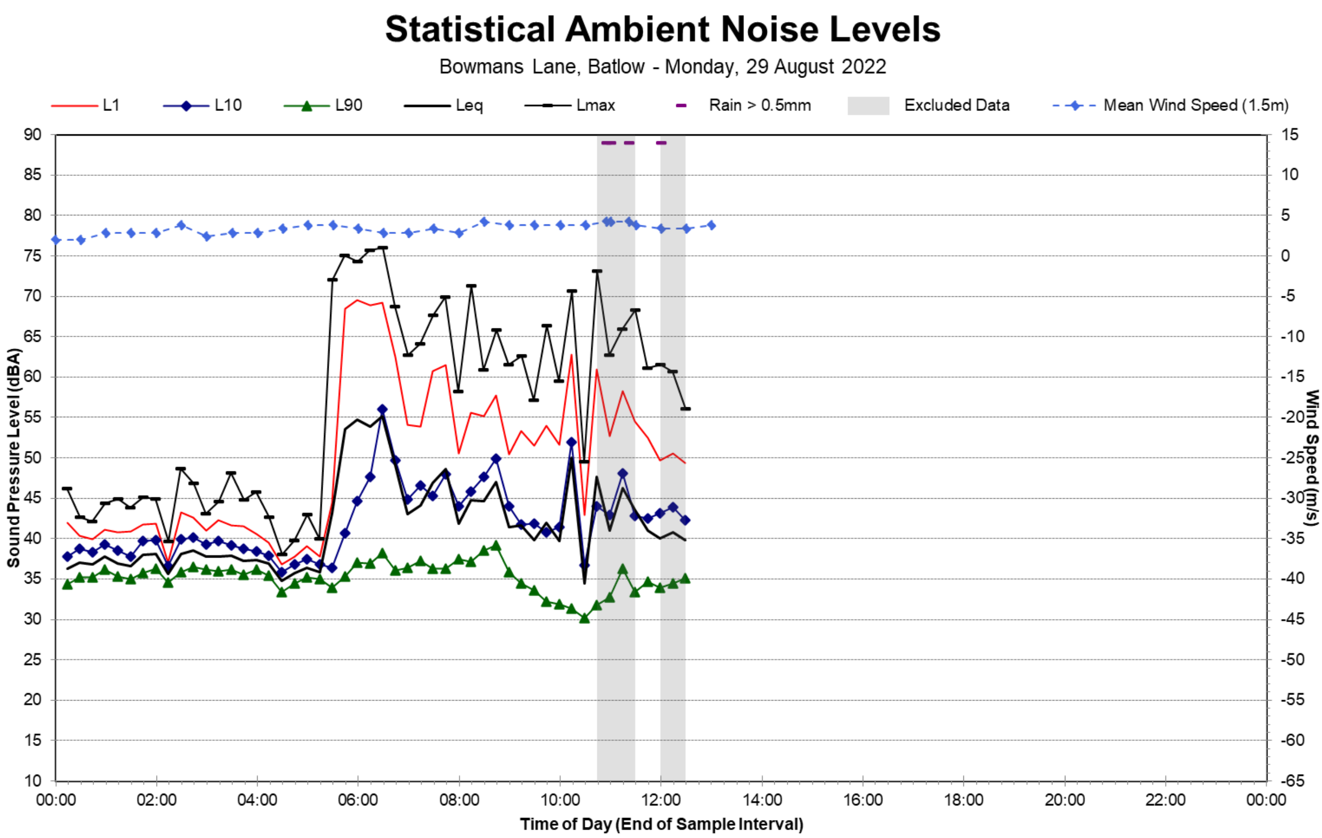

Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Wednesday, 24 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Thursday, 25 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Friday, 26 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Saturday, 27 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Sunday, 28 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Bowmans Lane, Batlow - Monday, 29 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.08
Noise Monitoring Address	Perry Street, Yass

Logger Device Type: Svantek 957, Logger Serial No: 20668
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3005904

Ambient noise logger deployed around 200 m west of the residential suburbs at Perry Street, Yass. Logger located with direct view of Perry Street.

Attended noise measurements indicate the ambient noise environment at this location is influenced by wildlife noise, such as birds and insects, and by occasional aircraft noise.

Recorded Noise Levels (LAmax) 28/03/2022:

Wind: 30-35 dBA
Birds: 31-41 dBA
Insects: 30-35 dBA
Aircraft: 35-45 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	38	56	53	63
Evening	42	58	59	61
Night-time	34	52	50	55

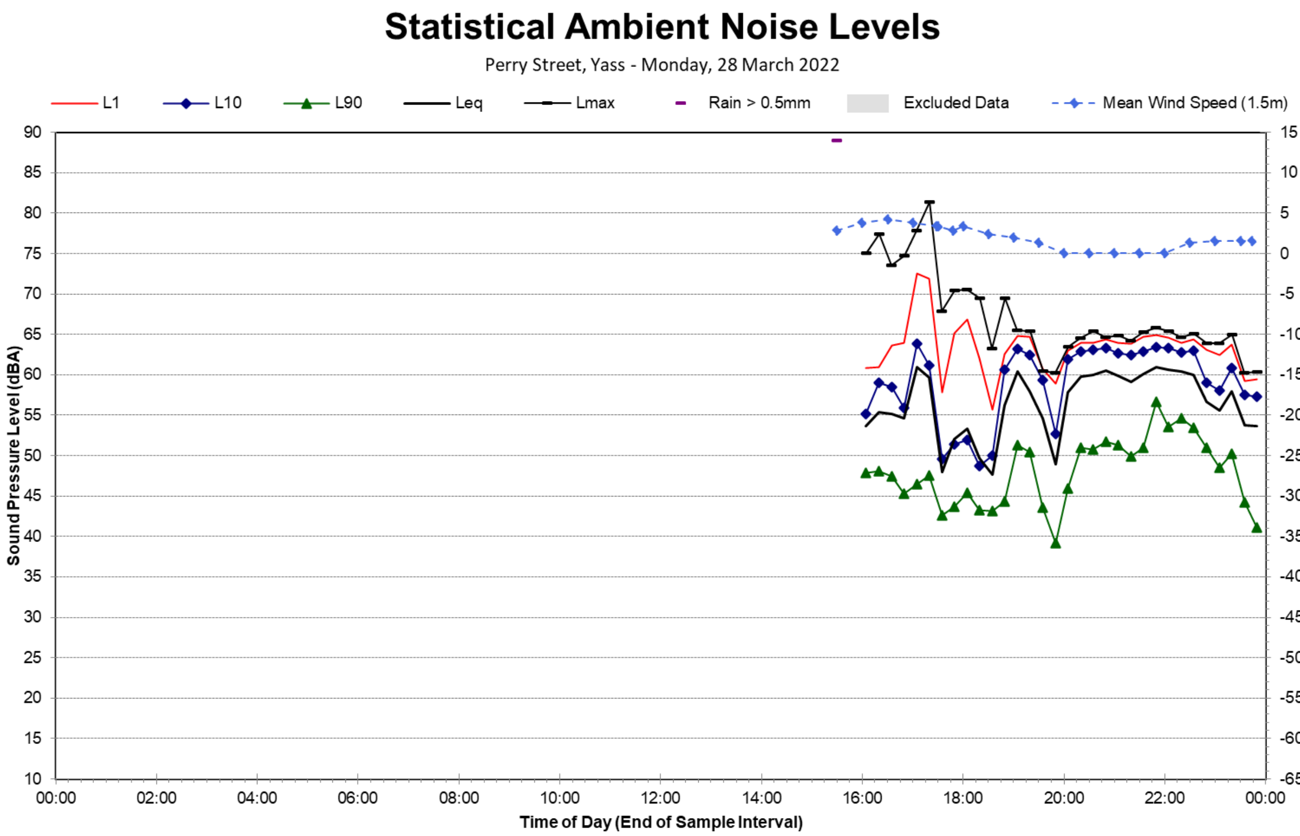
Ambient Noise Logging Results – RNP Defined Time Periods

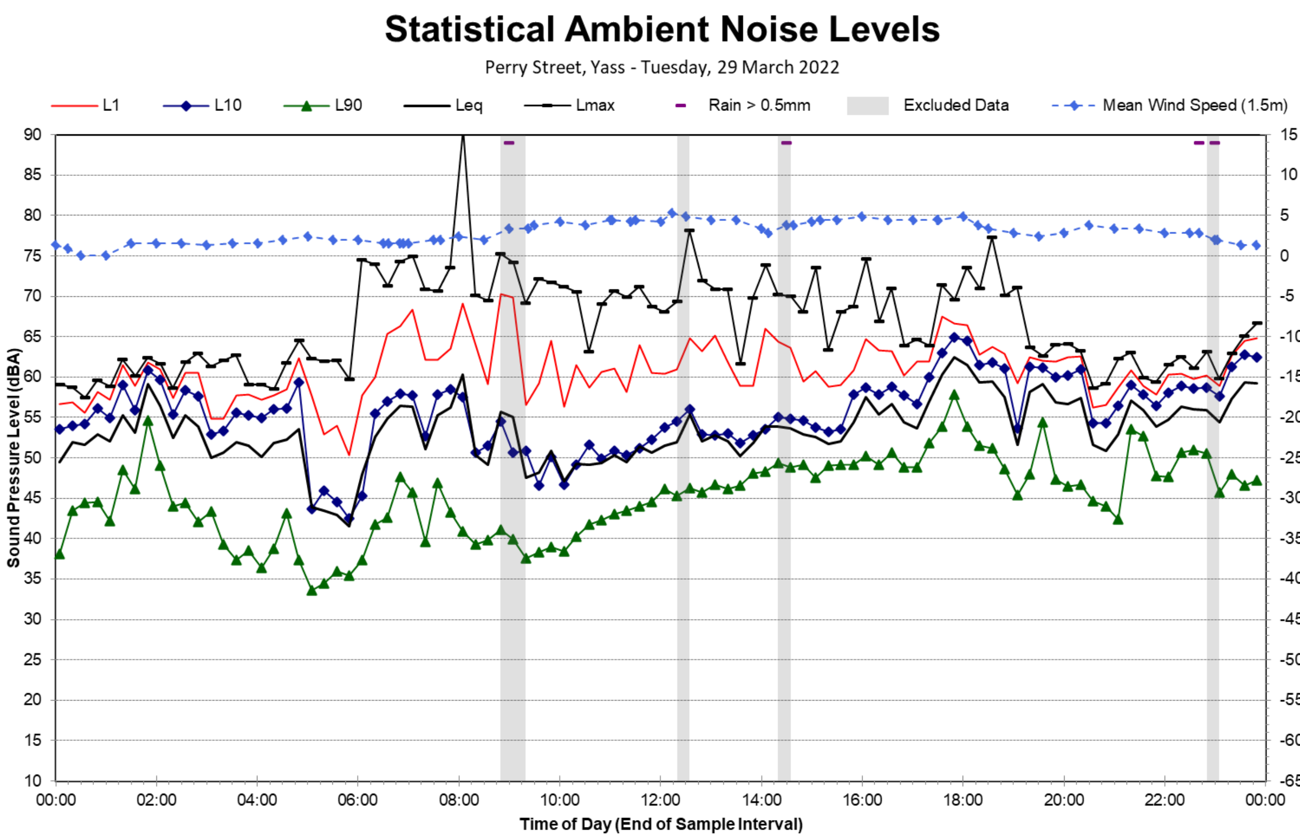
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	57	59
Night-time (10pm-7am)	52	52

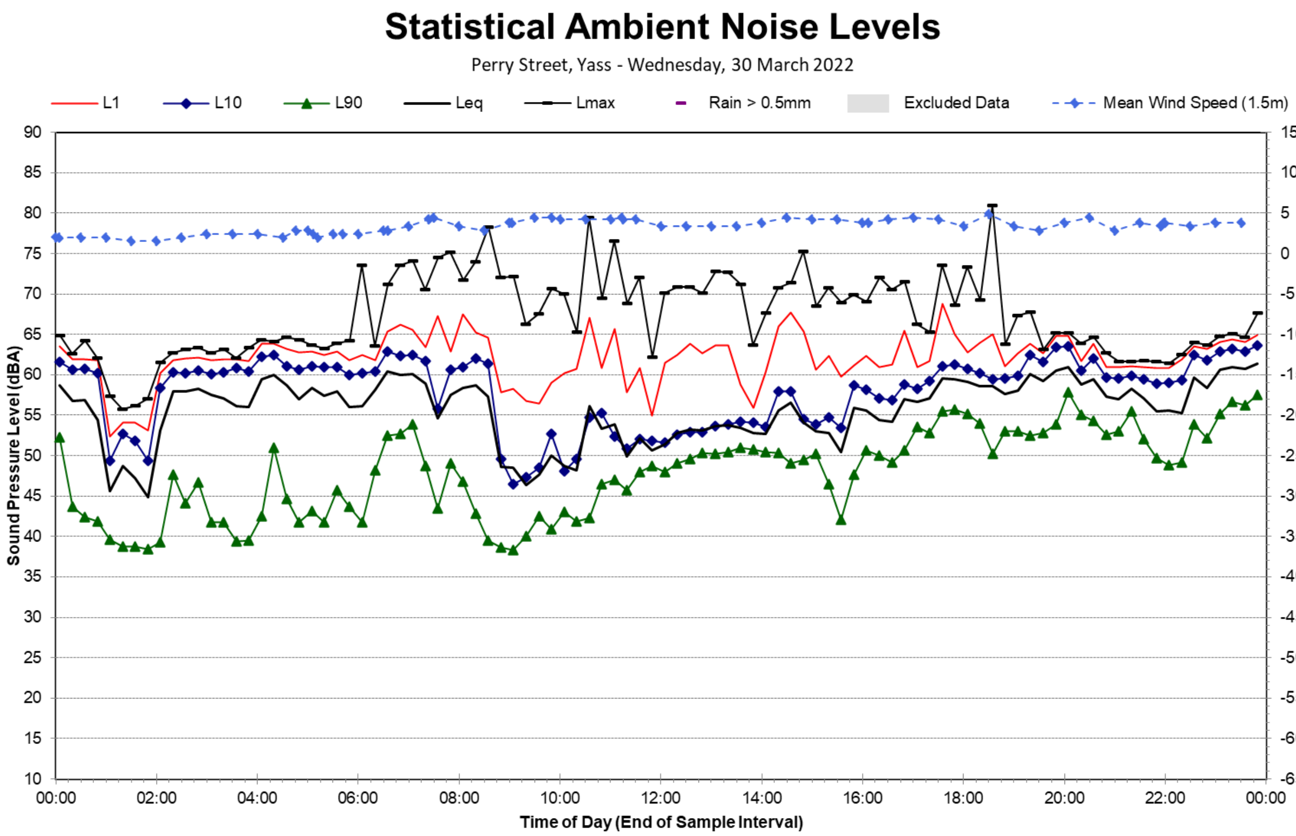
Attended Noise Measurement Results

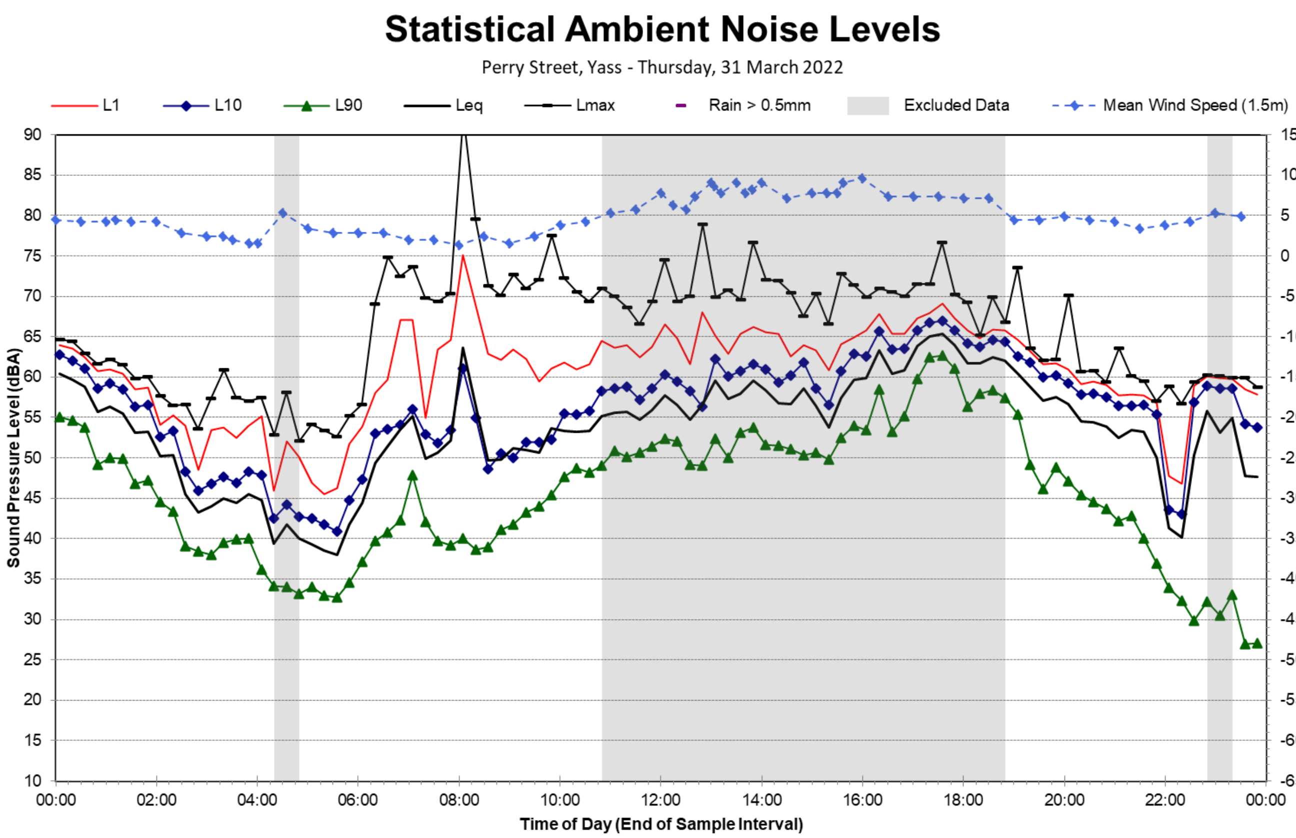
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
28/03/2022	09:29	31	35	67

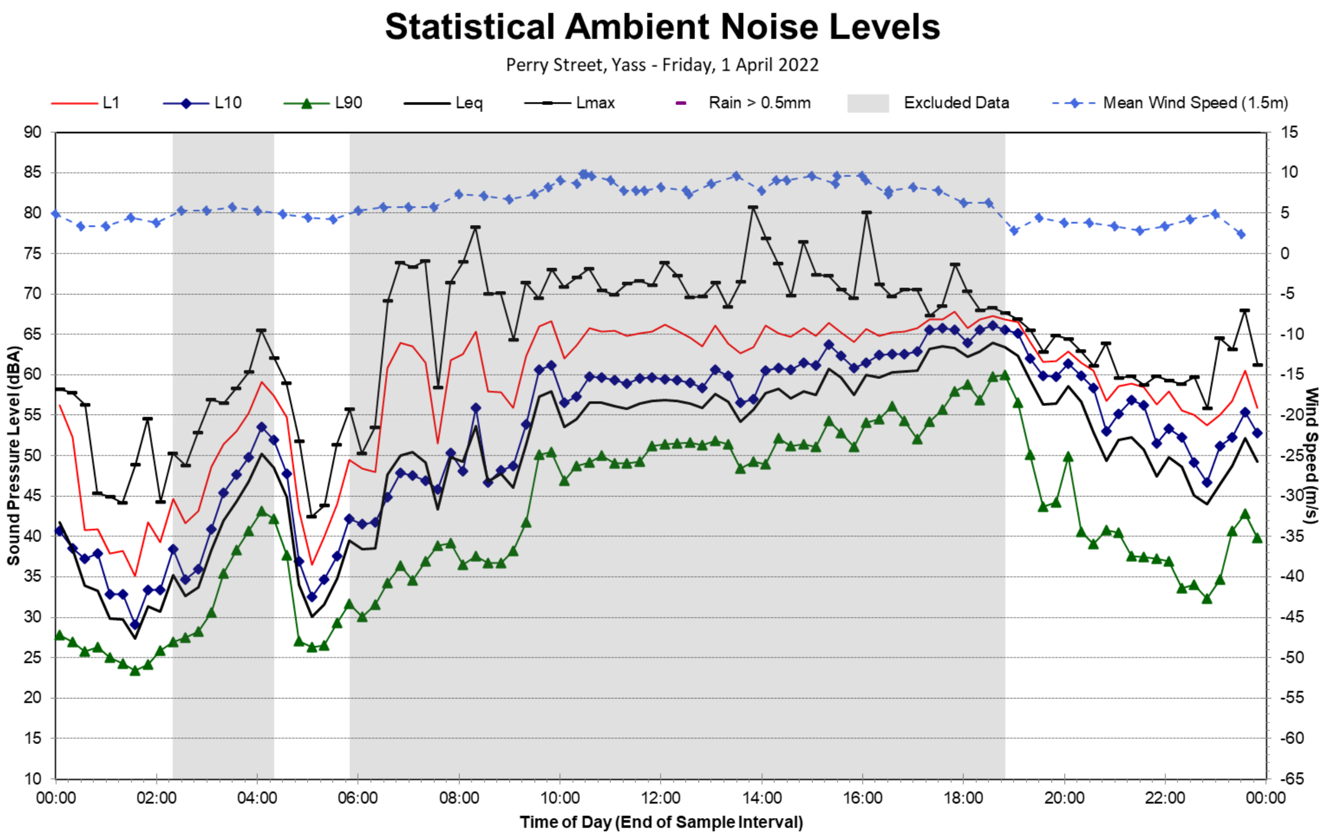
Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
Perry Street, Yass - Monday, 28 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

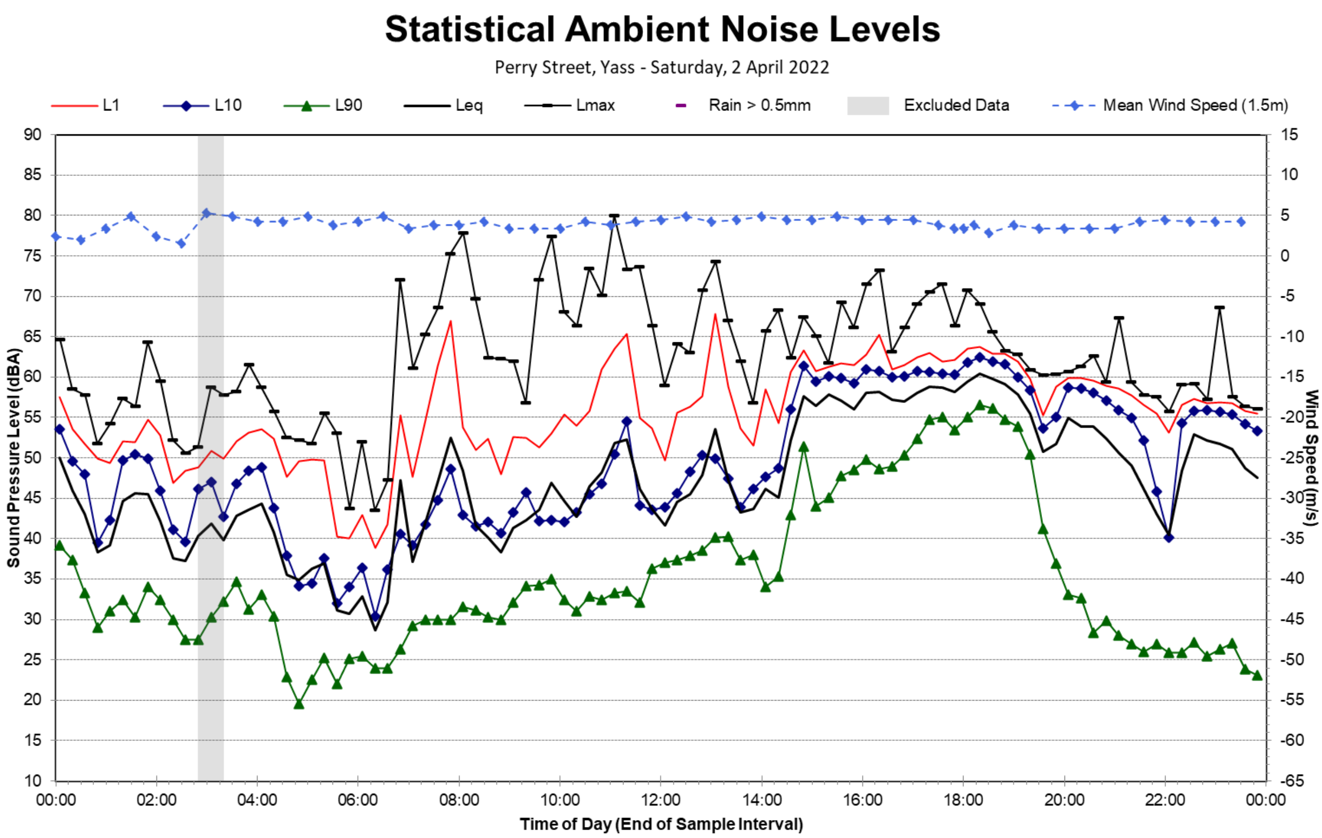

Statistical Ambient Noise Levels
Perry Street, Yass - Tuesday, 29 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Perry Street, Yass - Wednesday, 30 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Perry Street, Yass - Thursday, 31 March 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



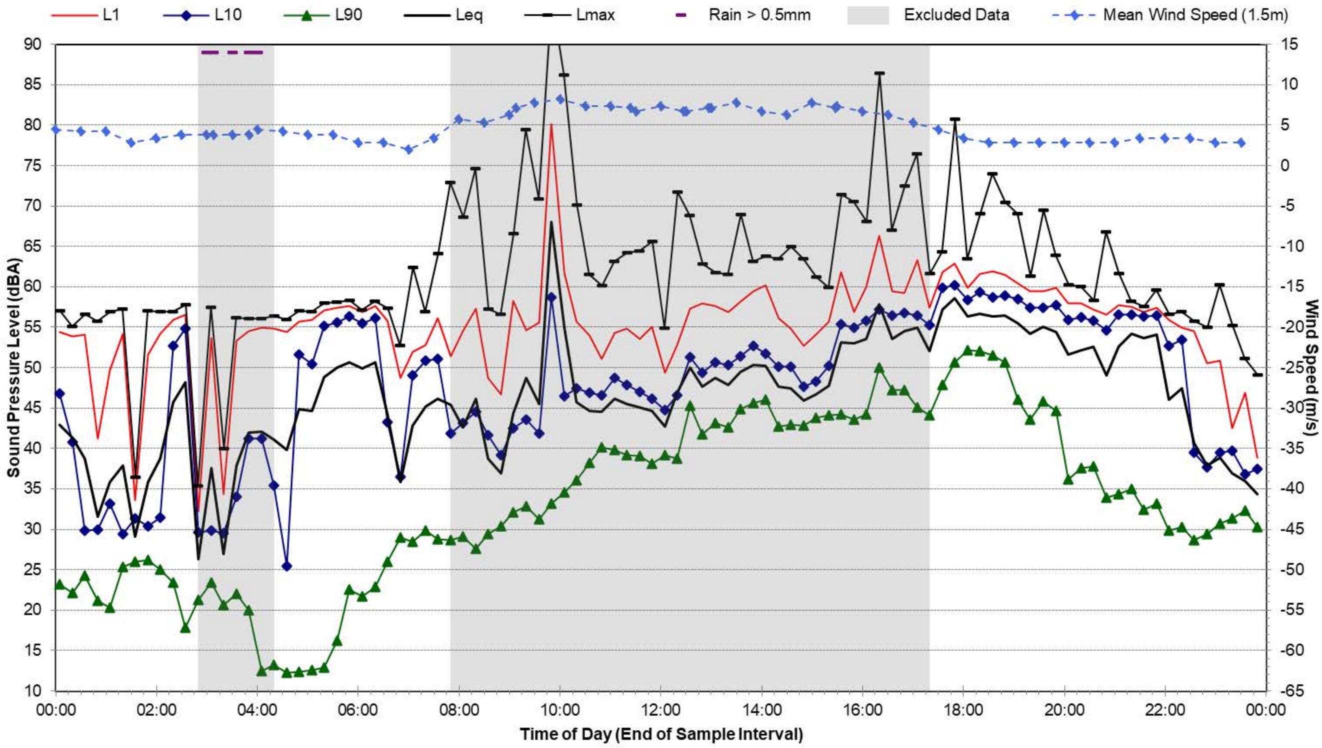
Statistical Ambient Noise Levels
Perry Street, Yass - Friday, 1 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Perry Street, Yass - Saturday, 2 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

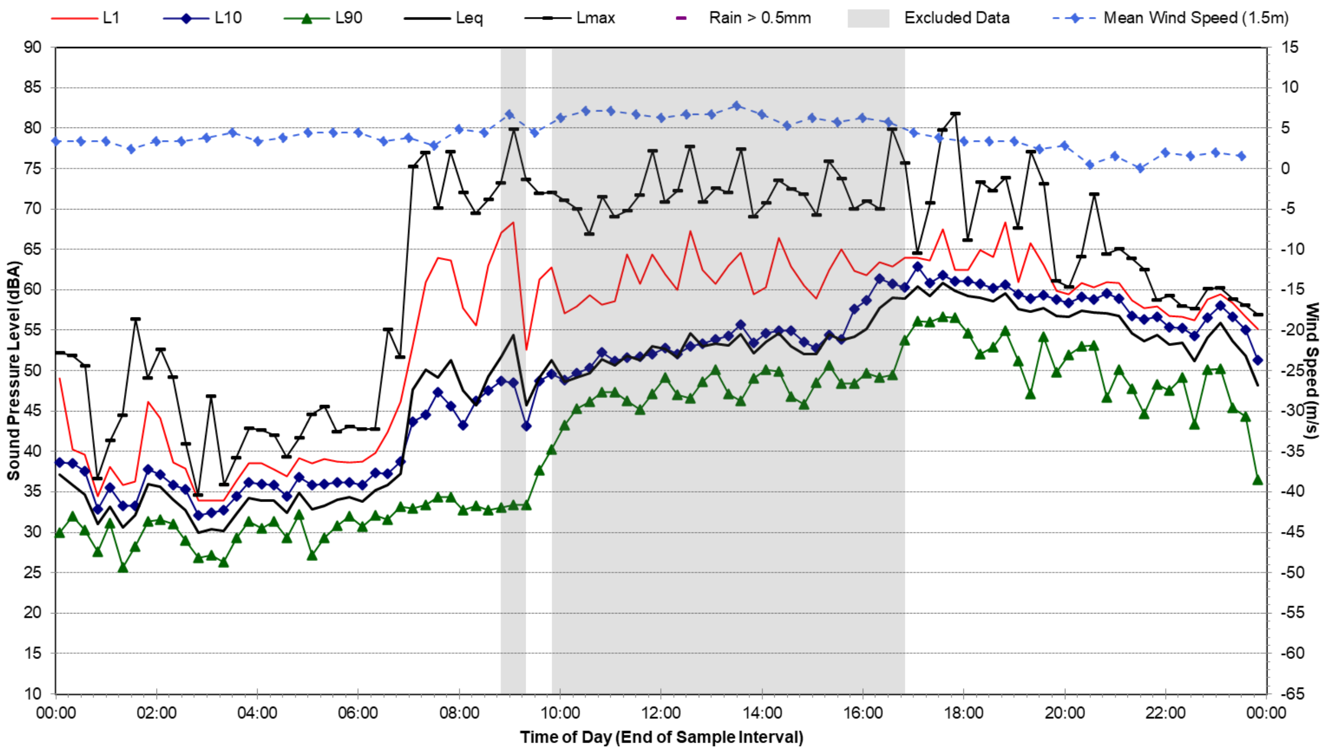
Statistical Ambient Noise Levels

Perry Street, Yass - Sunday, 3 April 2022



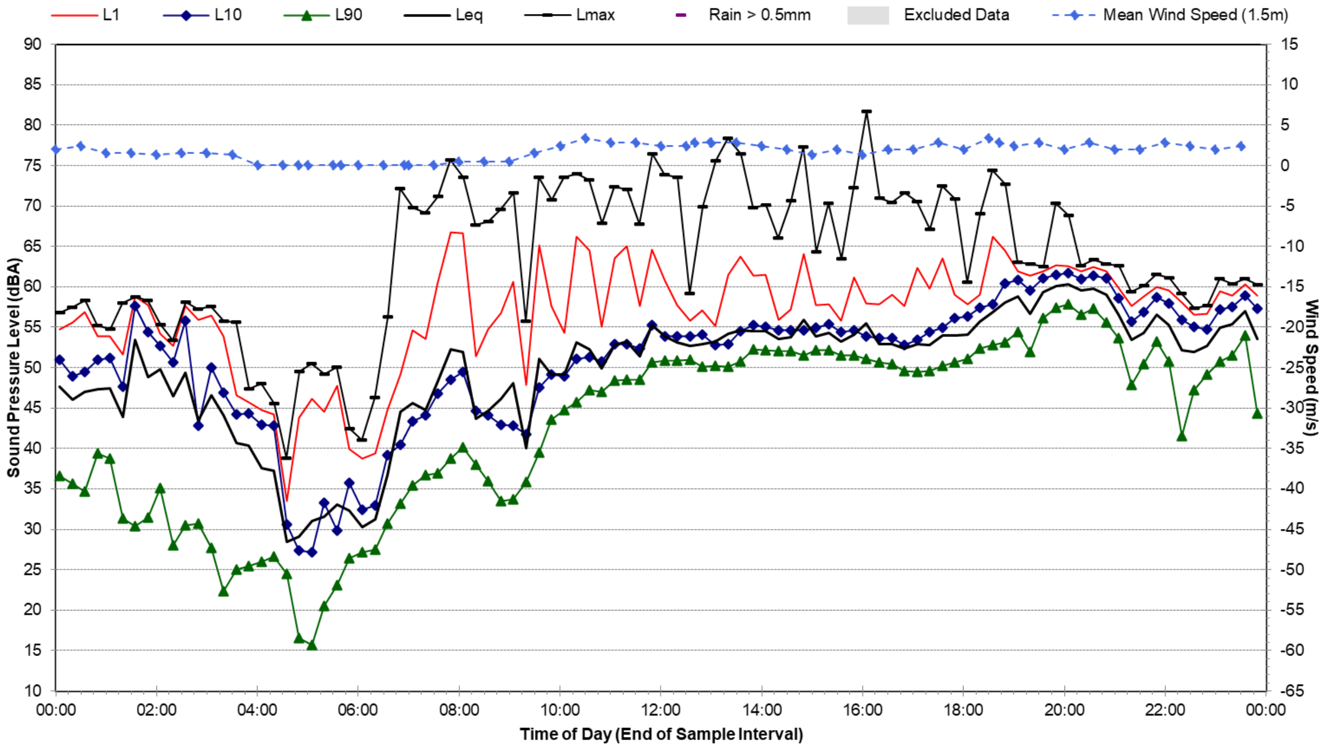
Statistical Ambient Noise Levels

Perry Street, Yass - Monday, 4 April 2022



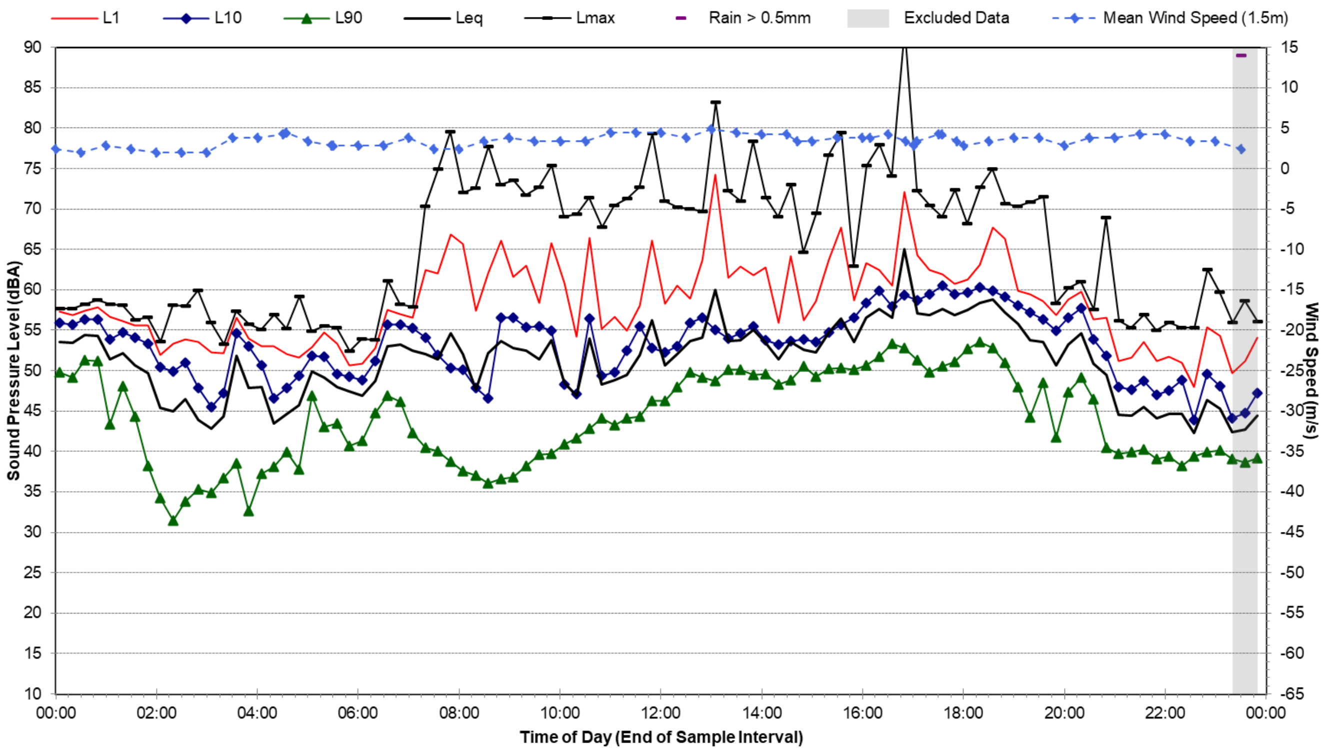
Statistical Ambient Noise Levels

Perry Street, Yass - Tuesday, 5 April 2022



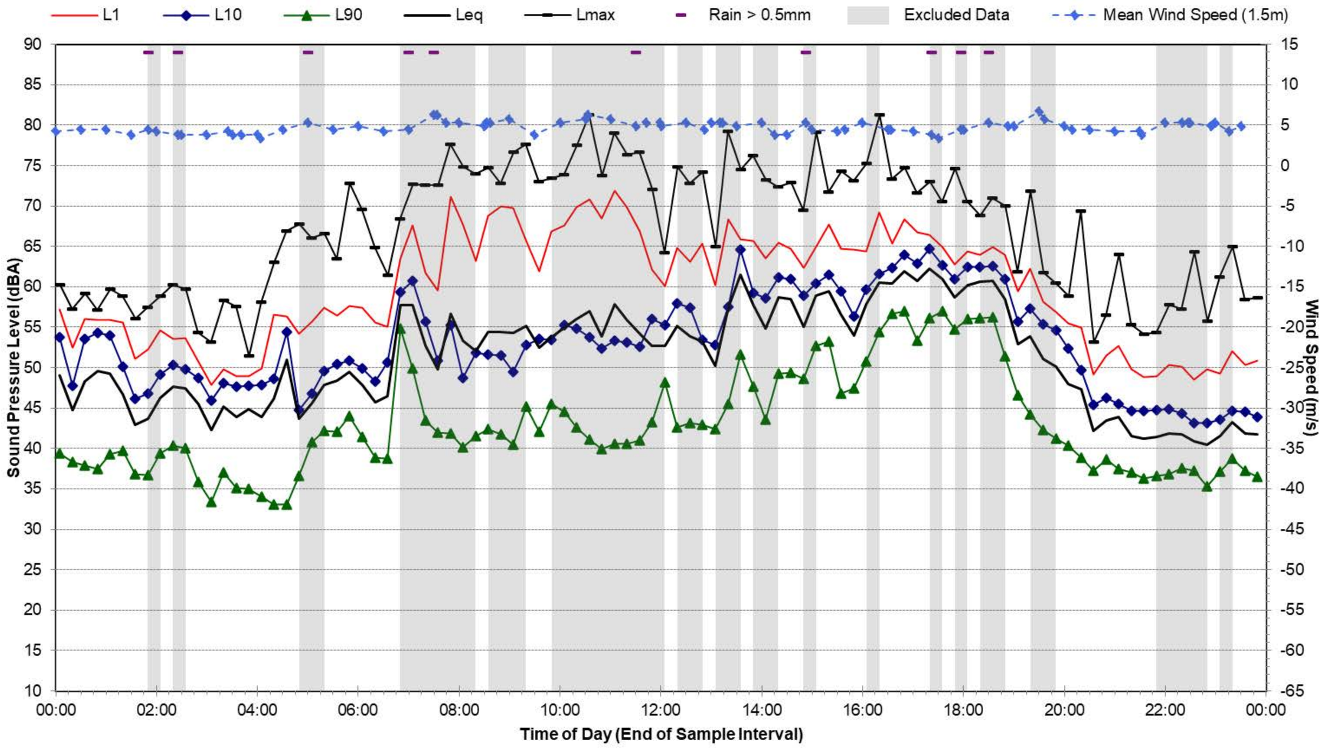
Statistical Ambient Noise Levels

Perry Street, Yass - Wednesday, 6 April 2022



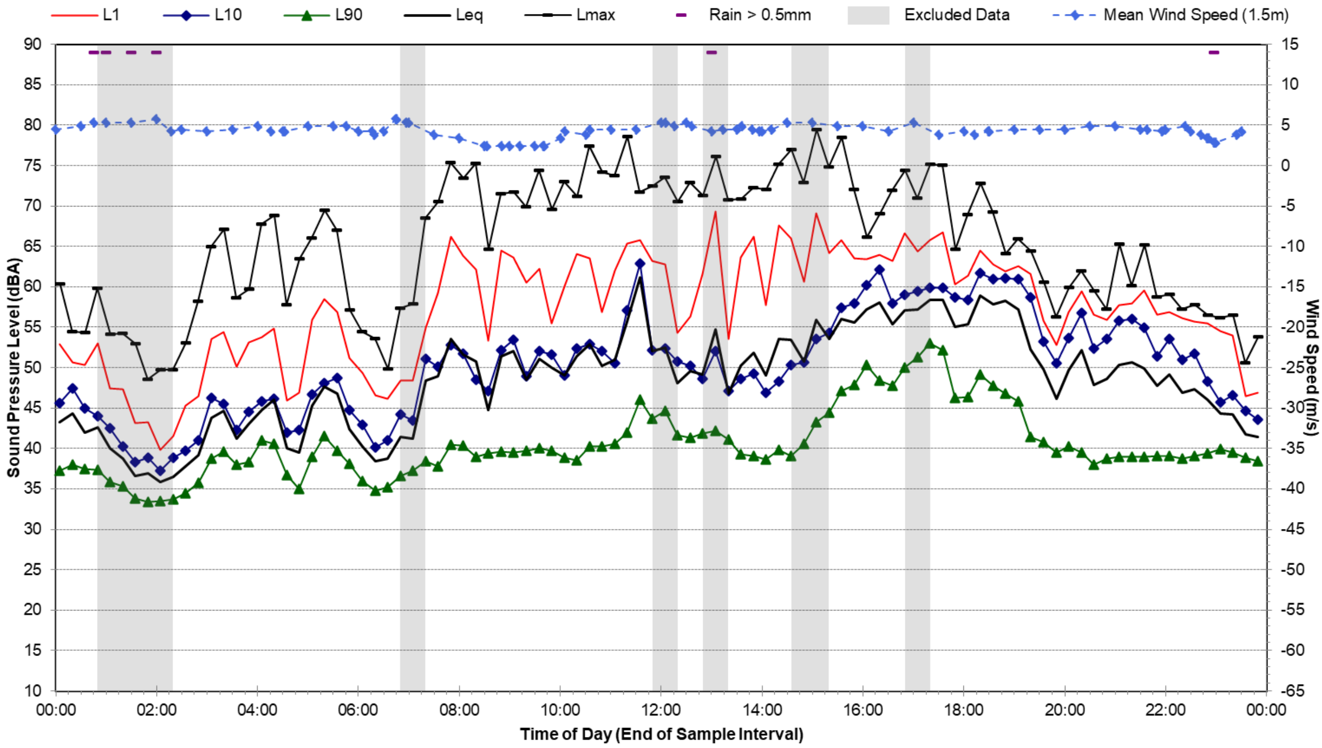
Statistical Ambient Noise Levels

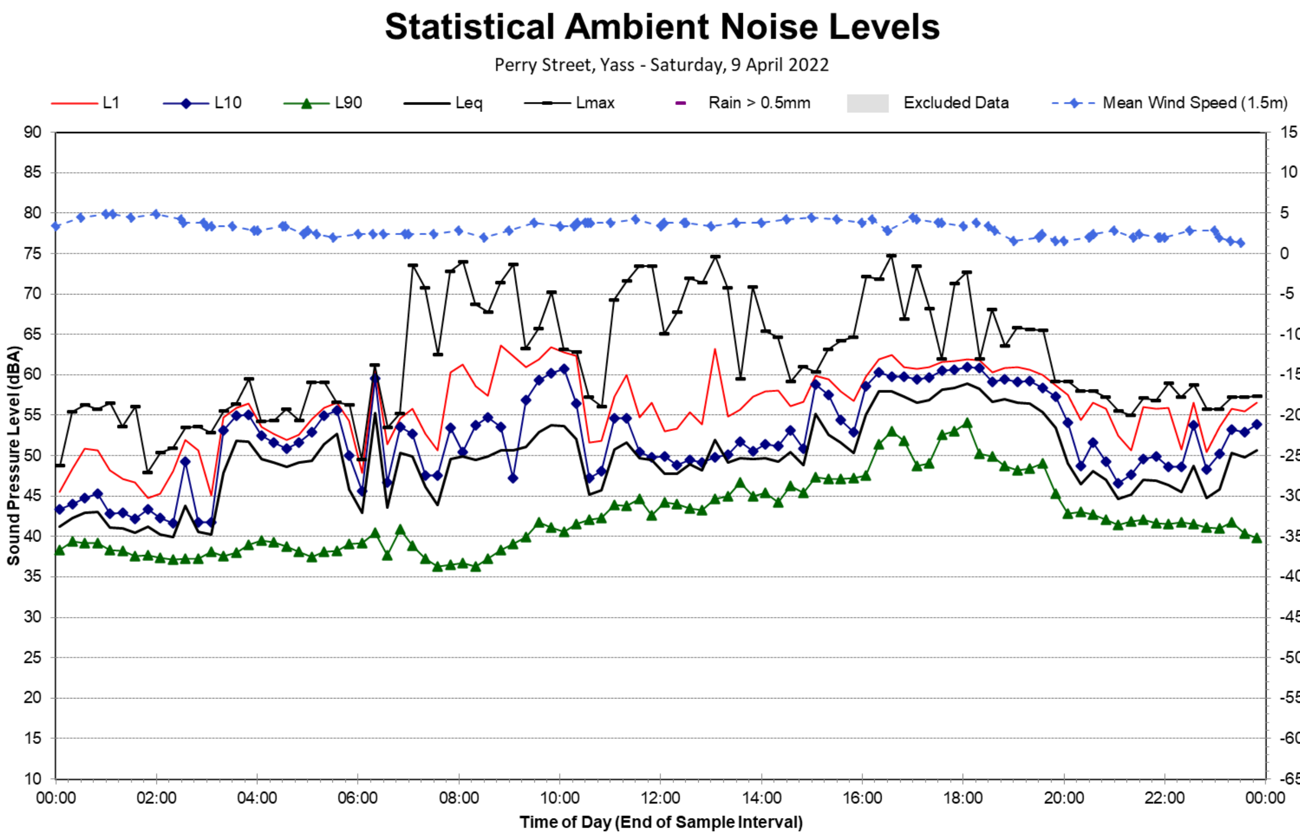
Perry Street, Yass - Thursday, 7 April 2022



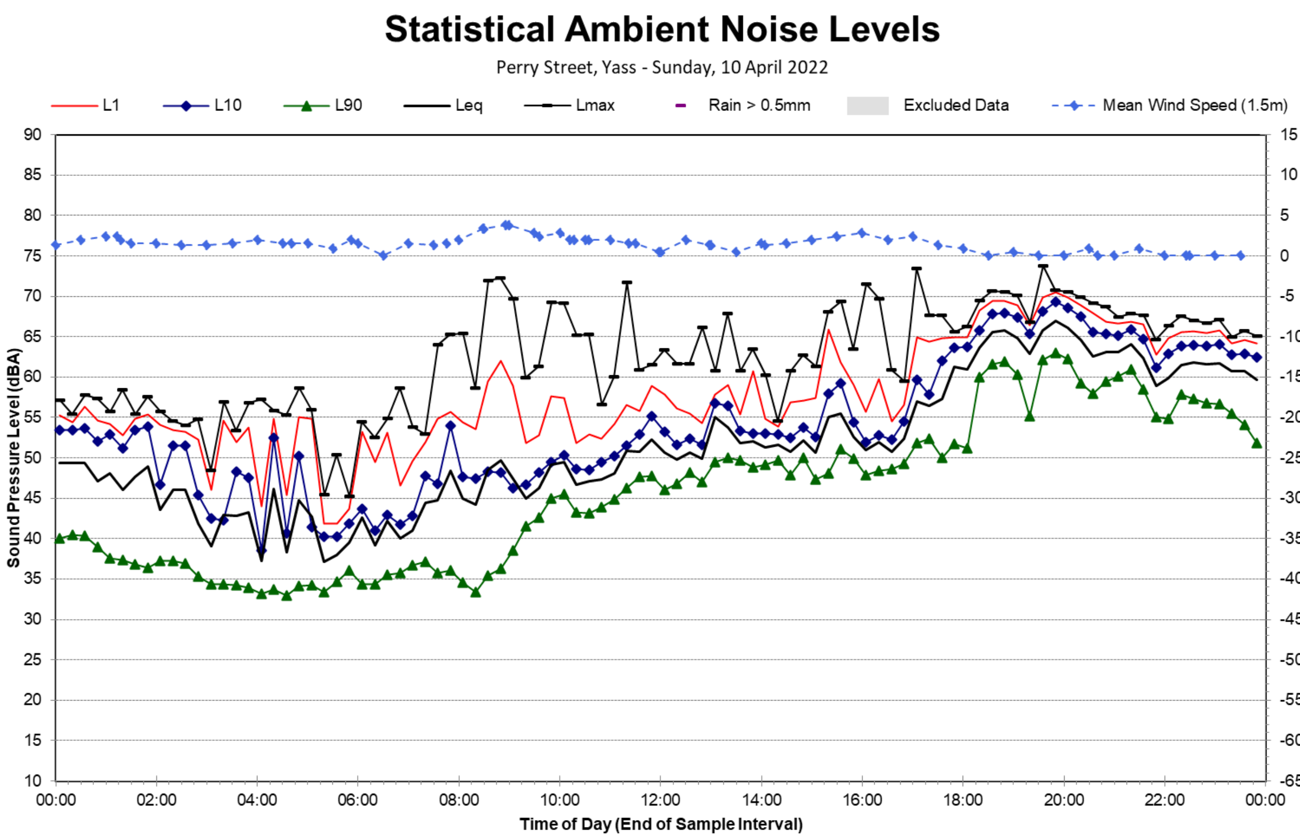
Statistical Ambient Noise Levels

Perry Street, Yass - Friday, 8 April 2022

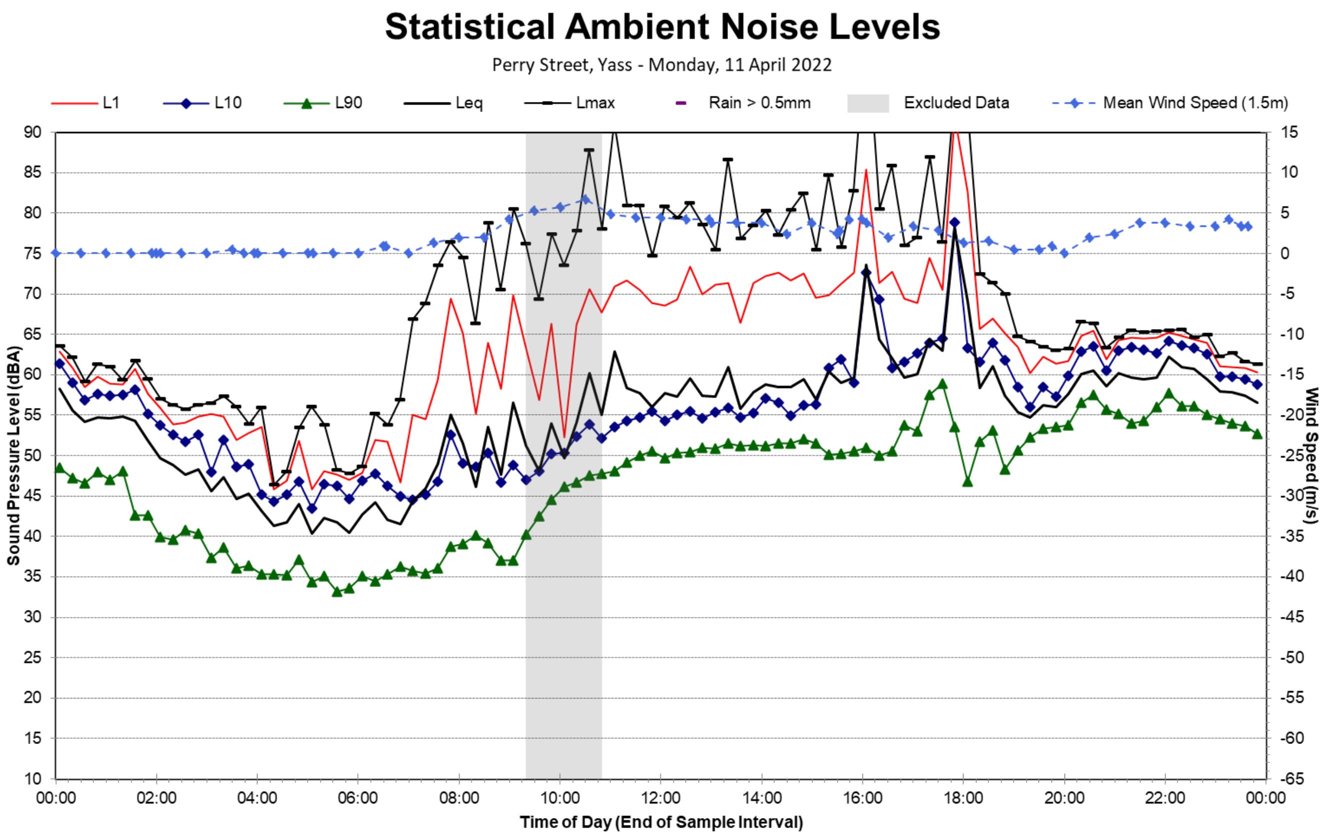




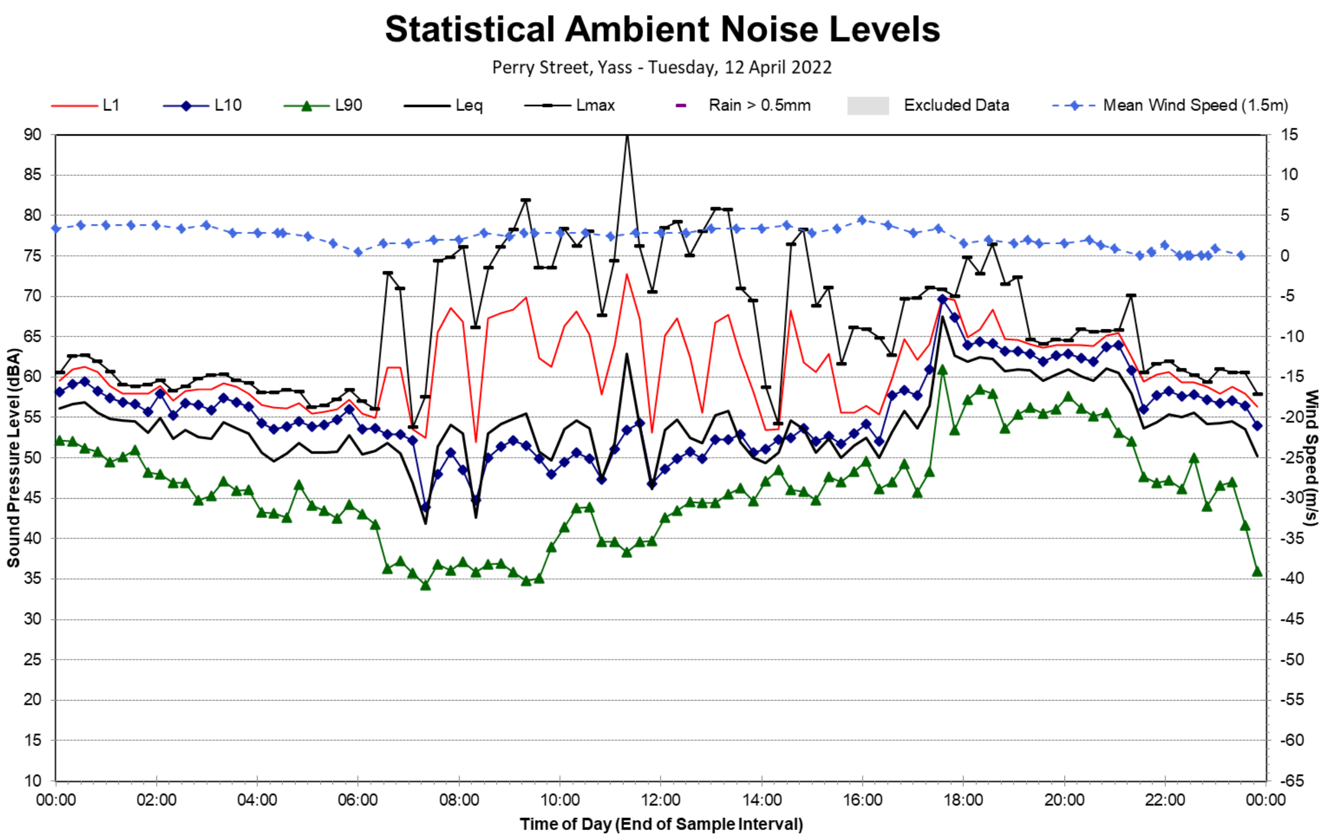
Statistical Ambient Noise Levels
Perry Street, Yass - Saturday, 9 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Perry Street, Yass - Sunday, 10 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Perry Street, Yass - Monday, 11 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Perry Street, Yass - Tuesday, 12 April 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.09
Noise Monitoring Address	**38 Alfred Street, Tumbarumba**

Logger Device Type: Svantek 957, Logger Serial No: 23241
Sound Level Meter Device Type: Rion NA-28, Sound Level Meter Serial No: 106005

Ambient noise logger deployed around the corner of Courabyra Road and Alfred Street, Tumbarumba. Logger located with direct view of Courabyra Road to the west.

Attended noise measurements indicate the ambient noise environment at this location is influenced by road traffic and wildlife noise, such as frogs and birds.

Recorded Noise Levels (LAmax) 16/08/2022:

Road traffic noise: 75-80 dBA
Birds: 40 dBA
Insects/frogs: 35-55 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	30	54	50	67
Evening	53	58	58	61
Night-time	39	53	52	54

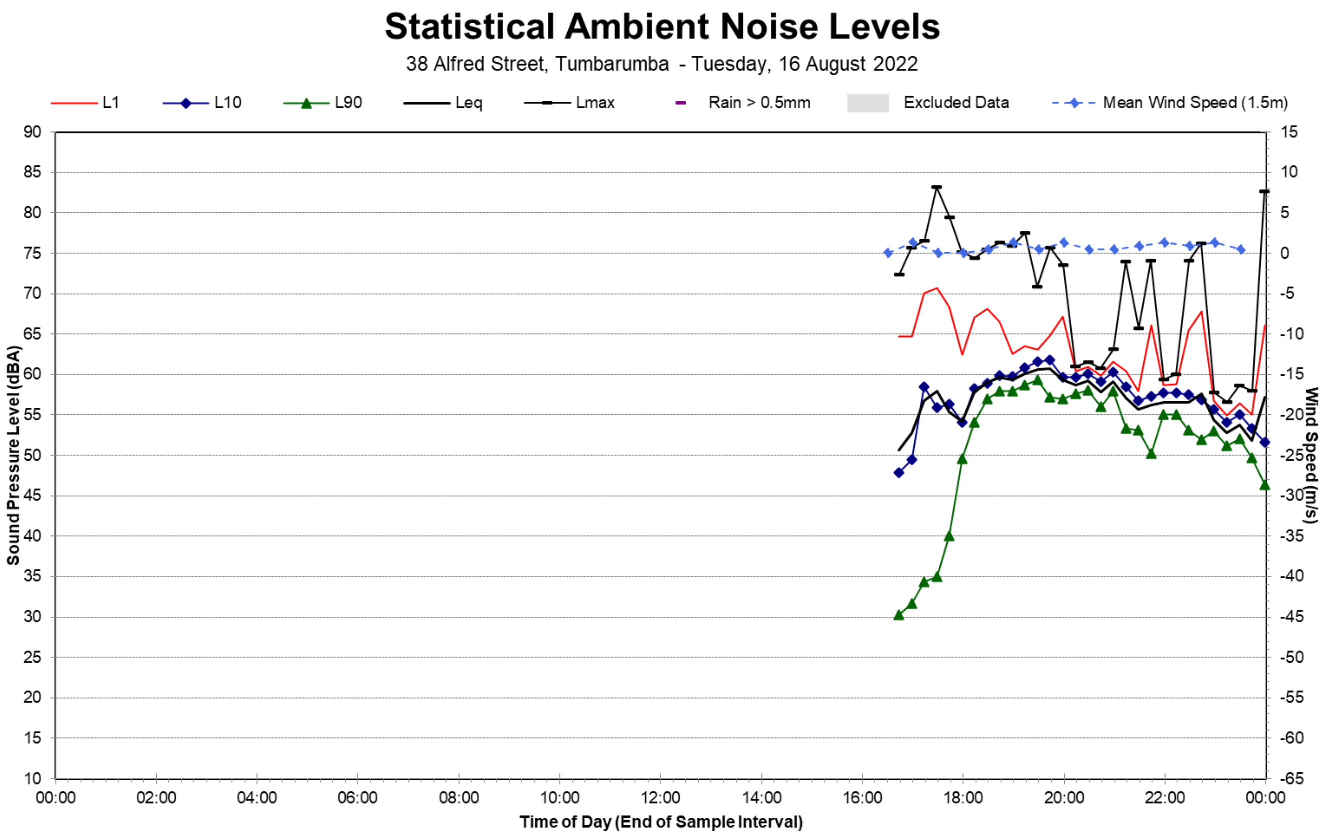
Ambient Noise Logging Results – RNP Defined Time Periods

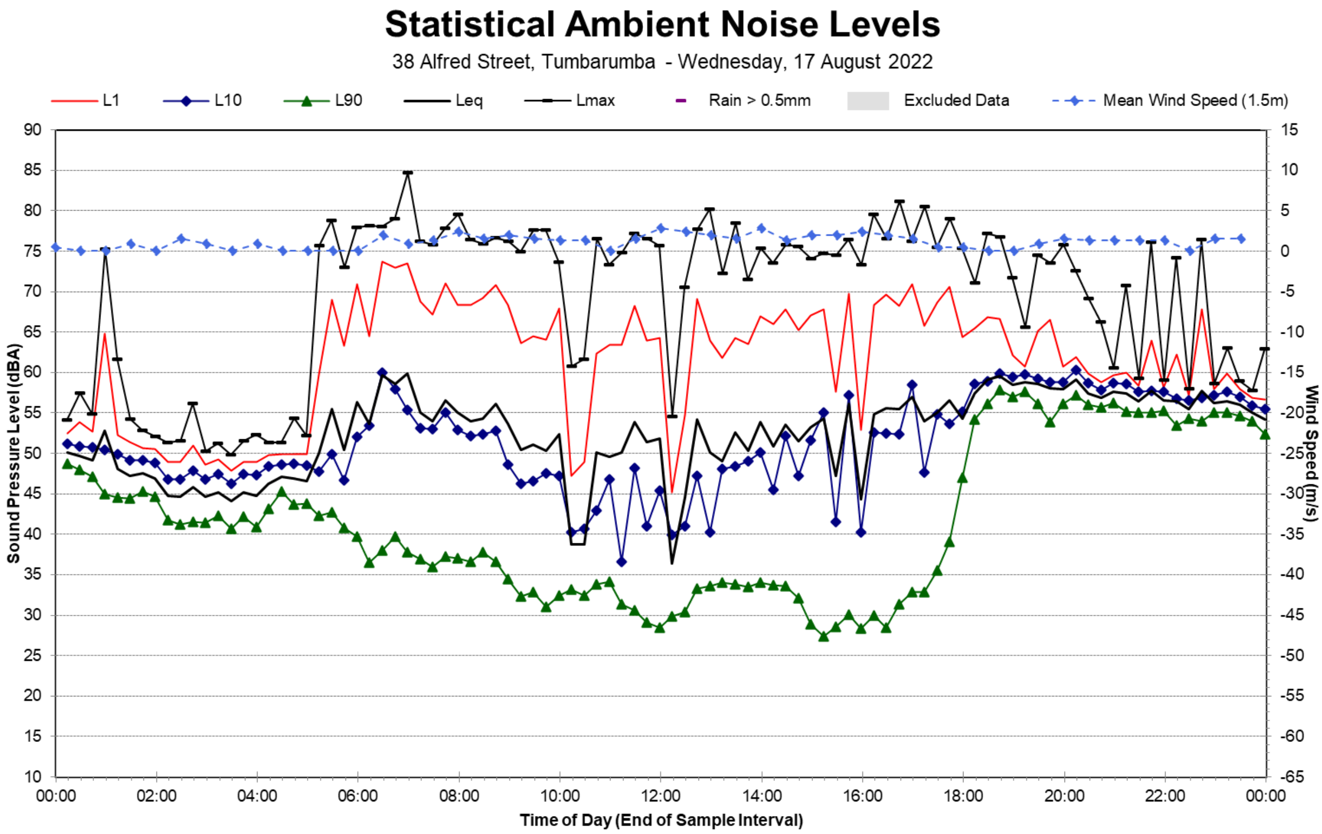
Monitoring Period	**Noise Level (dBA)**	
	LAeq(period)	**LAeq(1hour)**
Daytime (7am-10pm)	55	57
Night-time (10pm-7am)	53	55

Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
16/08/2022	16:46			

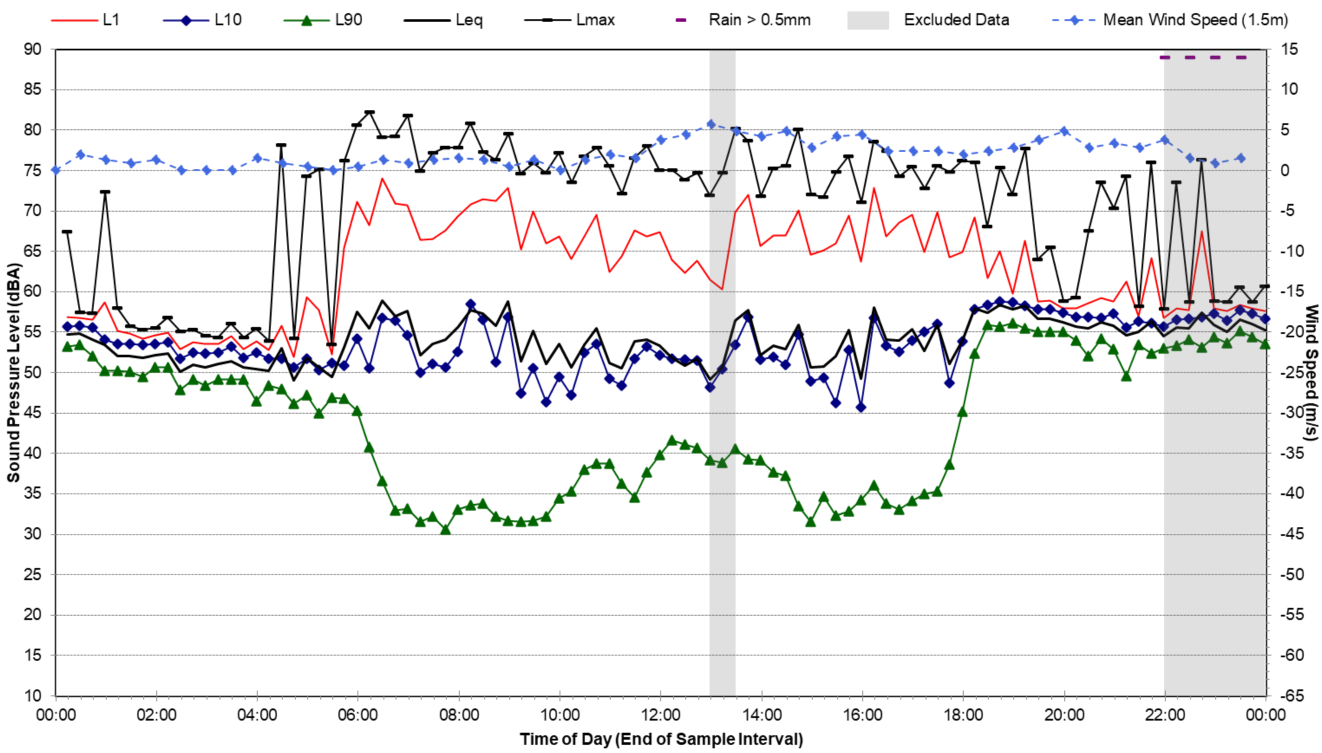
Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
38 Alfred Street, Tumbarumba - Tuesday, 16 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Statistical Ambient Noise Levels
38 Alfred Street, Tumbarumba - Wednesday, 17 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

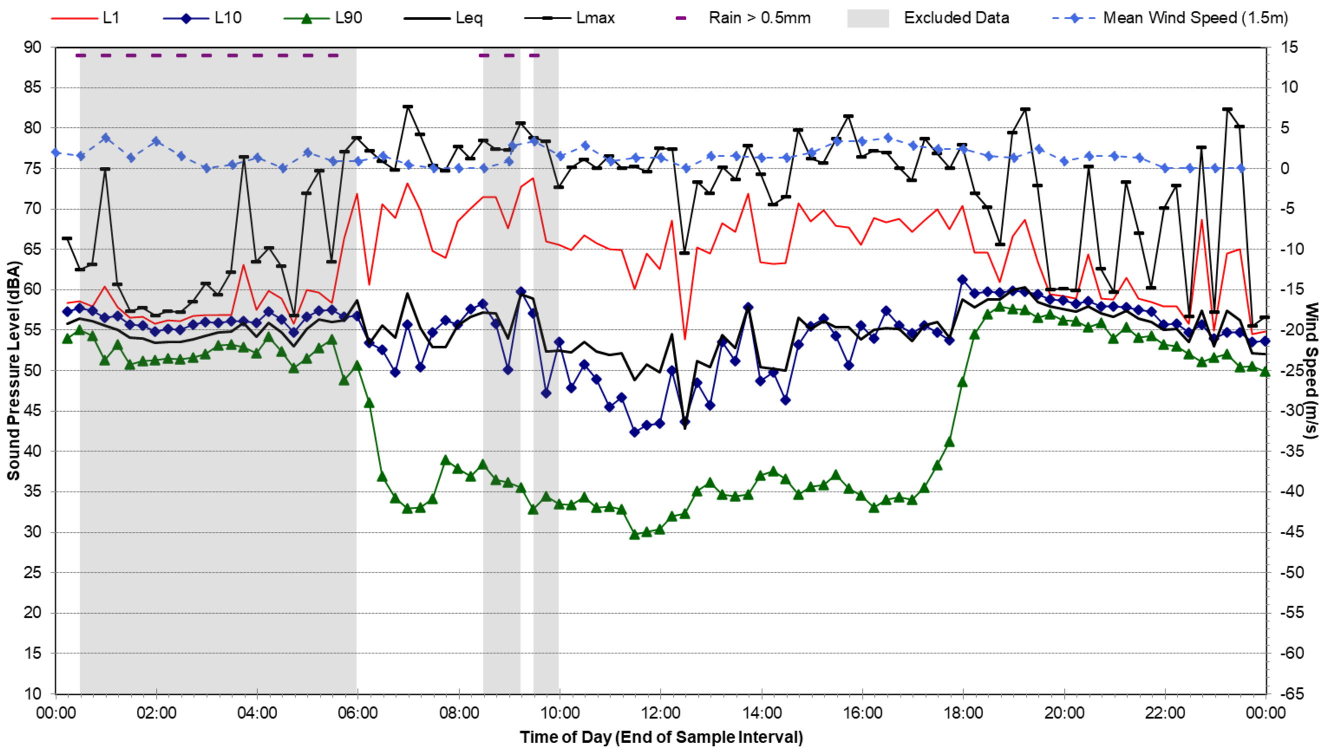
Statistical Ambient Noise Levels

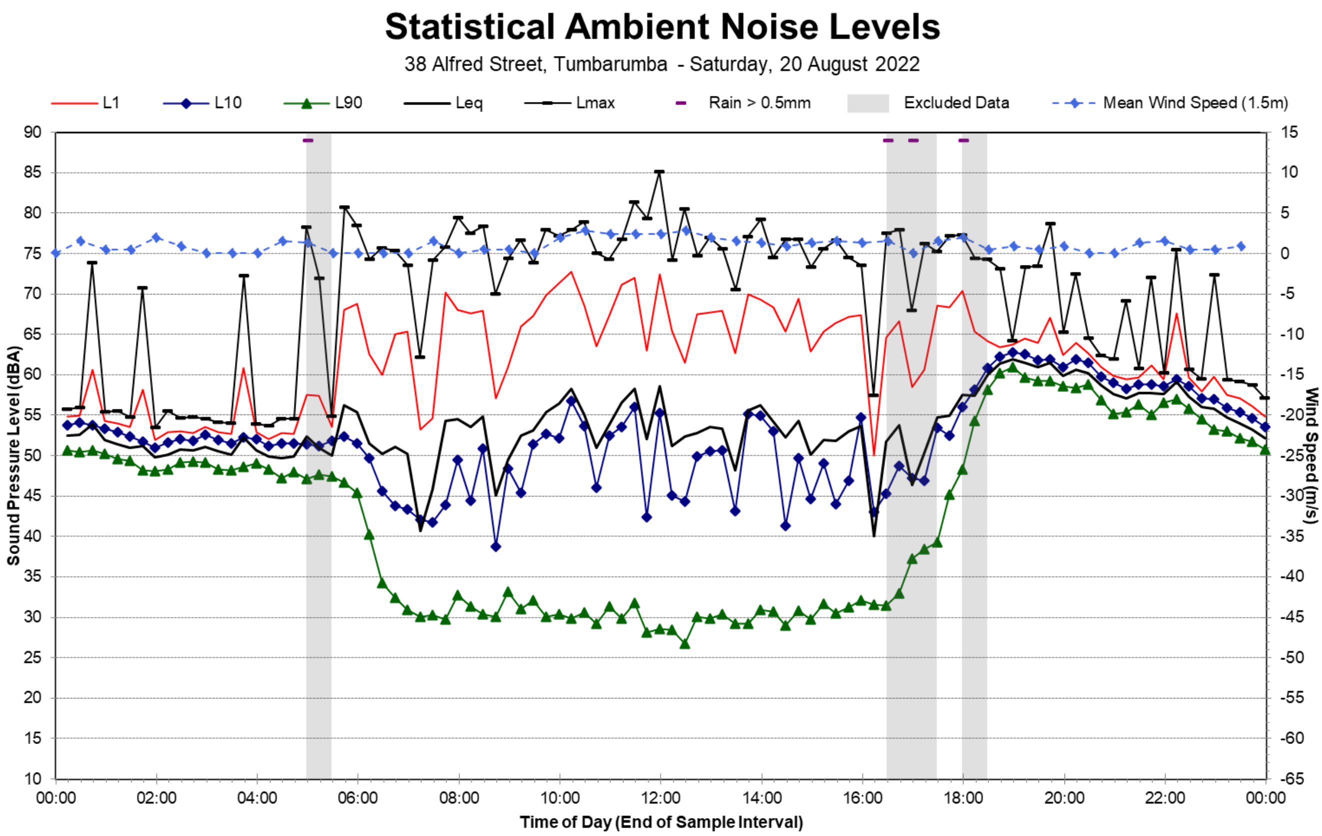
38 Alfred Street, Tumbarumba - Thursday, 18 August 2022



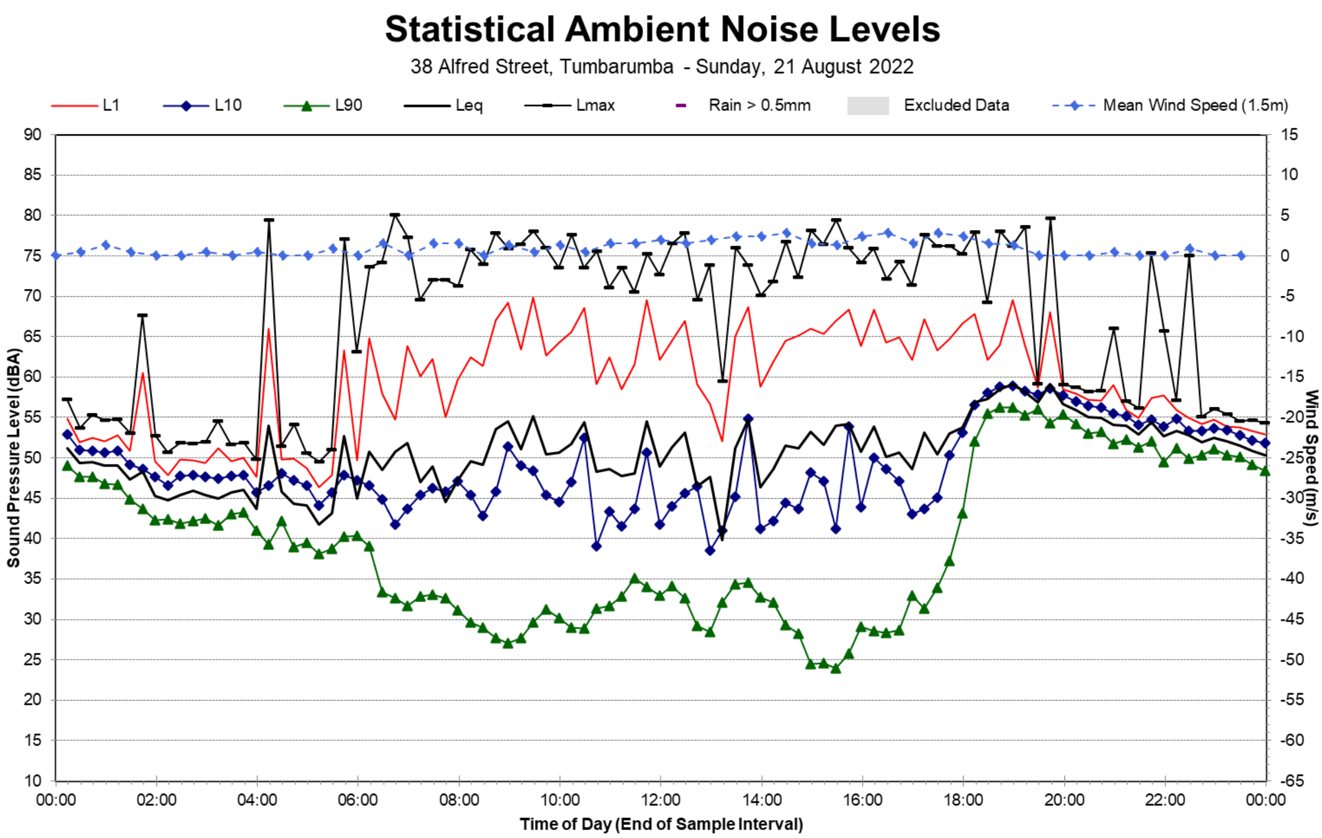
Statistical Ambient Noise Levels

38 Alfred Street, Tumbarumba - Friday, 19 August 2022

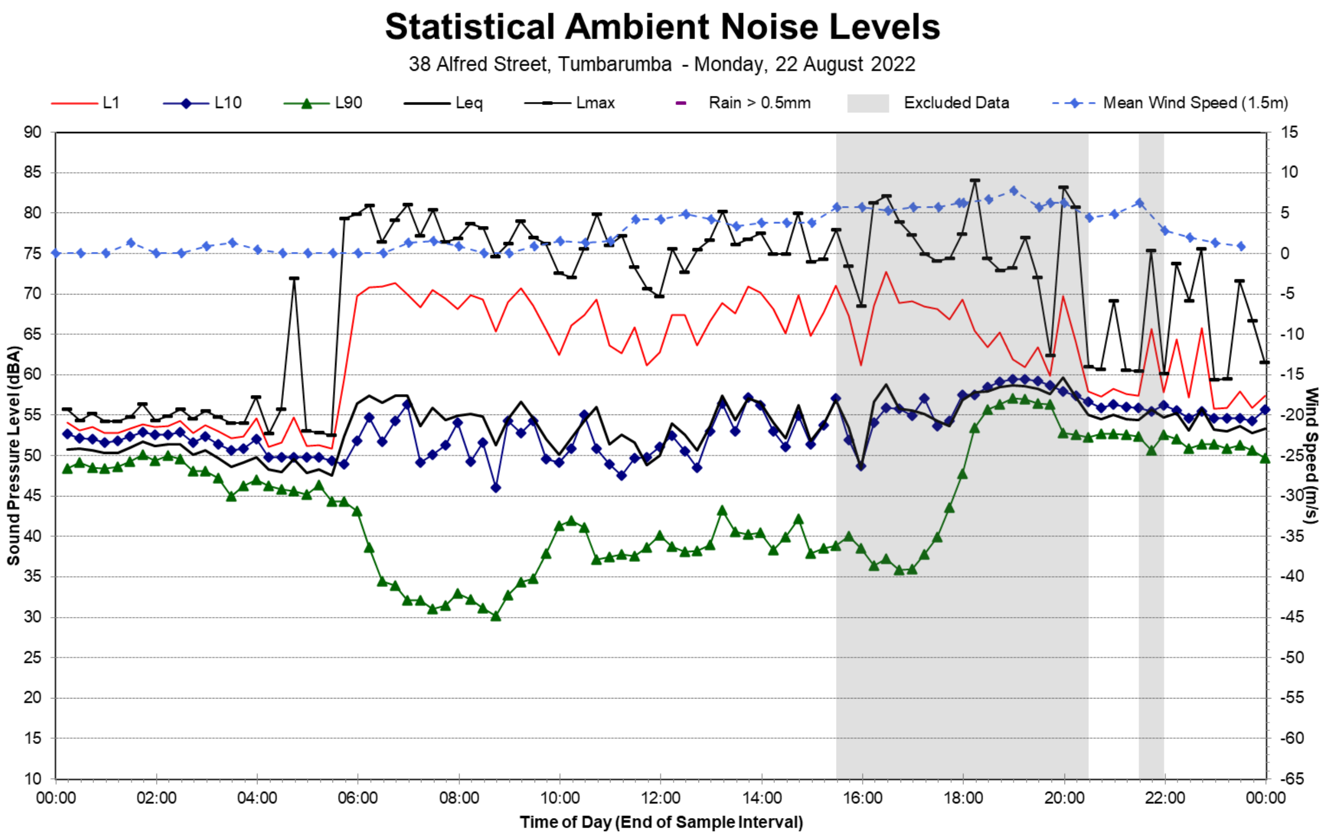


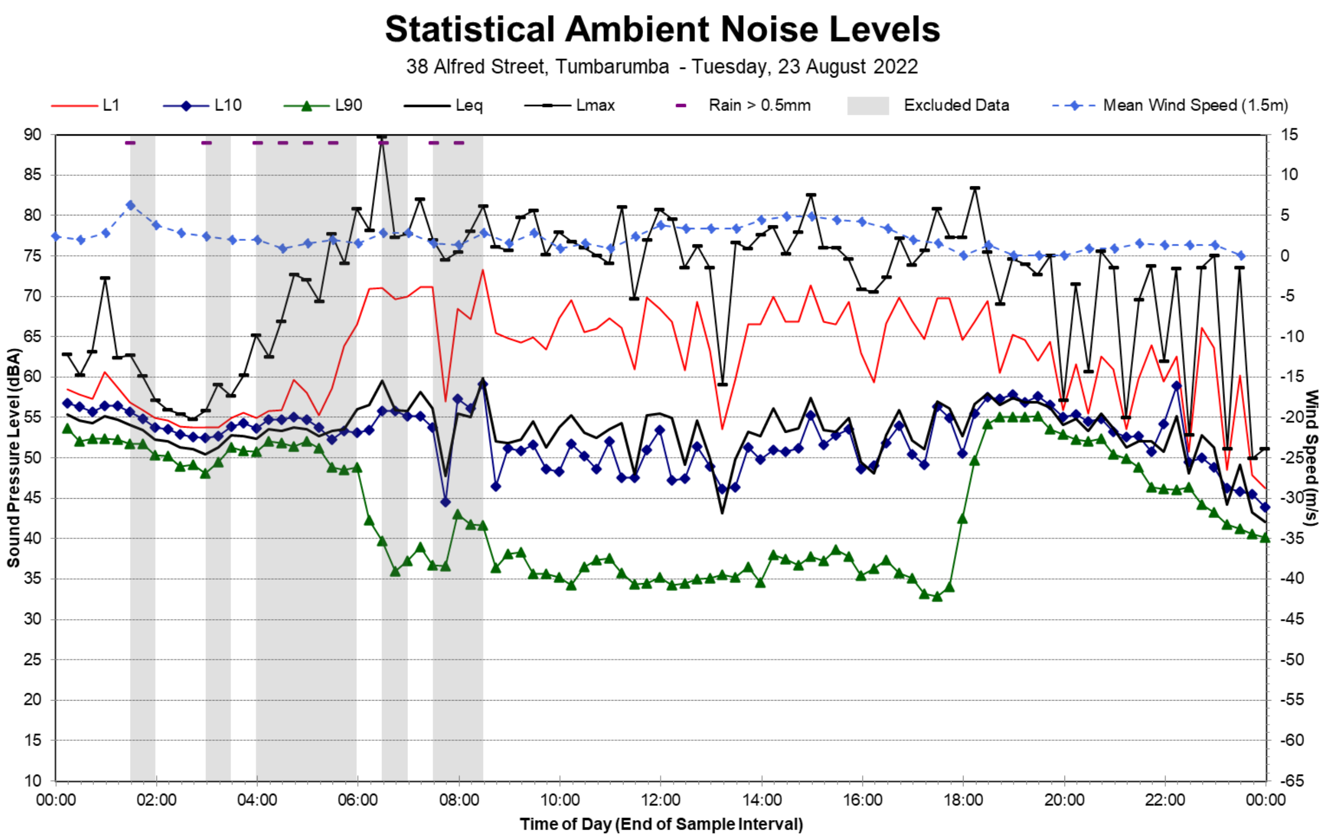


Statistical Ambient Noise Levels
38 Alfred Street, Tumbarumba - Saturday, 20 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



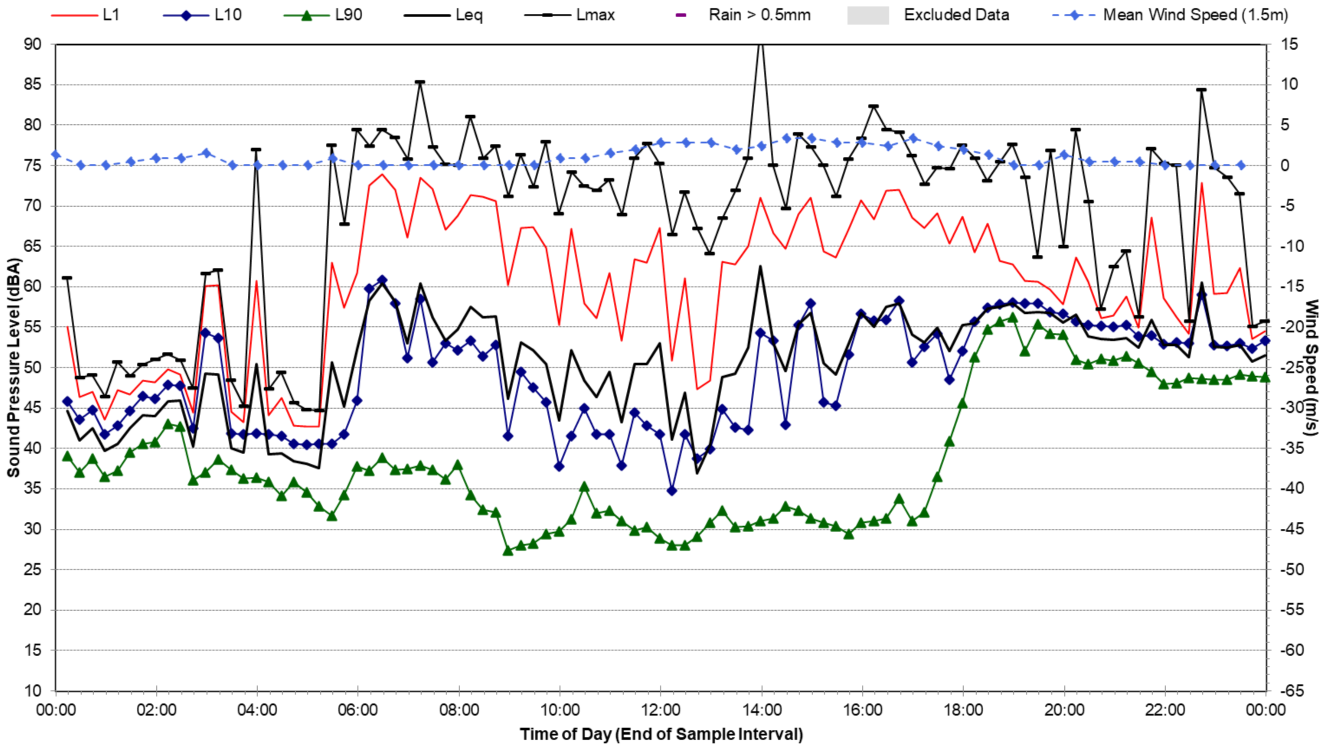
Statistical Ambient Noise Levels
38 Alfred Street, Tumbarumba - Sunday, 21 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
38 Alfred Street, Tumbarumba - Monday, 22 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
38 Alfred Street, Tumbarumba - Tuesday, 23 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

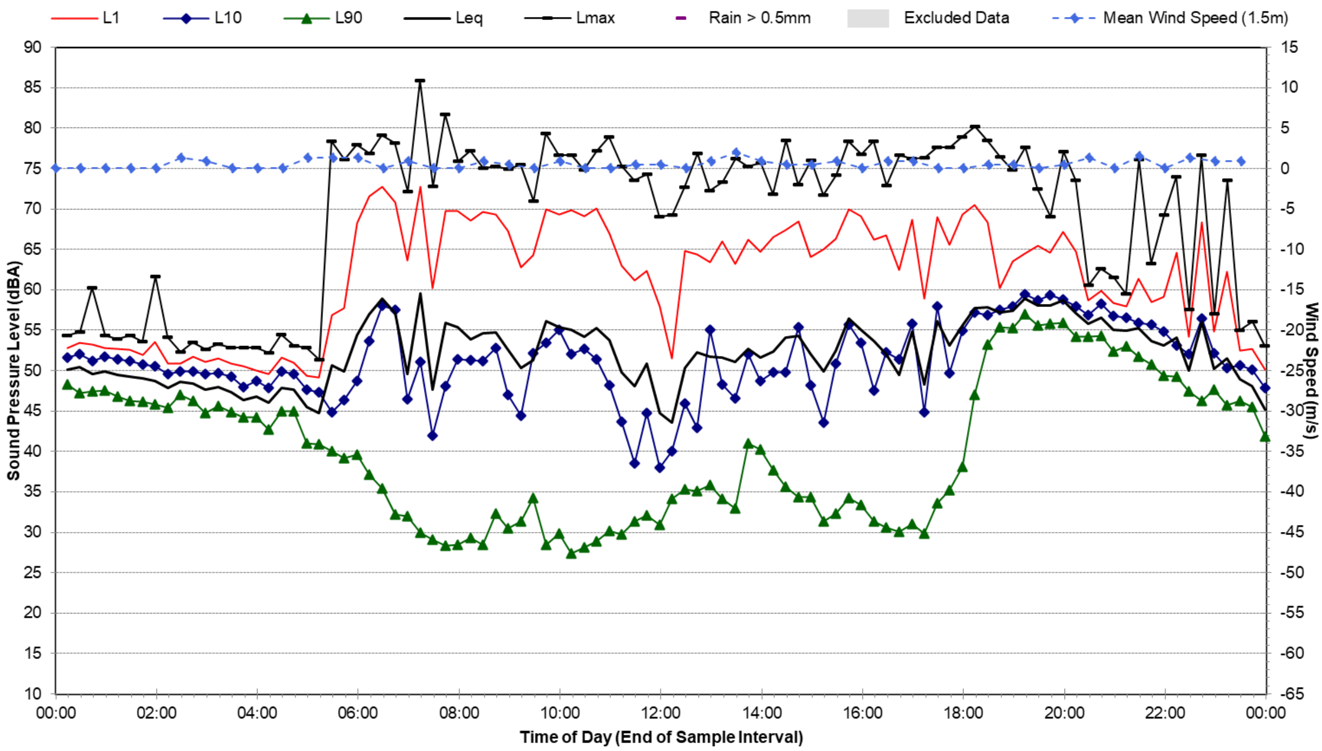
Statistical Ambient Noise Levels

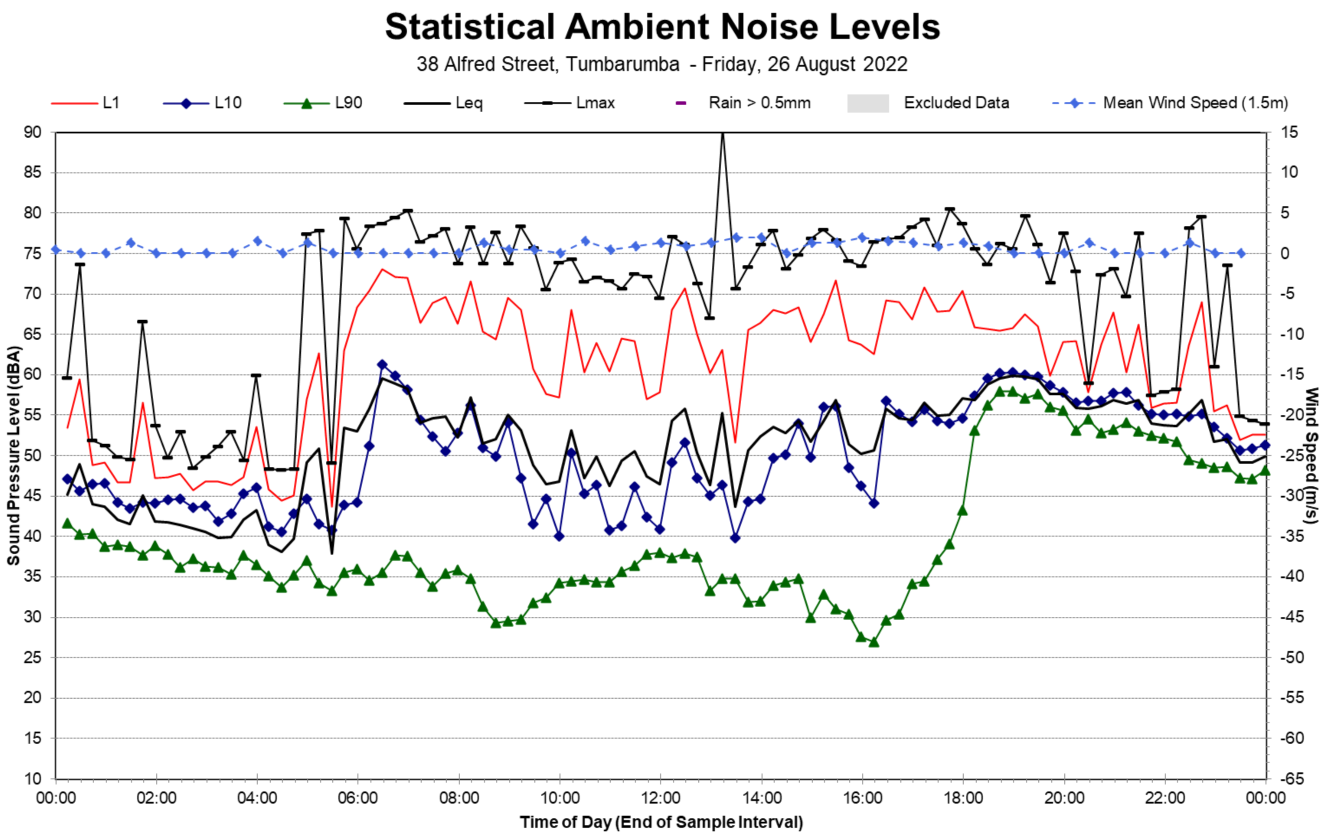
38 Alfred Street, Tumbarumba - Wednesday, 24 August 2022

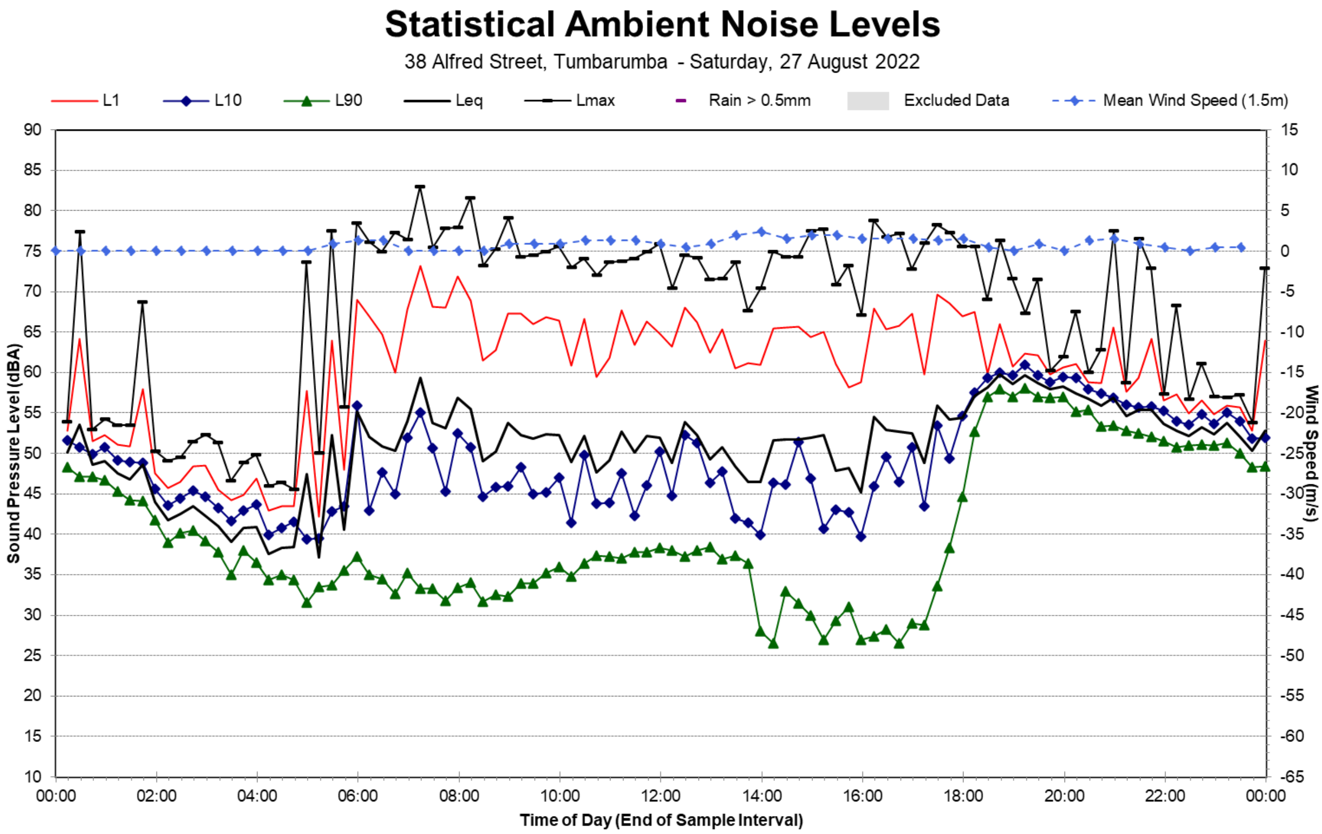


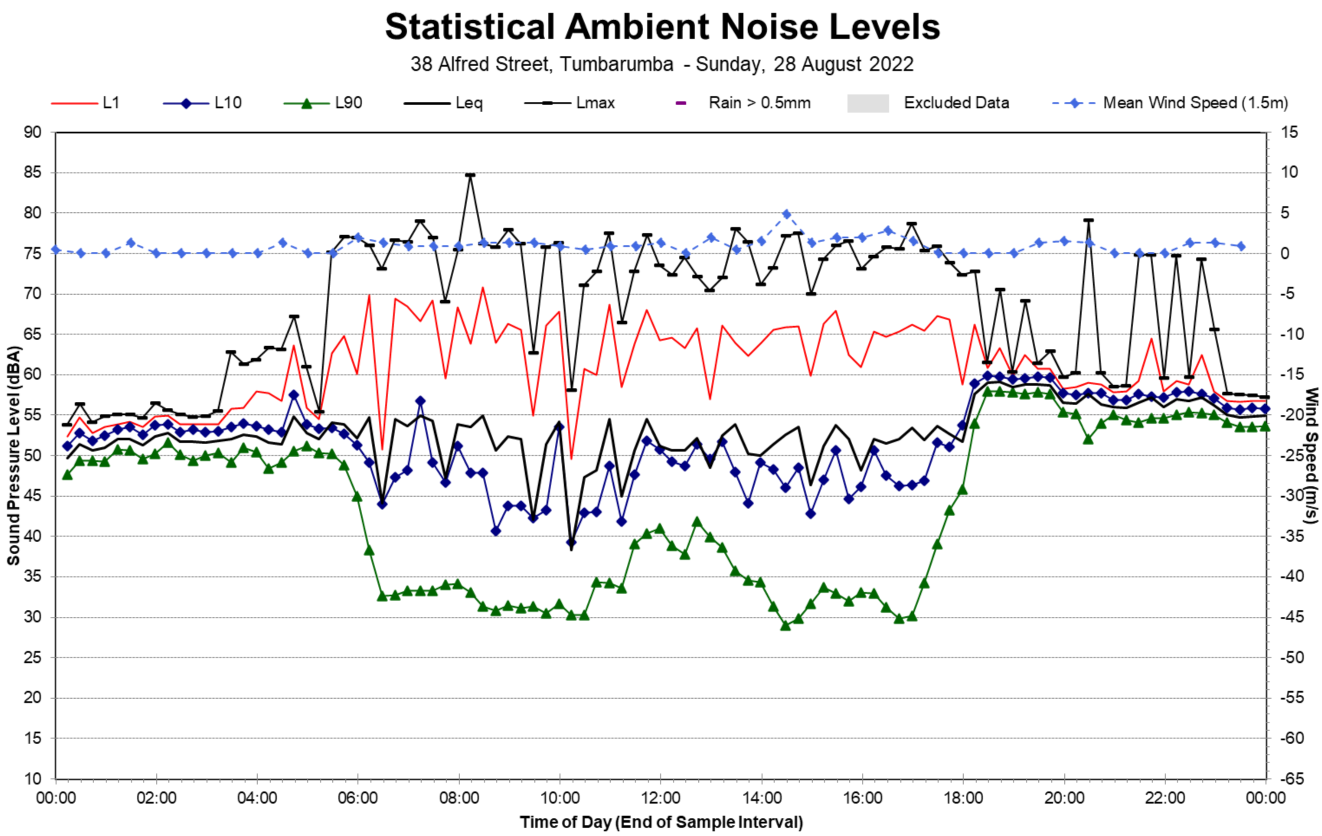
Statistical Ambient Noise Levels

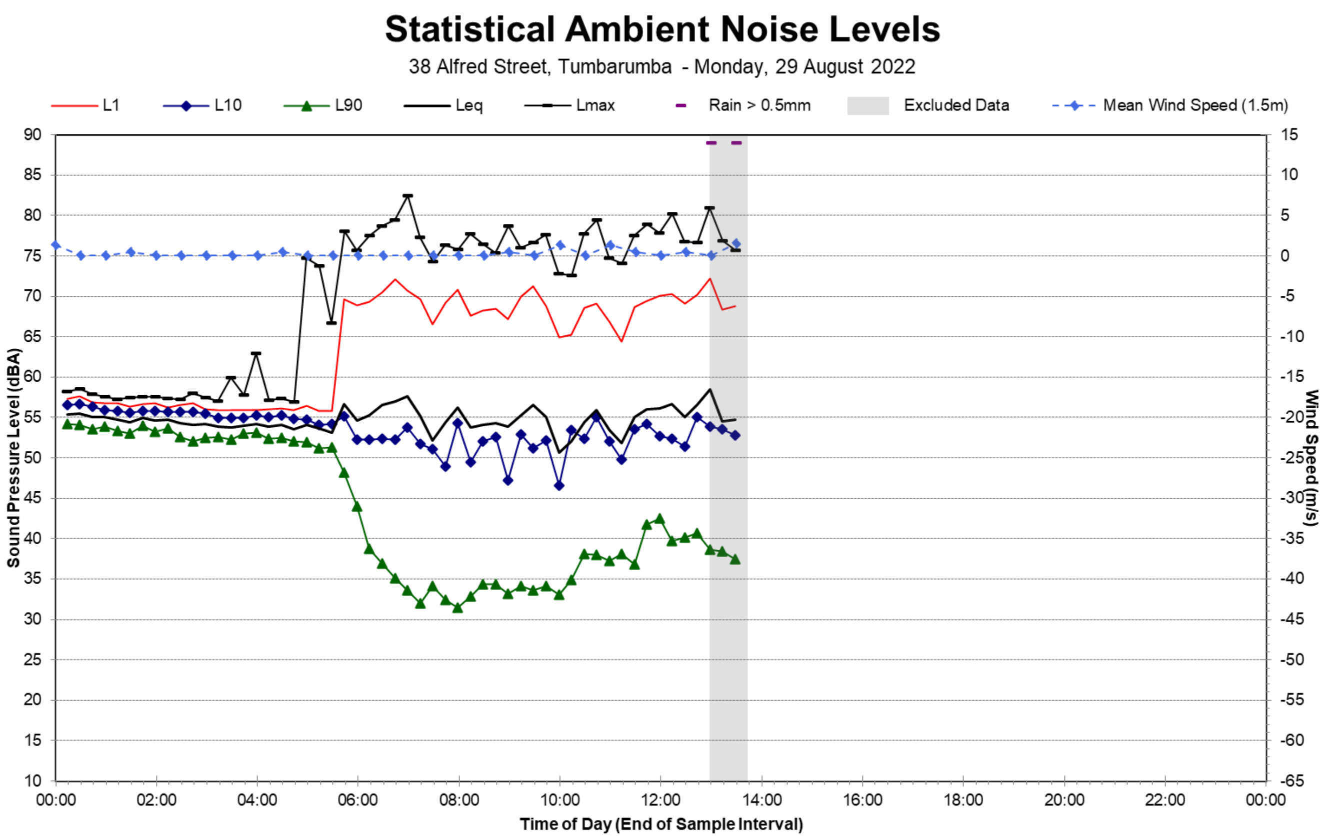
38 Alfred Street, Tumbarumba - Thursday, 25 August 2022



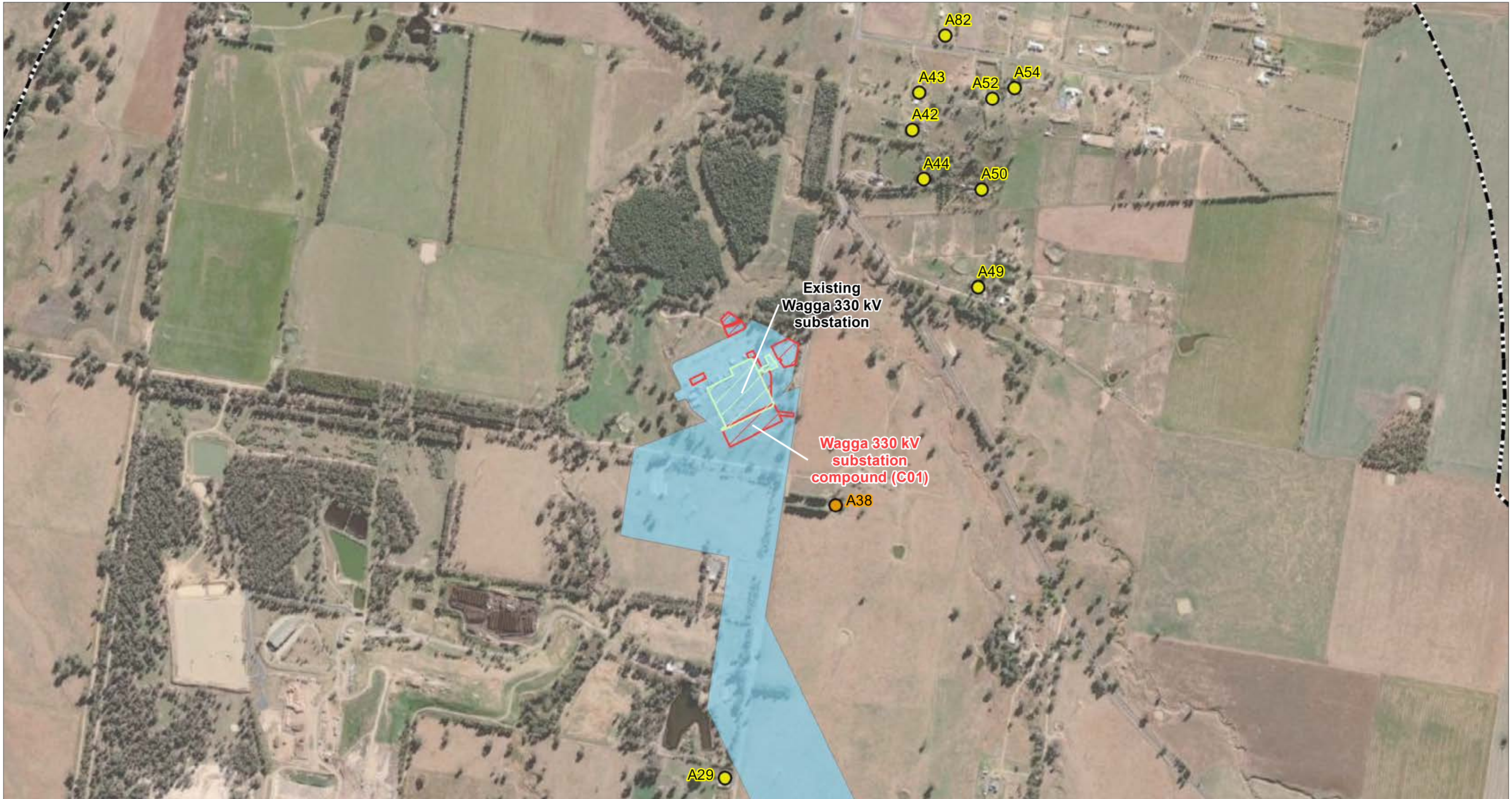

Statistical Ambient Noise Levels
38 Alfred Street, Tumbarumba - Friday, 26 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
38 Alfred Street, Tumbarumba - Saturday, 27 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
38 Alfred Street, Tumbarumba - Sunday, 28 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
38 Alfred Street, Tumbarumba - Monday, 29 August 2022
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

ATTACHMENT G
Construction noise impact mapping



0 50 100 200
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:15,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

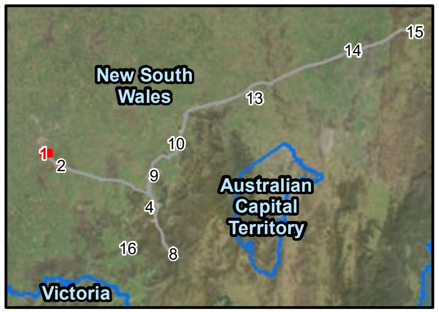
Existing Substation fence line

Daytime noise impacts

- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut

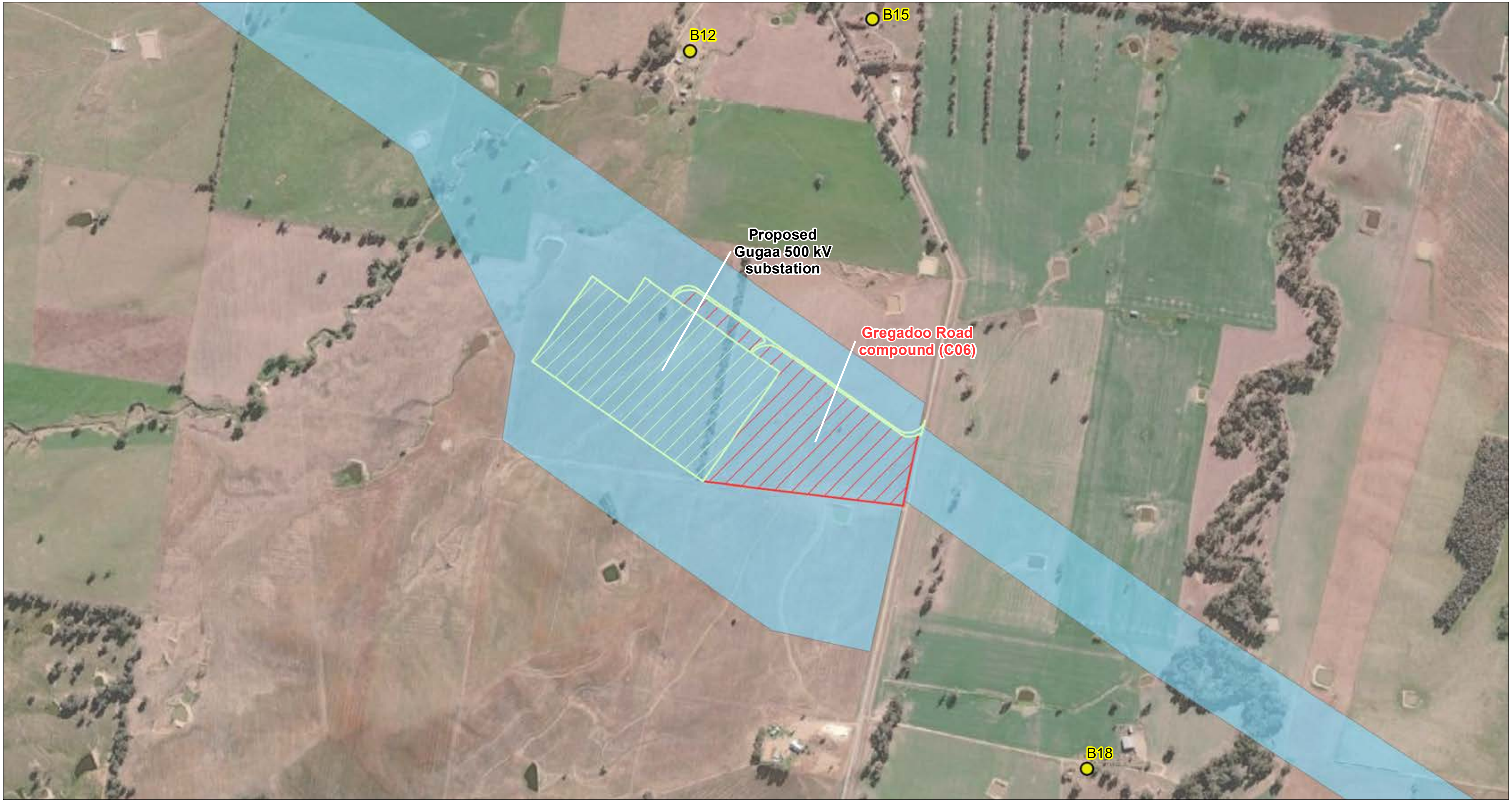


HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND
CONSTRUCTION NOISE IMPACTS
WAGGA 330 KV SUBSTATION COMPOUND
(C01)
PAGE 1 OF 16

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd



0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:15,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City
Study area
Existing Substation fence line

Daytime noise impacts

1 – 10 dB (Clearly audible)
11 – 20 dB (Moderately intrusive)
>20 dB (Highly intrusive)

Project components

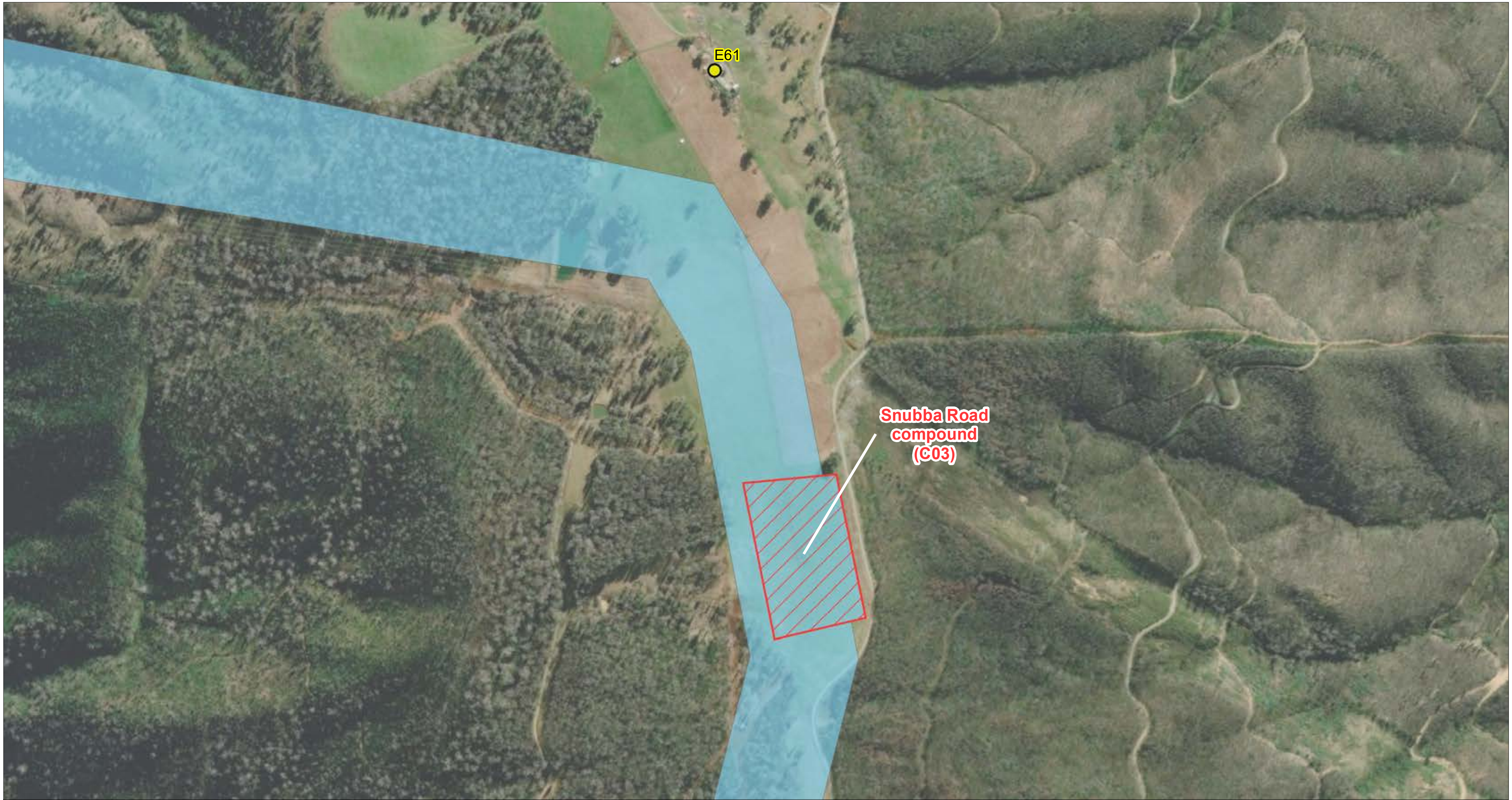
Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut

HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS GREGADOO ROAD COMPOUND (C06) PAGE 2 OF 16

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd



0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City
Study area
Existing Substation fence line

Daytime noise impacts

1 – 10 dB (Clearly audible)
11 – 20 dB (Moderately intrusive)
>20 dB (Highly intrusive)

Project components

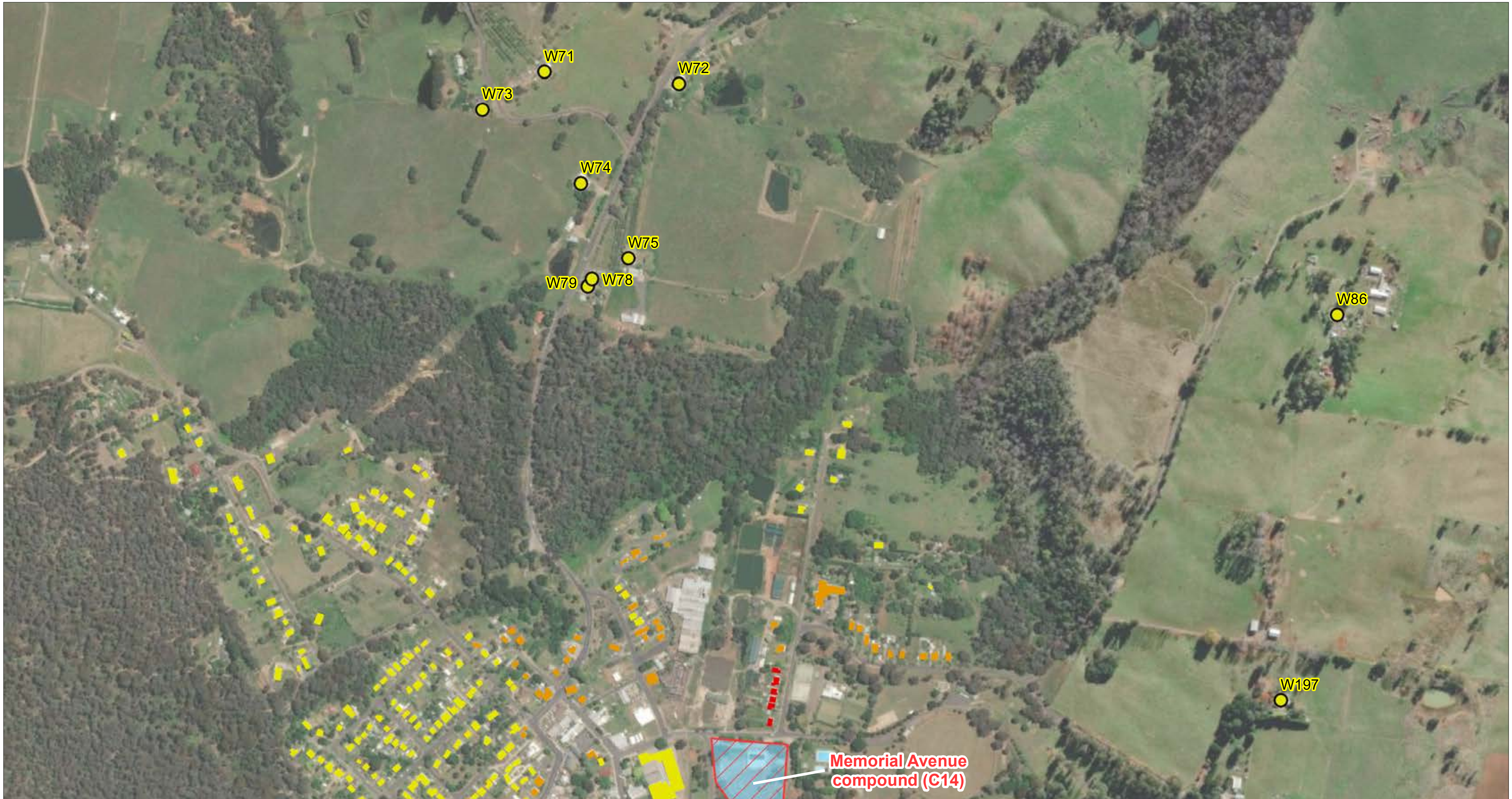
Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS SNUBBA ROAD COMPOUND (C03) PAGE 3 OF 16

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd



0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

SLR

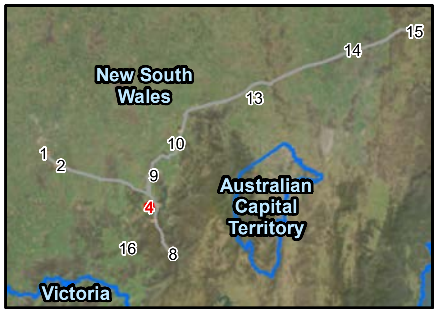
City
Study area
Existing Substation fence line

Daytime noise impacts

- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

Project components

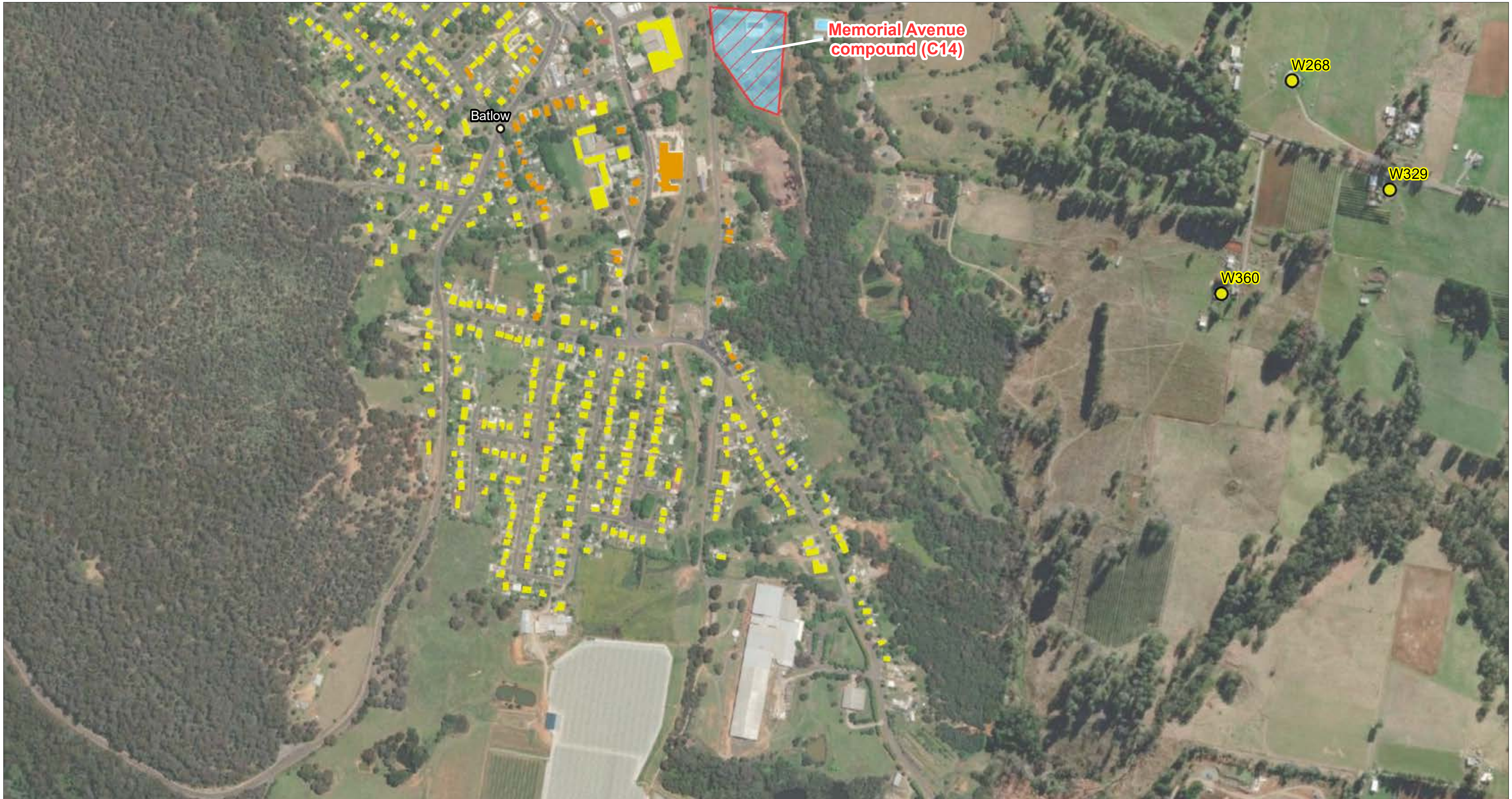
- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS MEMORIAL AVENUE COMPOUND (C14)
PAGE 4 OF 16

ATTACHMENT G.1



0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Existing Substation fence line

Daytime noise impacts

- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

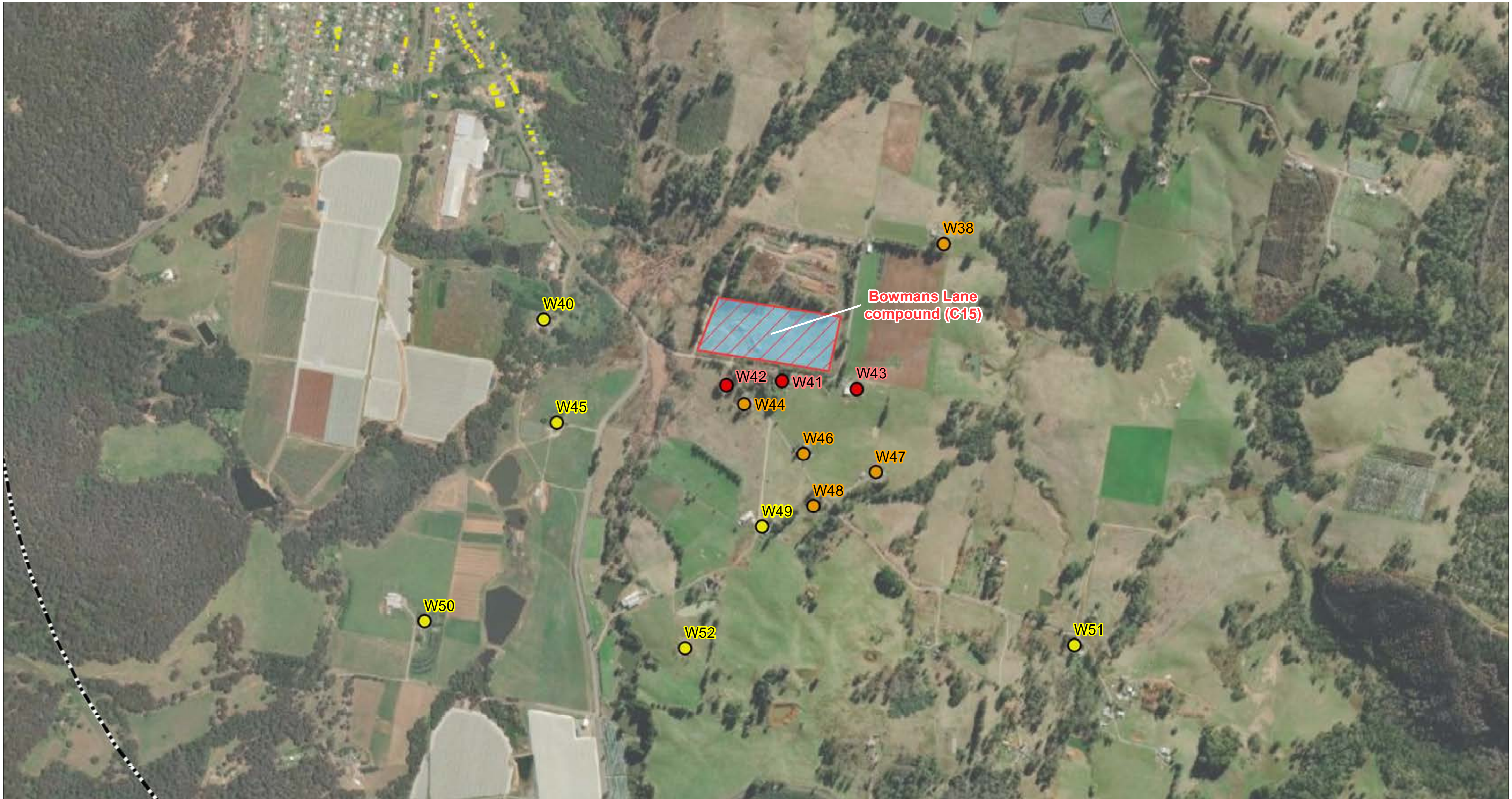
Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS MEMORIAL AVENUE COMPOUND (C14)
PAGE 5 OF 16

ATTACHMENT G.1



0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:15,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

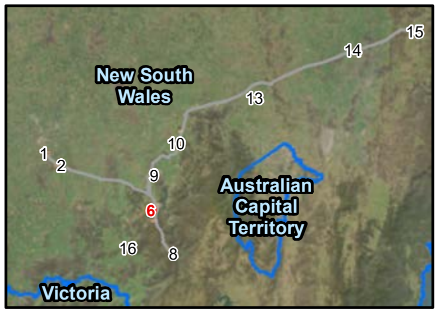
City
Study area
Existing Substation fence line

Daytime noise impacts

1 – 10 dB (Clearly audible)
11 – 20 dB (Moderately intrusive)
>20 dB (Highly intrusive)

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS BOWMANS LANE COMPOUND (C15)
PAGE 6 OF 16

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd

0 50 100 200
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

SLR

City

Study area

Existing Substation fence line

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

Substation

Accommodation facility

Construction compound

Project footprint

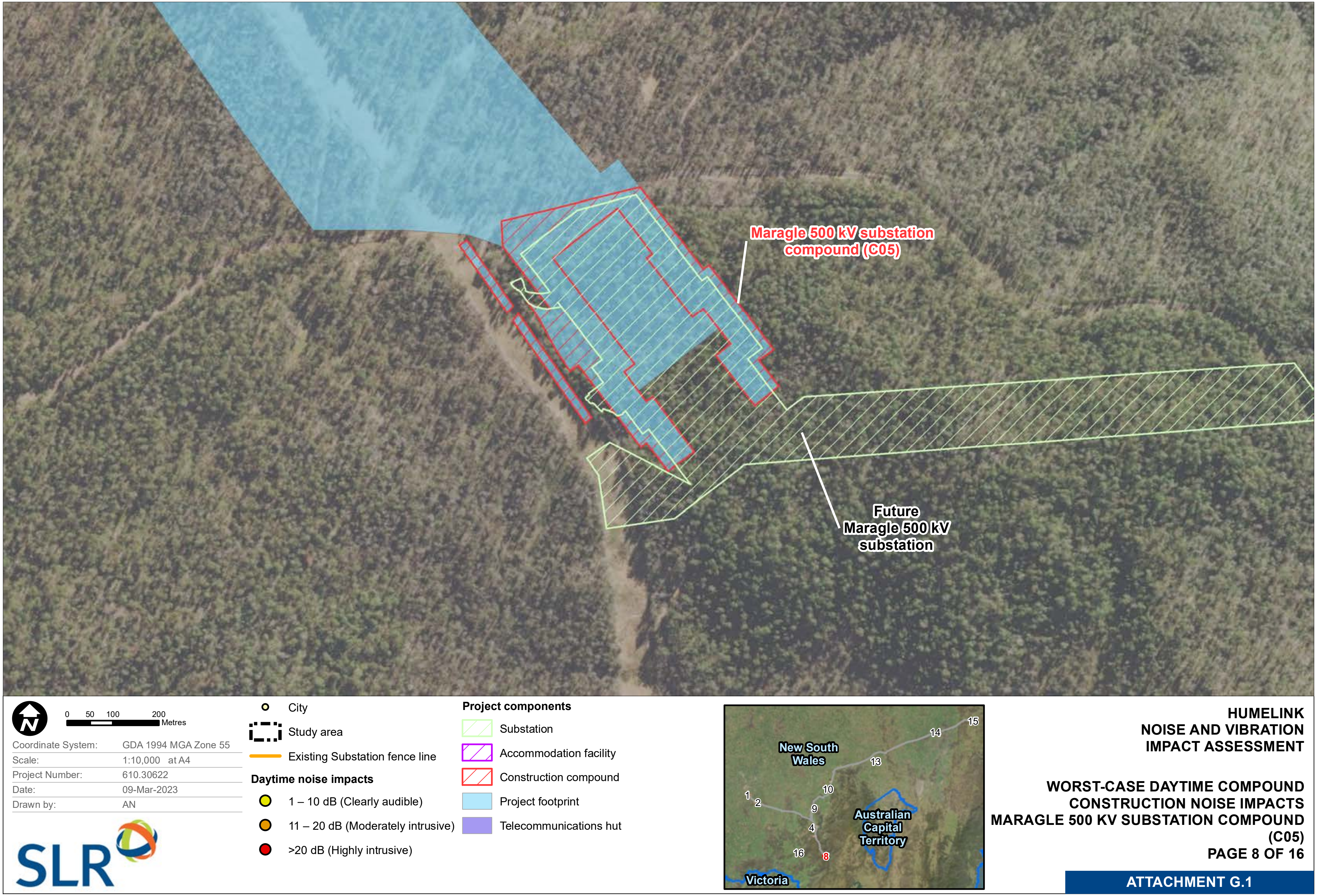
Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS SNUBBA ROAD COMPOUND (C16)
PAGE 7 OF 16

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND
CONSTRUCTION NOISE IMPACTS
MARAGLE 500 KV SUBSTATION COMPOUND
(C05)

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd

0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City
Study area
Existing Substation fence line

Daytime noise impacts
- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

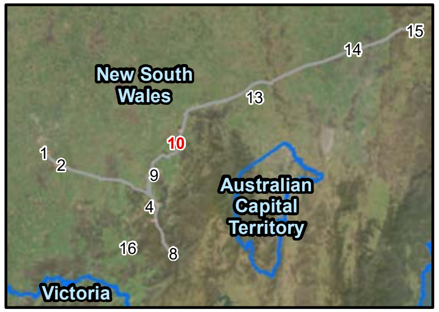
Project components
- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND
CONSTRUCTION NOISE IMPACTS
SNOWY MOUNTAINS HIGHWAY COMPOUND
(C02)

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd



0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City
Study area
Existing Substation fence line

Daytime noise impacts

- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

Project components

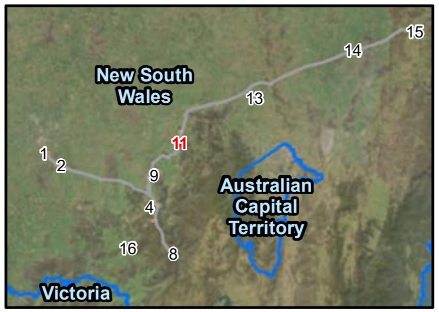
- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS HONEYSUCKLE ROAD COMPOUND (C07)
PAGE 10 OF 16

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd



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Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

SLR

City
Study area
Existing Substation fence line

Daytime noise impacts

1 – 10 dB (Clearly audible)
11 – 20 dB (Moderately intrusive)
>20 dB (Highly intrusive)

Project components

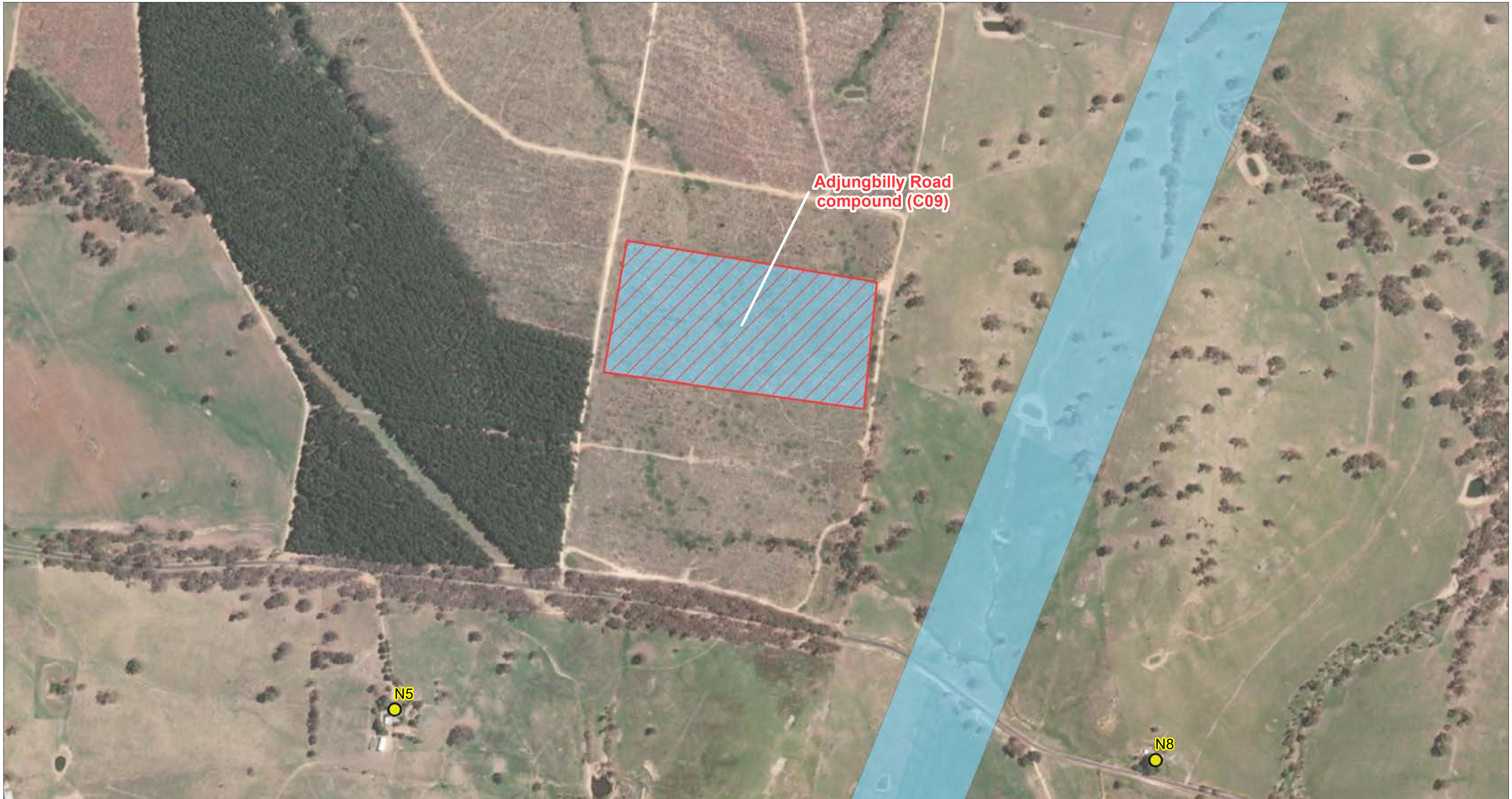
Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS RED HILL ROAD COMPOUND (C08)
PAGE 11 OF 16

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd



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Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Existing Substation fence line

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS ADJUNGBILLY ROAD COMPOUND (C09)
PAGE 12 OF 16

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd

0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

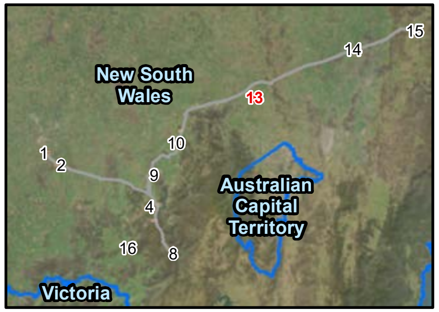
City
Study area
Existing Substation fence line

Daytime noise impacts

1 – 10 dB (Clearly audible)
11 – 20 dB (Moderately intrusive)
>20 dB (Highly intrusive)

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS YASS SUBSTATION COMPOUND (C10)
PAGE 13 OF 16

ATTACHMENT G.1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Day).mxd

0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City
Study area
Existing Substation fence line

Daytime noise impacts

1 – 10 dB (Clearly audible)
11 – 20 dB (Moderately intrusive)
>20 dB (Highly intrusive)

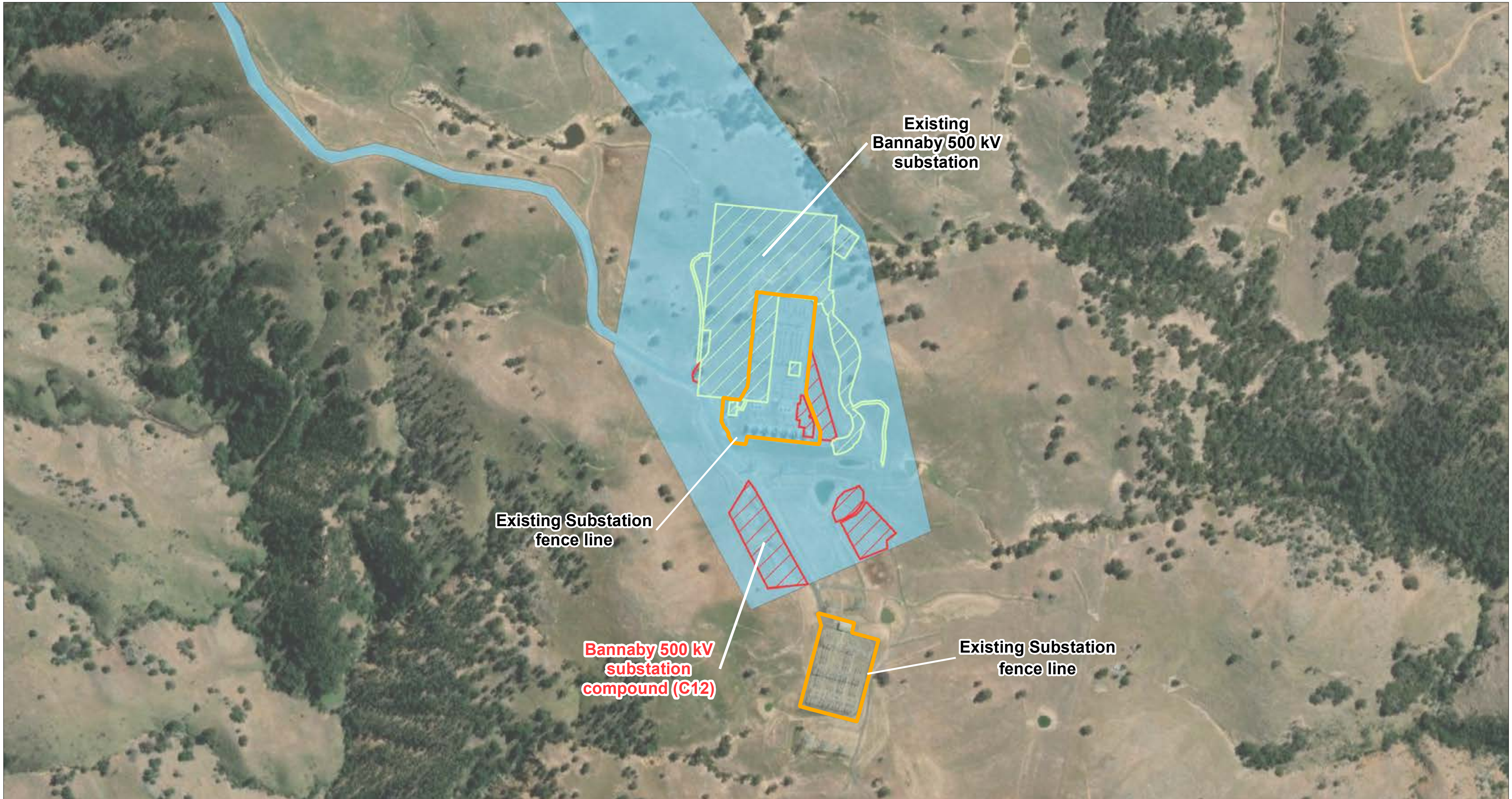
Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut

HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS WOODHOUSELEE ROAD COMPOUND (C11) PAGE 14 OF 16

ATTACHMENT G.1



0 50 100 200
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:10,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

SLR

City

Study area

Existing Substation fence line

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

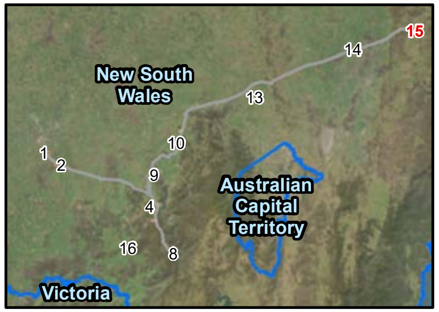
Substation

Accommodation facility

Construction compound

Project footprint

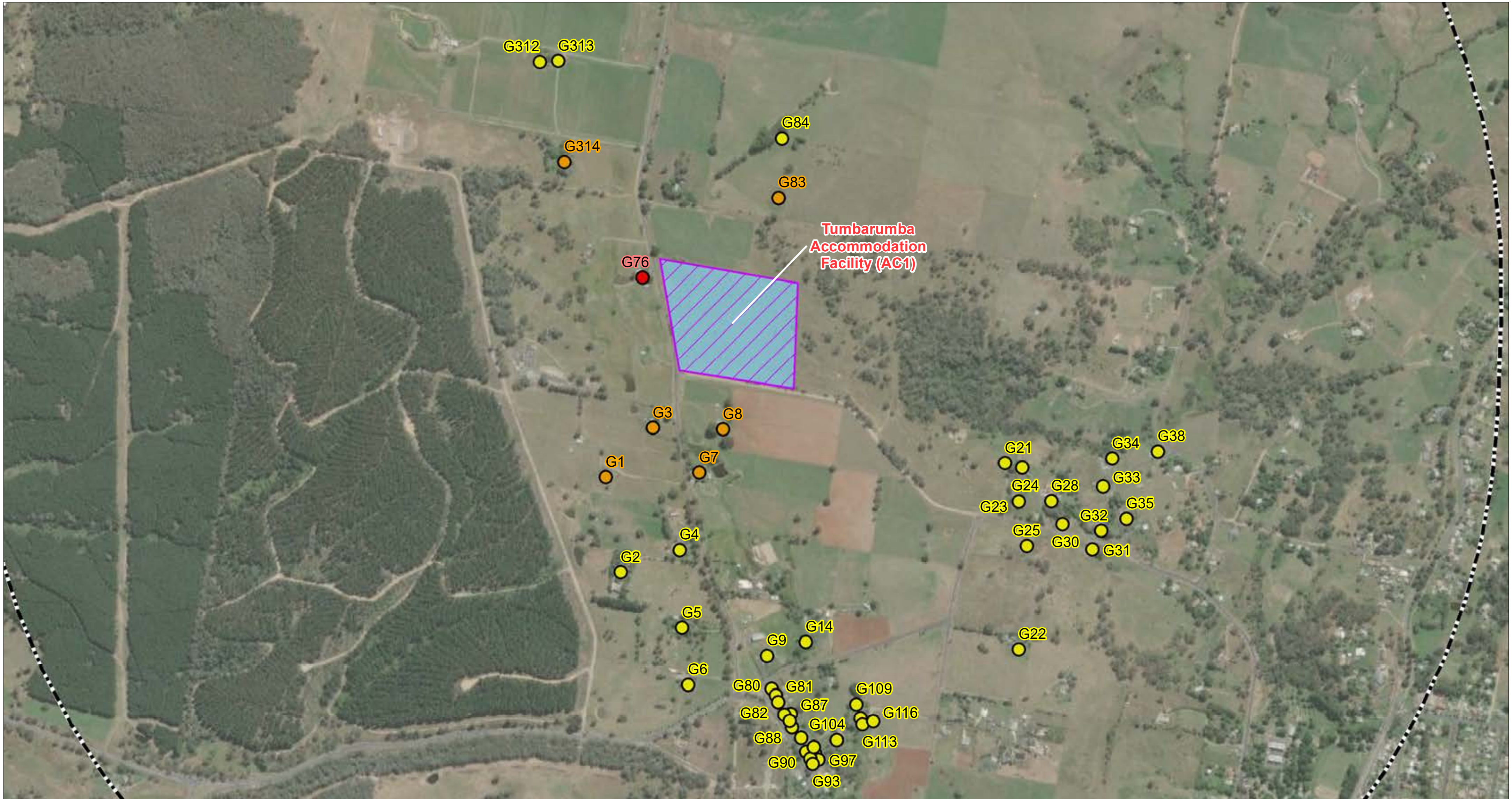
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS BANNABY 500 KV SUBSTATION COMPOUND (C12)

ATTACHMENT G.1



0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:15,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Existing Substation fence line

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

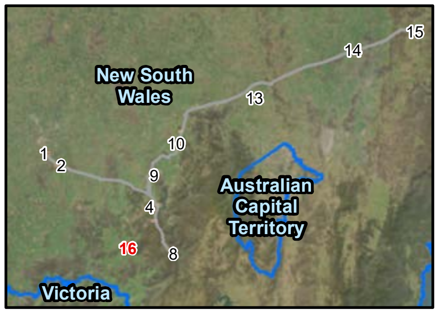
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut

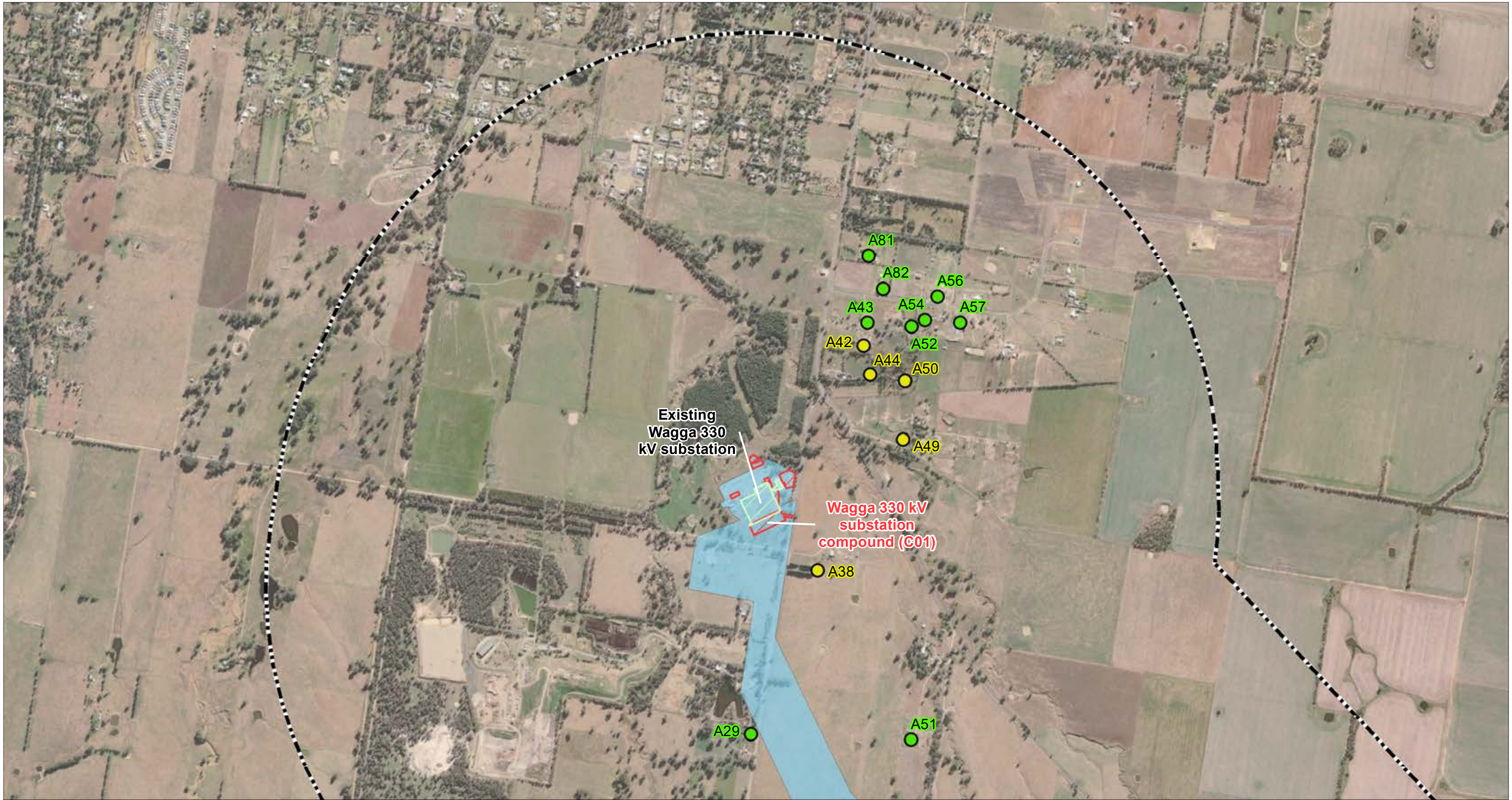


HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME COMPOUND CONSTRUCTION NOISE IMPACTS TUMBARUMBA ACCOMMODATION FACILITY (AC1)

PAGE 16 OF 16

ATTACHMENT G.1



0 150 300 600 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:25,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

SLR

City

Study area

Night-time noise impacts

- 1 – 5 dB (Noticeable)
- 6 – 15 dB (Clearly audible)
- 16 – 25 dB (Moderately intrusive)
- >25 dB (Highly intrusive)

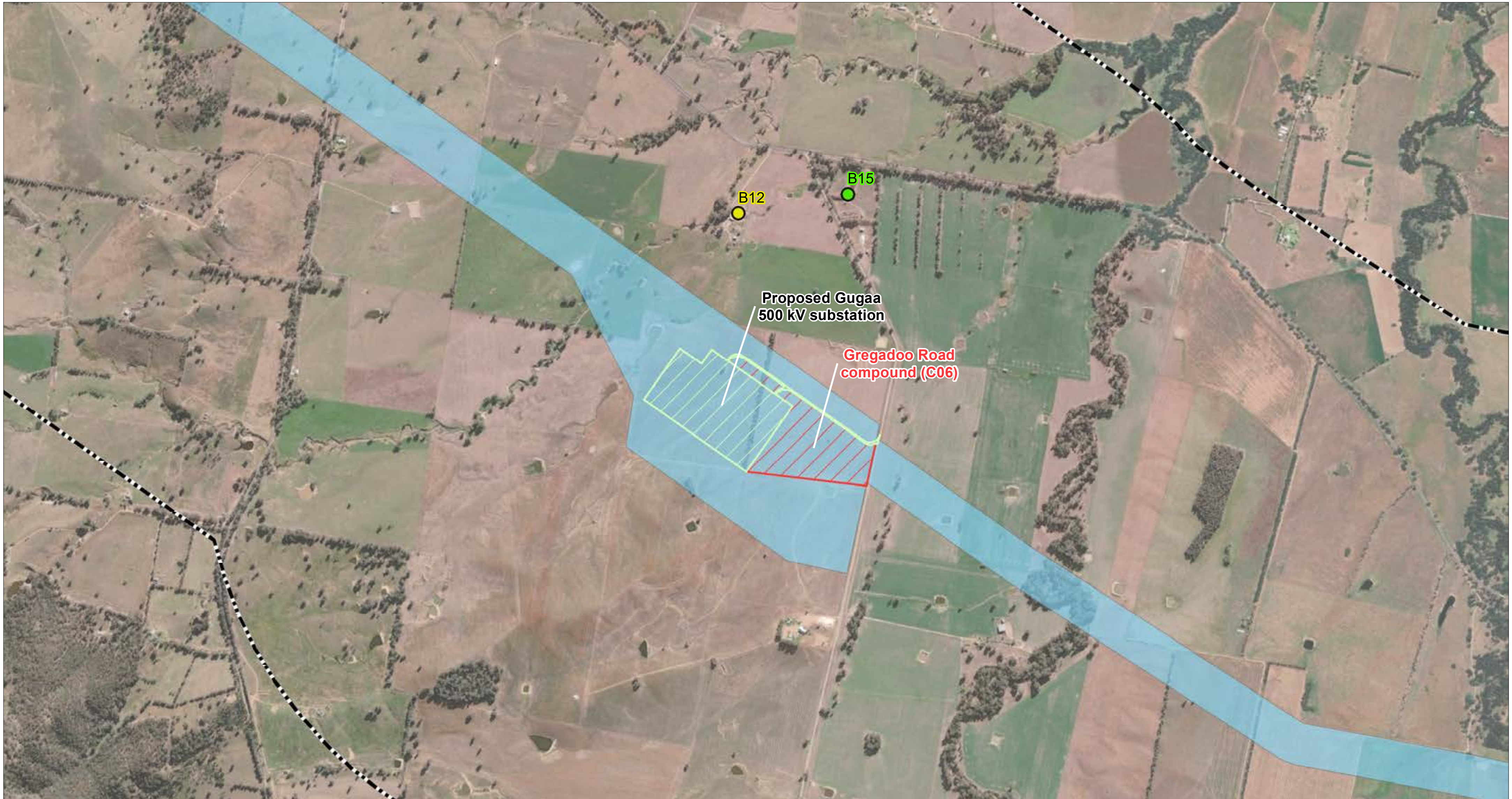
Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE NIGHT-TIME COMPOUND CONSTRUCTION NOISE IMPACTS WAGGA 330 KV SUBSTATION COMPOUND (C01)
PAGE 1 OF 3

ATTACHMENT G.2



0 150 300 600
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:25,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Night-time noise impacts

- 1 – 5 dB (Noticeable)
- 6 – 15 dB (Clearly audible)
- 16 – 25 dB (Moderately intrusive)
- >25 dB (Highly intrusive)

Project components

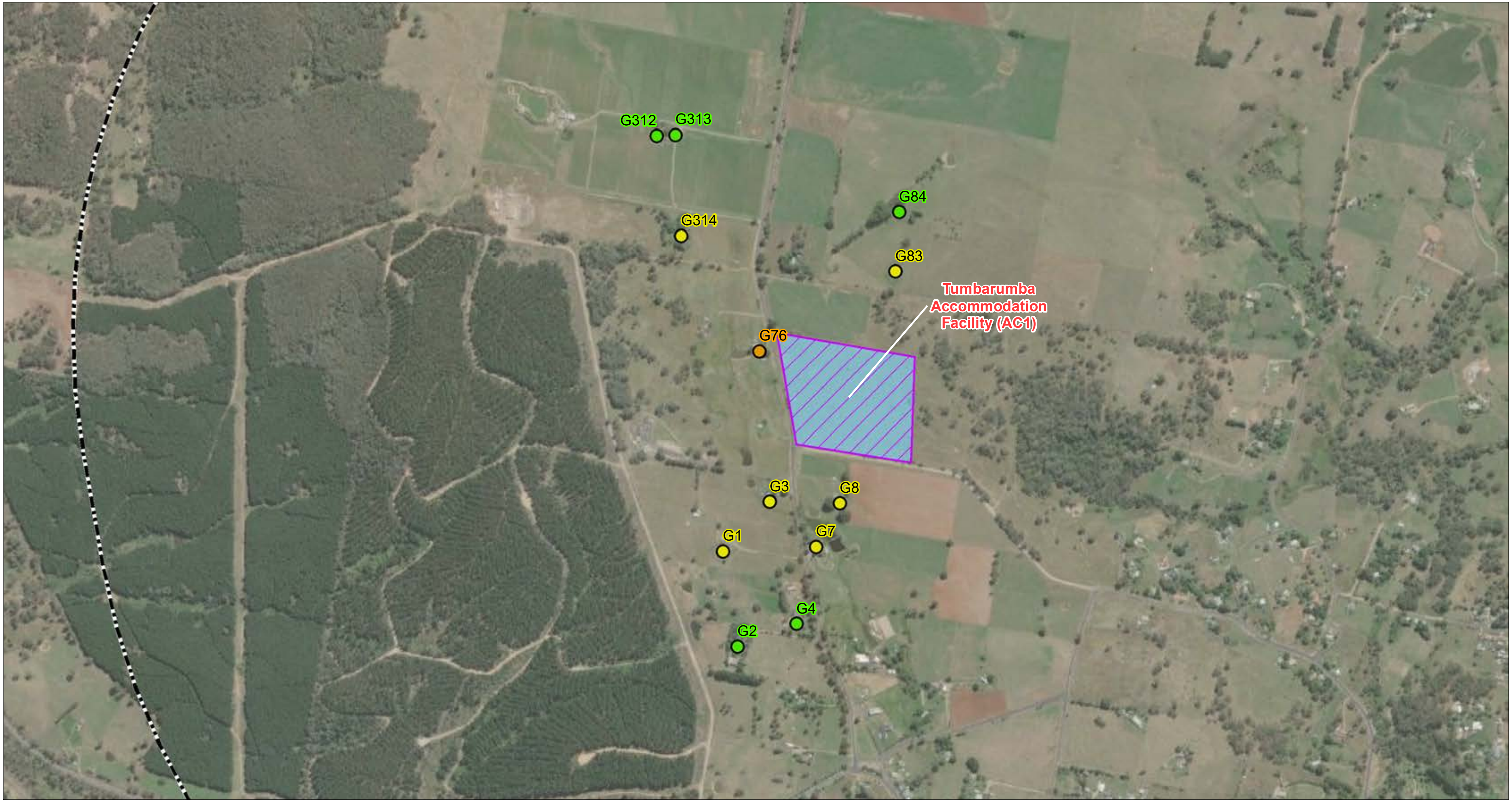
- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

WORST-CASE NIGHT-TIME COMPOUND
CONSTRUCTION NOISE IMPACTS
GREGADOO ROAD COMPOUND (C06)
PAGE 2 OF 3

ATTACHMENT G.2

H:\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Compound Noise Impacts (Night).mxd



0 50 100 200 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:15,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Night-time noise impacts

- 1 – 5 dB (Noticeable)
- 6 – 15 dB (Clearly audible)
- 16 – 25 dB (Moderately intrusive)
- >25 dB (Highly intrusive)

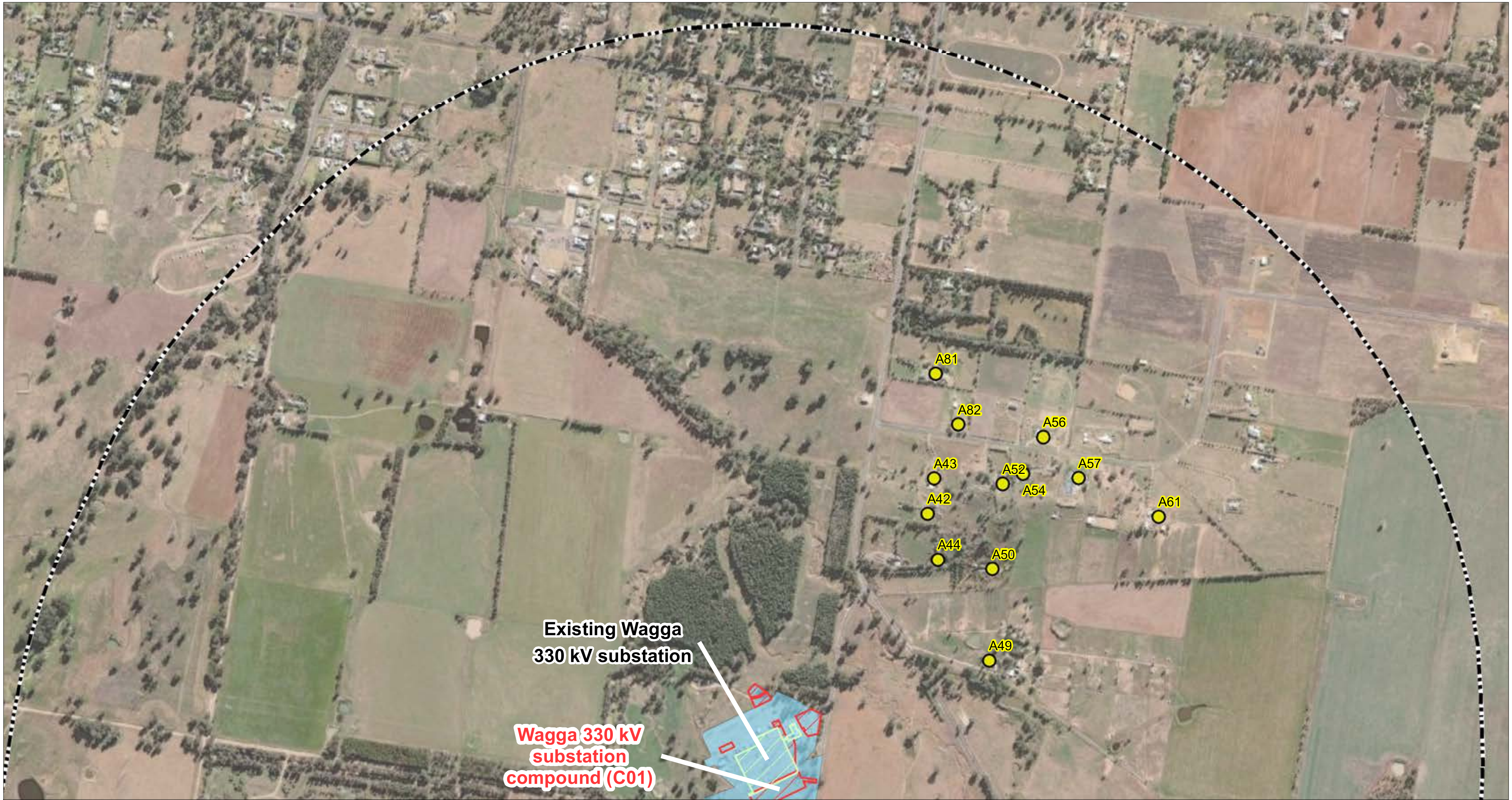
Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE NIGHT-TIME COMPOUND CONSTRUCTION NOISE IMPACTS TUMBARUMBA ACCOMMODATION FACILITY (AC1)
PAGE 3 OF 3

ATTACHMENT G.2



0 100 200 400 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:16,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

SLR

City

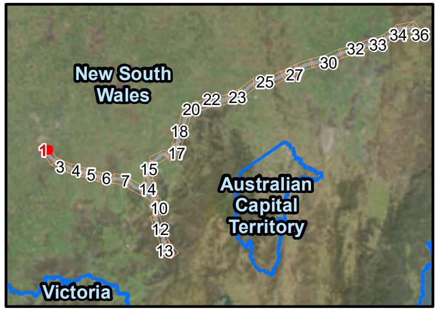
Study area

Daytime noise impacts

- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

Project components

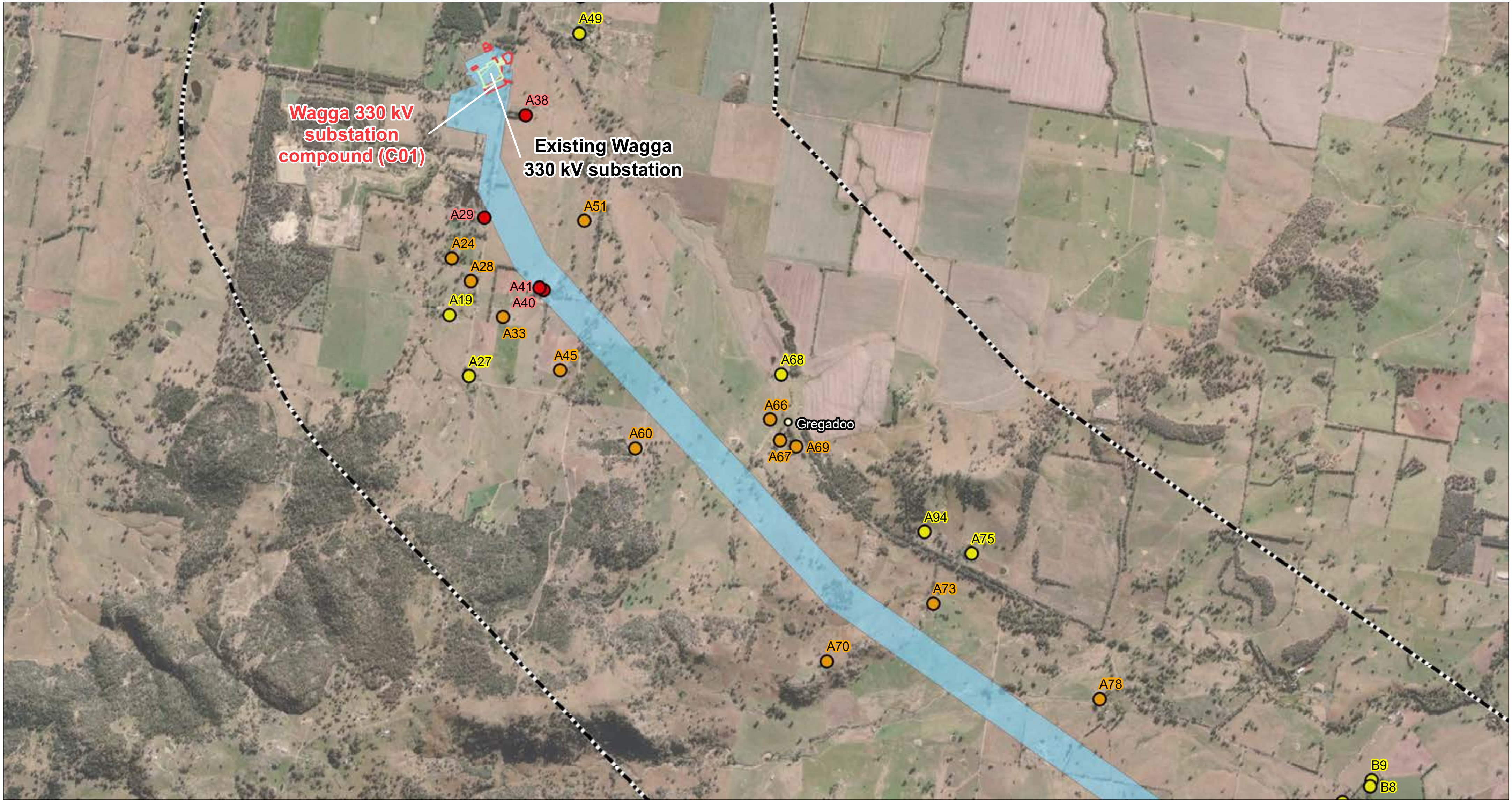
- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut

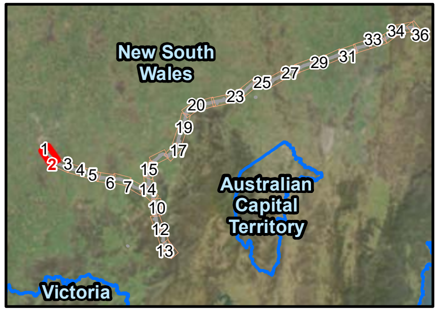


HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 1 OF 36

ATTACHMENT G.3





0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

SLR

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 2 OF 36

ATTACHMENT G.3

H:\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Transmission Line Construction Noise Impacts (Day).mxd

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

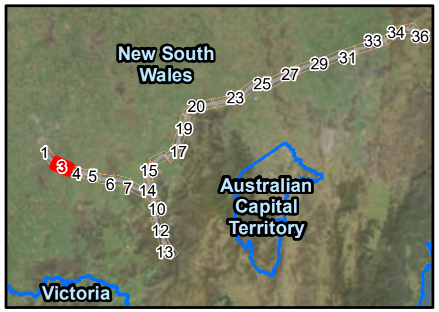
Study area

Daytime noise impacts

- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 3 OF 36

ATTACHMENT G.3

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

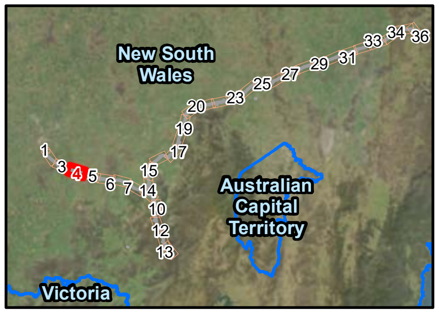
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 4 OF 36

ATTACHMENT G.3

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

SLR

City

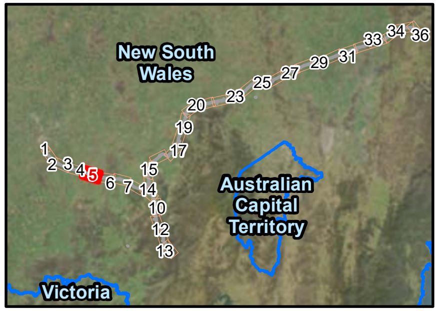
Study area

Daytime noise impacts

- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

Project components

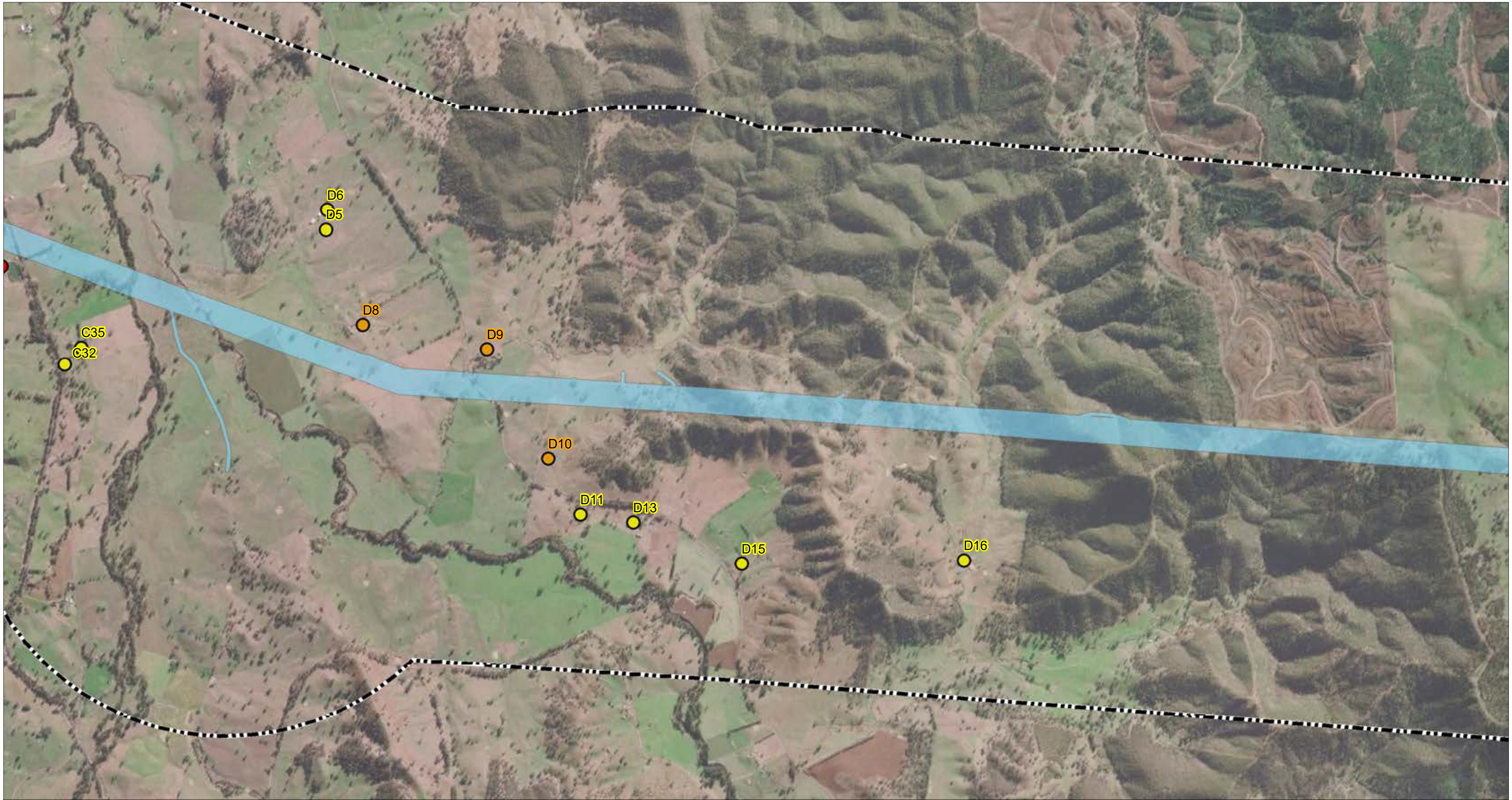
- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 5 OF 36

ATTACHMENT G.3



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

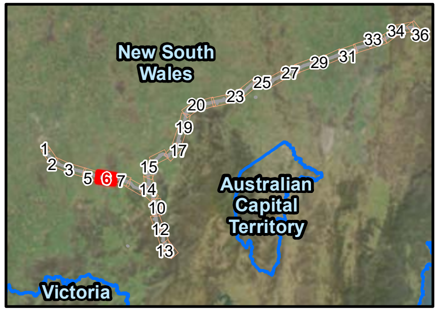
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut

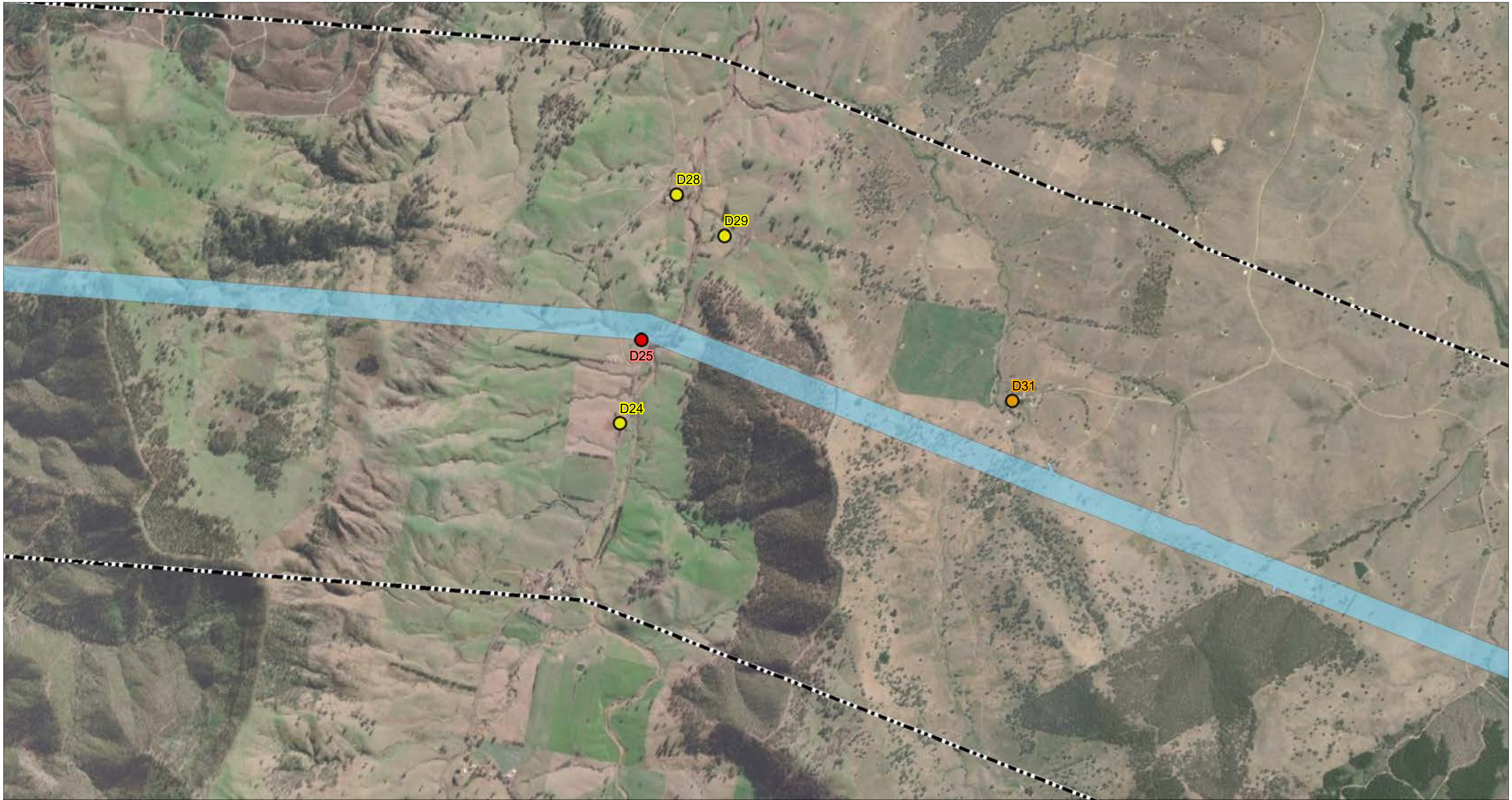


HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 6 OF 36

ATTACHMENT G.3

H:\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Transmission Line Construction Noise Impacts (Day).mxd



0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

SLR

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

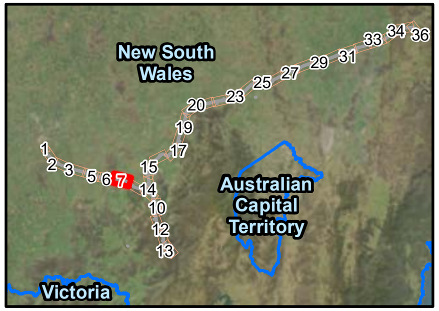
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 7 OF 36

ATTACHMENT G.3

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0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

SLR

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

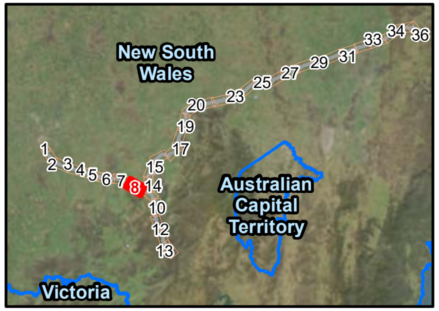
Substation

Accommodation facility

Construction compound

Project footprint

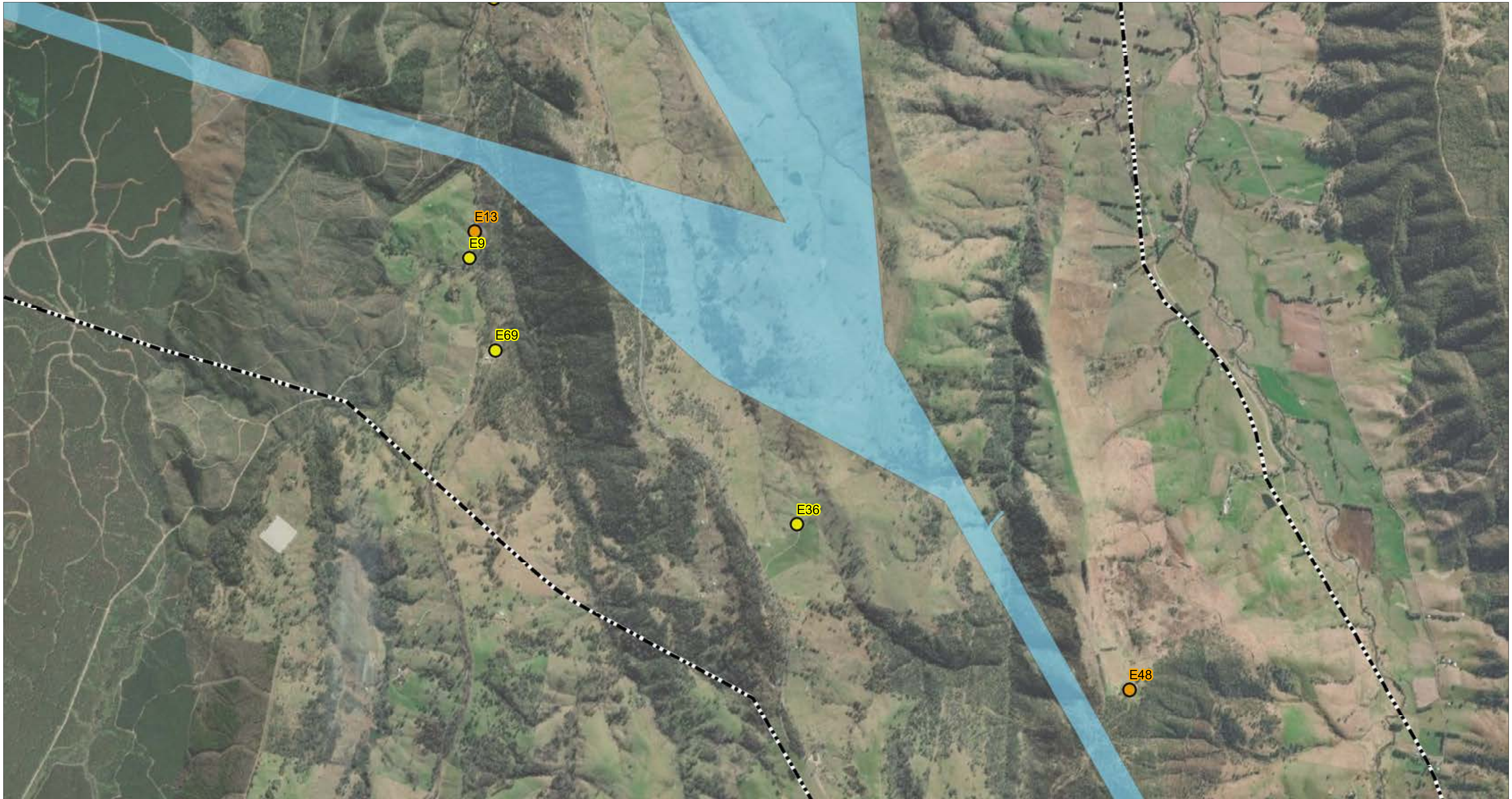
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 8 OF 36

ATTACHMENT G.3



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

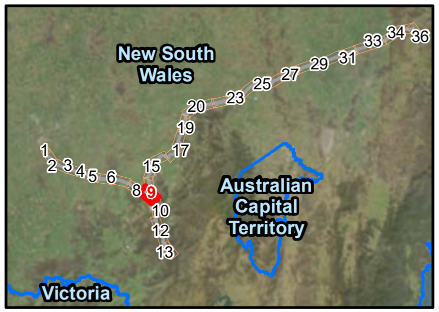
City
Study area

Daytime noise impacts

- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 9 OF 36

ATTACHMENT G.3

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

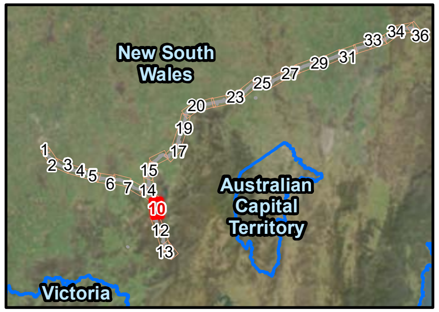
Substation

Accommodation facility

Construction compound

Project footprint

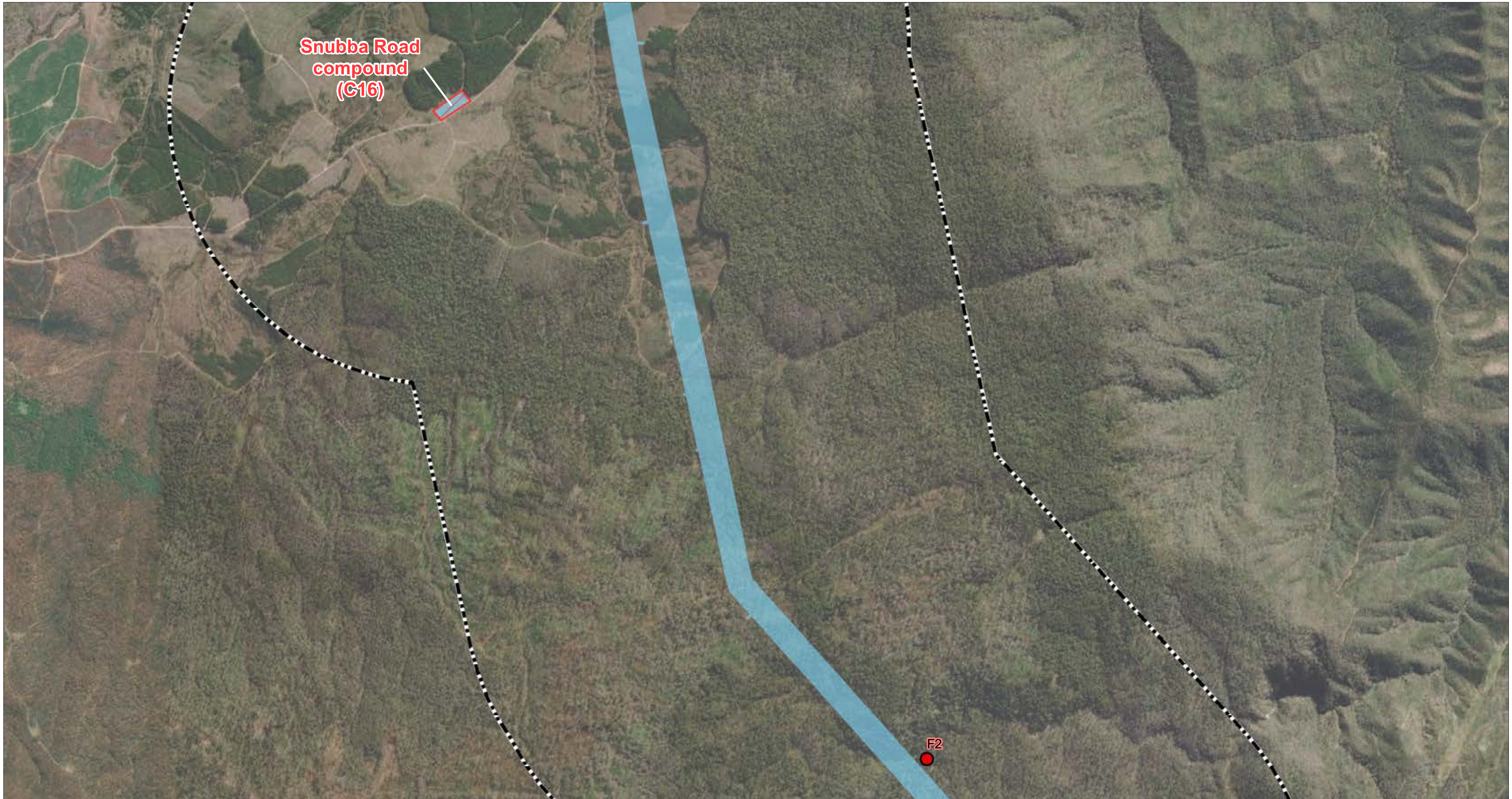
Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 10 OF 36

ATTACHMENT G.3



0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

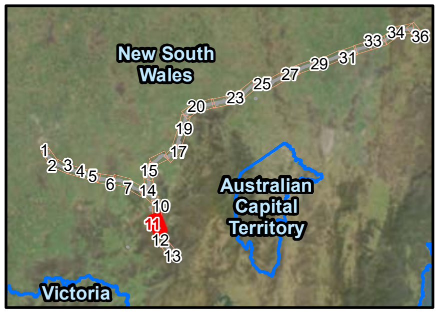
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 11 OF 36

ATTACHMENT G.3

H:\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Transmission Line Construction Noise Impacts (Day).mxd

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

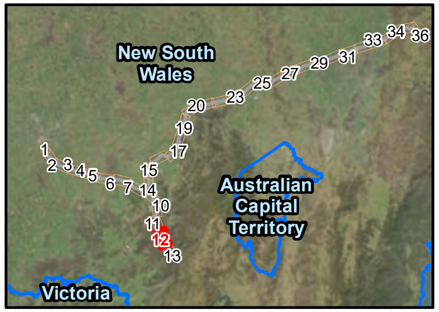
Study area

Daytime noise impacts

- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

Project components

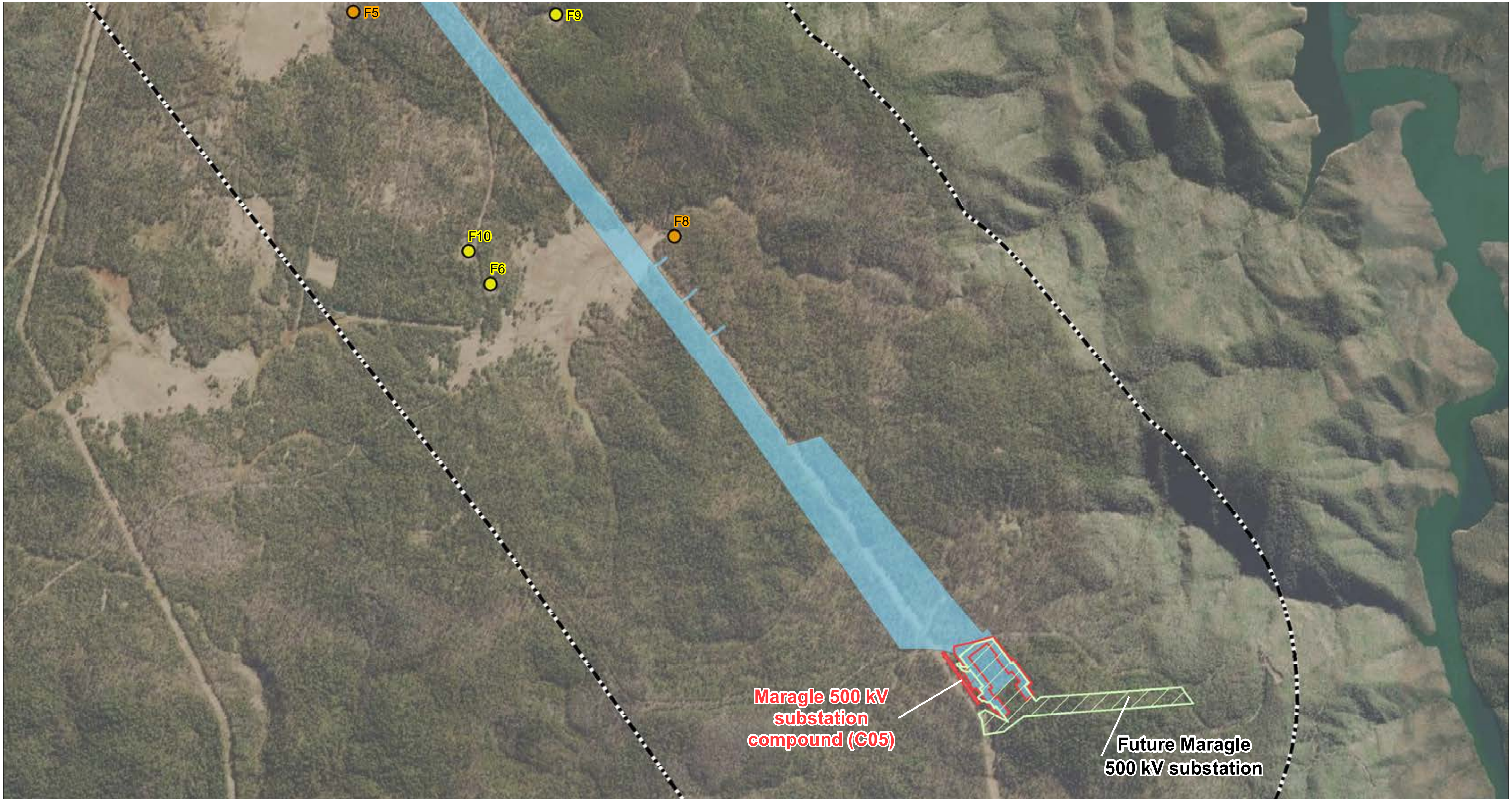
- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS PAGE 12 OF 36

ATTACHMENT G.3



Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:40,000 at A4
Project Number: 610.30622
Date: 09-Mar-2023
Drawn by: AN

0 250 500 1,000 Metres

City
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Daytime noise impacts
- 1 – 10 dB (Clearly audible)
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Project components
- Substation
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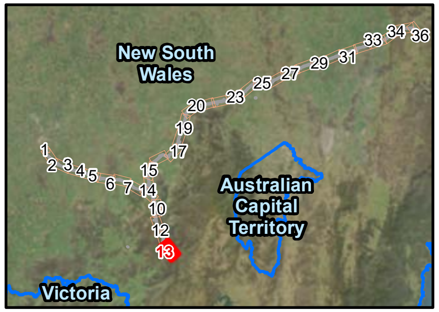
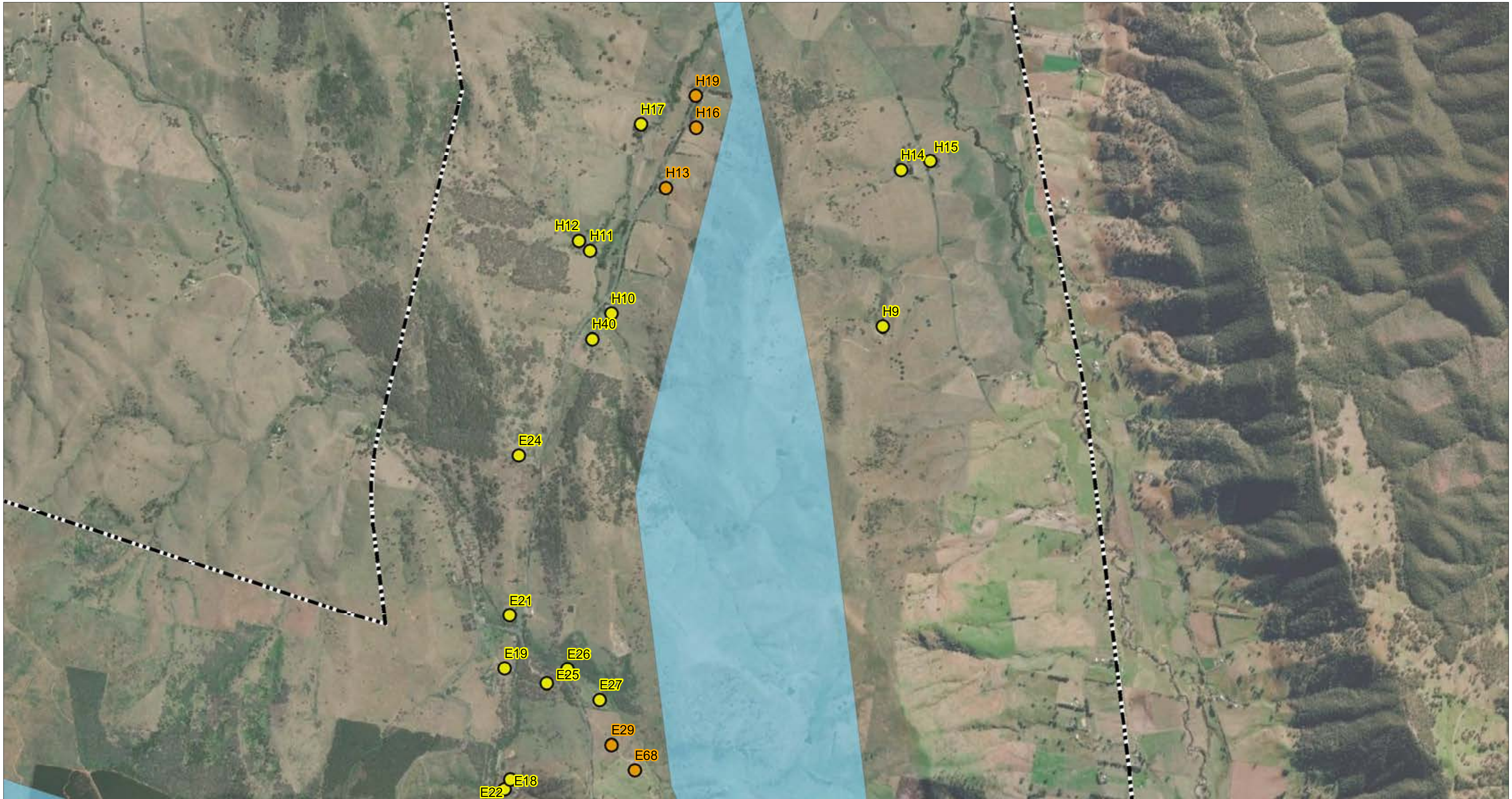


HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 13 OF 36

ATTACHMENT G.3

H:\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Transmission Line Construction Noise Impacts (Day).mxd



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

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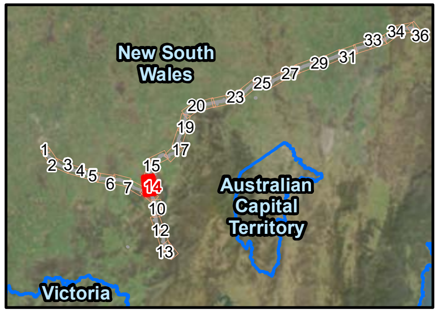
Construction compound

Project footprint

Telecommunications hut



**HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT**

**WORST-CASE DAYTIME TRANSMISSION
LINE CONSTRUCTION NOISE IMPACTS
PAGE 14 OF 36**

ATTACHMENT G.3

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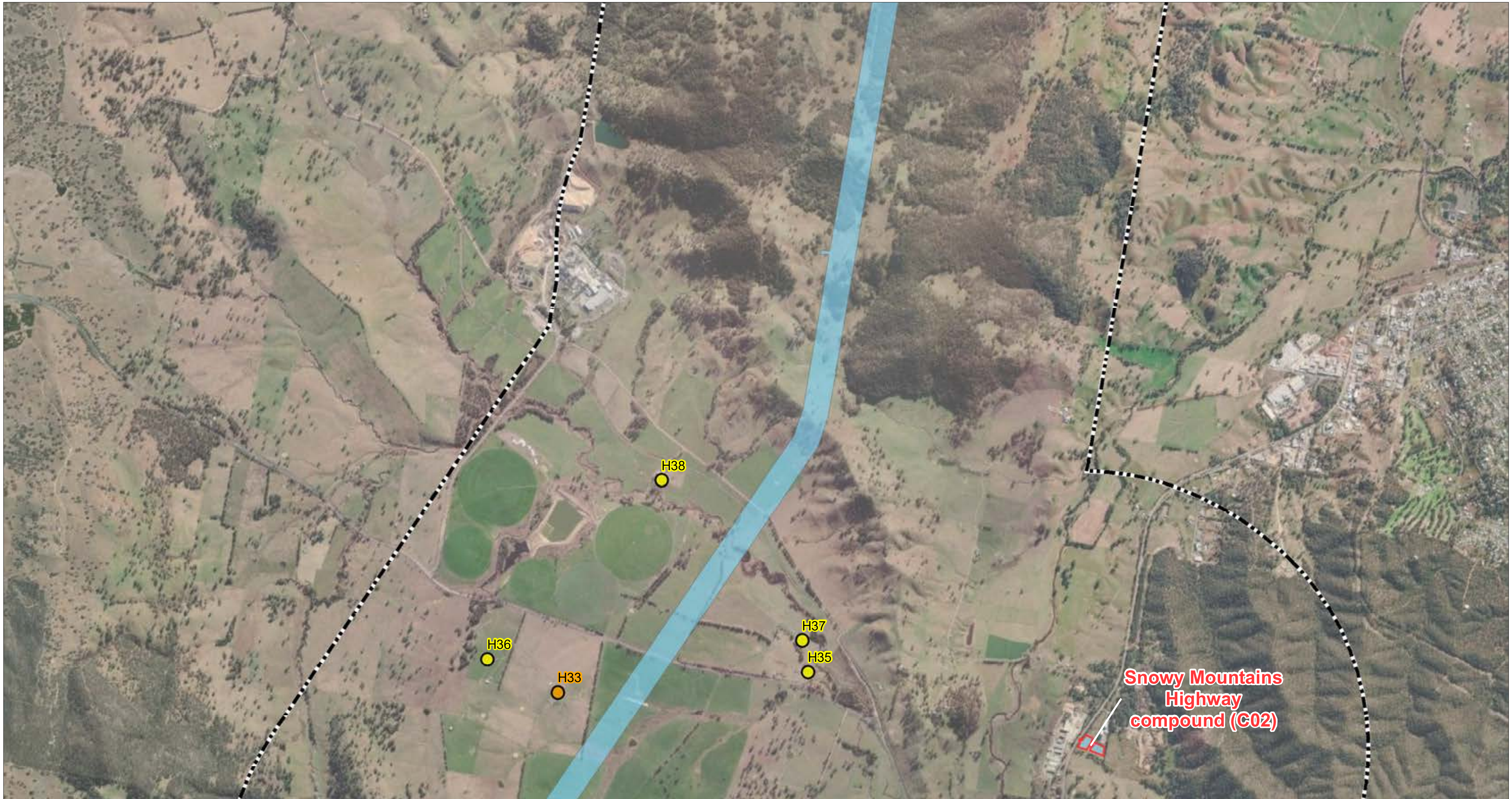

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
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City

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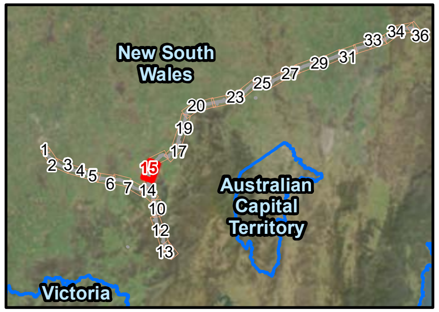
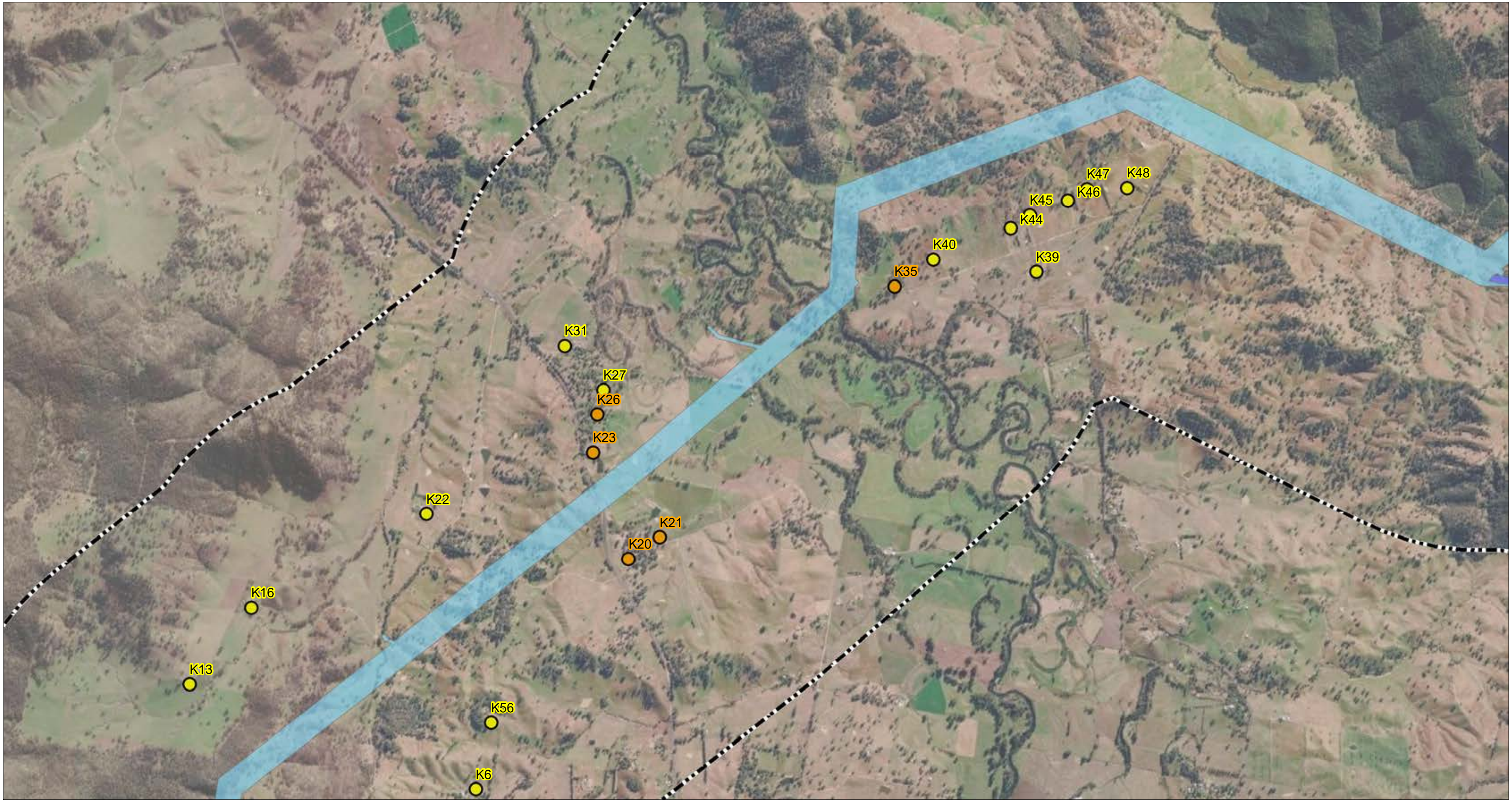


HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS PAGE 15 OF 36

ATTACHMENT G.3



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
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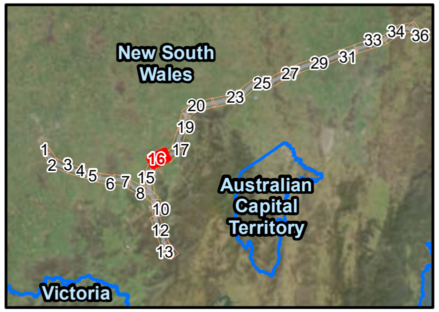

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 16 OF 36

ATTACHMENT G.3

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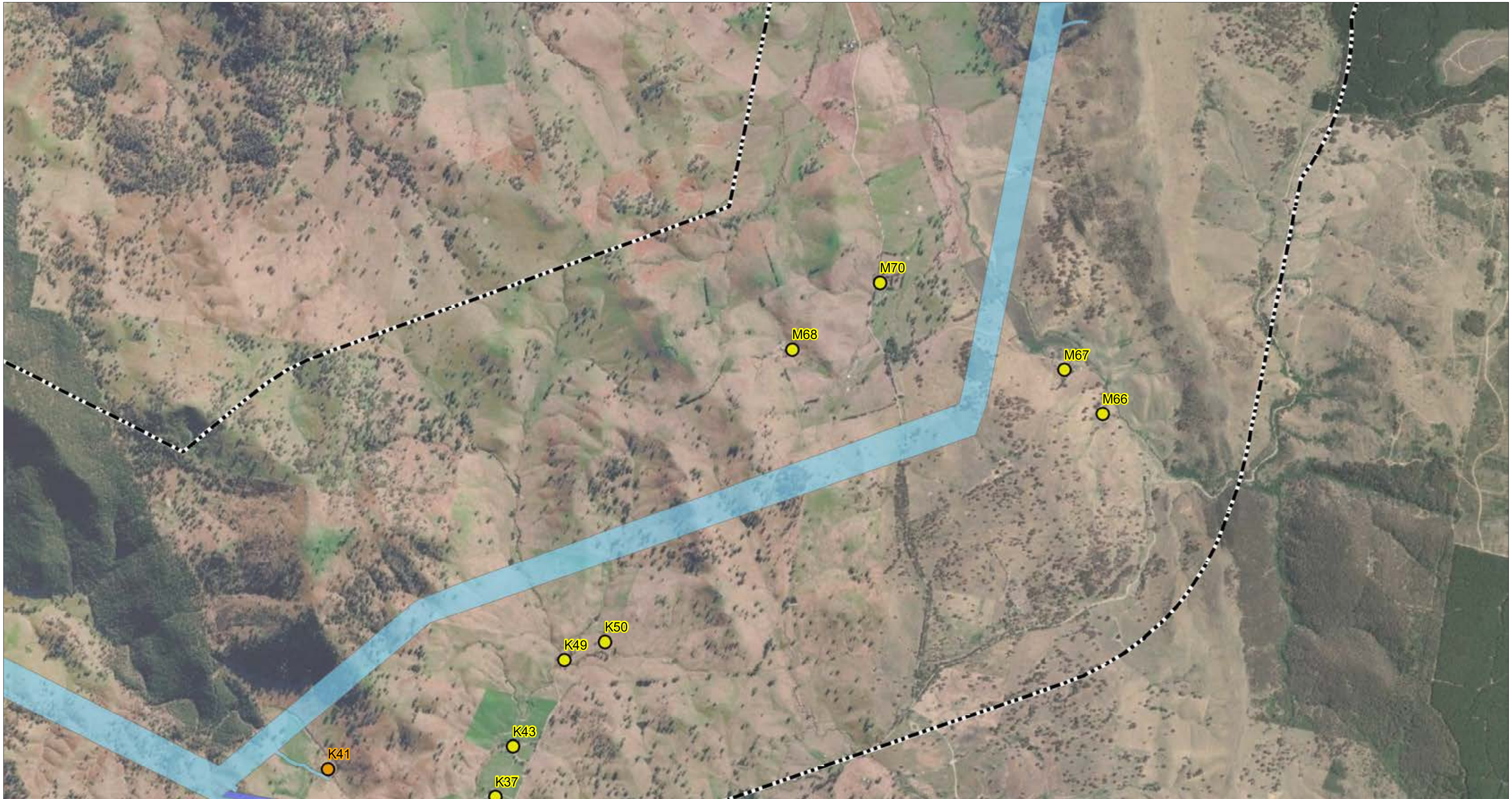

0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

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Construction compound

Project footprint

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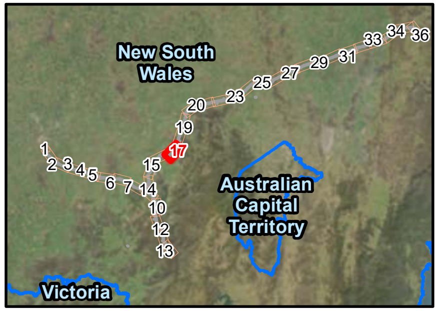
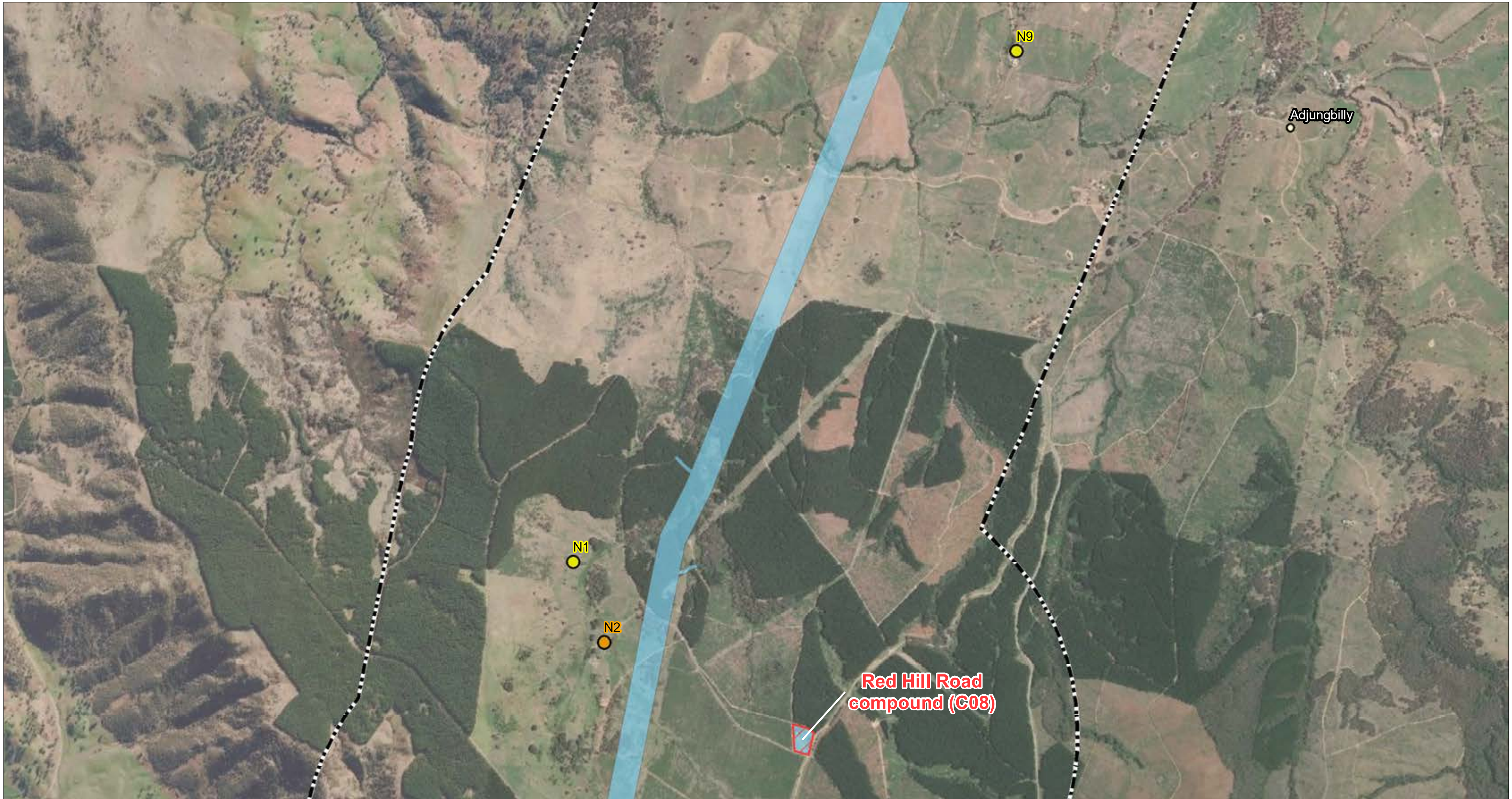


HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 17 OF 36

ATTACHMENT G.3



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
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City

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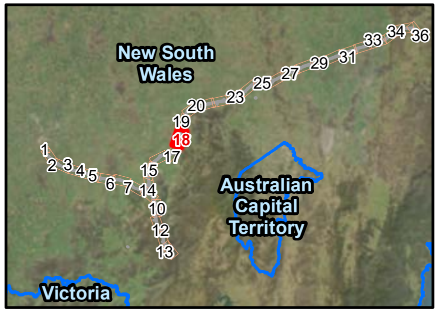
Project footprint

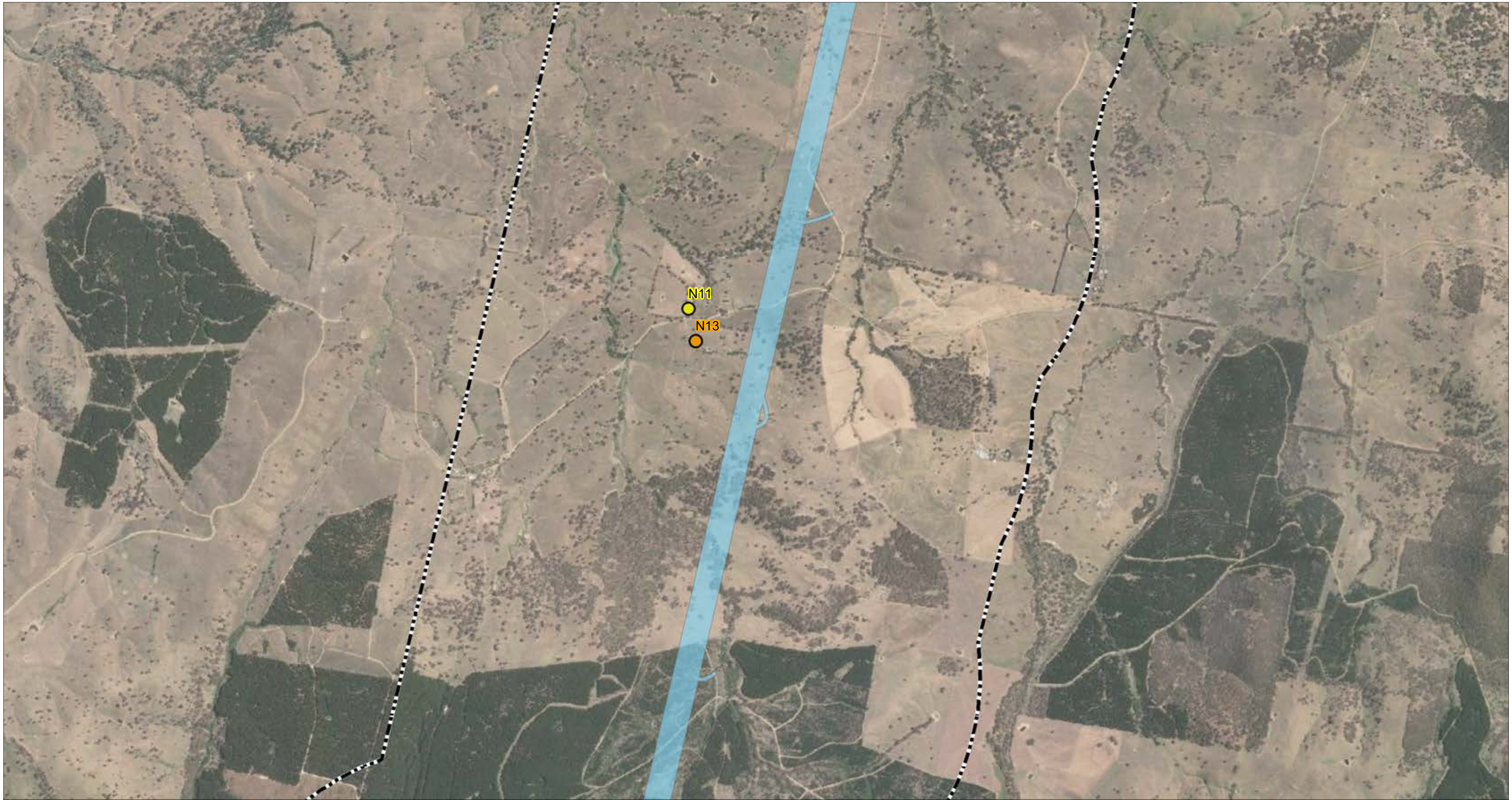
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 18 OF 36

ATTACHMENT G.3



0 250 500 1,000
Metres

Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:40,000 at A4
Project Number: 610.30622
Date: 09-Mar-2023
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City
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Project components

Substation
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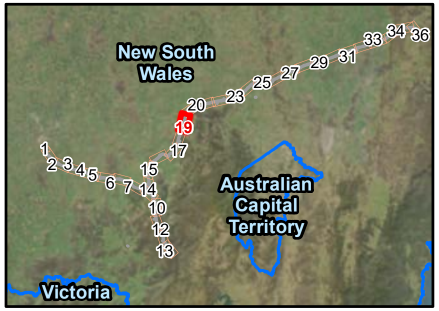
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 19 OF 36

ATTACHMENT G.3

H:\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Transmission Line Construction Noise Impacts (Day).mxd

Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:40,000 at A4
Project Number: 610.30622
Date: 09-Mar-2023
Drawn by: AN

0 250 500 1,000 Metres

City
Study area

Daytime noise impacts

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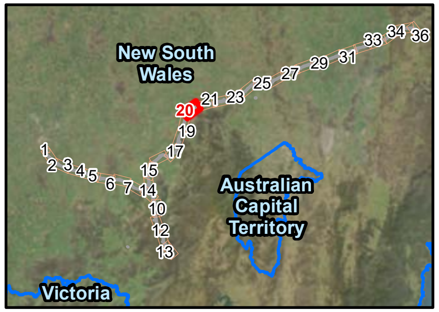
Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS PAGE 20 OF 36

ATTACHMENT G.3

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0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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Date:	09-Mar-2023
Drawn by:	AN

SLR

City

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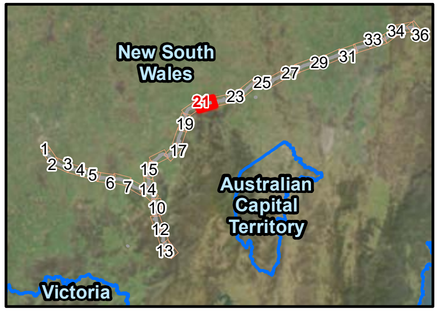
Project footprint

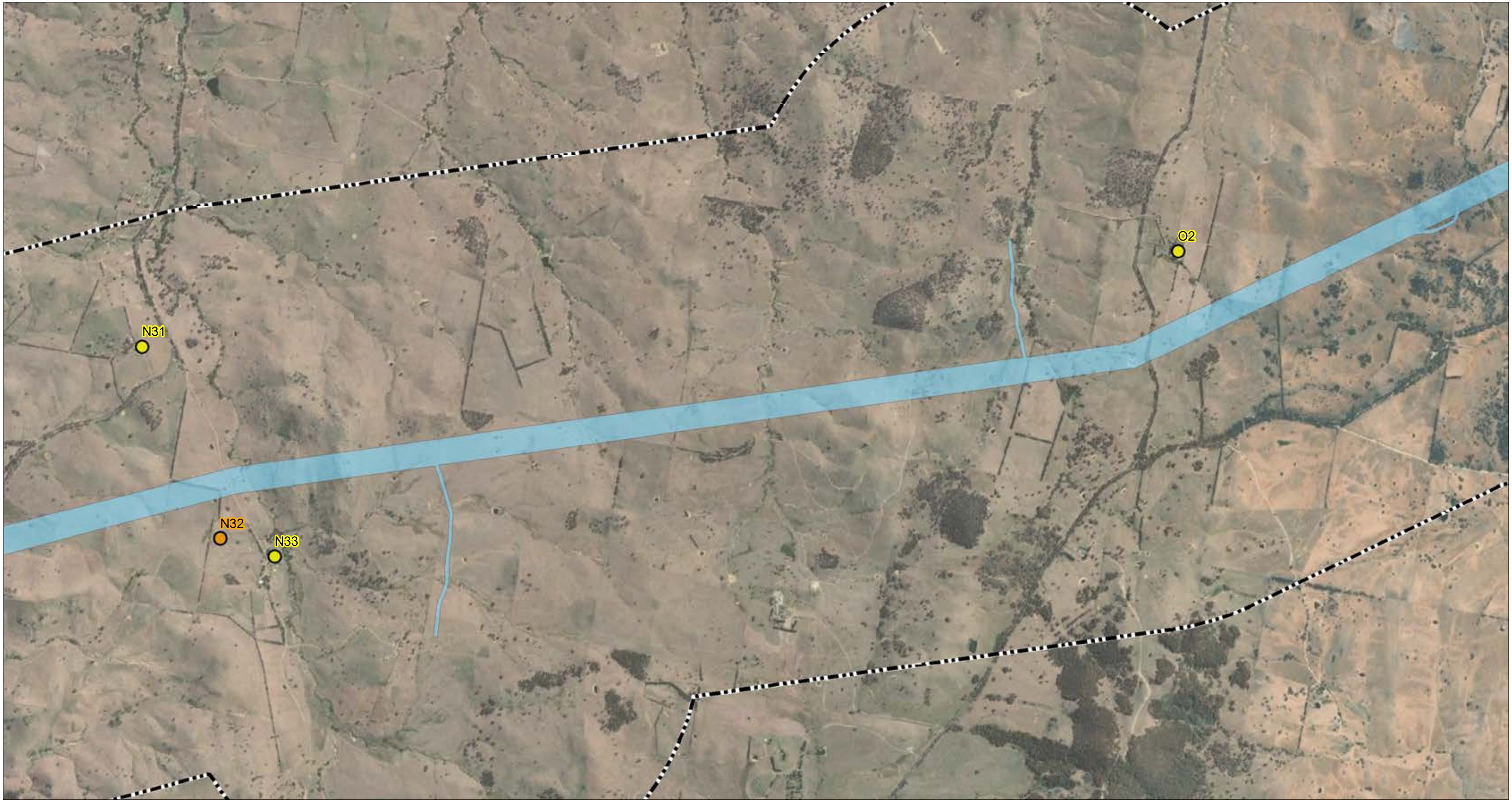
Telecommunications hut



HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS

ATTACHMENT G.3



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
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SLR

City

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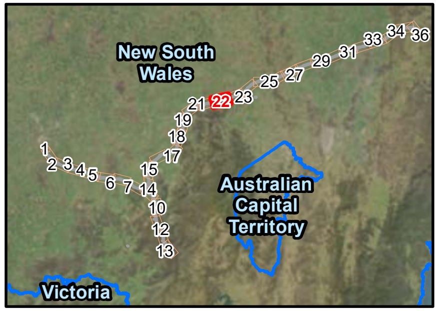
Project footprint

Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
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ATTACHMENT G.3

0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
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City
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Project components

- Substation
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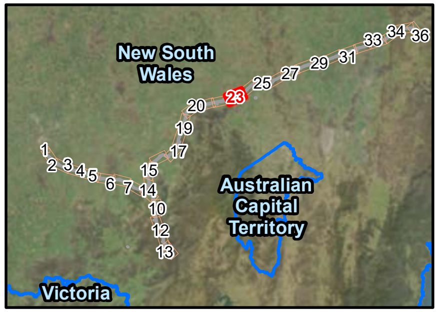
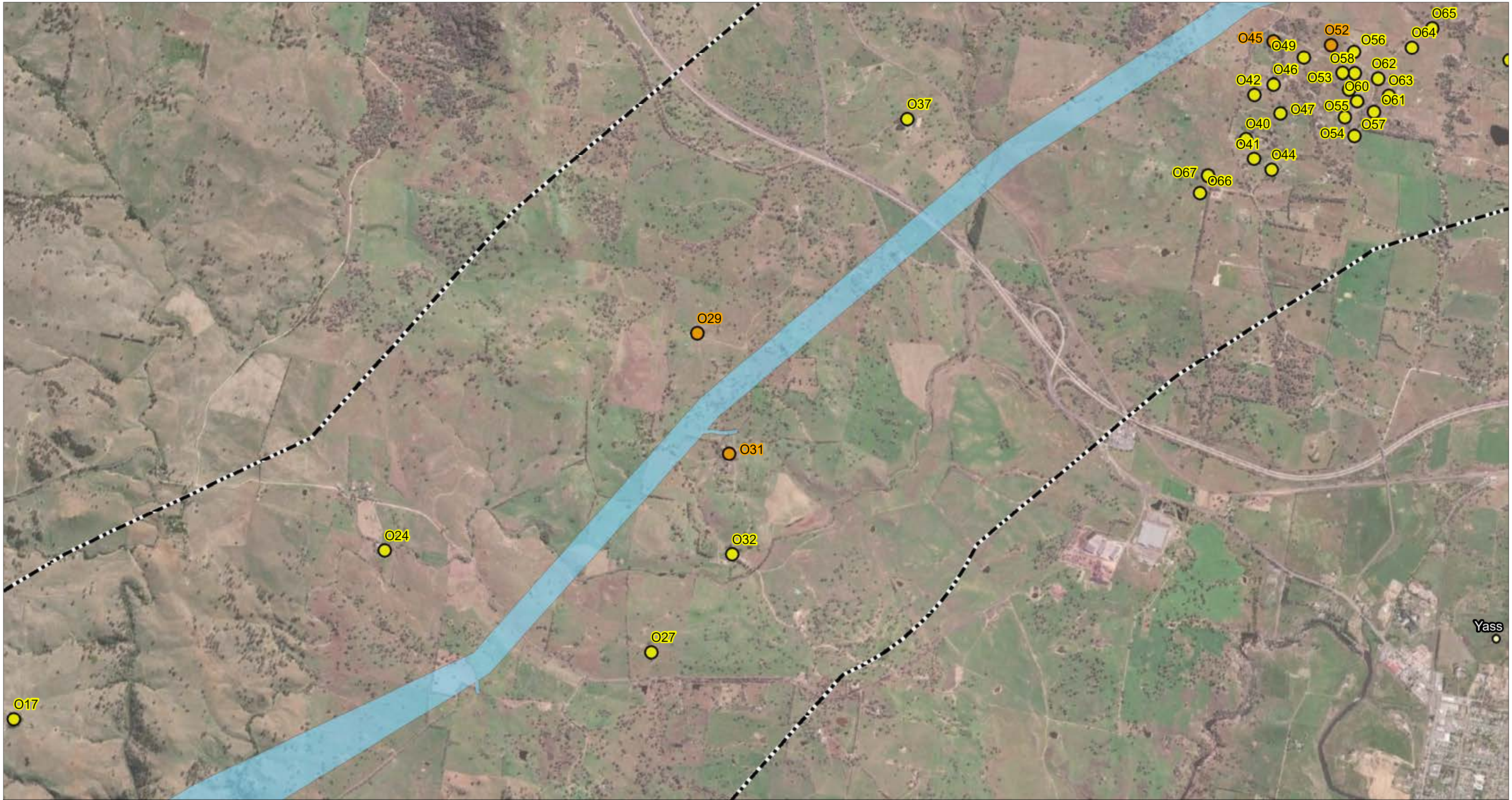
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS

ATTACHMENT G.3



Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:40,000 at A4
Project Number: 610.30622
Date: 09-Mar-2023
Drawn by: AN

0 250 500 1,000 Metres

City
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Project components
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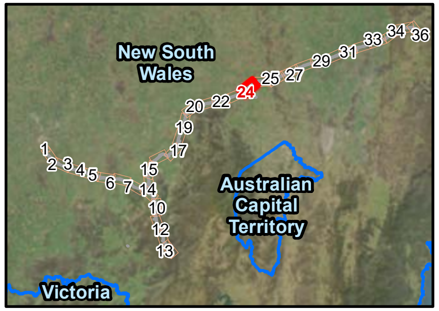
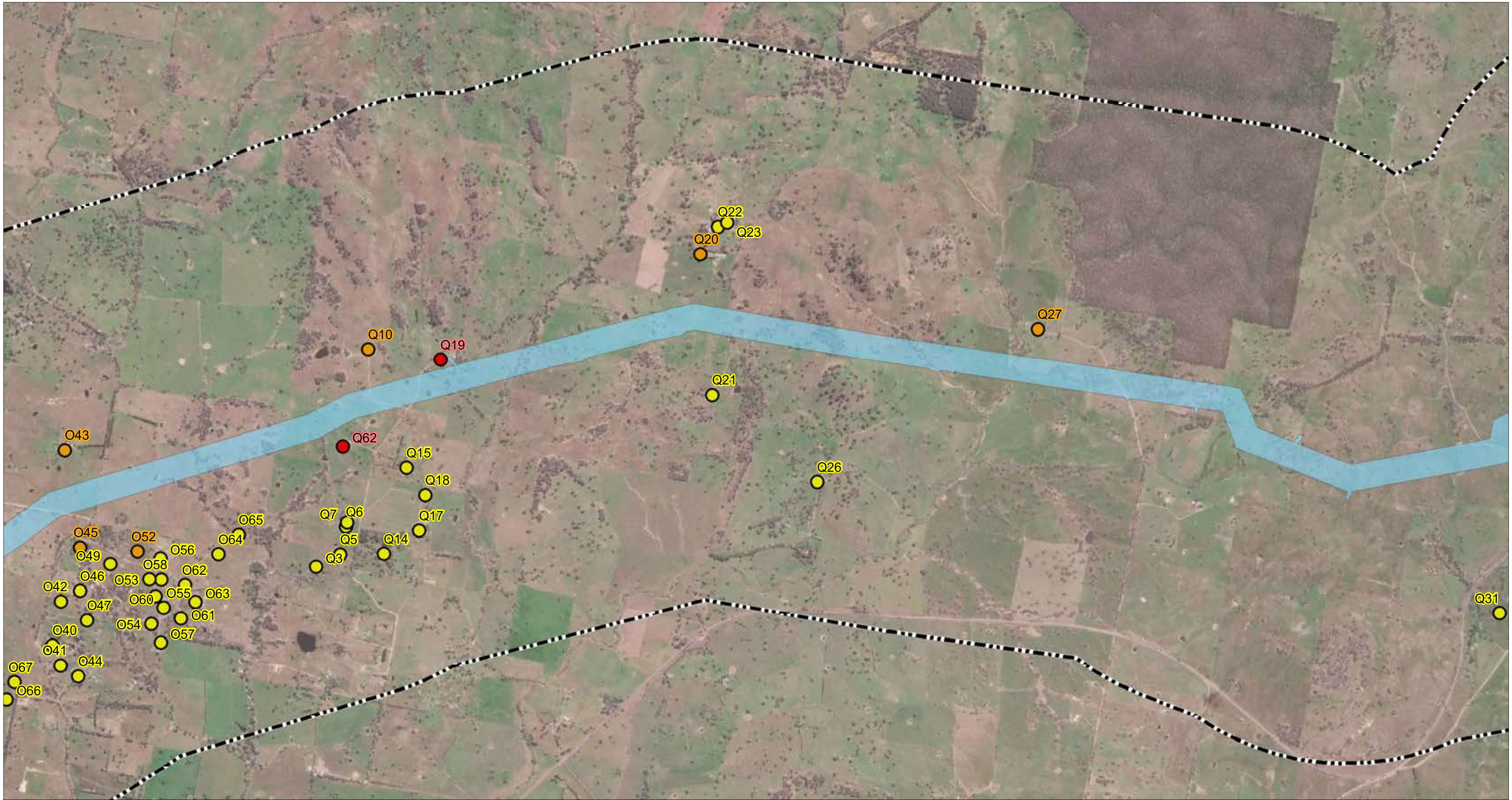
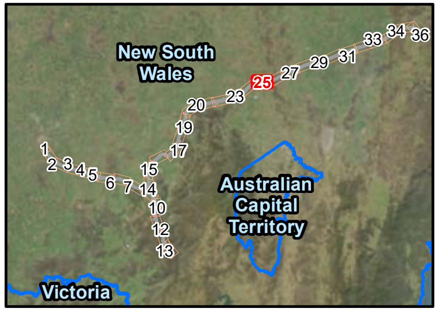


HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS

ATTACHMENT G.3





0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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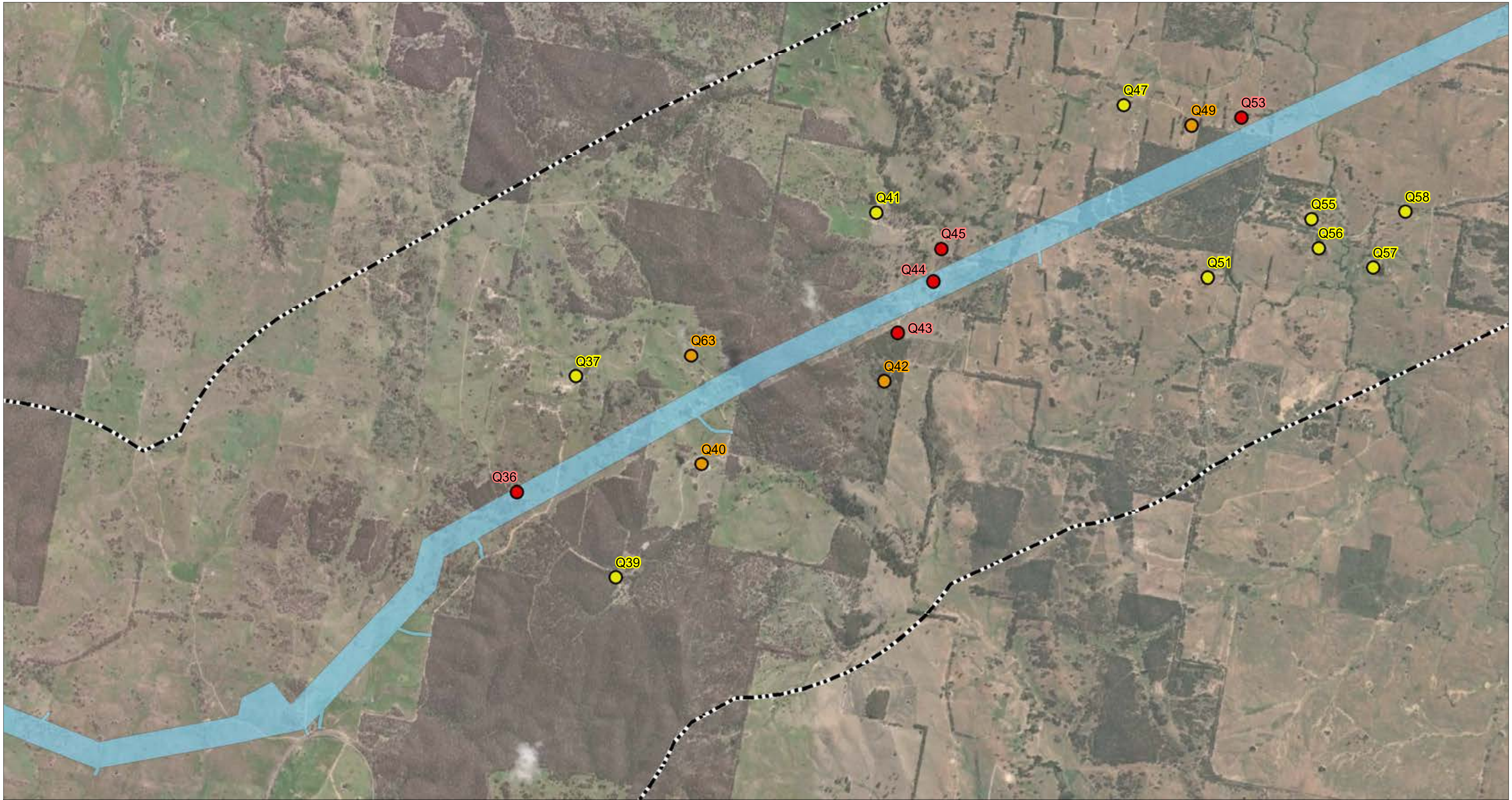
HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 25 OF 36

ATTACHMENT G.3



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
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Substation

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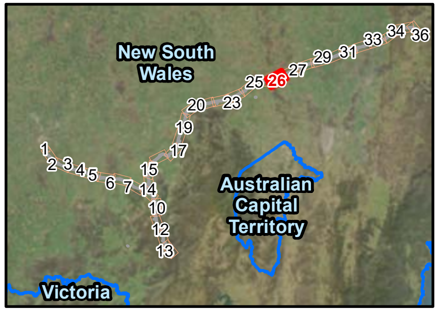
Construction compound

Project footprint

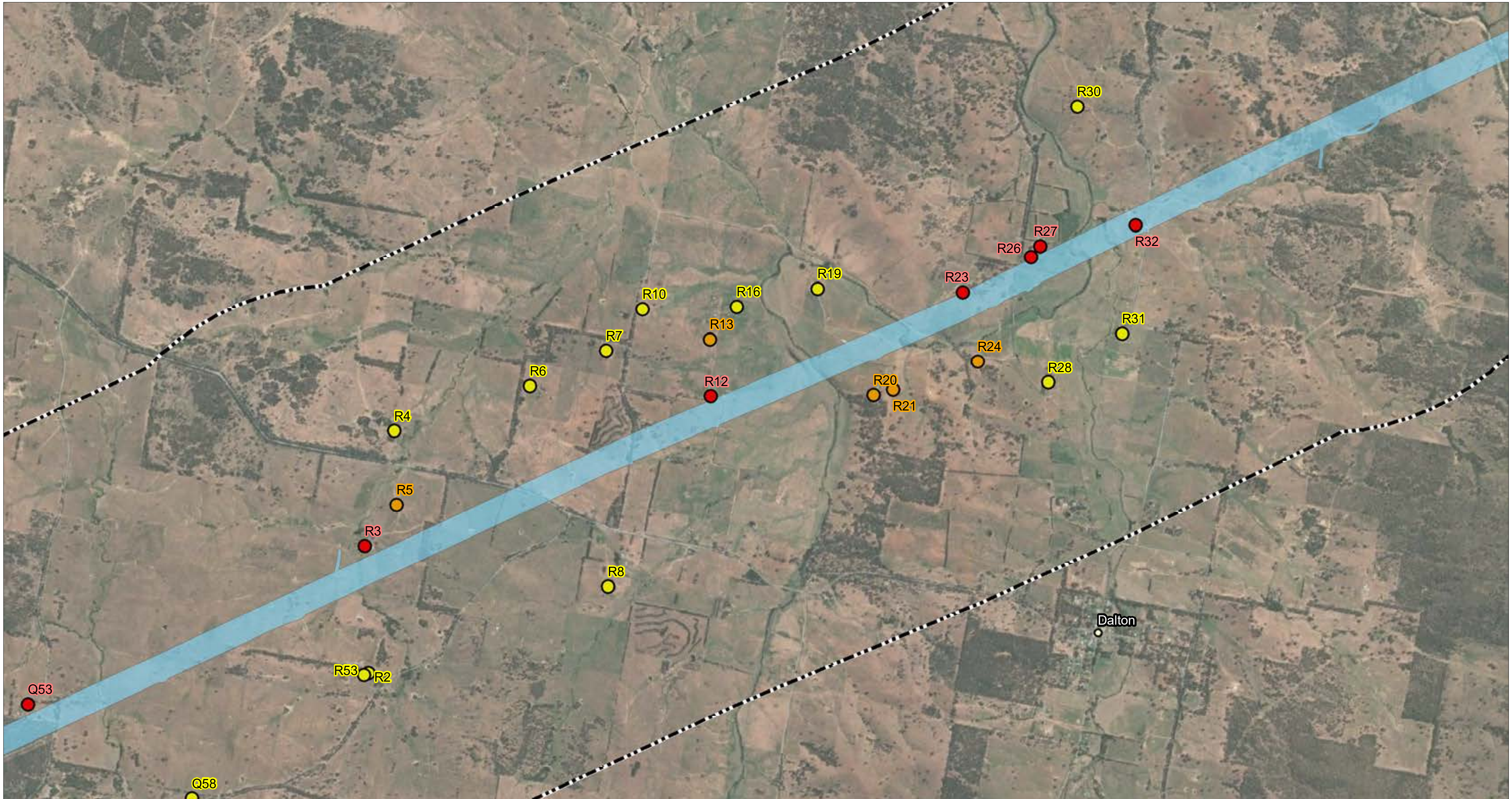
Telecommunications hut



HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS PAGE 26 OF 36

ATTACHMENT G.3



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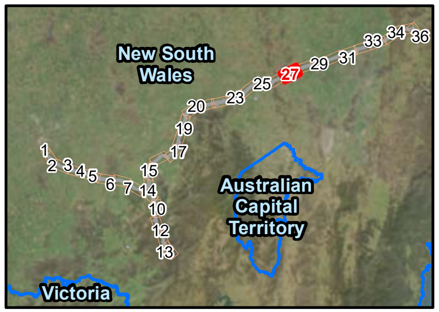

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
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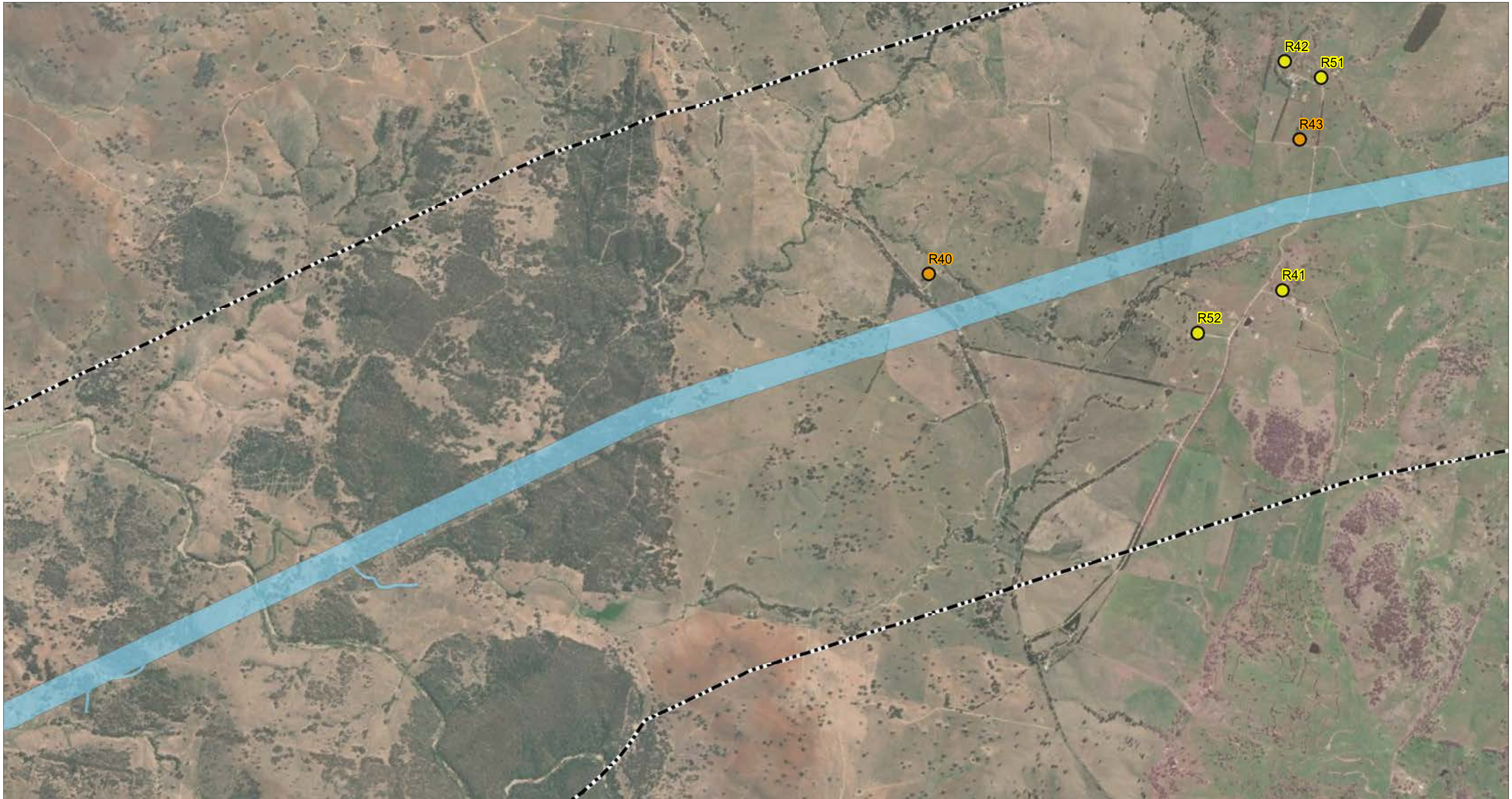
ATTACHMENT G.3

H:\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Transmission Line Construction Noise Impacts (Day).mxd



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Metres

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SLR

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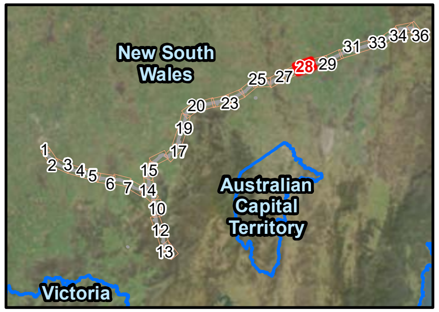

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 28 OF 36

ATTACHMENT G.3

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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SLR

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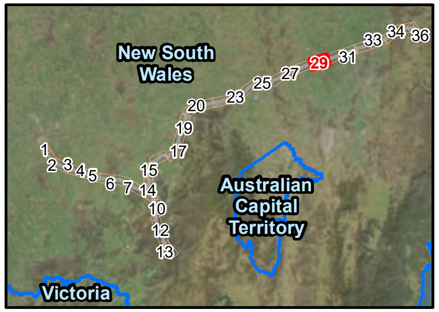
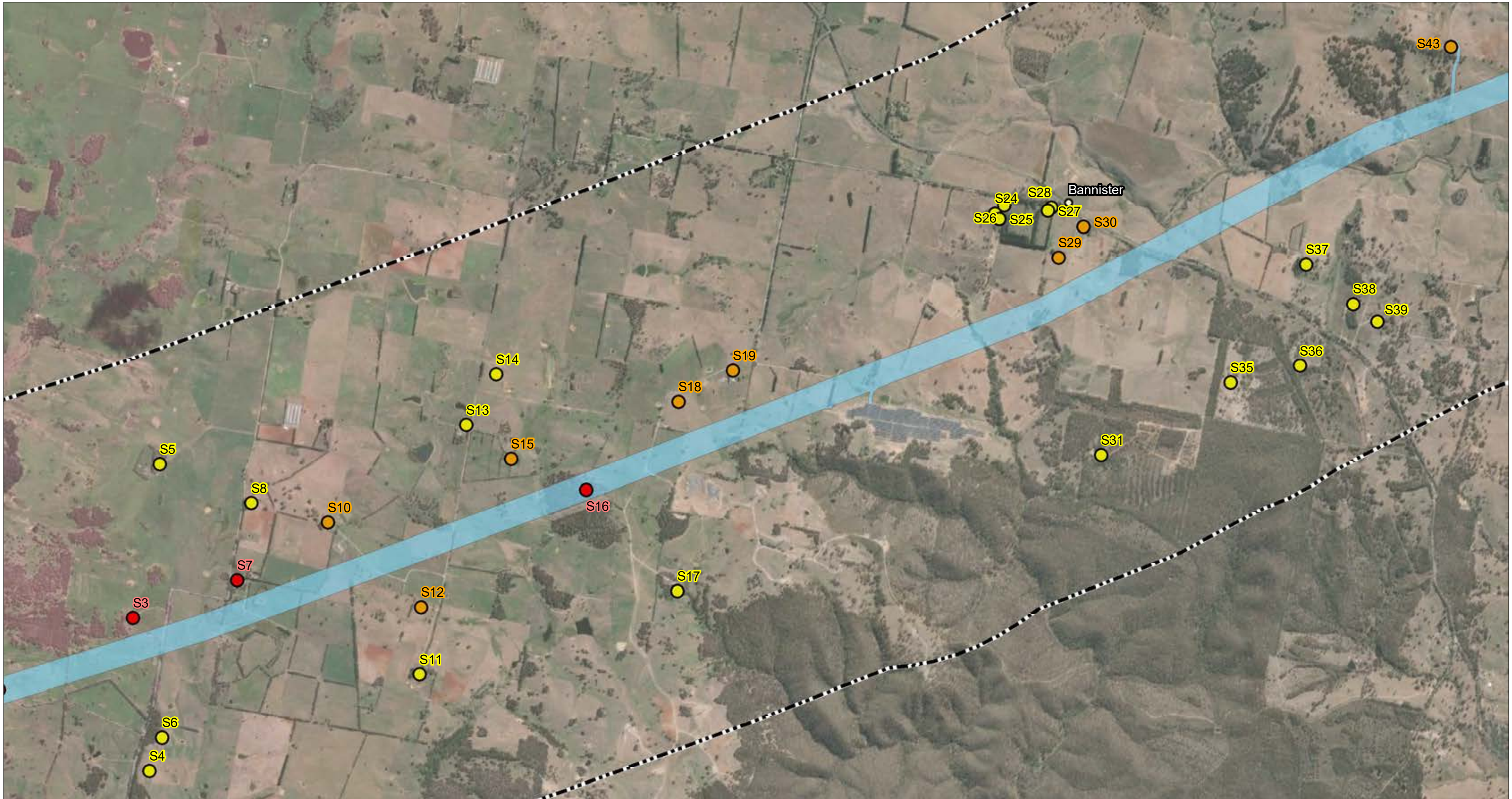


HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 29 OF 36

ATTACHMENT G.3

H:\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Transmission Line Construction Noise Impacts (Day).mxd



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Coordinate System:	GDA 1994 MGA Zone 55
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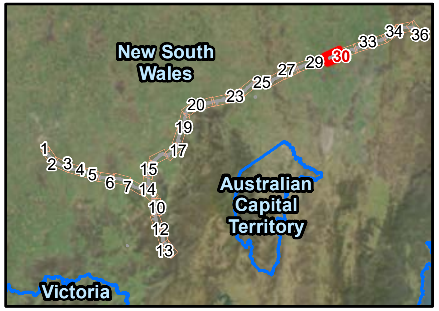
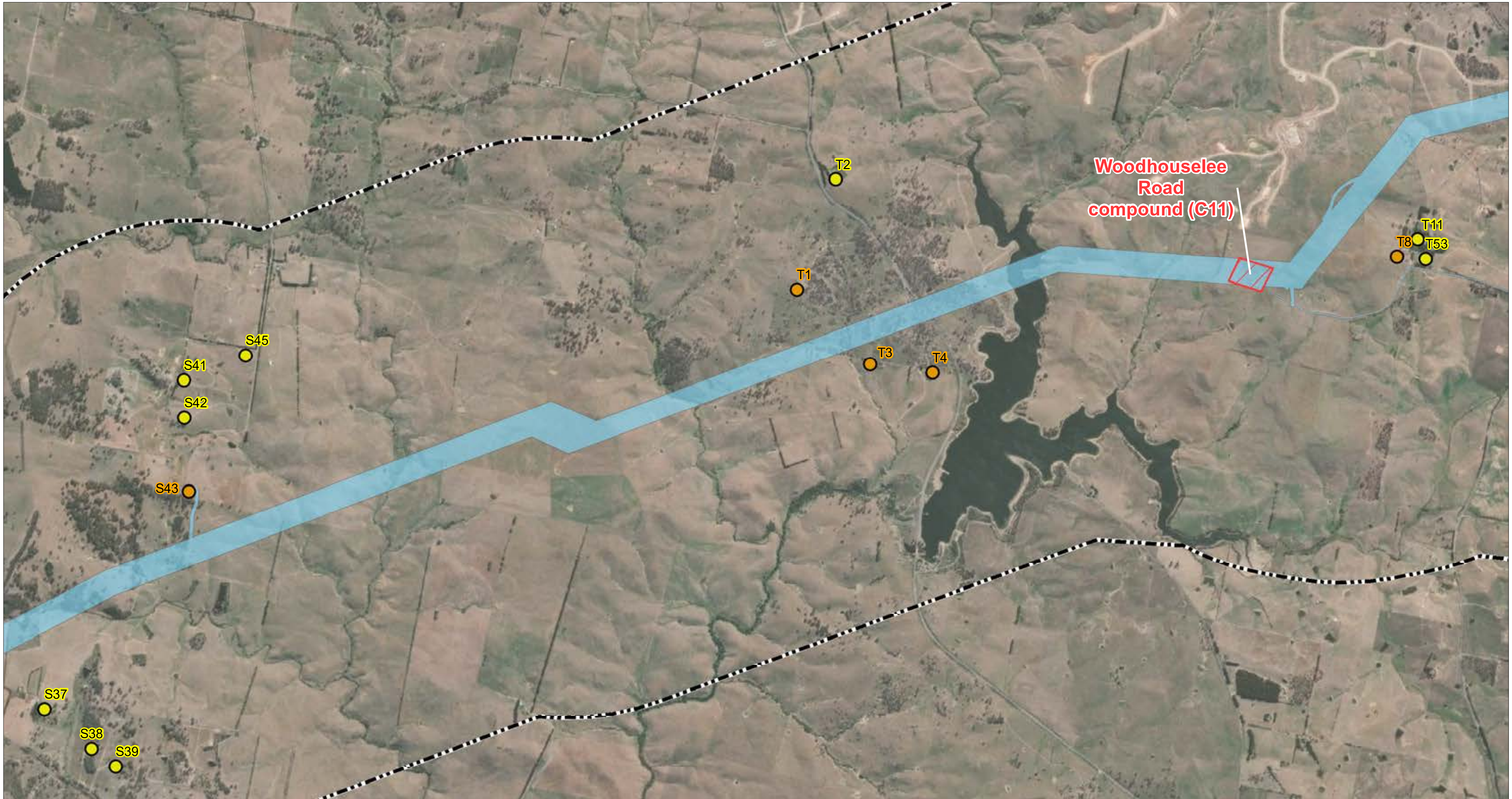


HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 30 OF 36

ATTACHMENT G.3

H:\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Transmission Line Construction Noise Impacts (Day).mxd



0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
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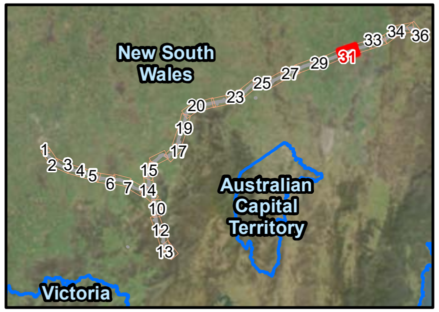

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION
LINE CONSTRUCTION NOISE IMPACTS
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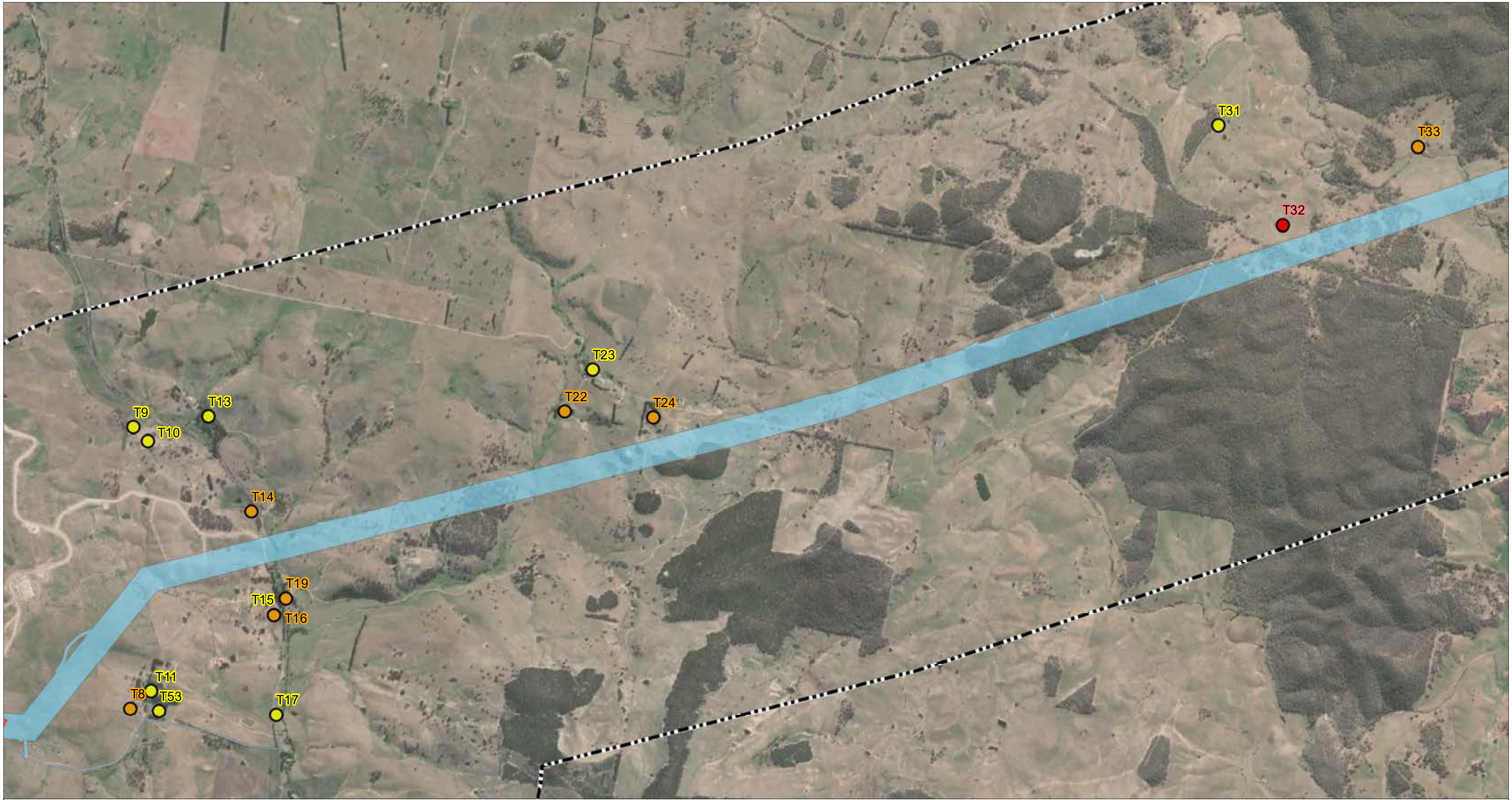
ATTACHMENT G.3



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

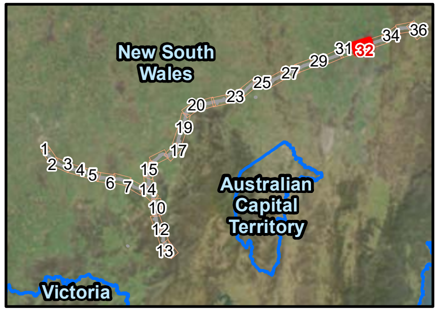
Substation

Accommodation facility

Construction compound

Project footprint

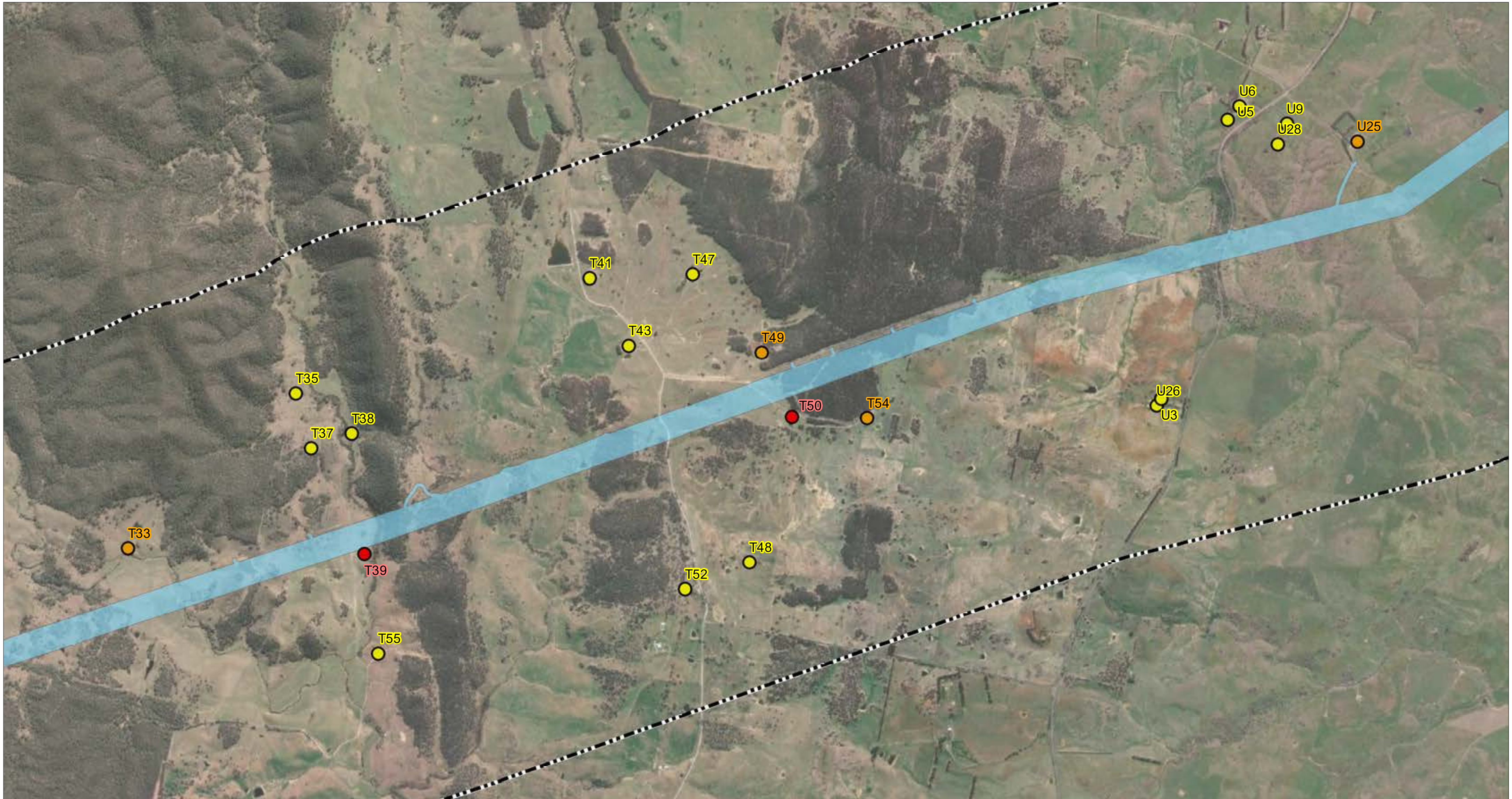
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 32 OF 36

ATTACHMENT G.3



0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

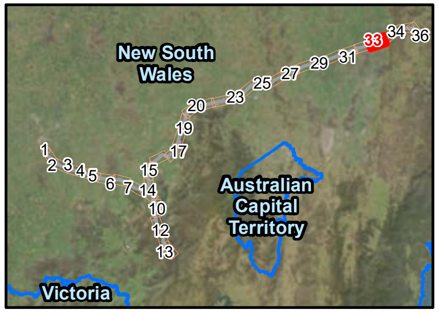
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 33 OF 36

ATTACHMENT G.3

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

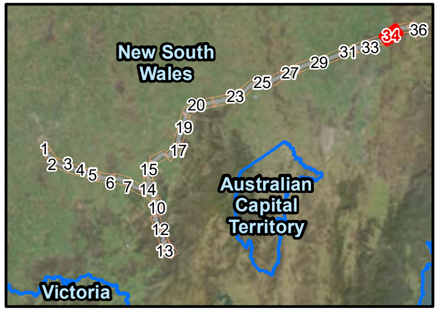
Substation

Accommodation facility

Construction compound

Project footprint

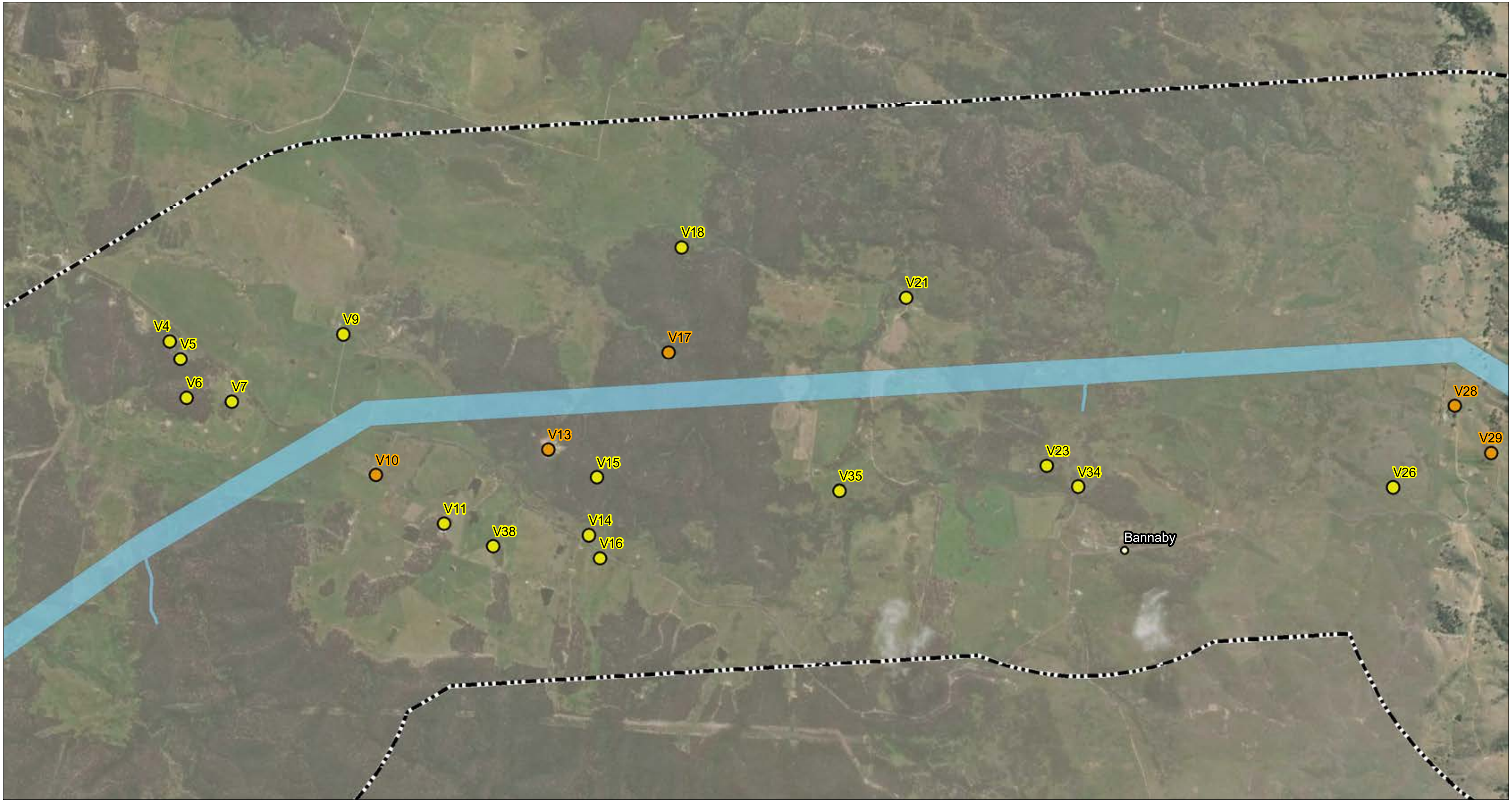
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 34 OF 36

ATTACHMENT G.3



0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

Study area

Daytime noise impacts

1 – 10 dB (Clearly audible)

11 – 20 dB (Moderately intrusive)

>20 dB (Highly intrusive)

Project components

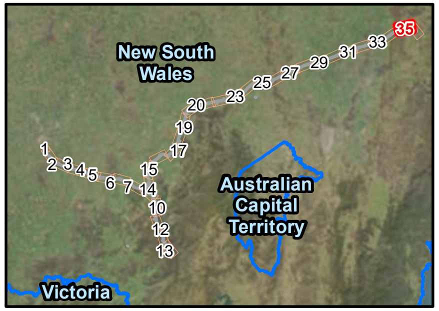
Substation

Accommodation facility

Construction compound

Project footprint

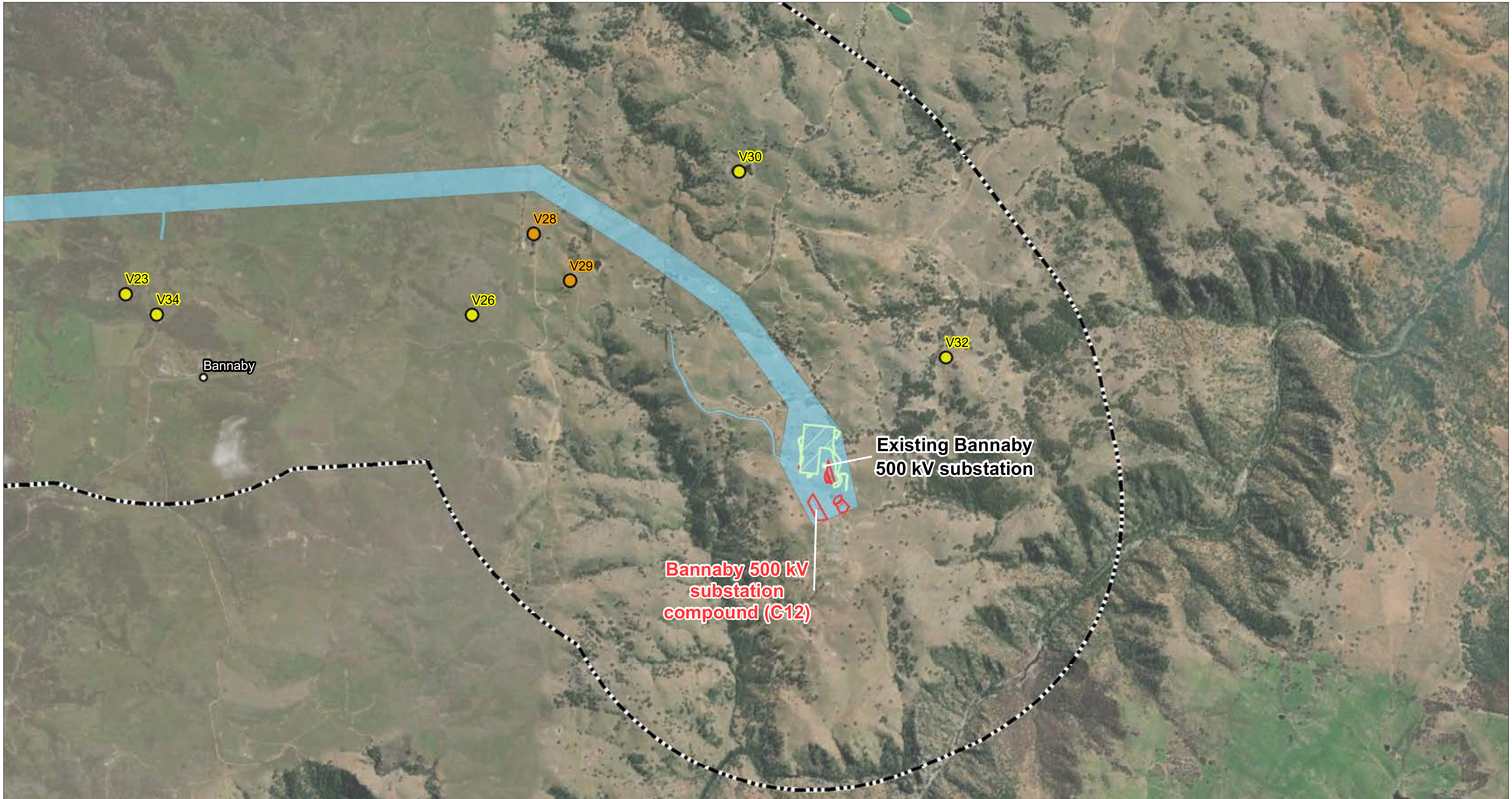
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 35 OF 36

ATTACHMENT G.3



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	09-Mar-2023
Drawn by:	AN

City

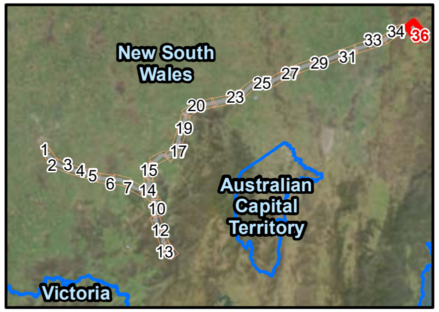
Study area

Daytime noise impacts

- 1 – 10 dB (Clearly audible)
- 11 – 20 dB (Moderately intrusive)
- >20 dB (Highly intrusive)

Project components

- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut



HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE DAYTIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS PAGE 36 OF 36

ATTACHMENT G.3

0 100 200 400 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:20,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City

Study area

Night-time noise impacts

1 – 5 dB (Noticeable)

6 – 15 dB (Clearly audible)

Project components

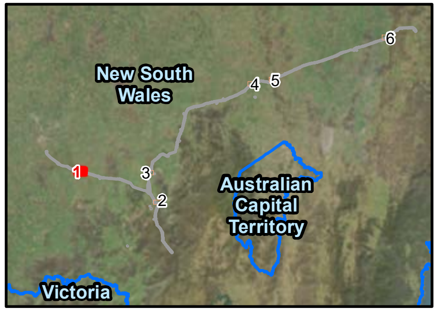
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE NIGHT-TIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 1 OF 6

ATTACHMENT G.4

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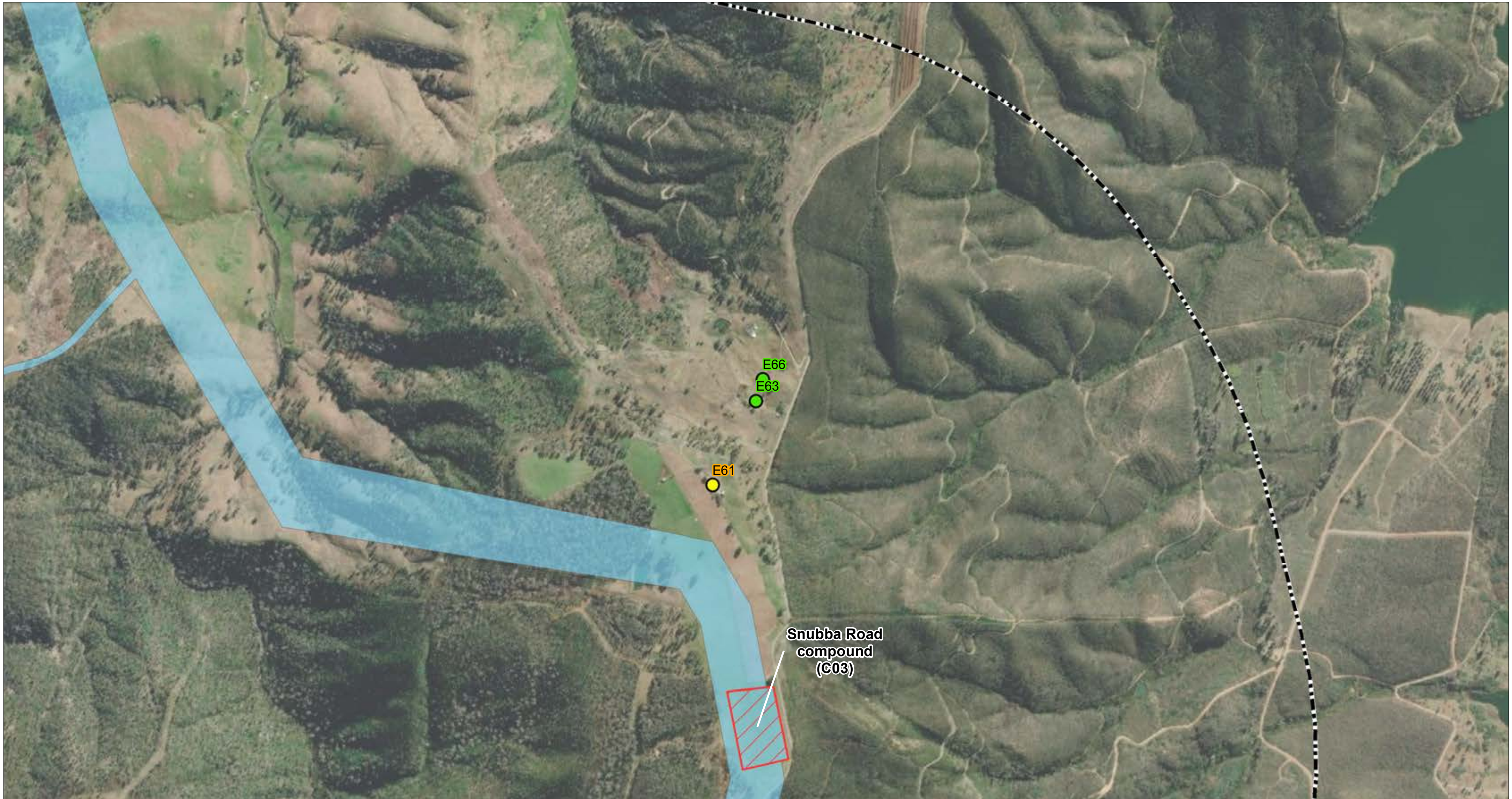
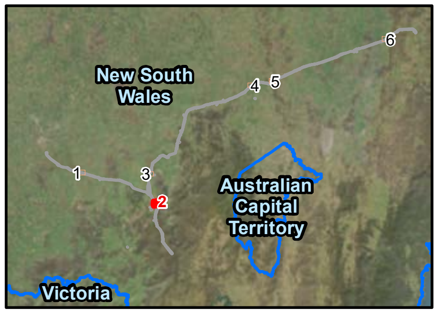




0 100 200 400 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:20,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City

Study area

Night-time noise impacts

1 – 5 dB (Noticeable)

6 – 15 dB (Clearly audible)

Project components

Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE NIGHT-TIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 2 OF 6

ATTACHMENT G.4

0 100 200 400
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:20,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City

Study area

Night-time noise impacts

1 – 5 dB (Noticeable)

6 – 15 dB (Clearly audible)

Project components

Substation

Accommodation facility

Construction compound

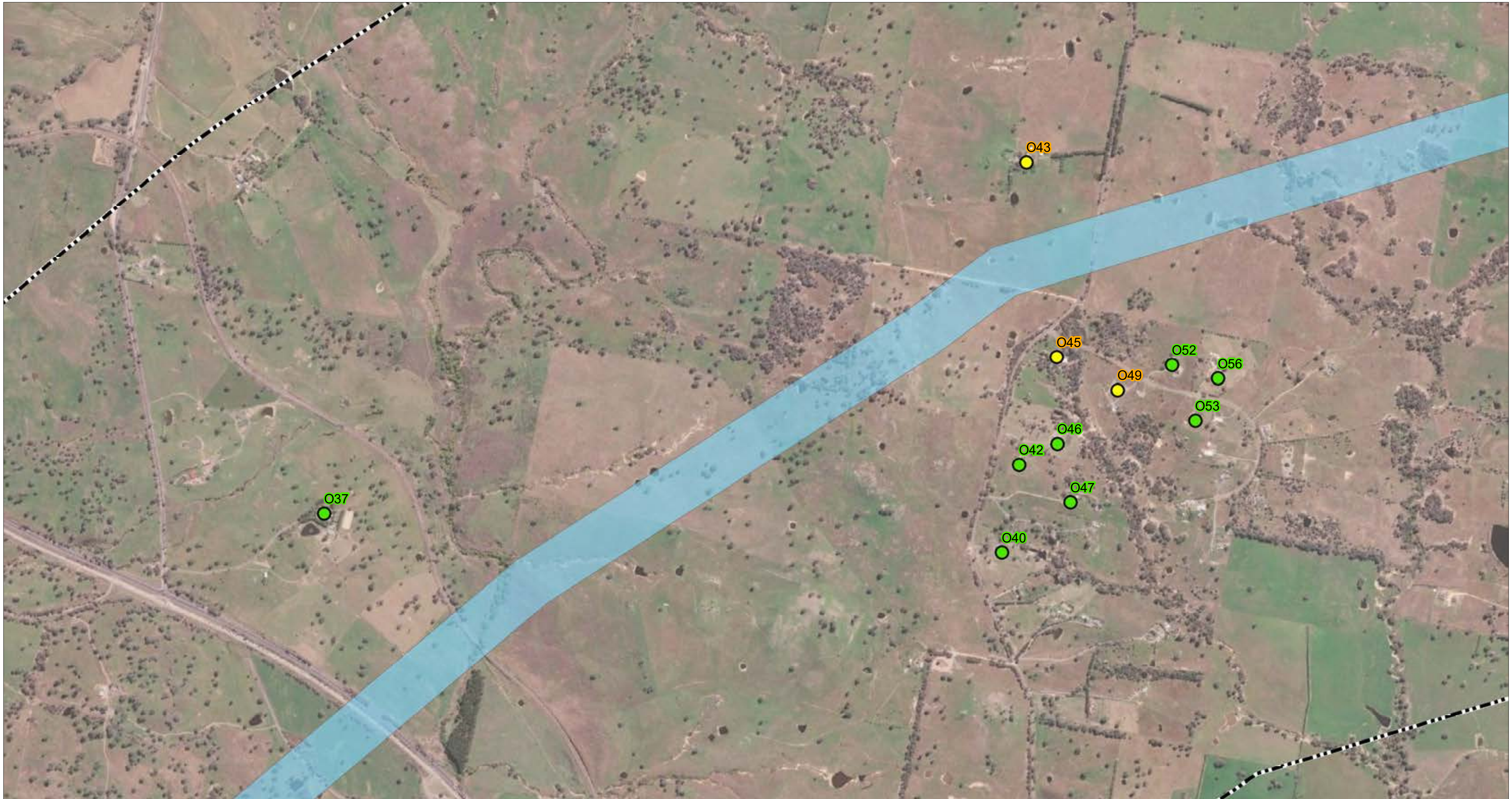
Project footprint

Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE NIGHT-TIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 3 OF 6

ATTACHMENT G.4



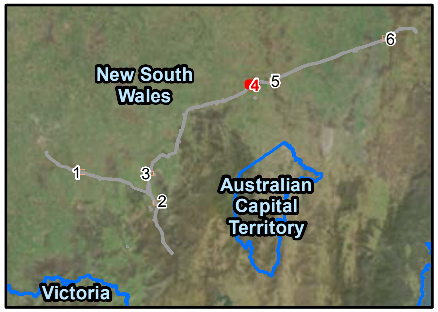
0 100 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:20,000 at A4
Project Number: 610.30622
Date: 15-Mar-2023
Drawn by: AN

City
Study area

Night-time noise impacts
1 – 5 dB (Noticeable)
6 – 15 dB (Clearly audible)

Project components
Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE NIGHT-TIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 4 OF 6

ATTACHMENT G.4

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Transmission Line Construction Noise Impacts (Night).mxd

0 100 200 400
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:20,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

SLR

City

Study area

Night-time noise impacts

1 – 5 dB (Noticeable)

6 – 15 dB (Clearly audible)

Project components

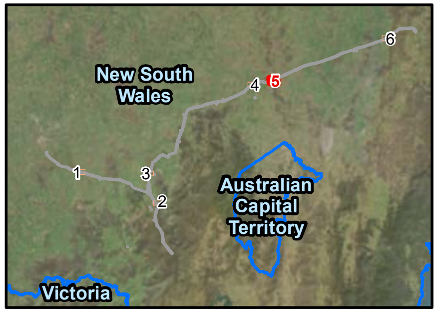
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

WORST-CASE NIGHT-TIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 5 OF 6

ATTACHMENT G.4

0 100 200 400 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:20,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

SLR

City

Study area

Night-time noise impacts

1 – 5 dB (Noticeable)

6 – 15 dB (Clearly audible)

Project components

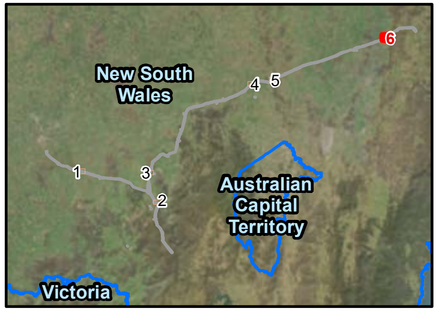
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE NIGHT-TIME TRANSMISSION LINE CONSTRUCTION NOISE IMPACTS
PAGE 6 OF 6

ATTACHMENT G.4

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Transmission Line Construction Noise Impacts (Night).mxd

ATTACHMENT H
Vibration impact mapping

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

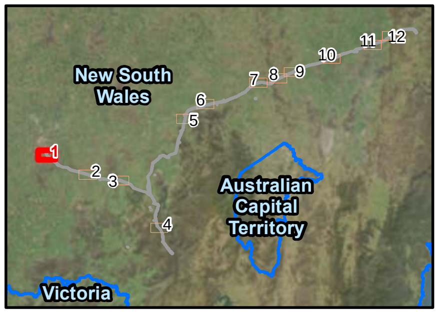
City
Study area

Vibration impacts

Human comfort
Cosmetic damage

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS
PAGE 1 OF 12

ATTACHMENT H

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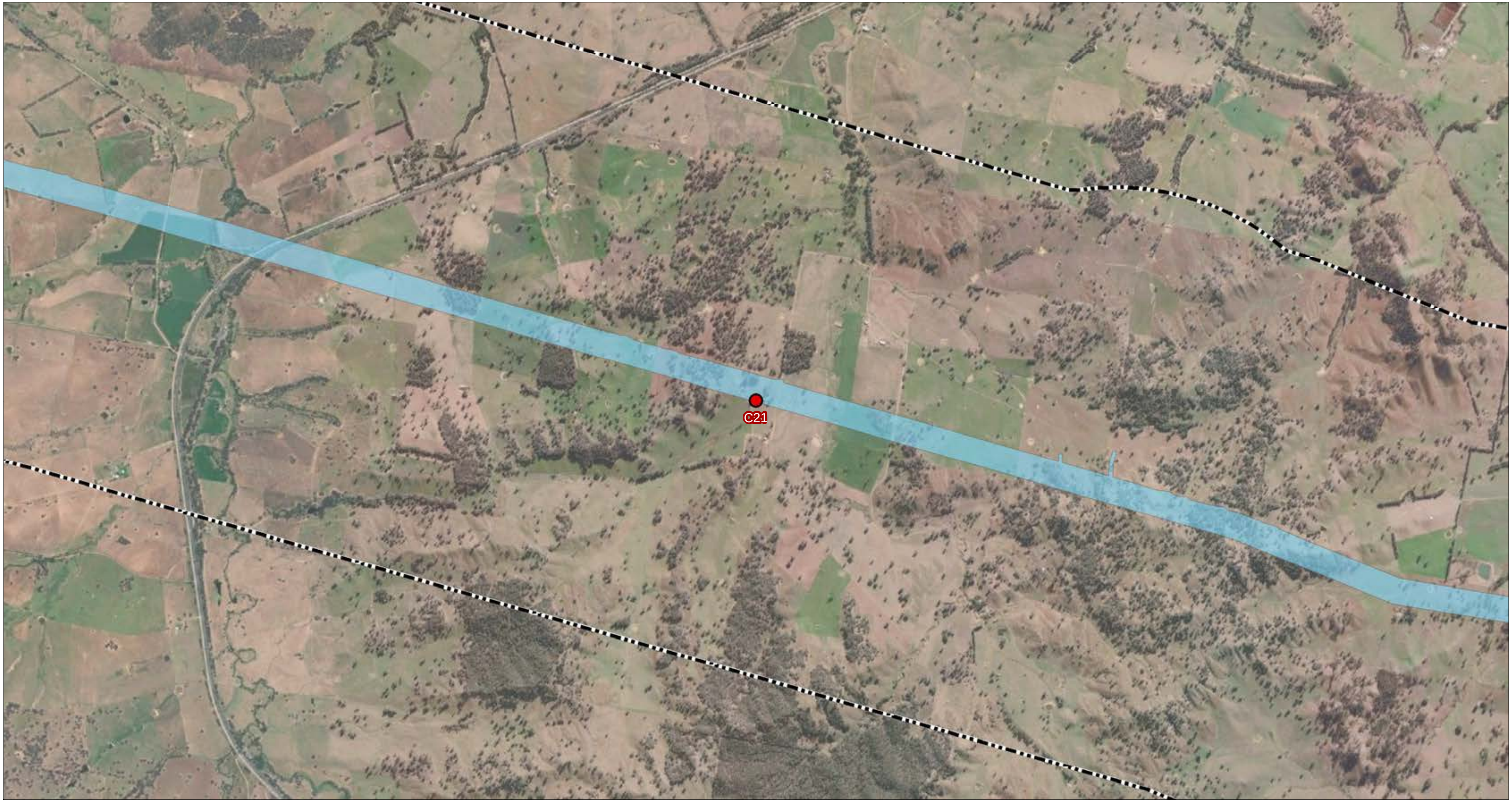
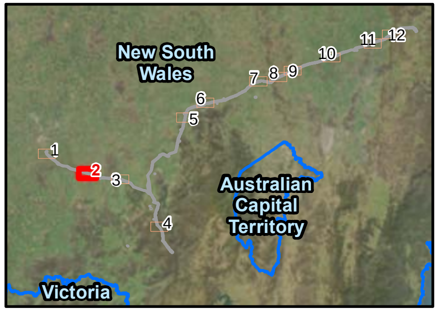




0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area

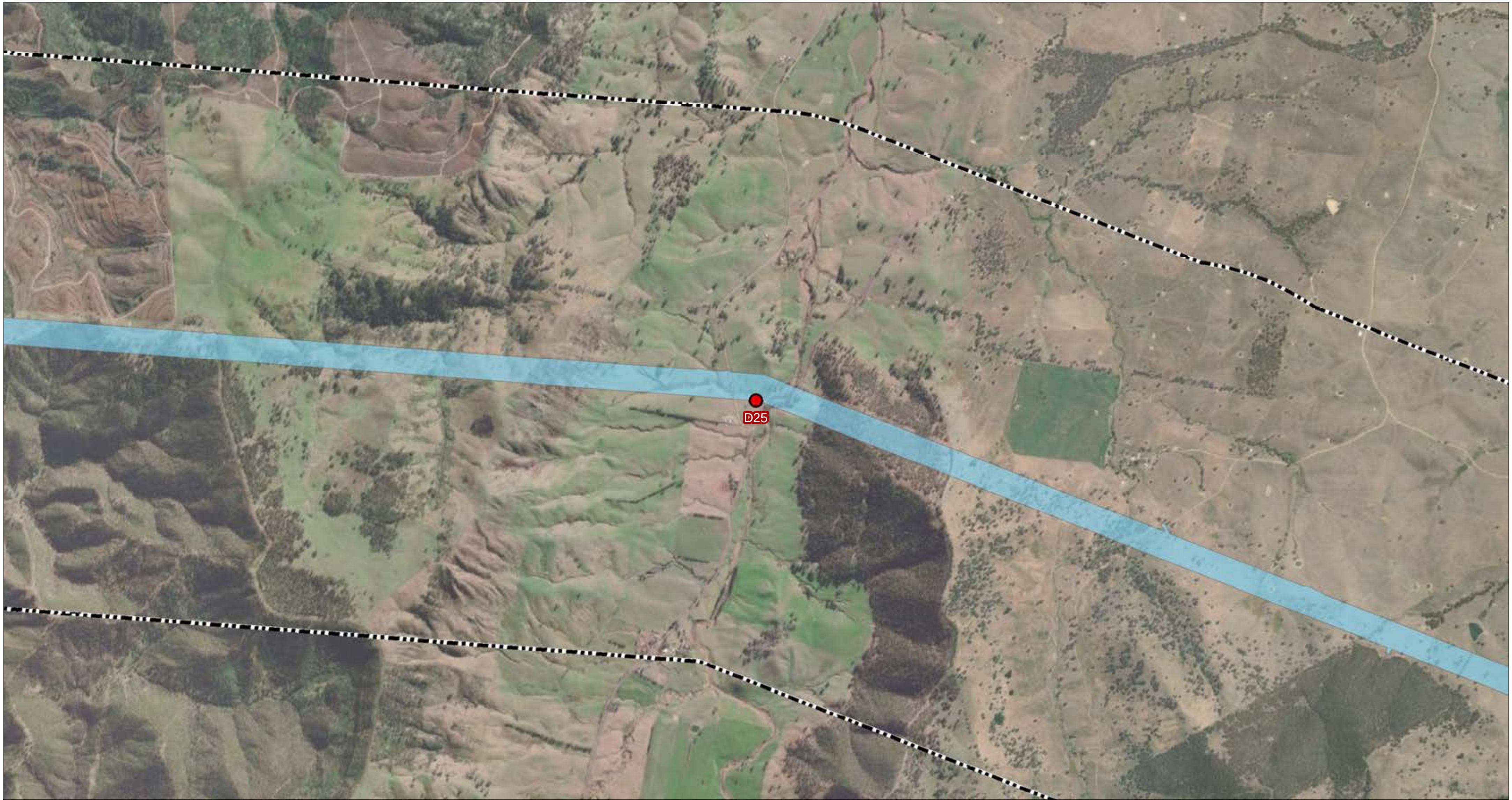
Vibration impacts
Human comfort
Cosmetic damage

Project components
Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS
PAGE 2 OF 12

ATTACHMENT H



0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City

Study area

Vibration impacts

Human comfort

Cosmetic damage

Project components

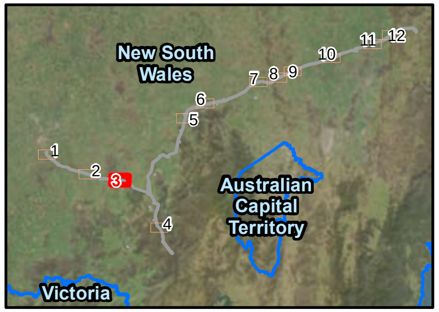
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS
PAGE 3 OF 12

ATTACHMENT H

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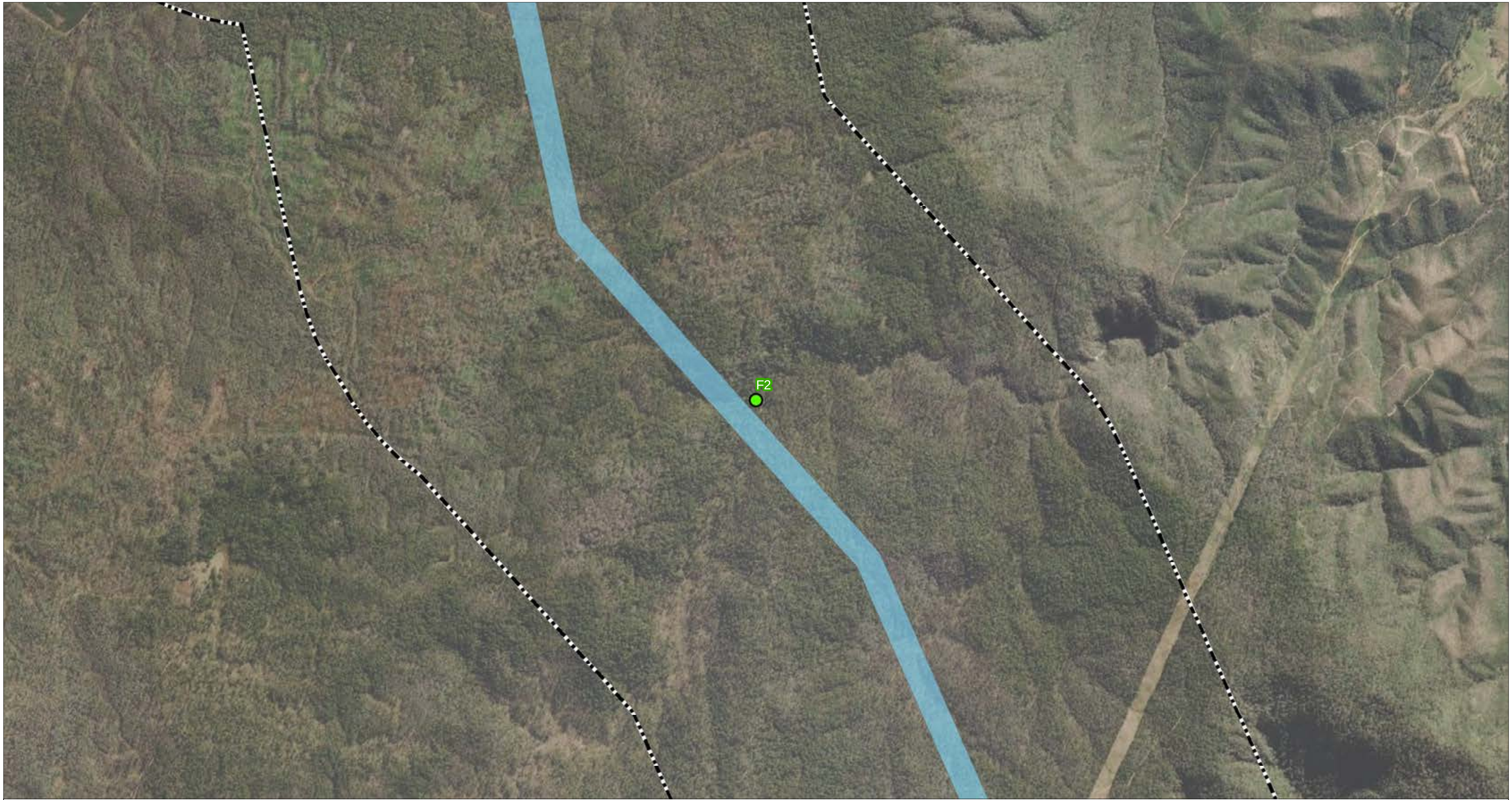


0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area

Vibration impacts

Human comfort
Cosmetic damage

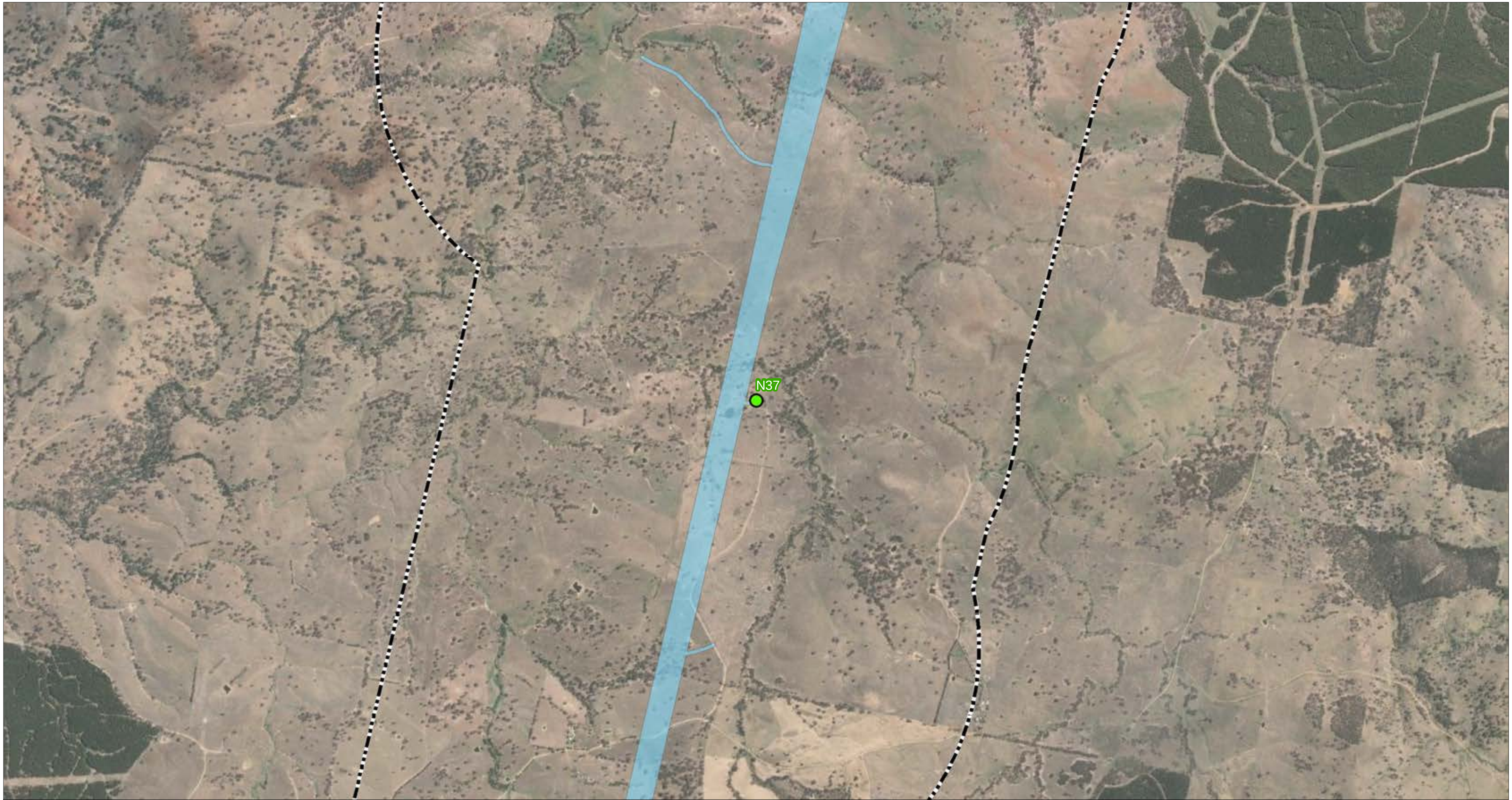
Project components

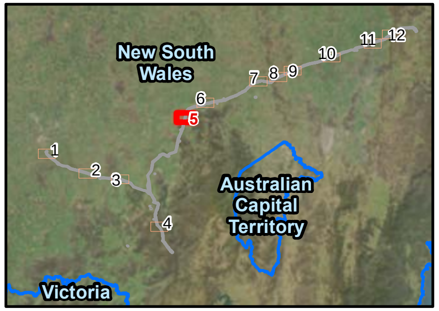
Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS
PAGE 4 OF 12

ATTACHMENT H





N

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

SLR

City

Study area

Vibration impacts

Human comfort

Cosmetic damage

Project components

Substation

Accommodation facility

Construction compound

Project footprint

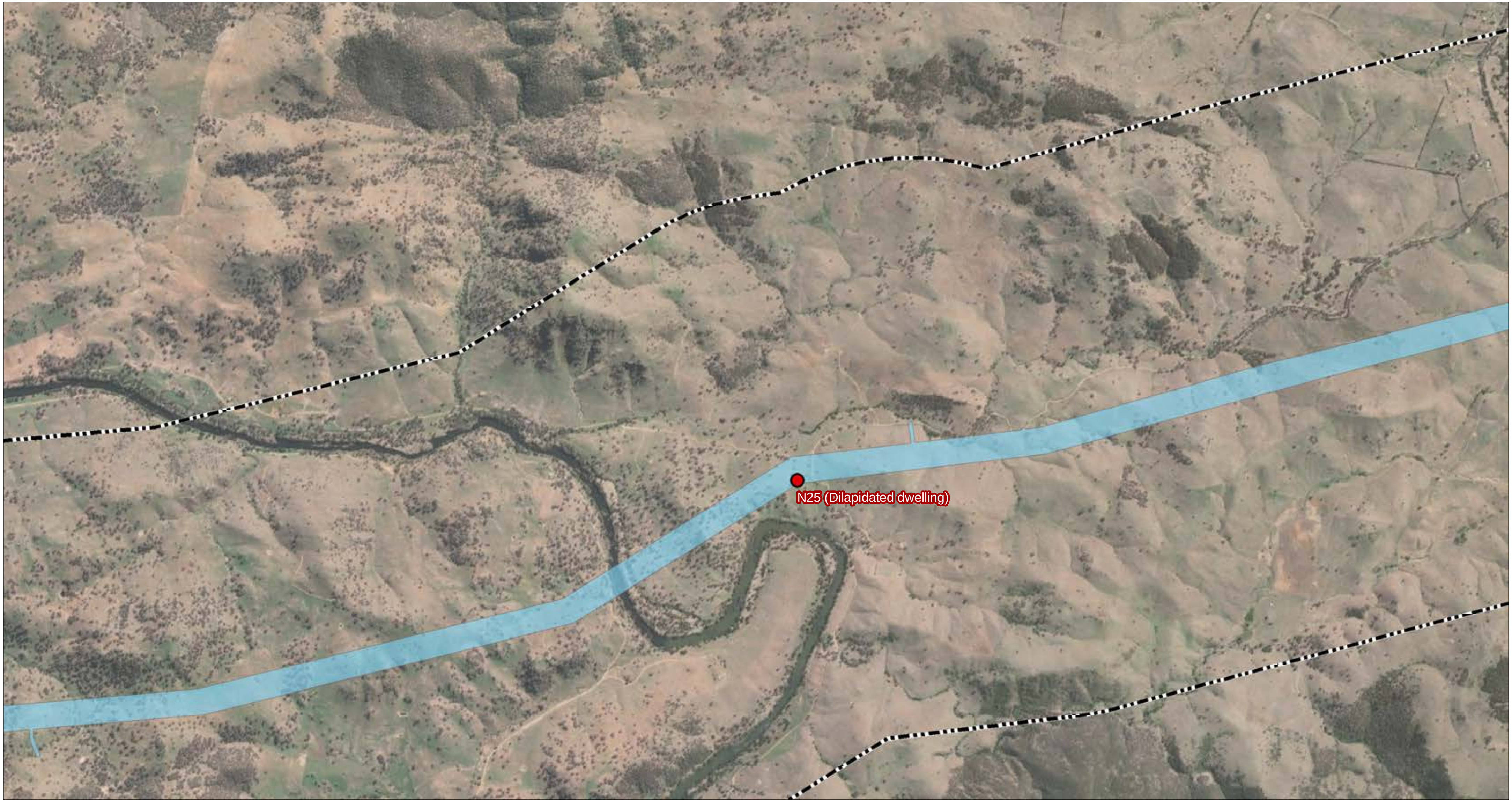
Telecommunications hut

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS
PAGE 5 OF 12

ATTACHMENT H

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Construction Vibration Impacts.mxd



0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

SLR

City

Study area

Vibration impacts

Human comfort

Cosmetic damage

Project components

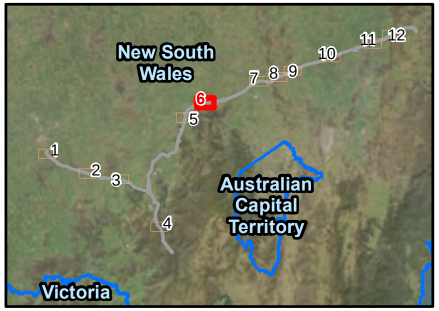
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS PAGE 6 OF 12

ATTACHMENT H

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area

Vibration impacts

Human comfort
Cosmetic damage

Project components

Substation
Accommodation facility
Construction compound
Project footprint
Telecommunications hut

HUMELINK
NOISE AND VIBRATION
IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS
PAGE 7 OF 12

ATTACHMENT H

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Construction Vibration Impacts.mxd

0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area

Vibration impacts
- Human comfort
- Cosmetic damage

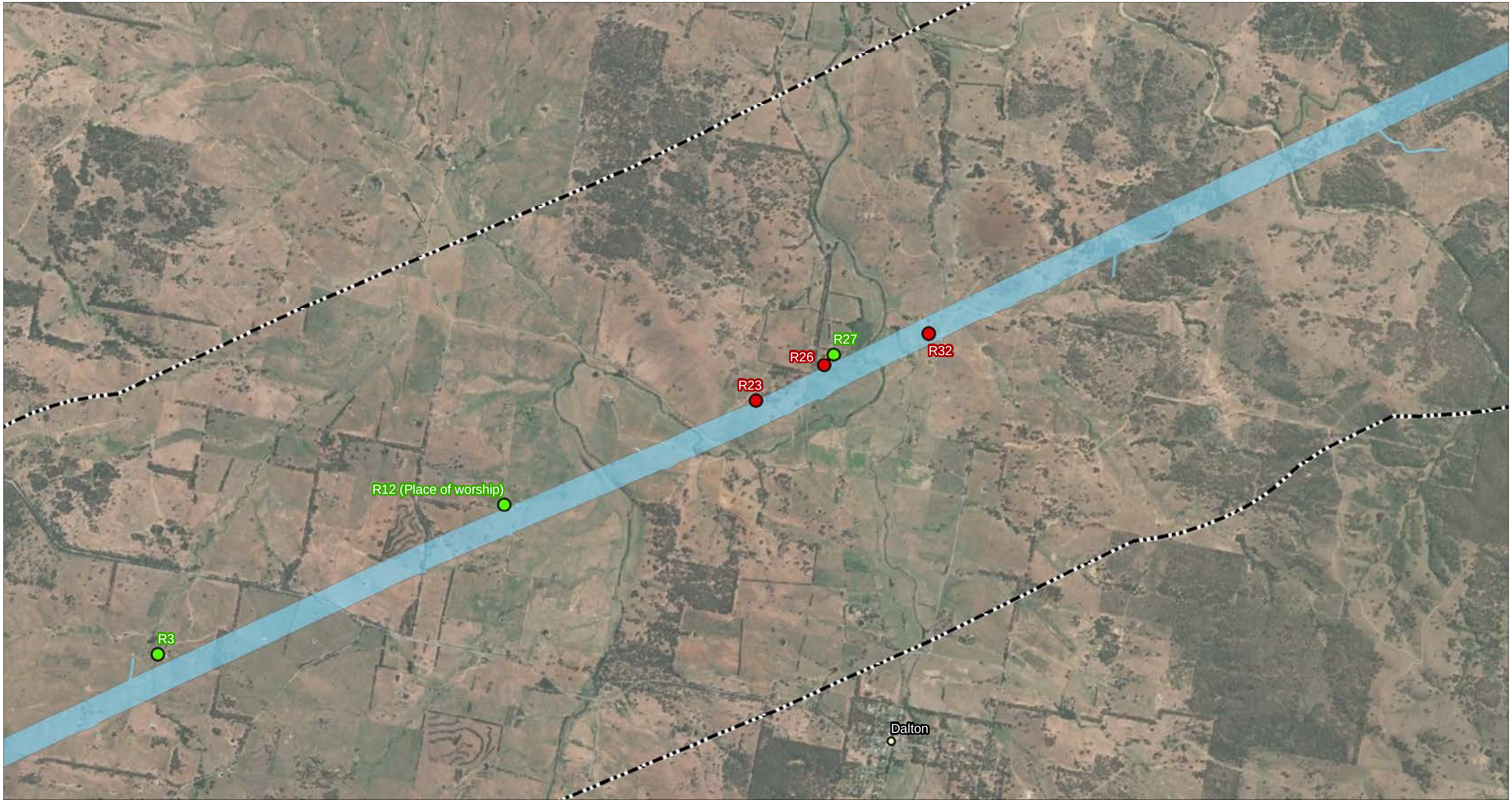
Project components
- Substation
- Accommodation facility
- Construction compound
- Project footprint
- Telecommunications hut

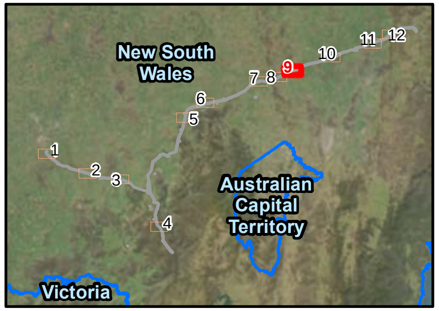
HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS
PAGE 8 OF 12

ATTACHMENT H

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Construction Vibration Impacts.mxd





0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City

Study area

Vibration impacts

Human comfort

Cosmetic damage

Project components

Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut

HUMELINK NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS PAGE 9 OF 12

ATTACHMENT H

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Construction Vibration Impacts.mxd

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City

Study area

Vibration impacts

Human comfort

Cosmetic damage

Project components

Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut

SLR

HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS
PAGE 10 OF 12

ATTACHMENT H

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Construction Vibration Impacts.mxd

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City

Study area

Vibration impacts

Human comfort

Cosmetic damage

Project components

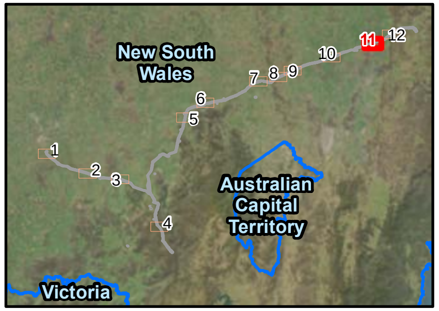
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS
PAGE 11 OF 12

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\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Construction Vibration Impacts.mxd

0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City

Study area

Vibration impacts

Human comfort

Cosmetic damage

Project components

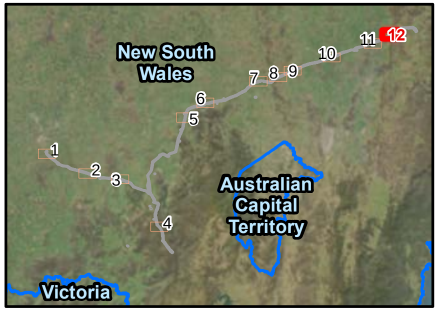
Substation

Accommodation facility

Construction compound

Project footprint

Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE CONSTRUCTION VIBRATION IMPACTS
PAGE 12 OF 12

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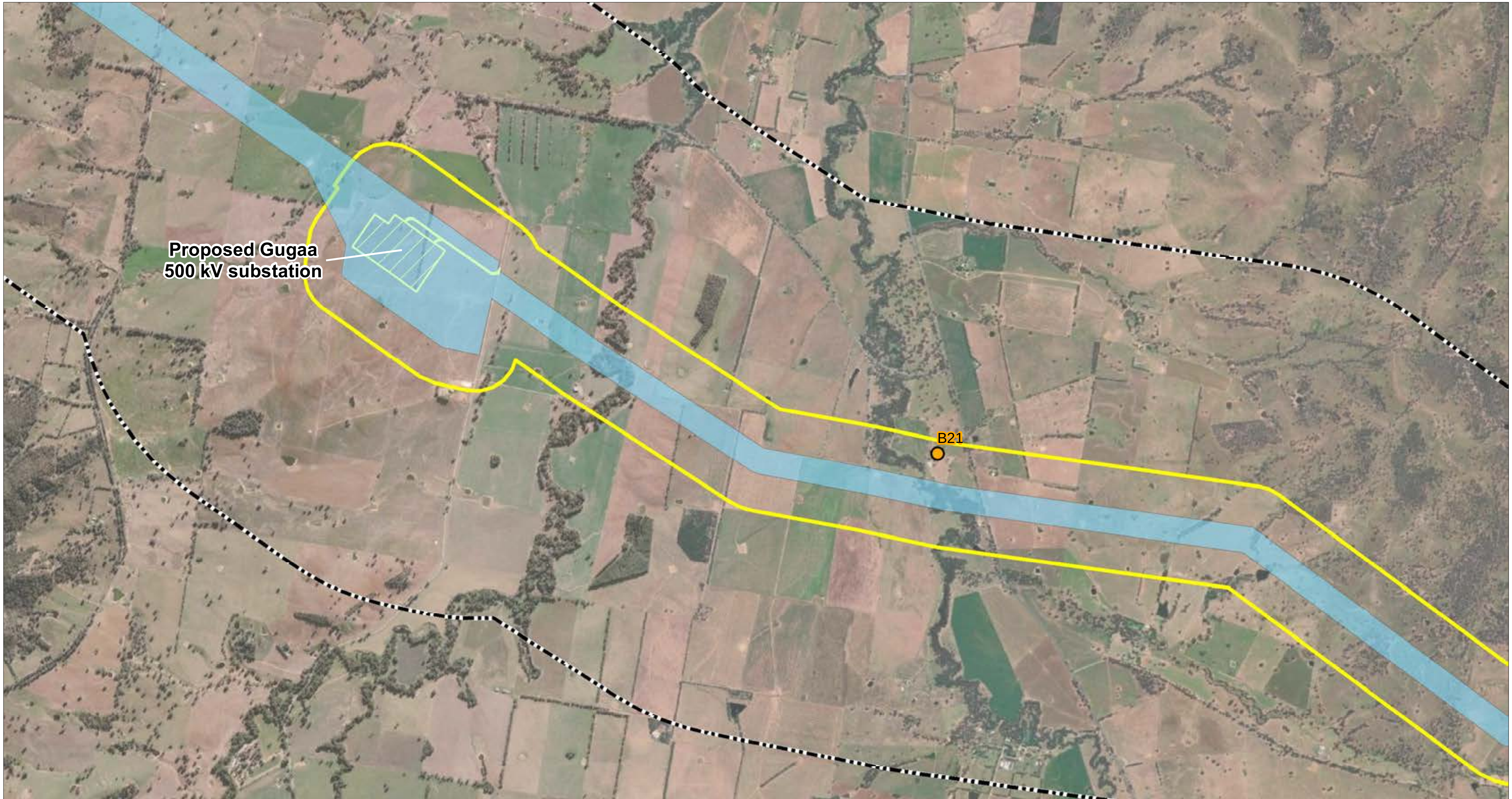
\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Construction Vibration Impacts.mxd

ATTACHMENT I

Operational noise impact mapping



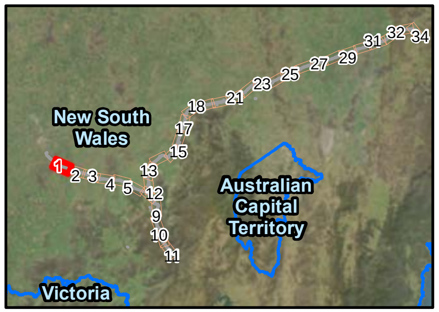
0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

SLR

City
Study area
Potentially impacted receivers
Transmission line noise impact zone

Project components
Substation
Project footprint
Telecommunications hut



HUMELINK
NOISE AND VIBRATION IMPACT ASSESSMENT

WORST-CASE NIGHT-TIME CUMULATIVE TRANSMISSION LINE OPERATIONAL NOISE IMPACTS
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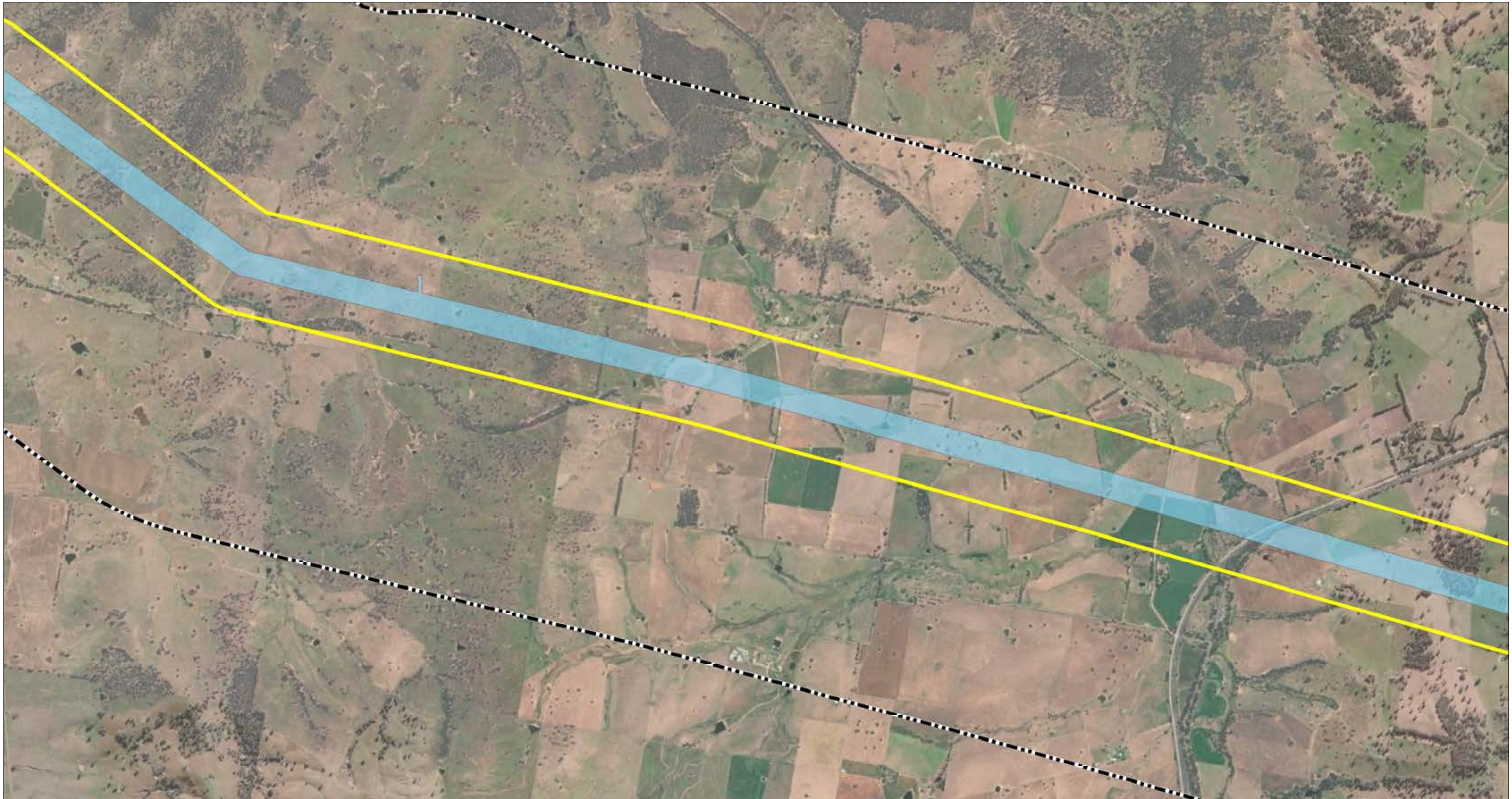
\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Cumulative Transmission Line Operational Noise Impacts.mxd



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Metres

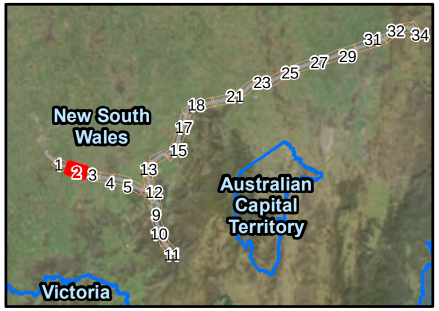
Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

SLR

- City
- Study area
- Potentially impacted receivers
- Transmission line noise impact zone

Project components

- Substation
- Project footprint
- Telecommunications hut



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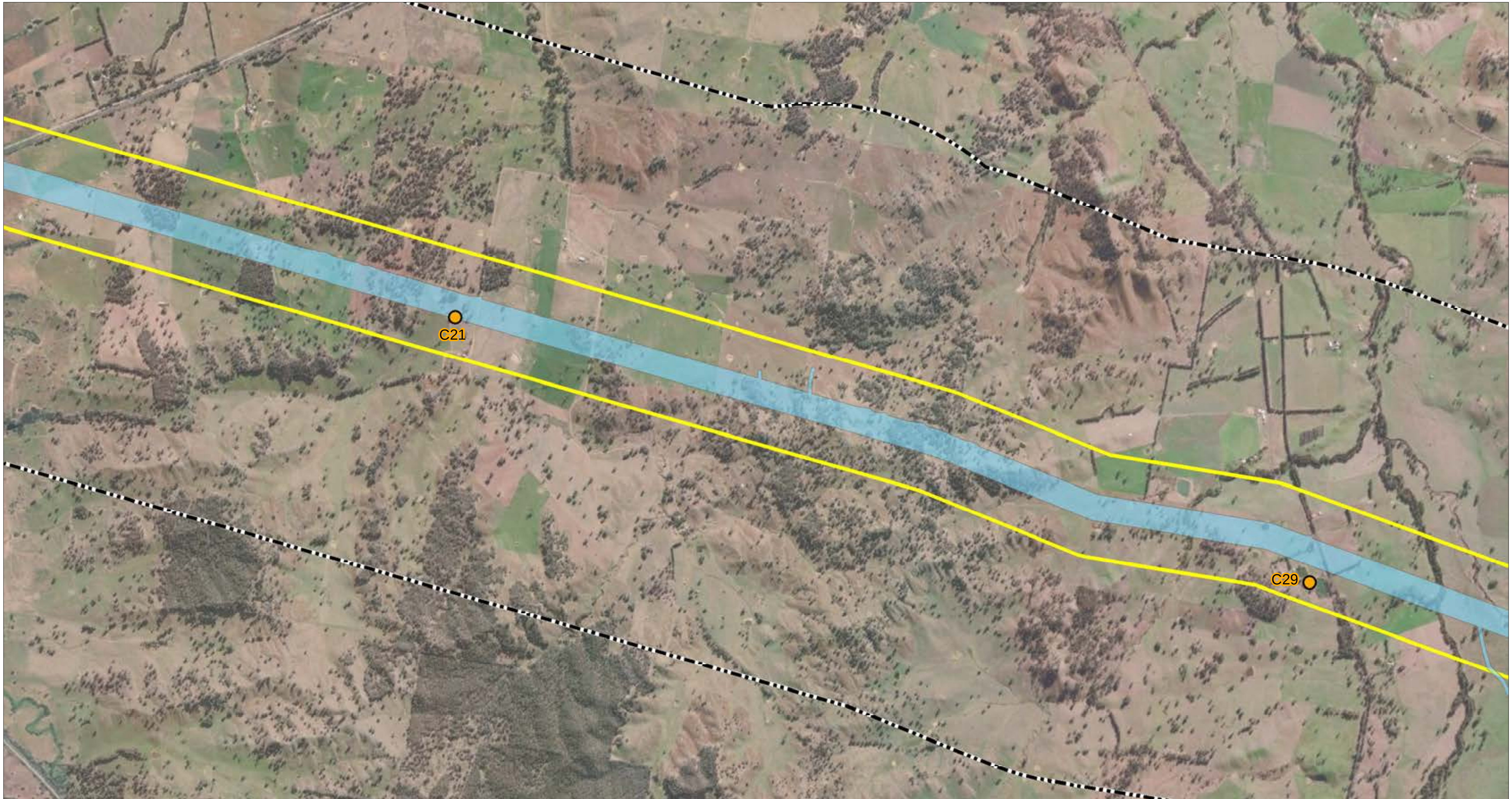

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Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
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SLR

City
Study area
Potentially impacted receivers
Transmission line noise impact zone

Project components
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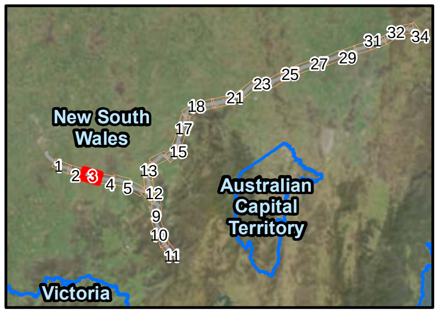
Telecommunications hut



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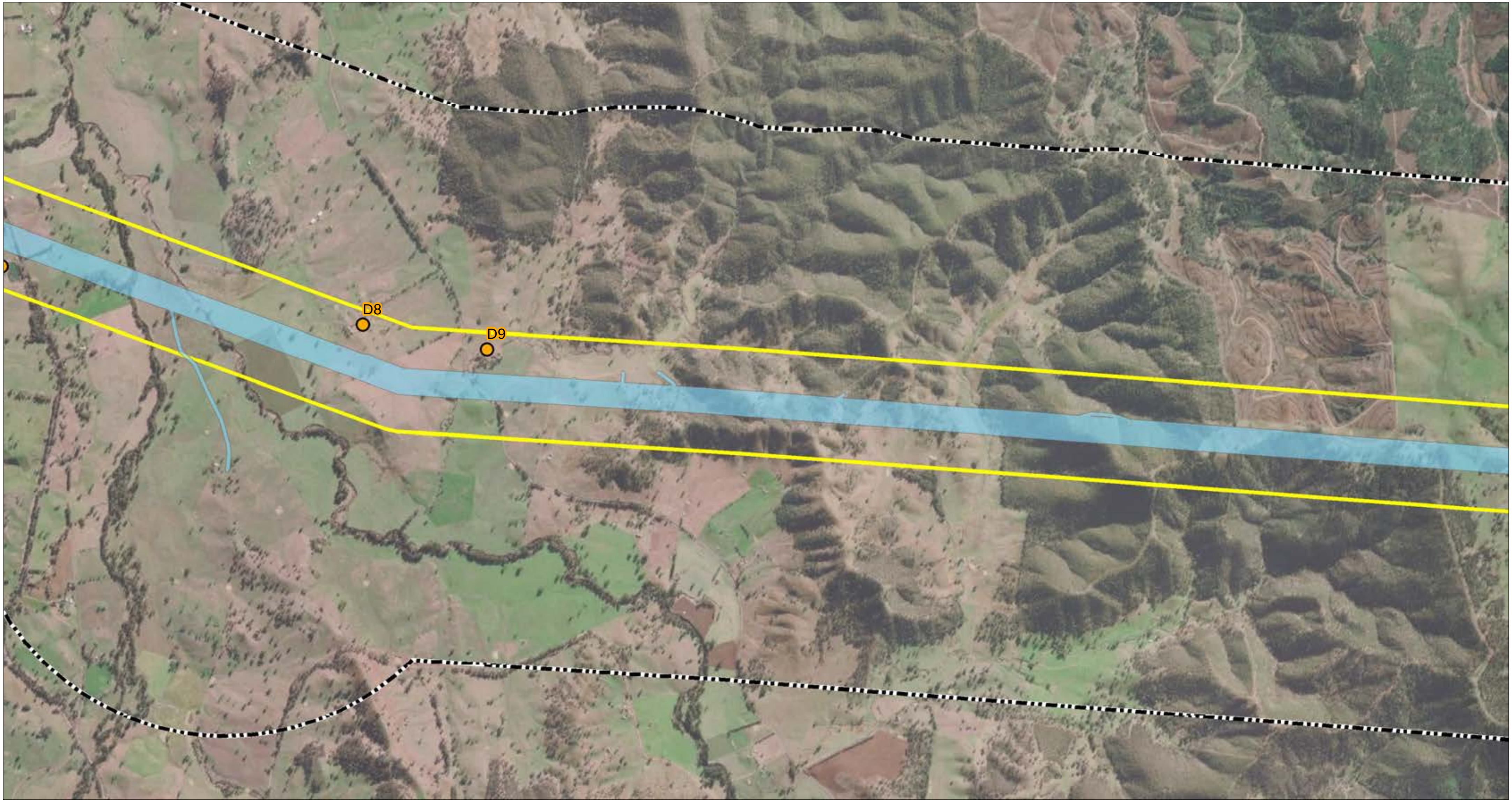

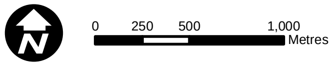

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City
Study area
Potentially impacted receivers
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Substation
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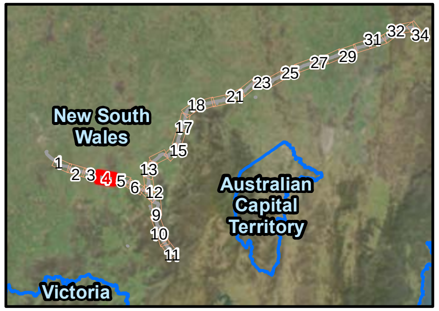

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NOISE AND VIBRATION IMPACT ASSESSMENT

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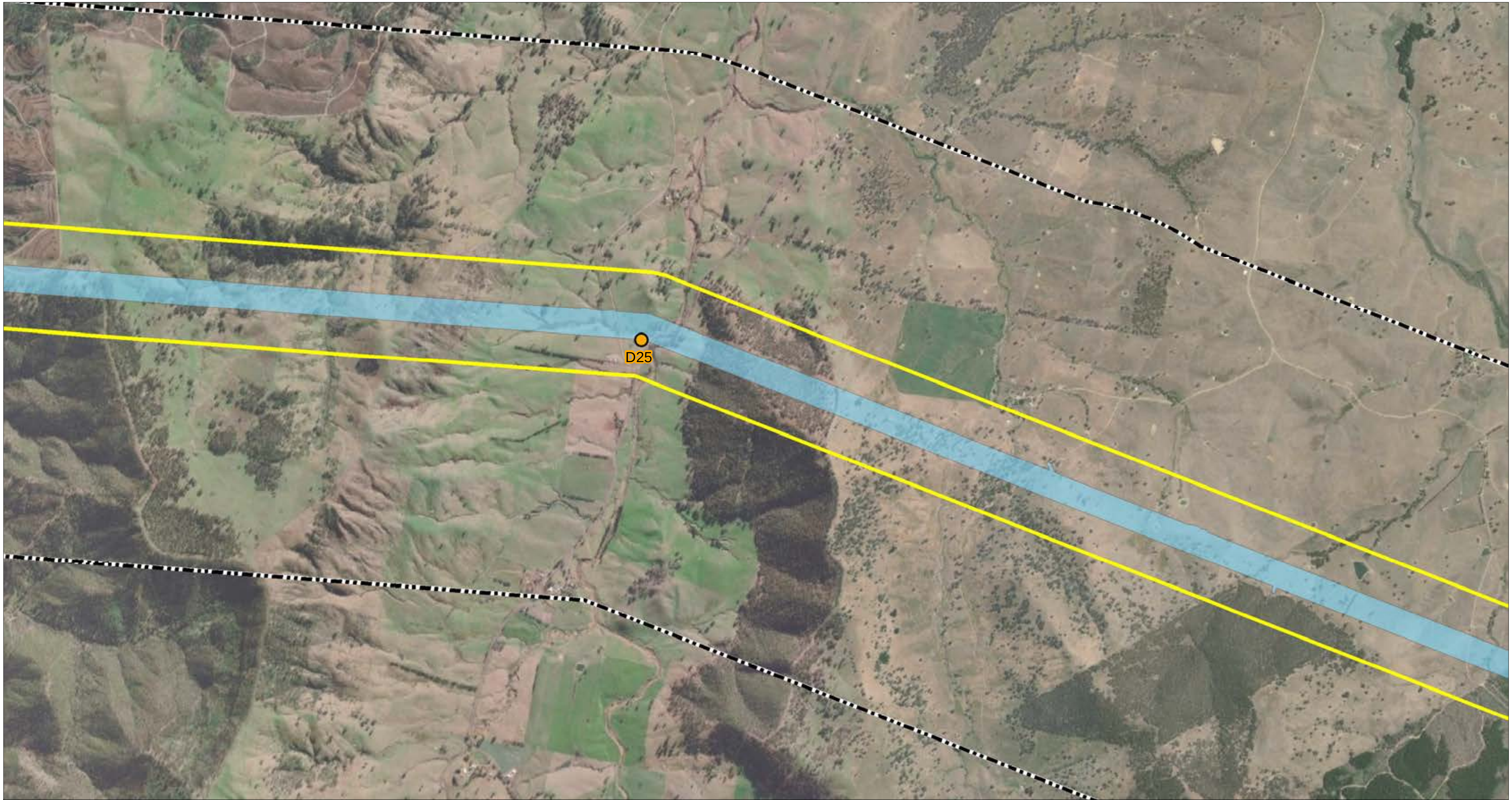

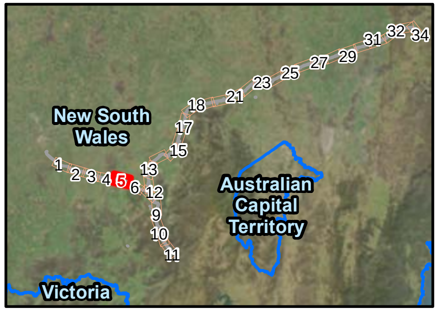

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City
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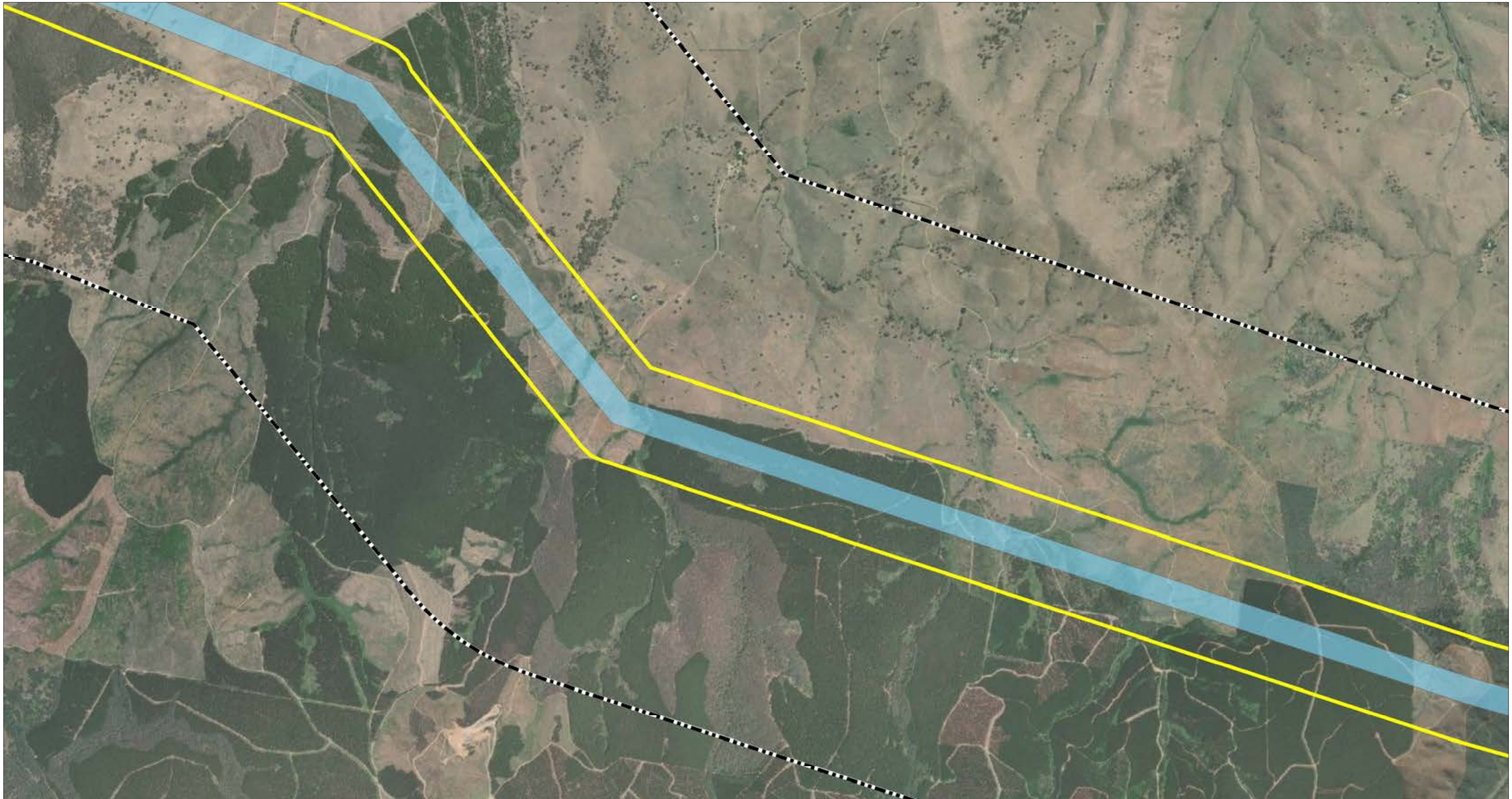

0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
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City
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Project components

Substation
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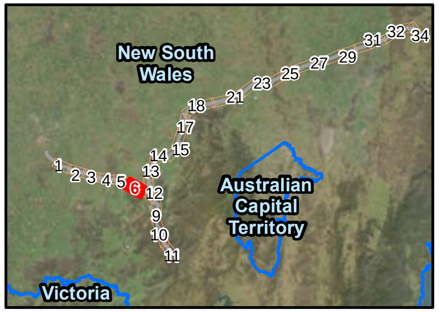
Telecommunications hut



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WORST-CASE NIGHT-TIME
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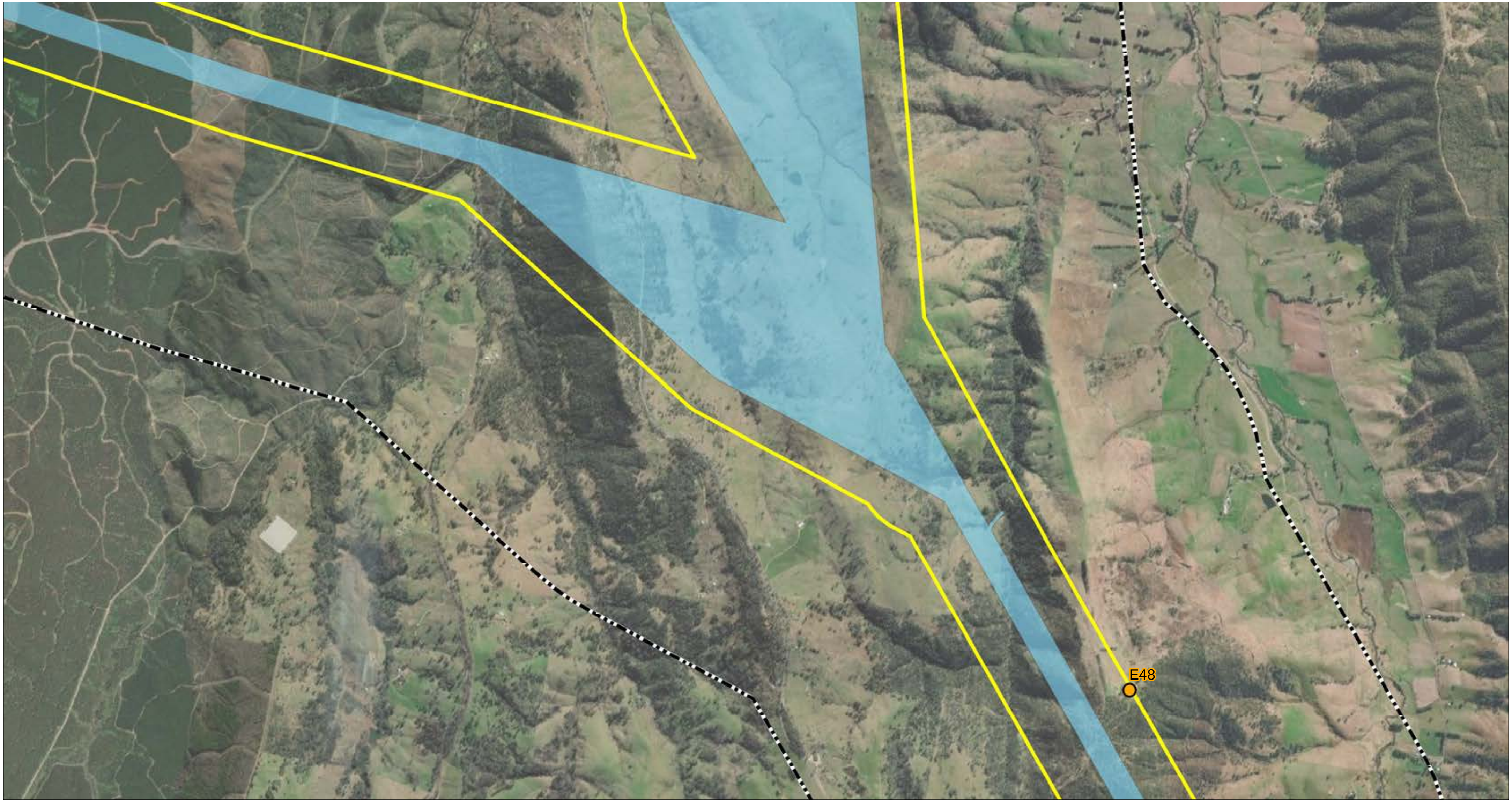
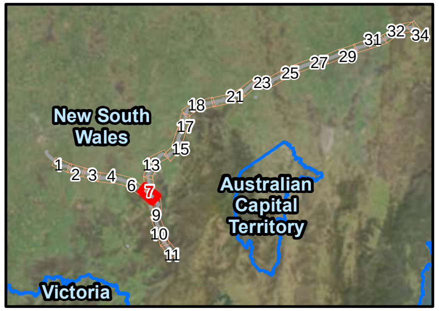
\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Cumulative Transmission Line Operational Noise Impacts.mxd





0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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NOISE AND VIBRATION IMPACT ASSESSMENT

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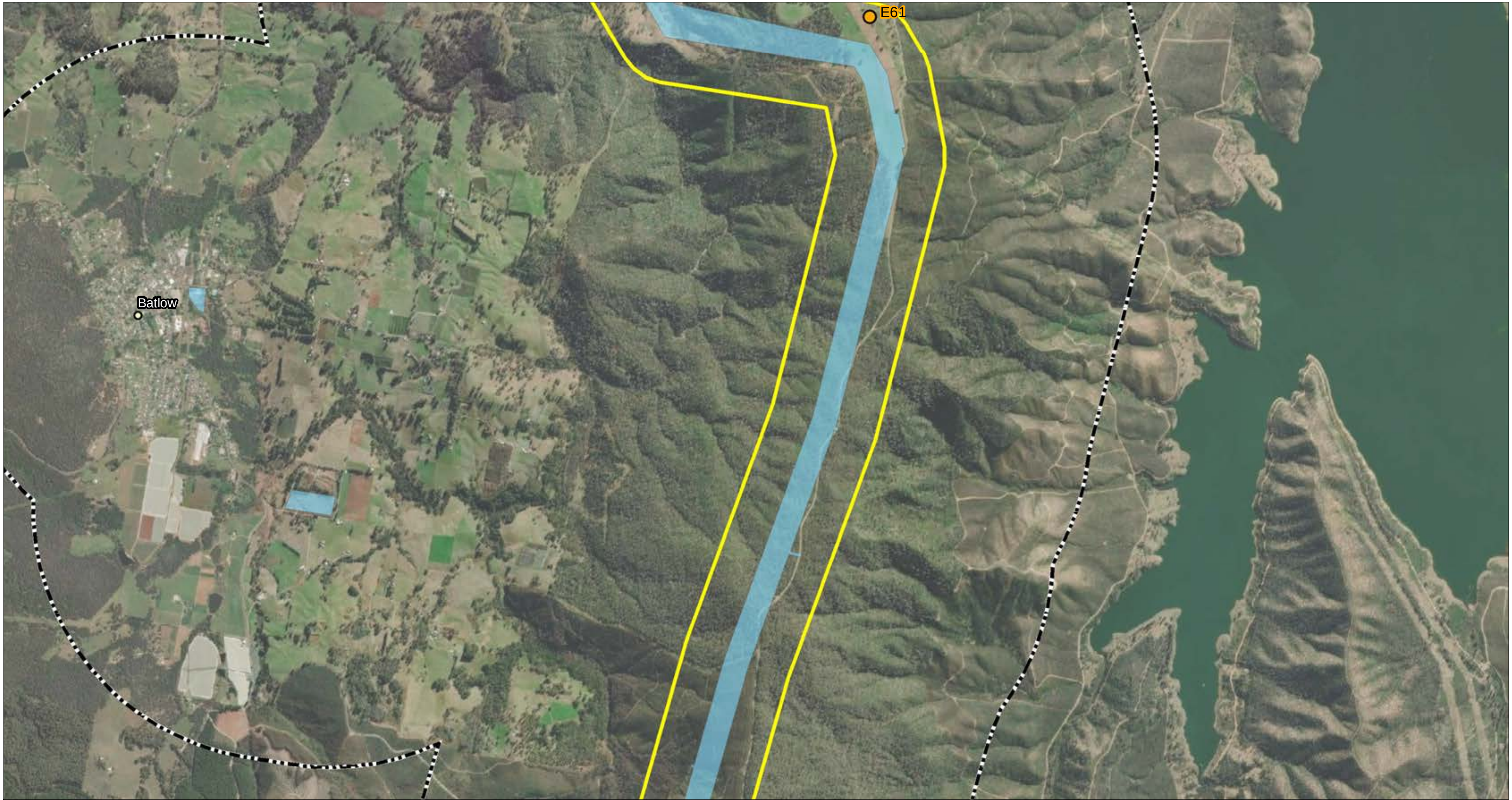
\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Cumulative Transmission Line Operational Noise Impacts.mxd



0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:42,000 at A4
Project Number:	610.30622
Date:	15-Mar-2023
Drawn by:	AN

City
Study area
Potentially impacted receivers
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Project components

Substation
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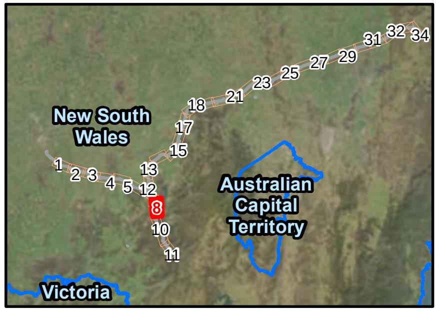
Telecommunications hut



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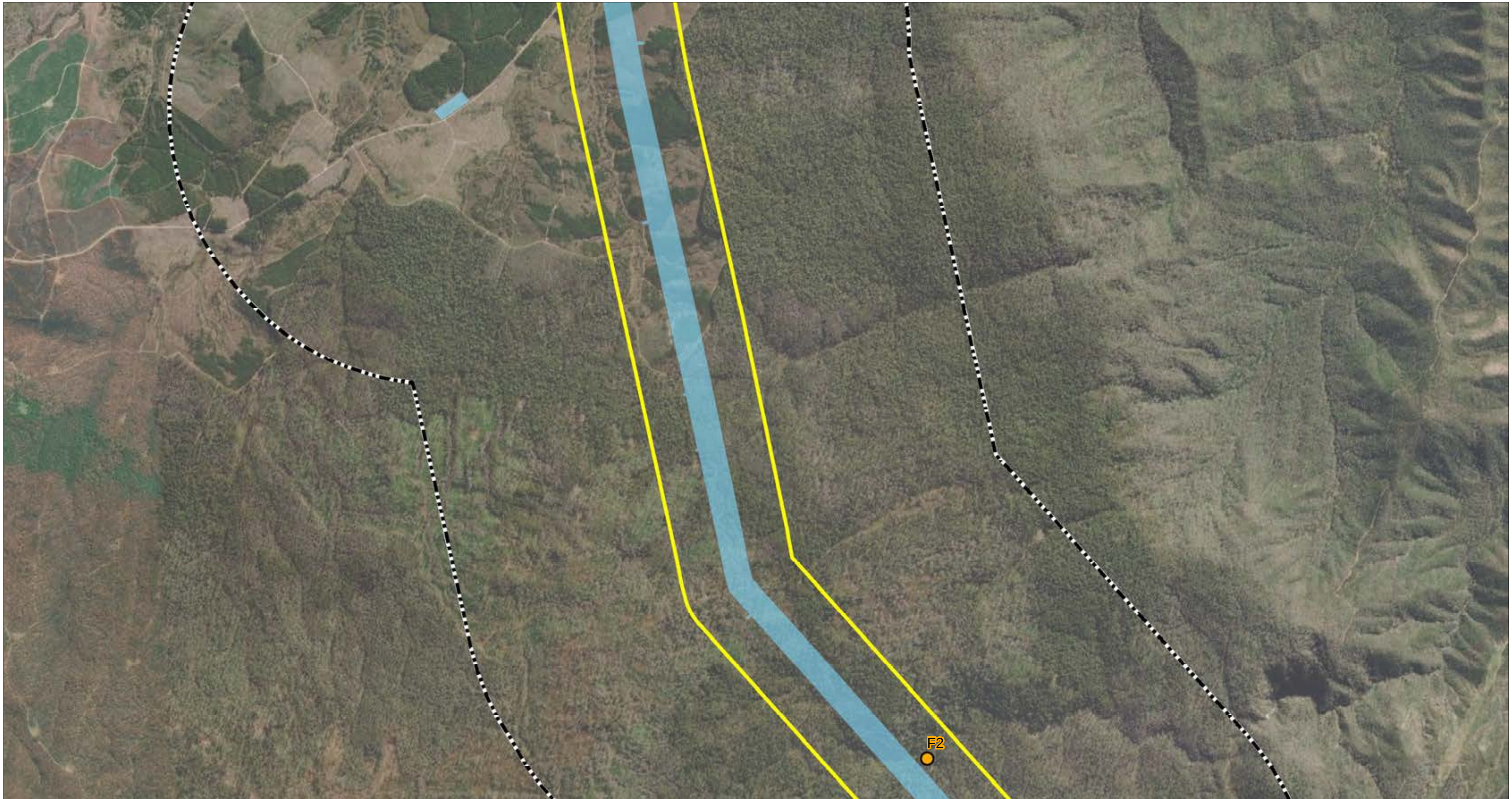

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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Date:	15-Mar-2023
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City
Study area
Potentially impacted receivers
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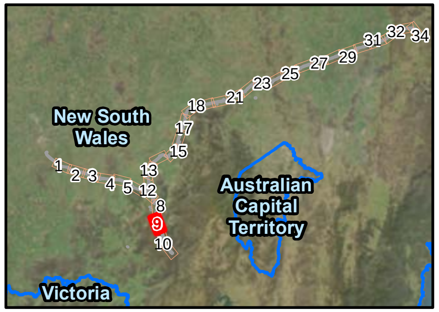

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WORST-CASE NIGHT-TIME CUMULATIVE TRANSMISSION LINE OPERATIONAL NOISE IMPACTS PAGE 9 OF 34

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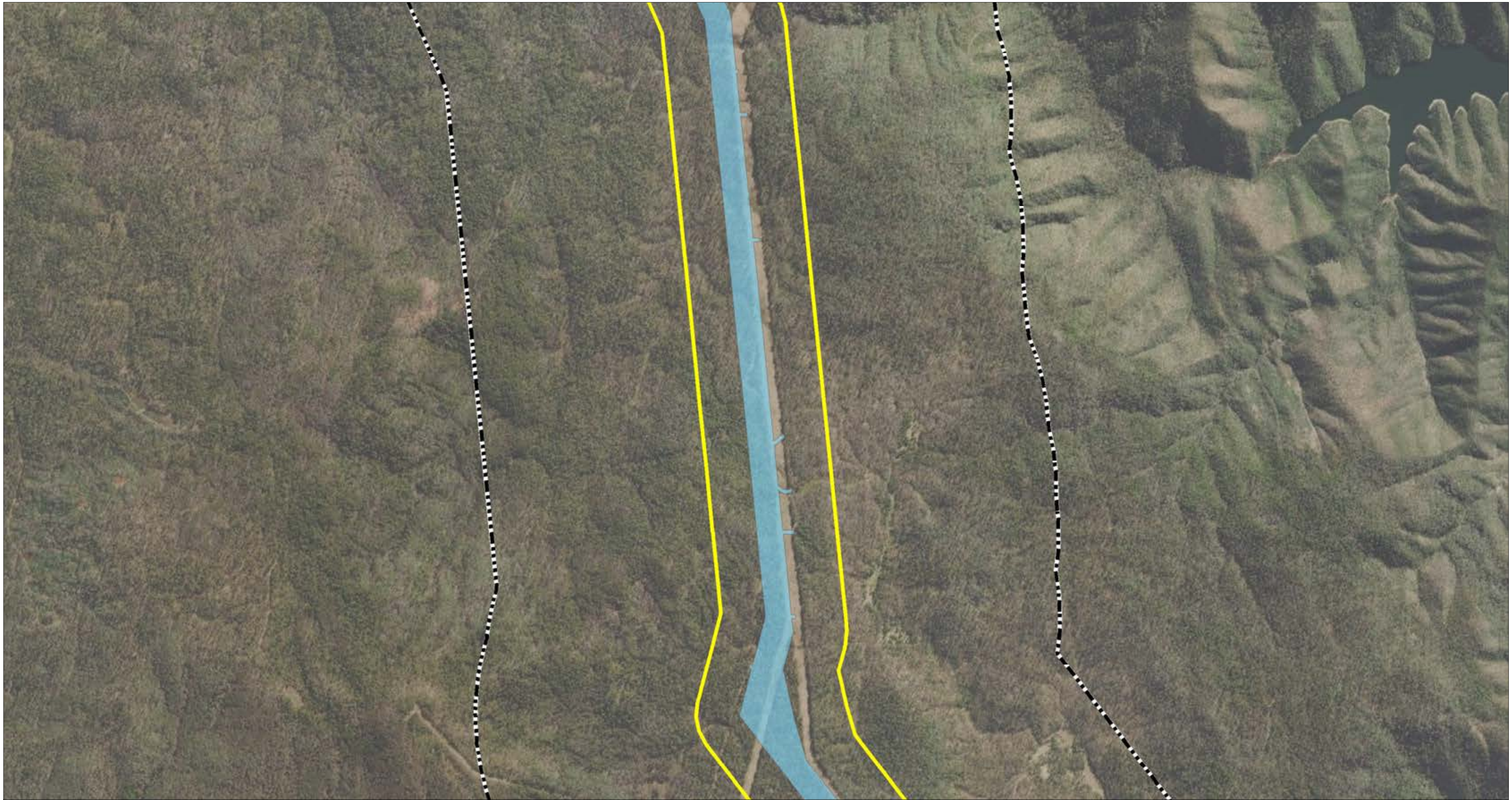

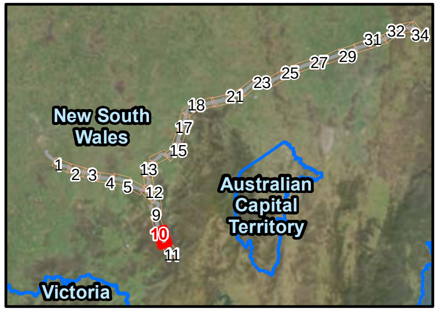

0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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City
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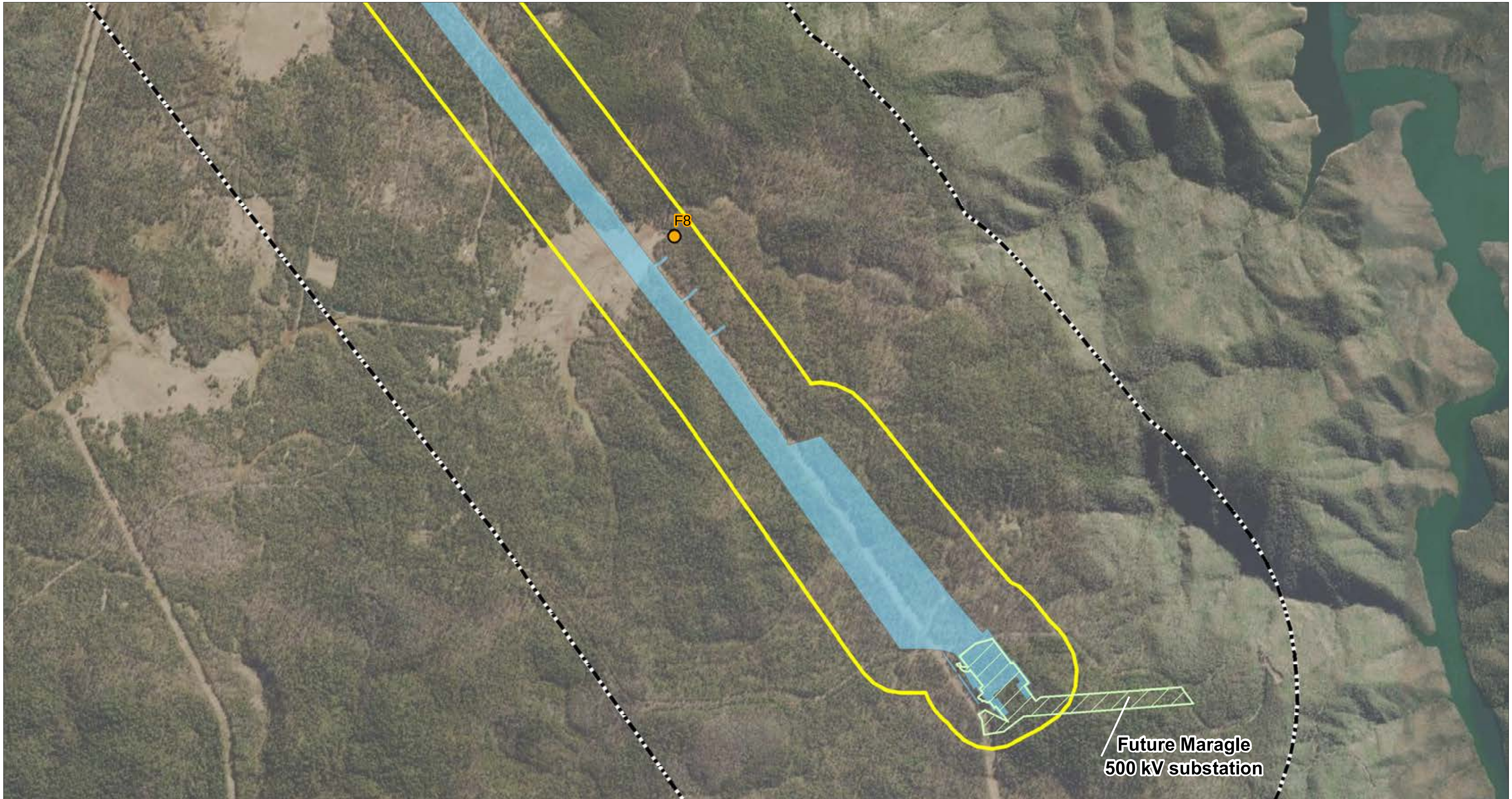

0 250 500 1,000
Metres

Coordinate System: GDA 1994 MGA Zone 55
Scale: 1:40,000 at A4
Project Number: 610.30622
Date: 15-Mar-2023
Drawn by: AN

SLR

City
Study area
Potentially impacted receivers
Transmission line noise impact zone

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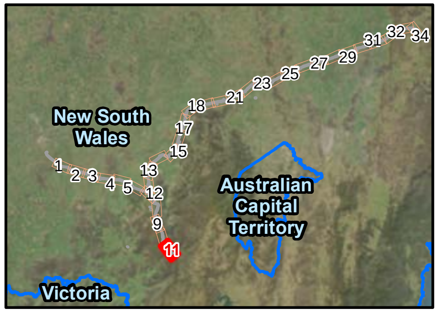
Substation
Project footprint
Telecommunications hut



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WORST-CASE NIGHT-TIME
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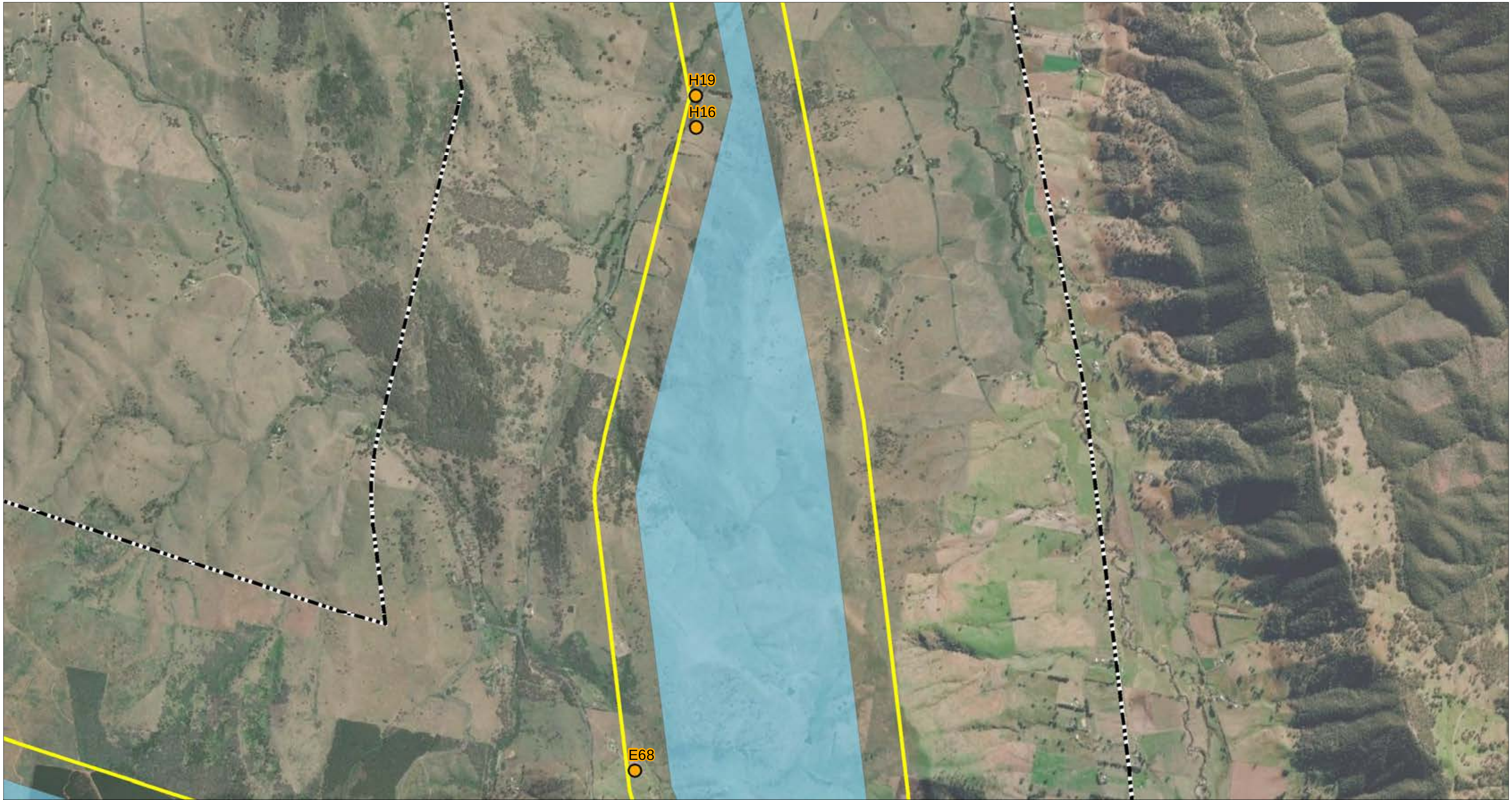
\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Cumulative Transmission Line Operational Noise Impacts.mxd



0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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City
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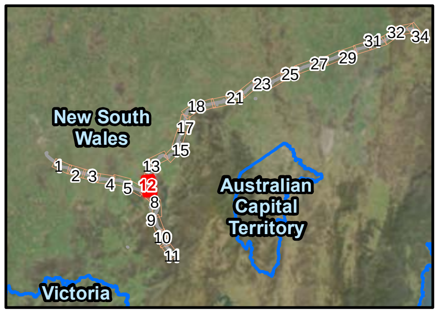
Telecommunications hut



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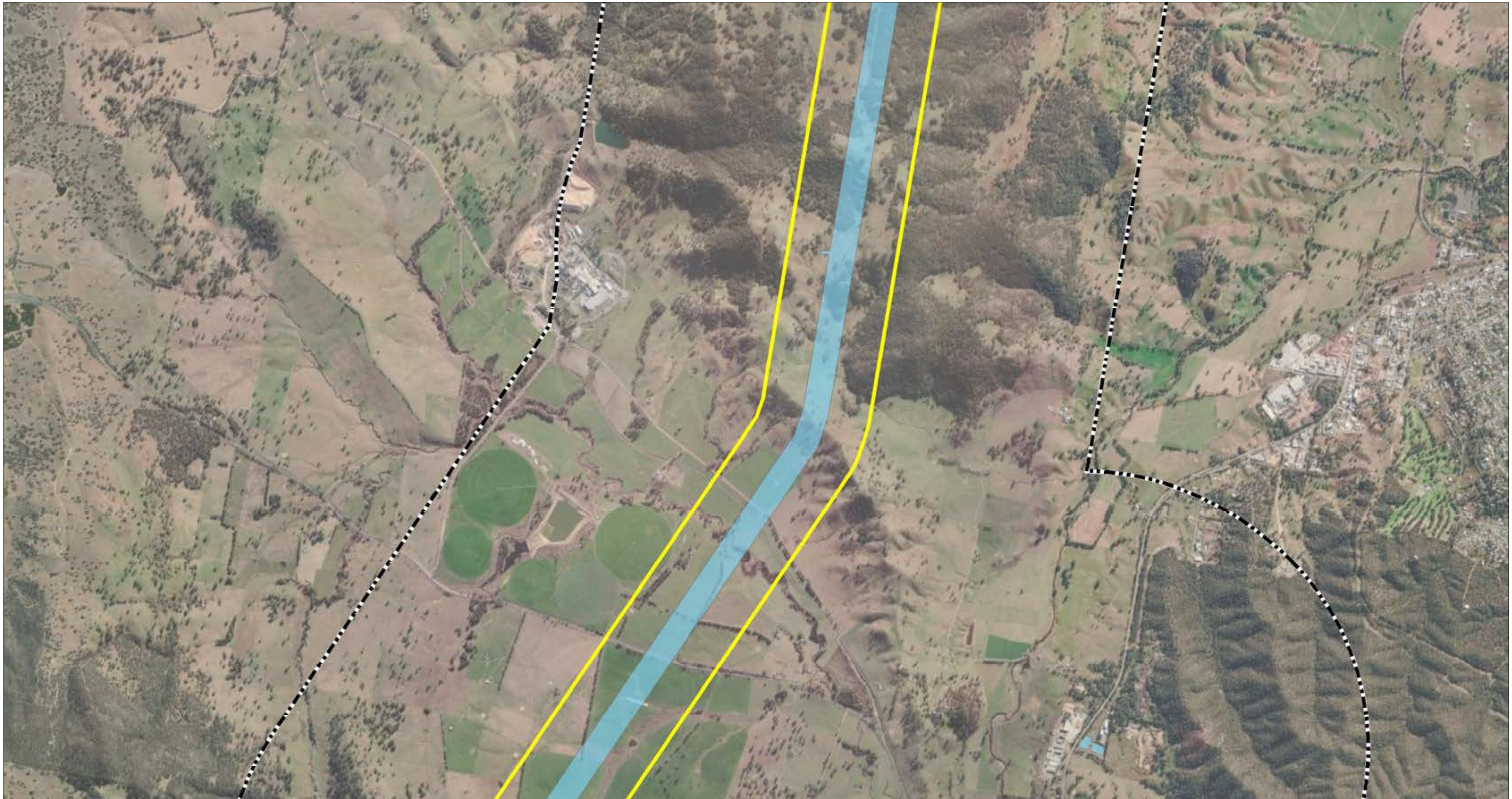

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City

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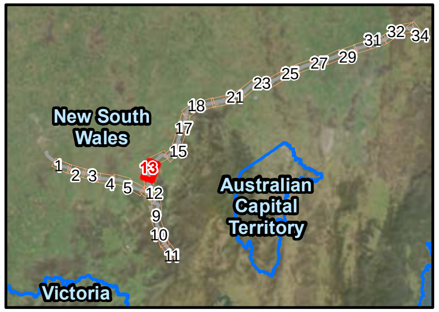
Telecommunications hut



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NOISE AND VIBRATION IMPACT ASSESSMENT

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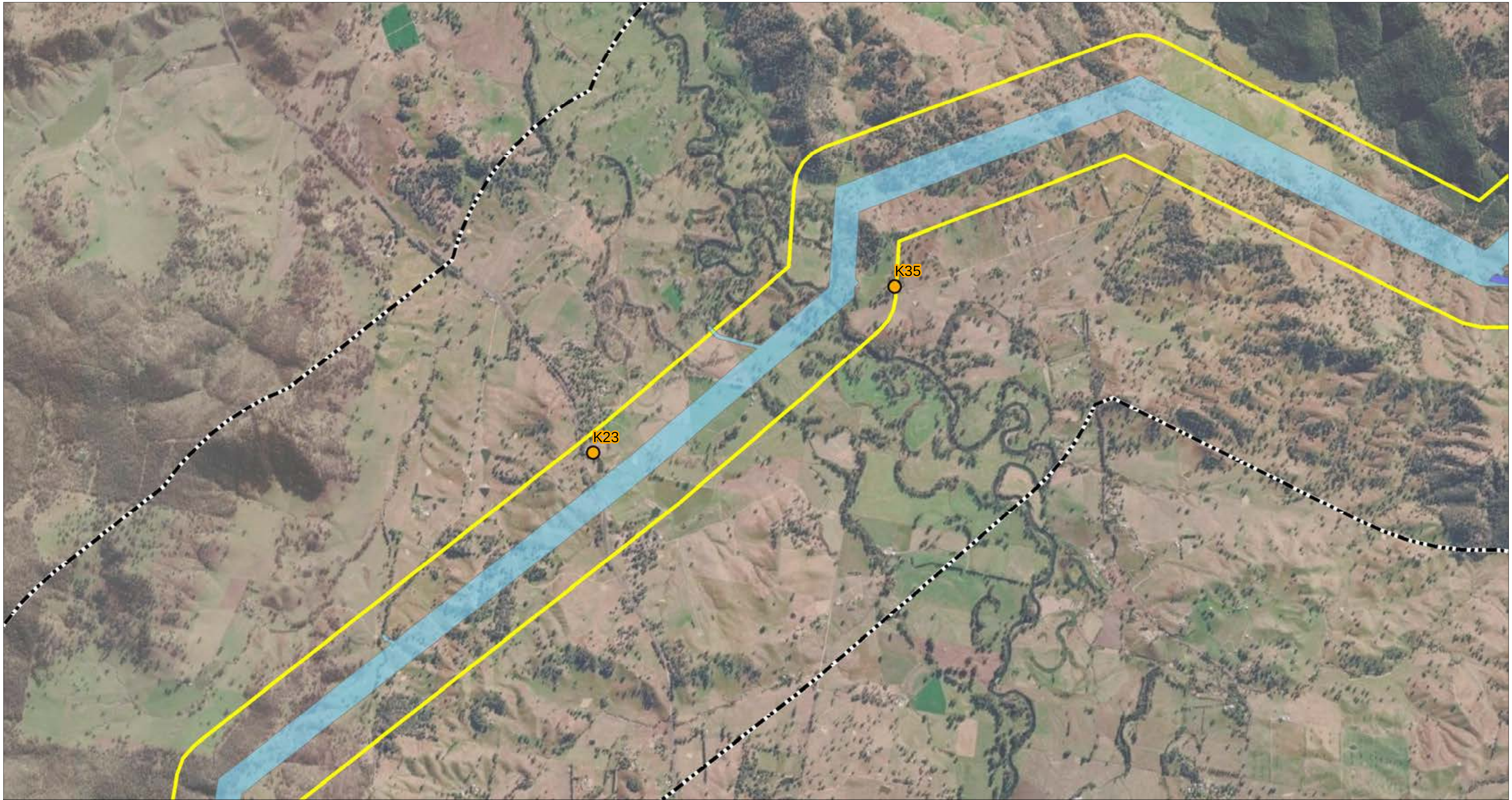

0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
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City
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Project components
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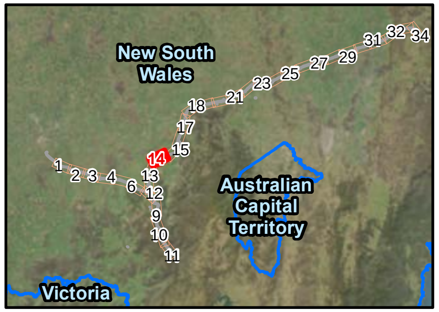

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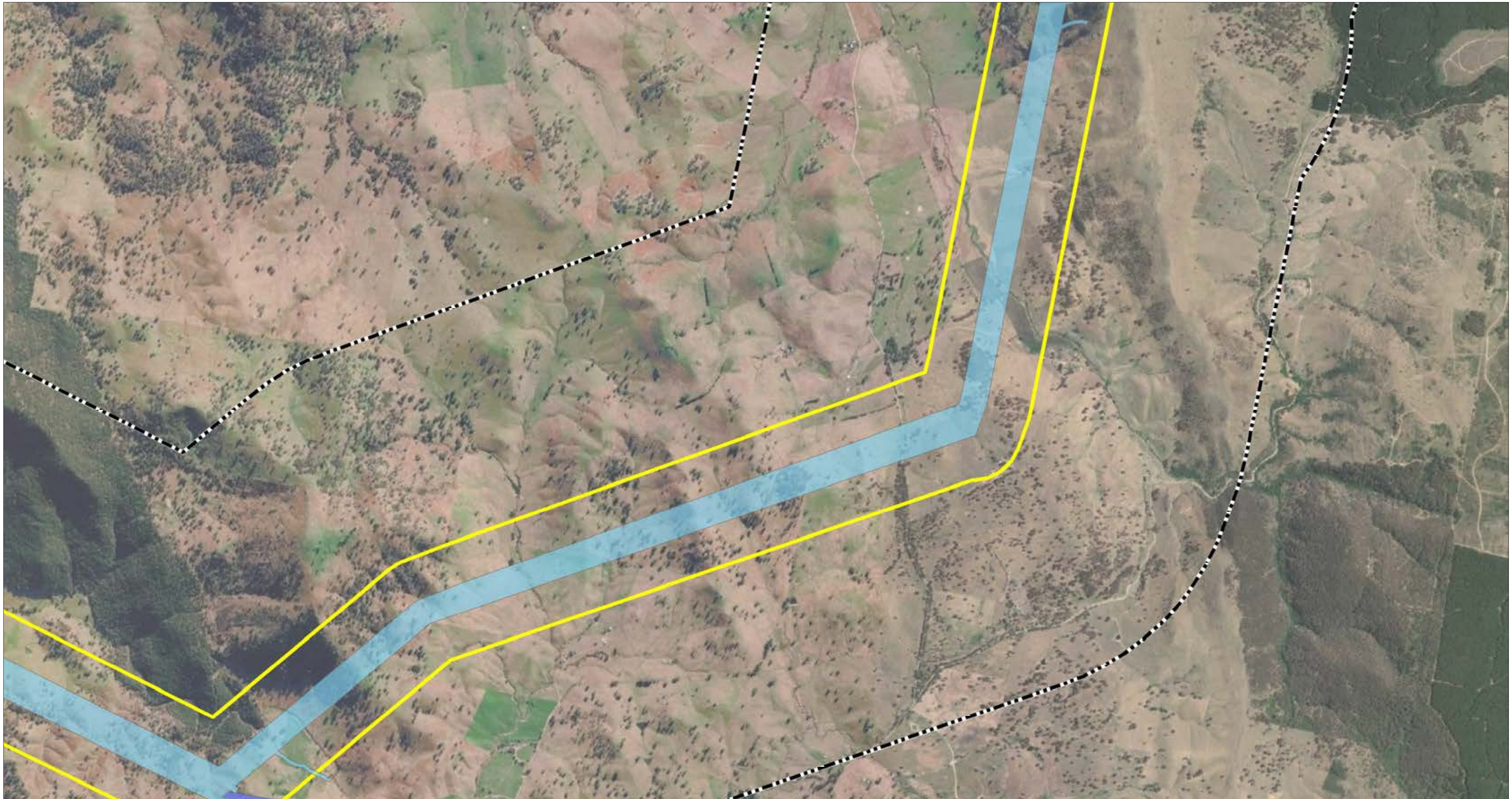

0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
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SLR

City
Study area
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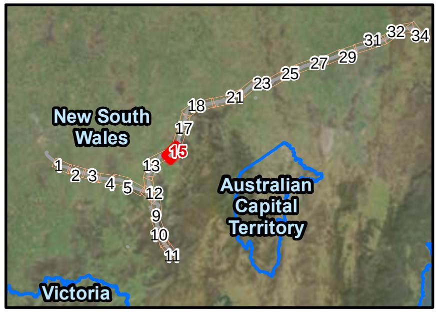

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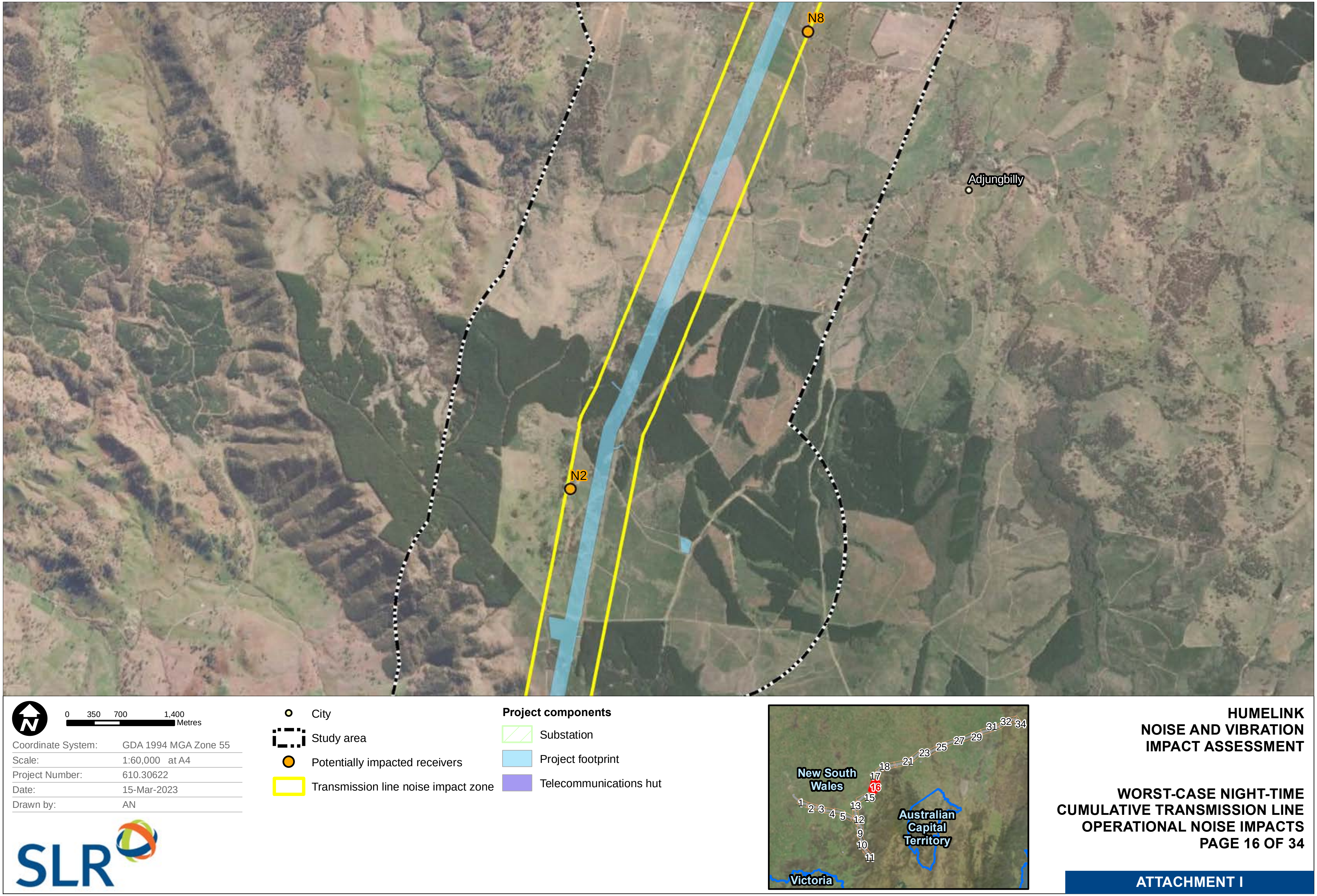

0 350 700 1,400 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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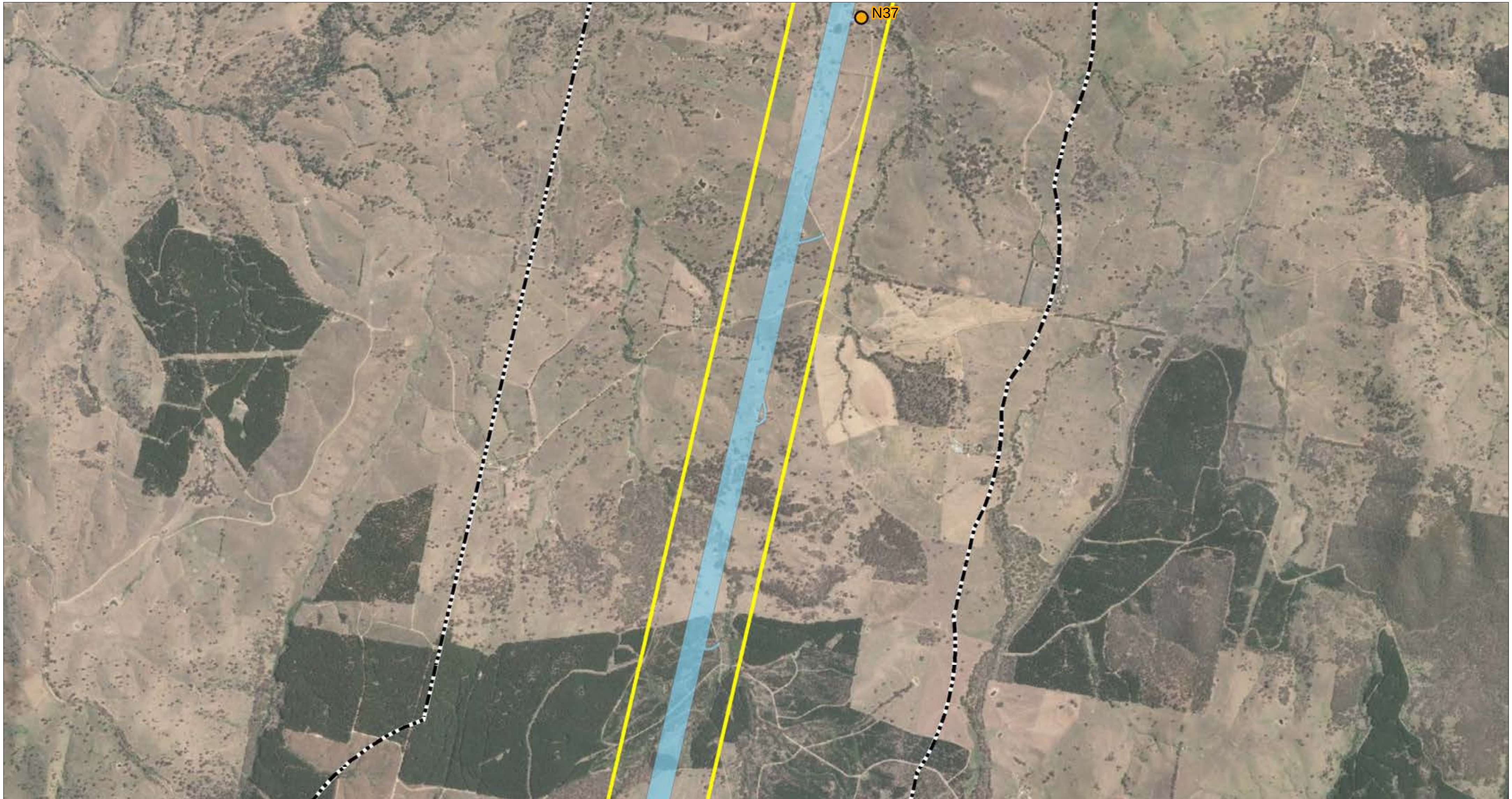
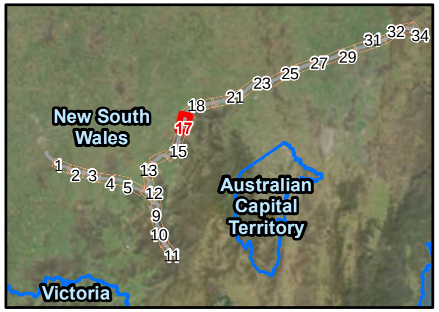
\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30622.00000 HumeLink EIS AV AQ\06 SLR Data\01 CADGIS\GIS\61030622 AV Fig Worst-case Cumulative Transmission Line Operational Noise Impacts.mxd





0 250 500 1,000 Metres

Coordinate System:	GDA 1994 MGA Zone 55
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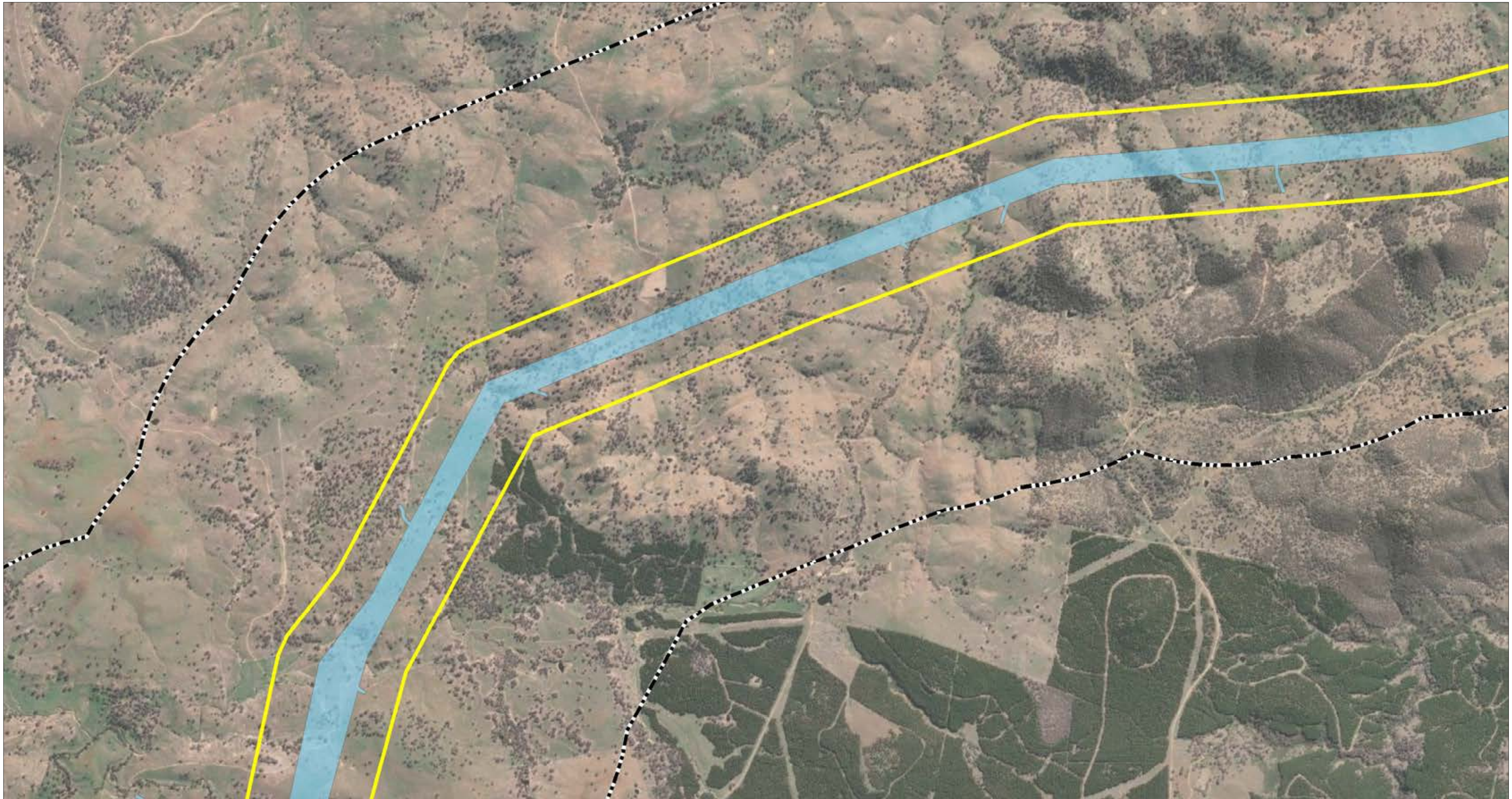

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Coordinate System:	GDA 1994 MGA Zone 55
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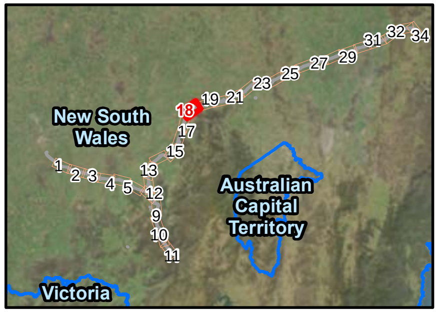

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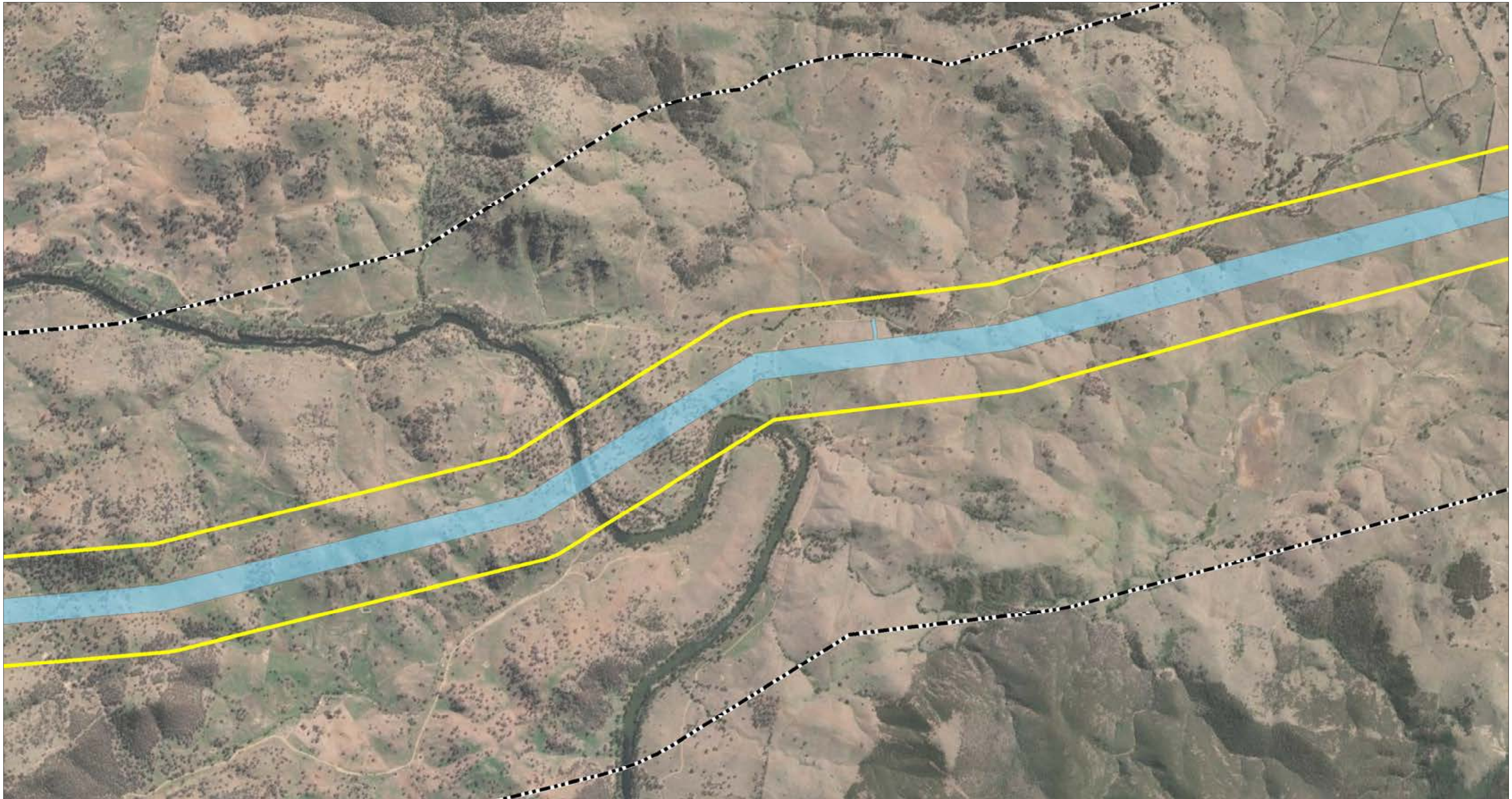

0 250 500 1,000
Metres

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	610.30622
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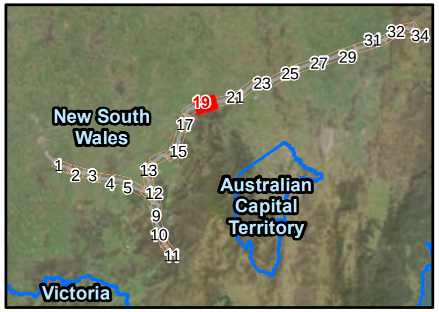
Drawn by:	AN

SLR

City
Study area
Potentially impacted receivers
Transmission line noise impact zone

Project components

Substation
Project footprint
Telecommunications hut



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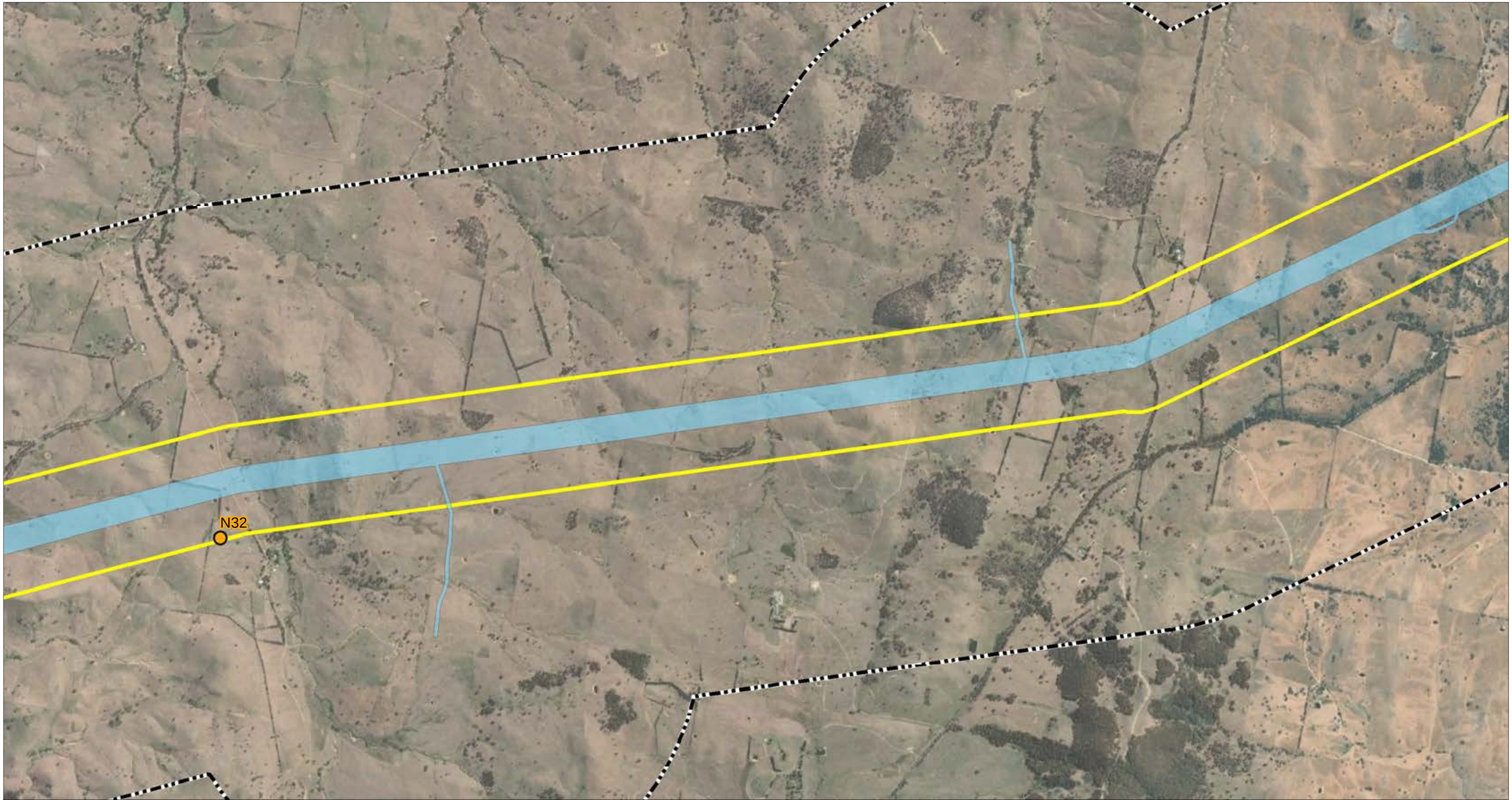

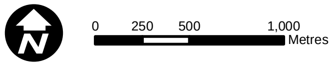

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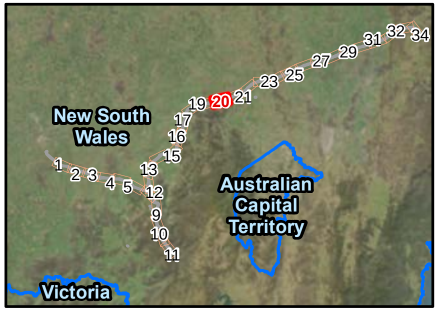

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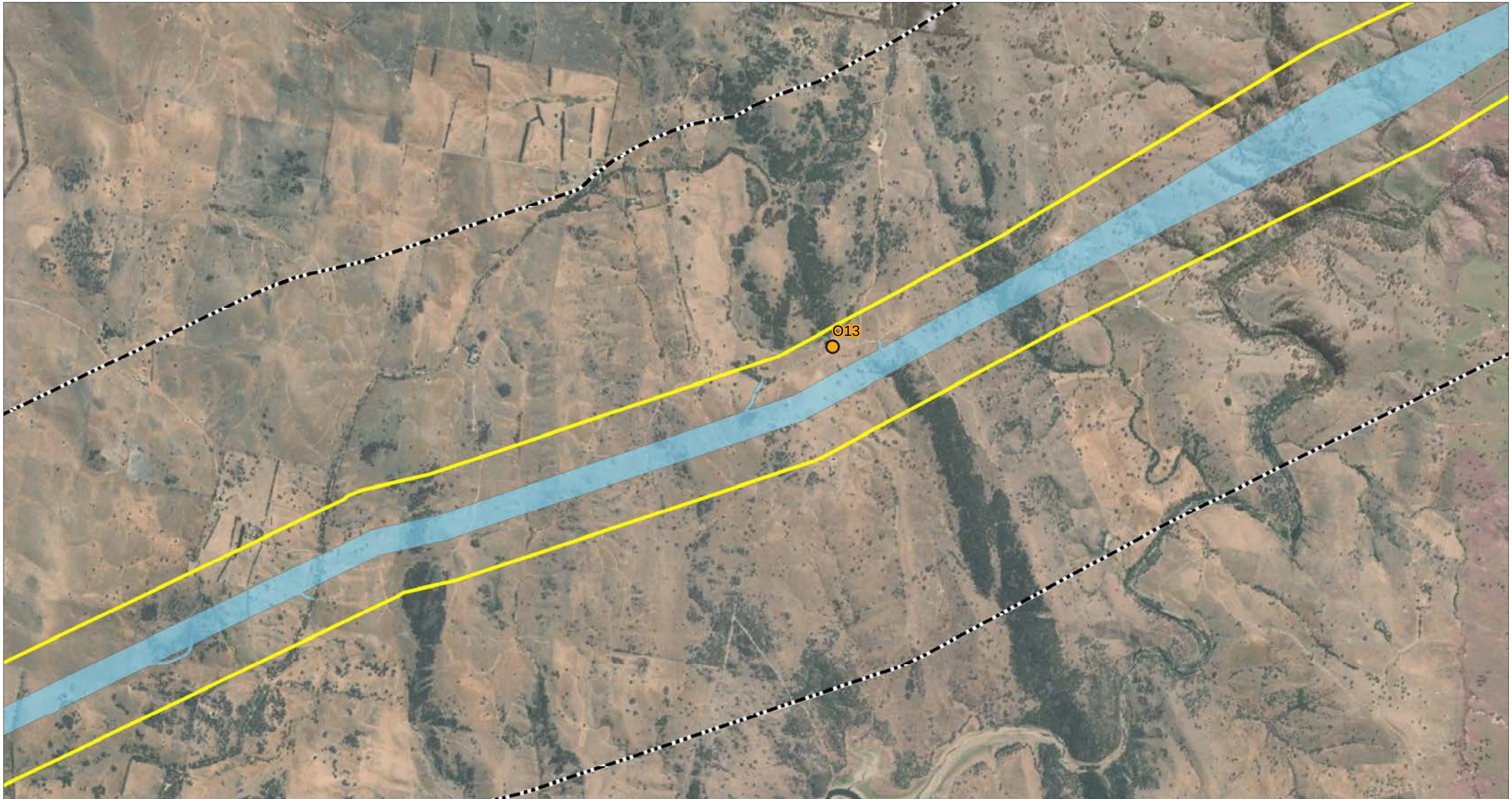

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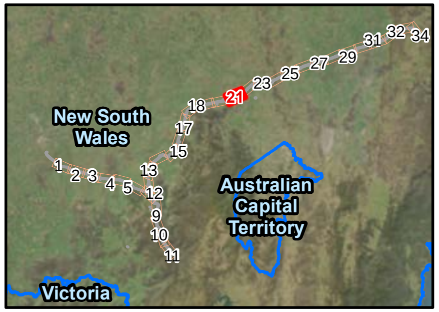

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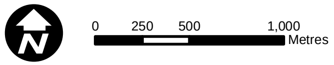

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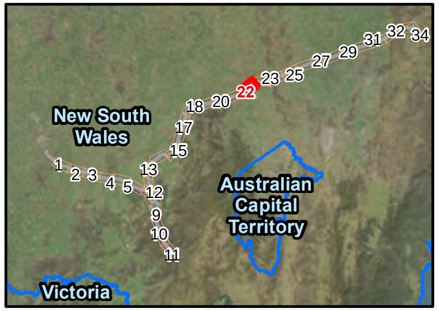

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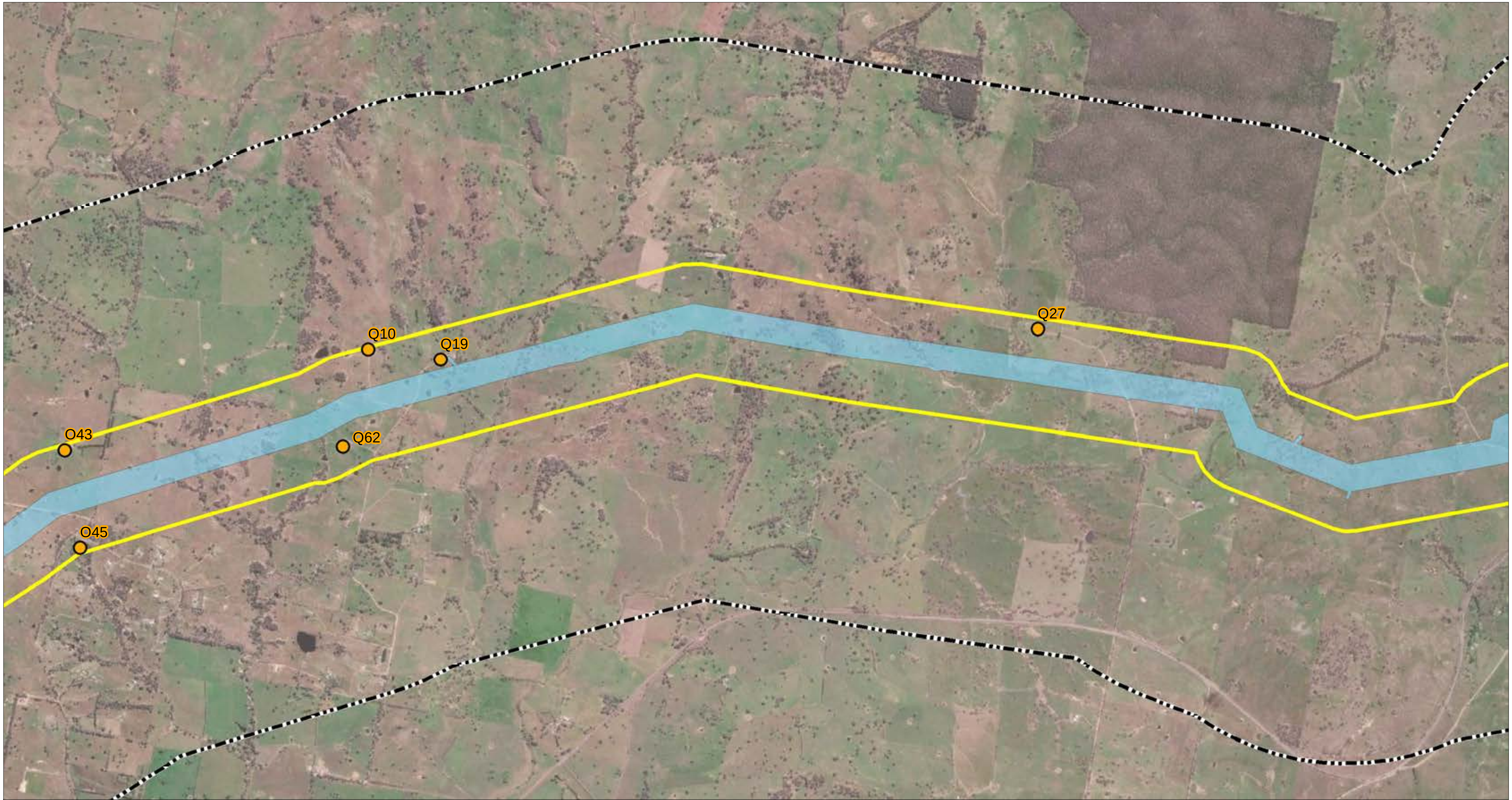

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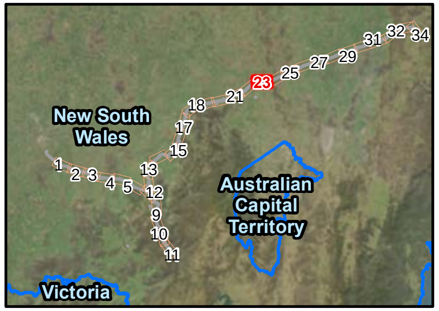

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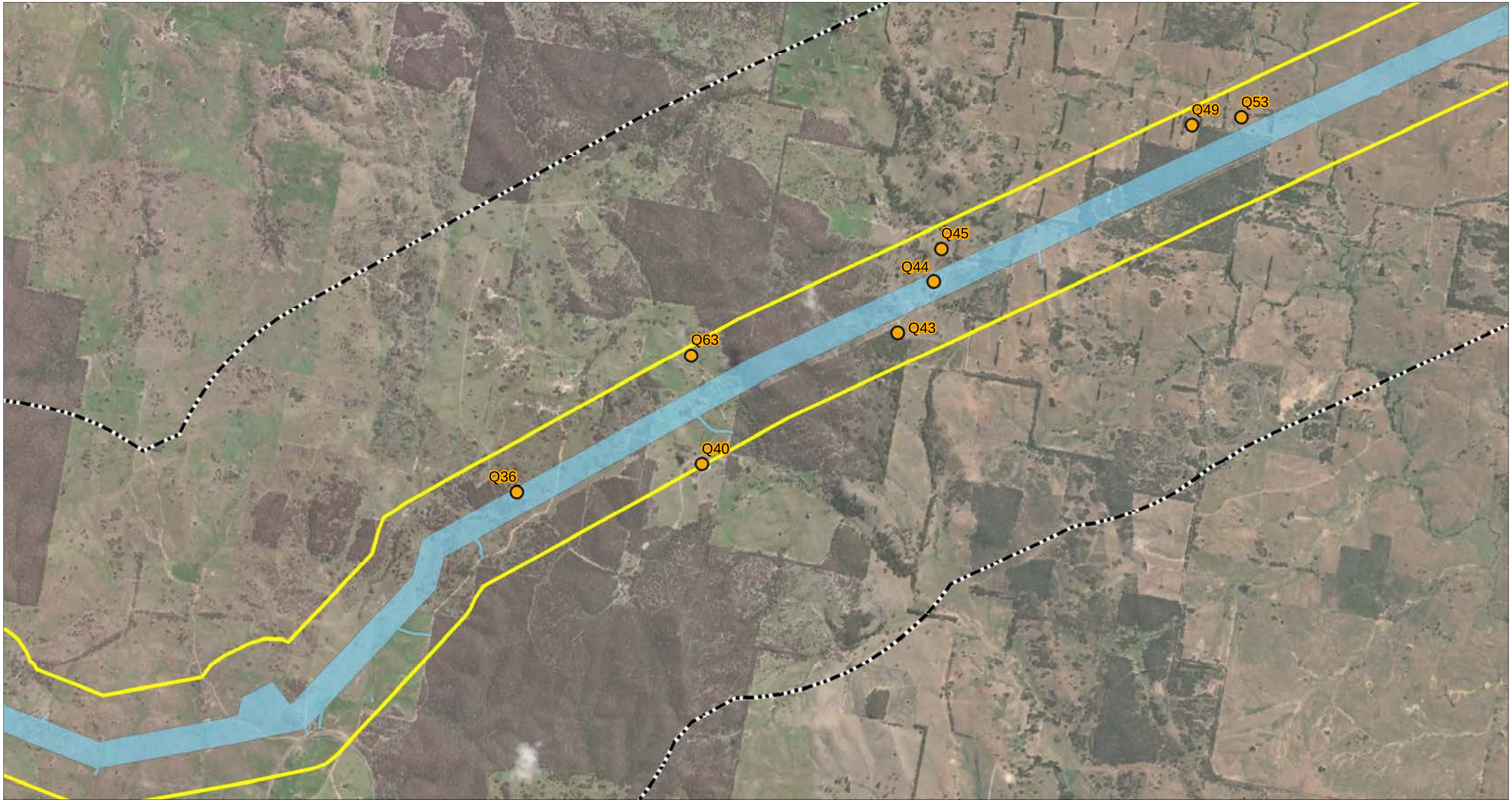

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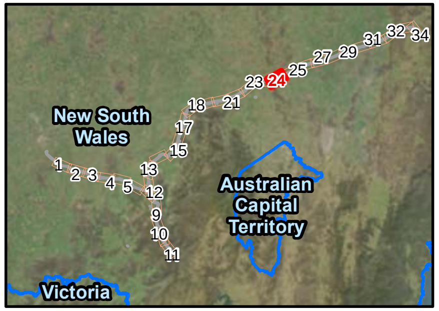

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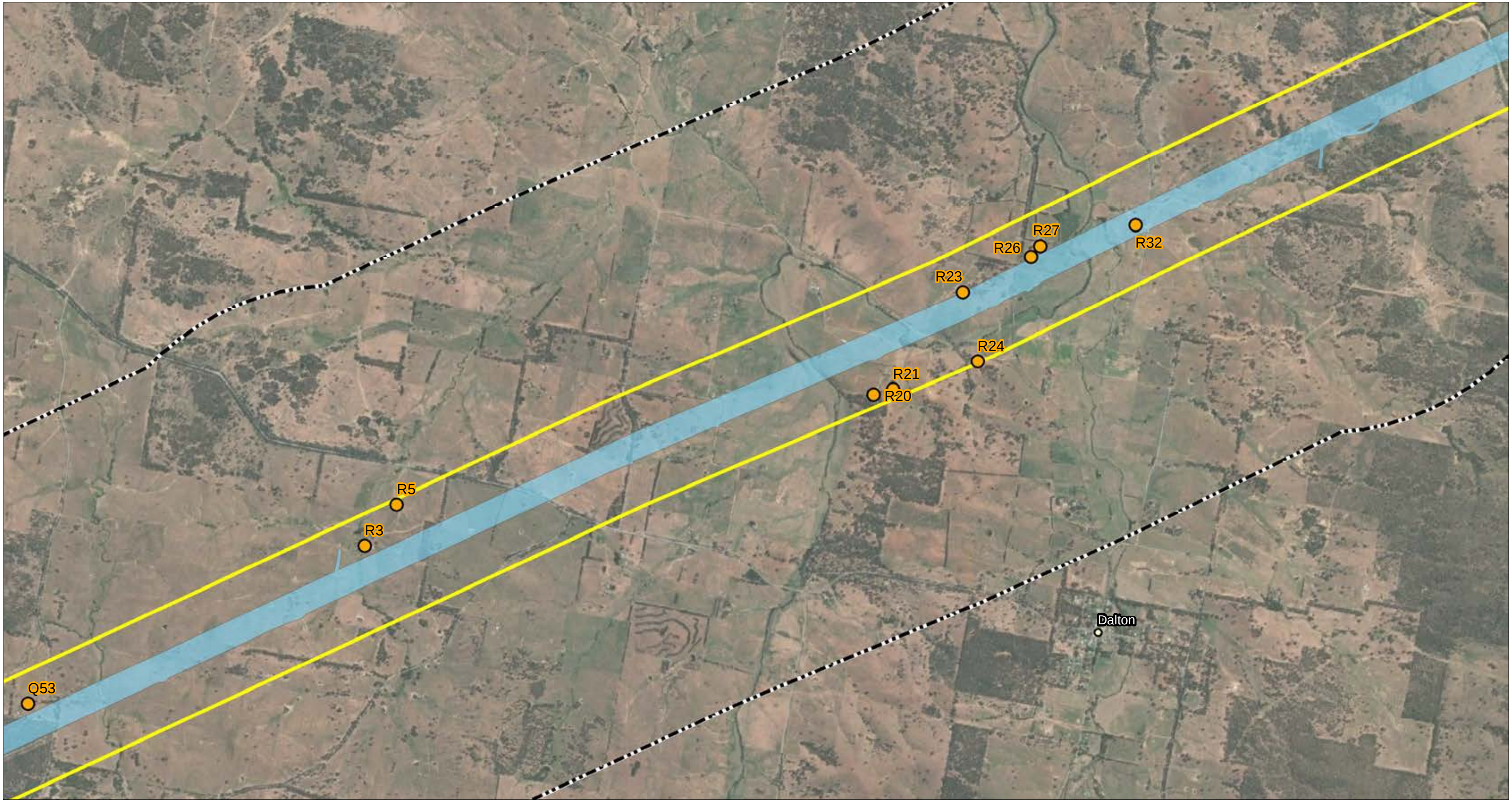

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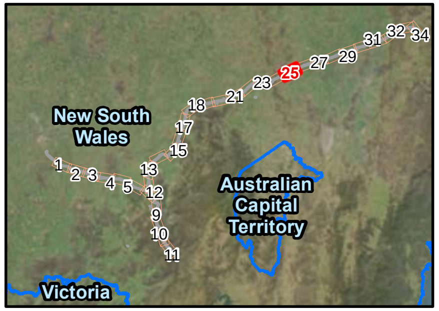

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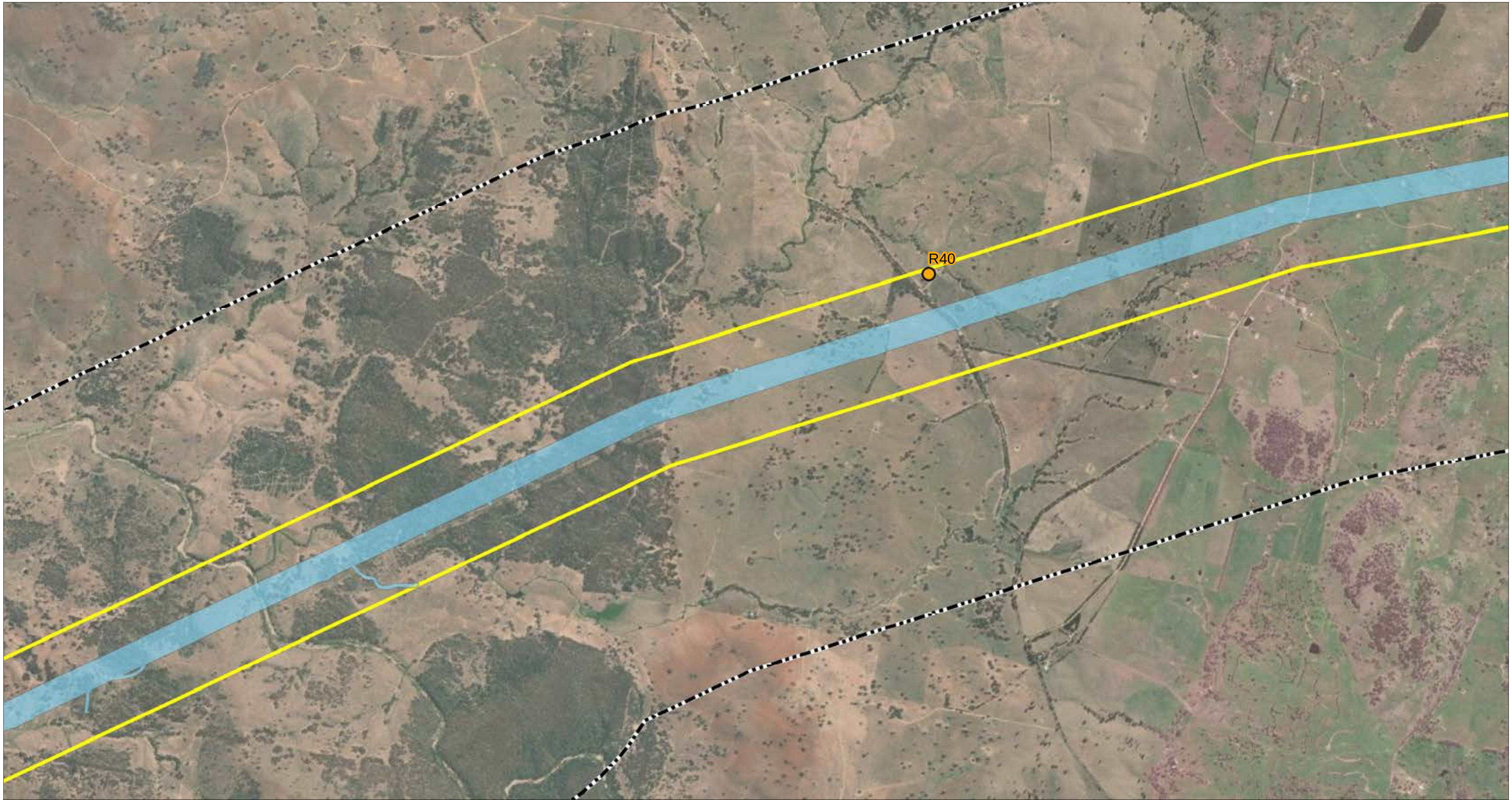

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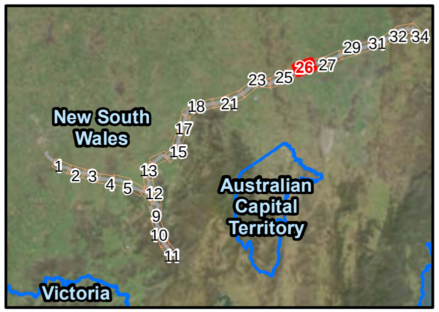

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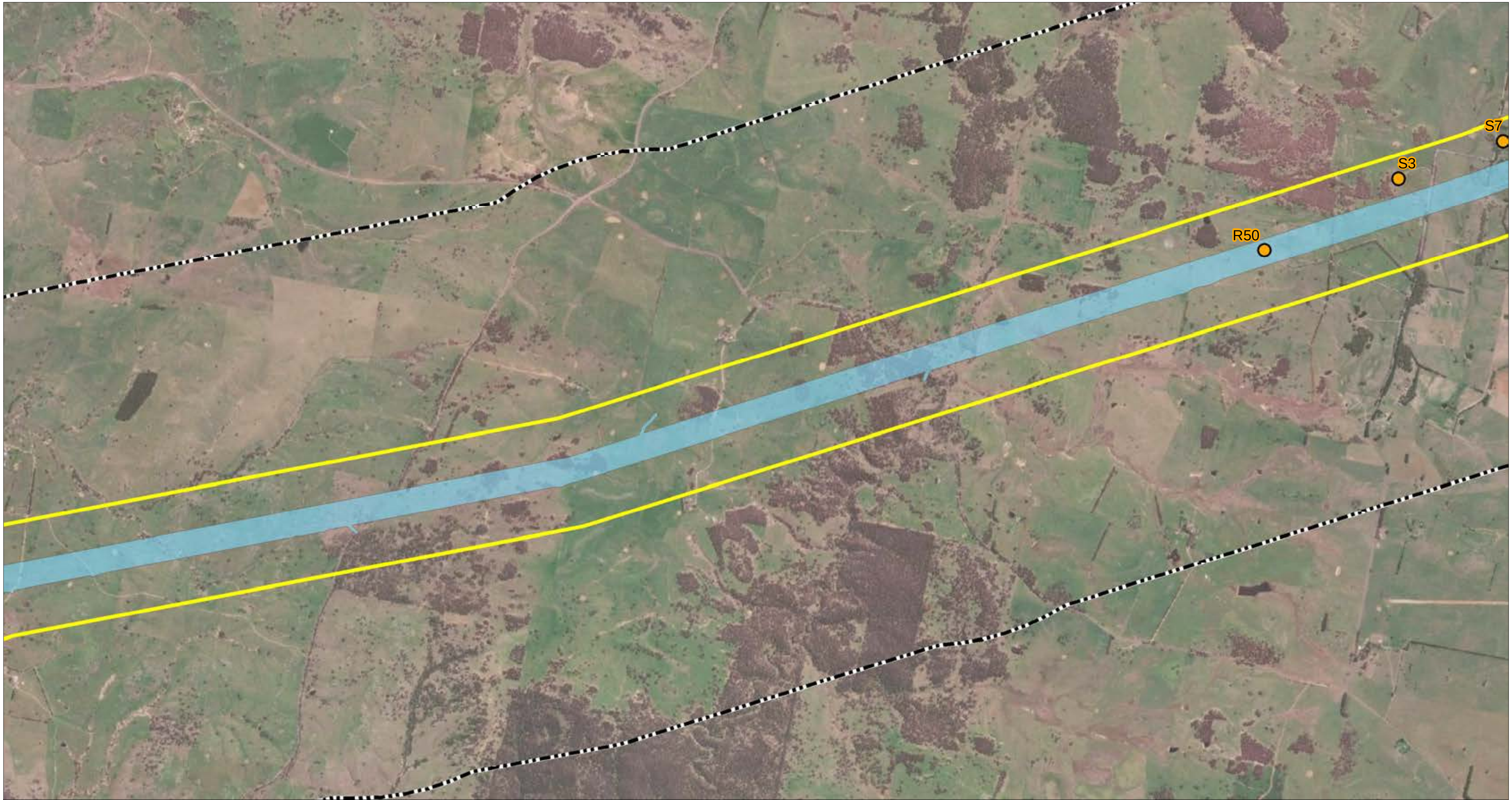

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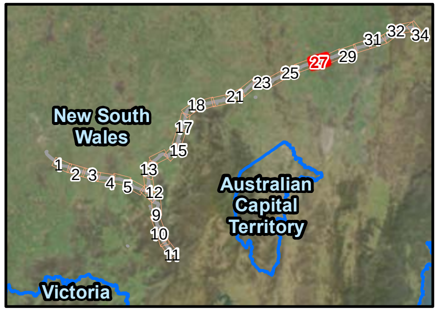

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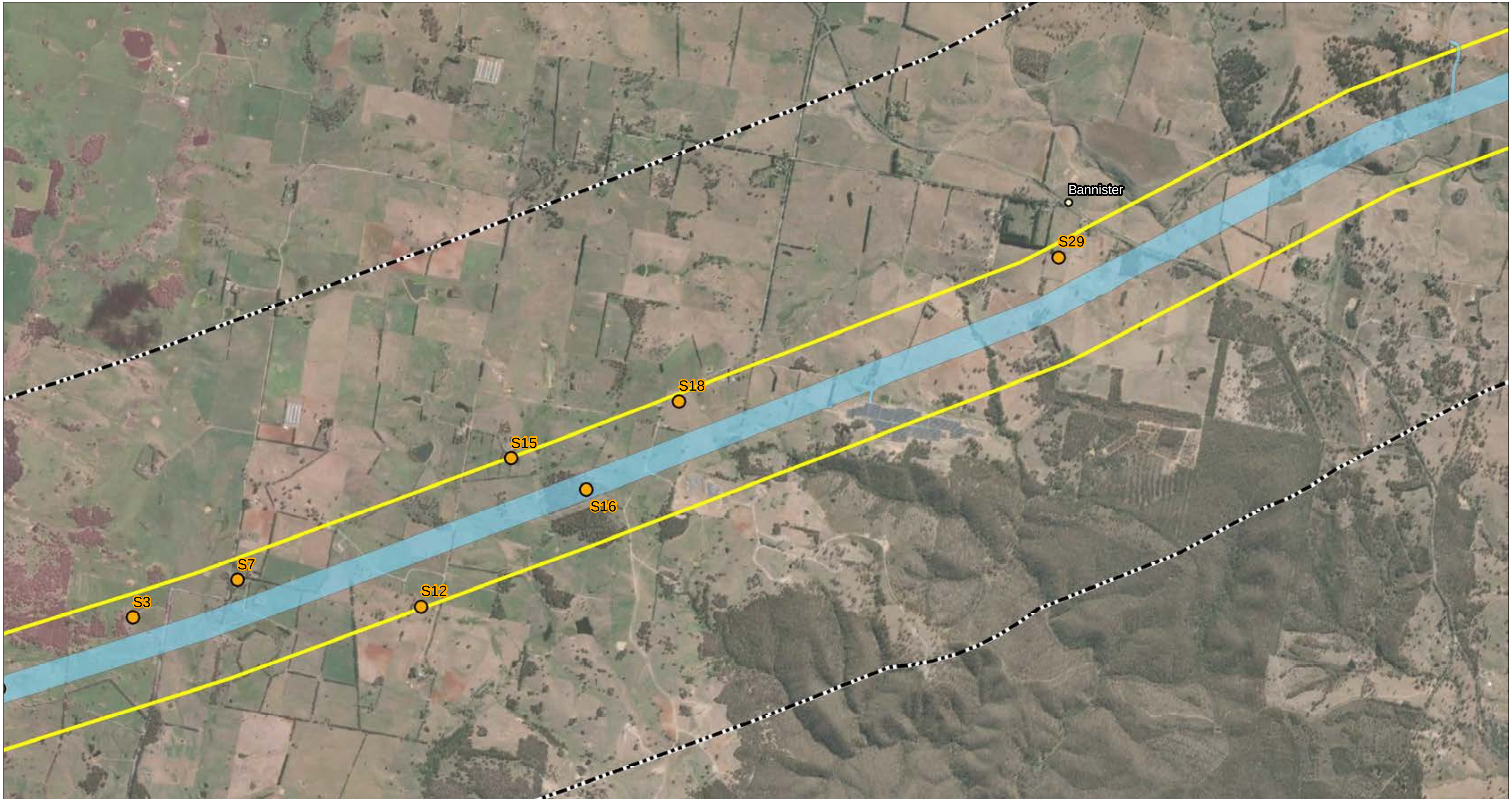

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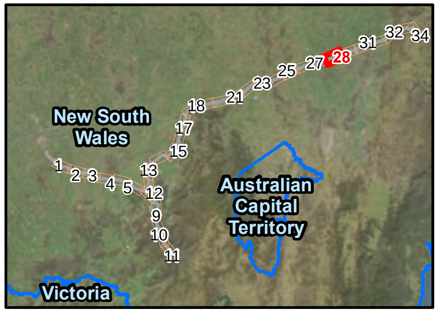

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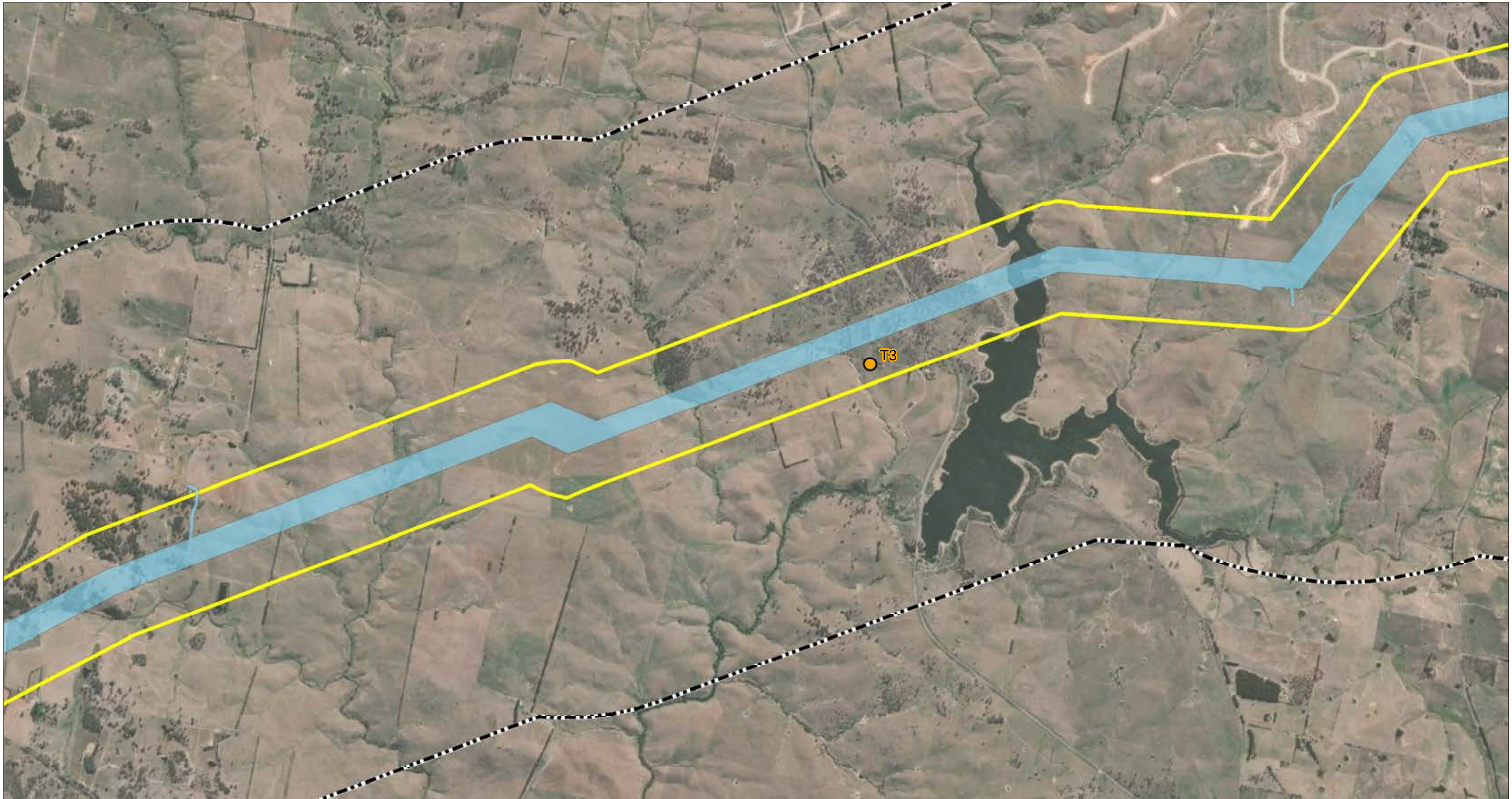

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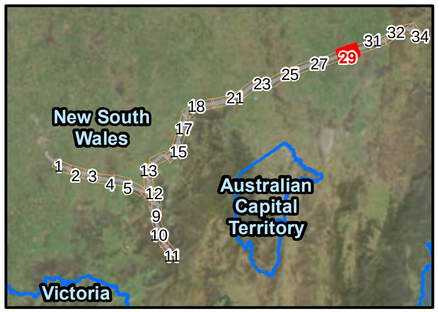

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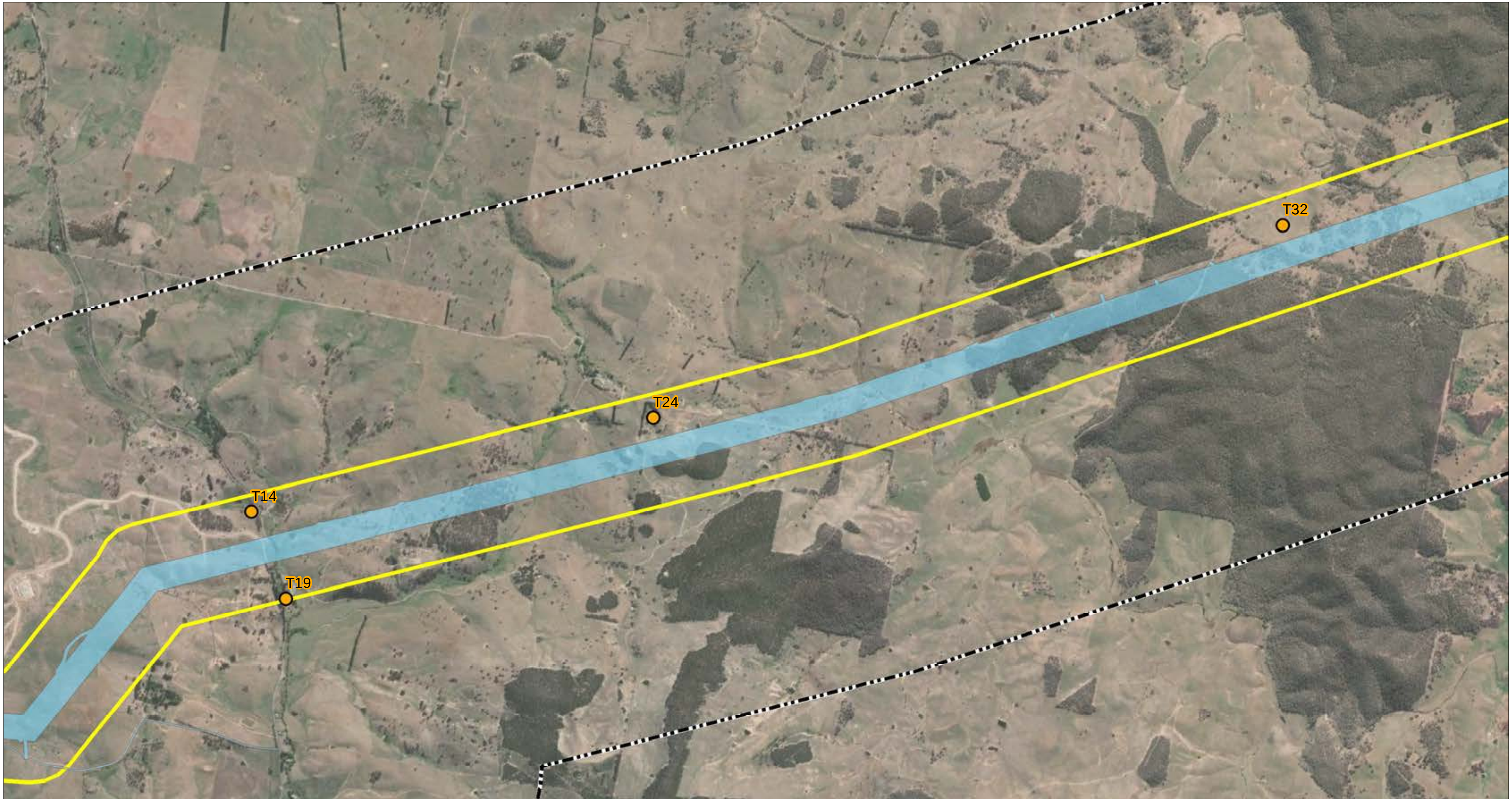

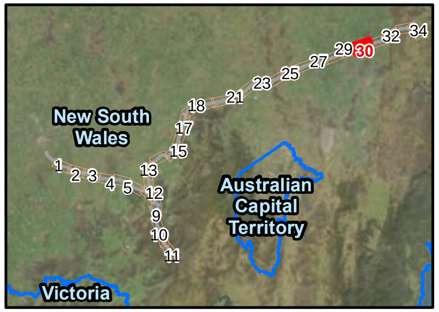

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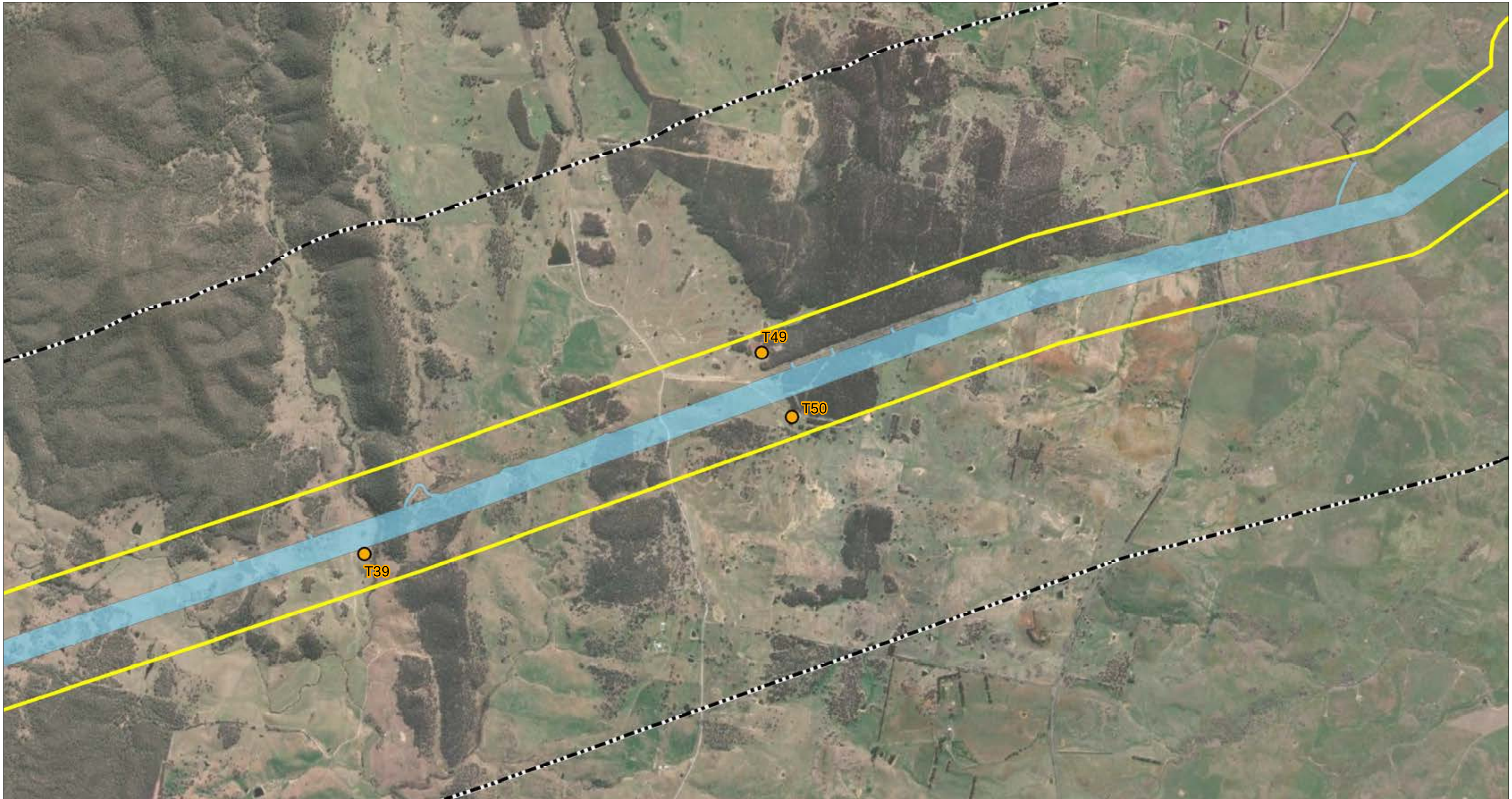

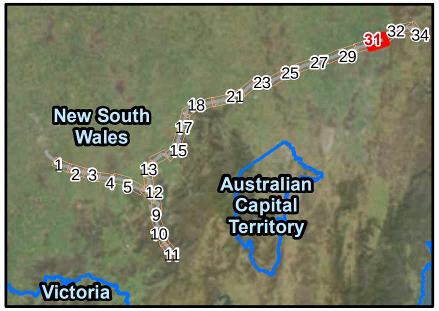

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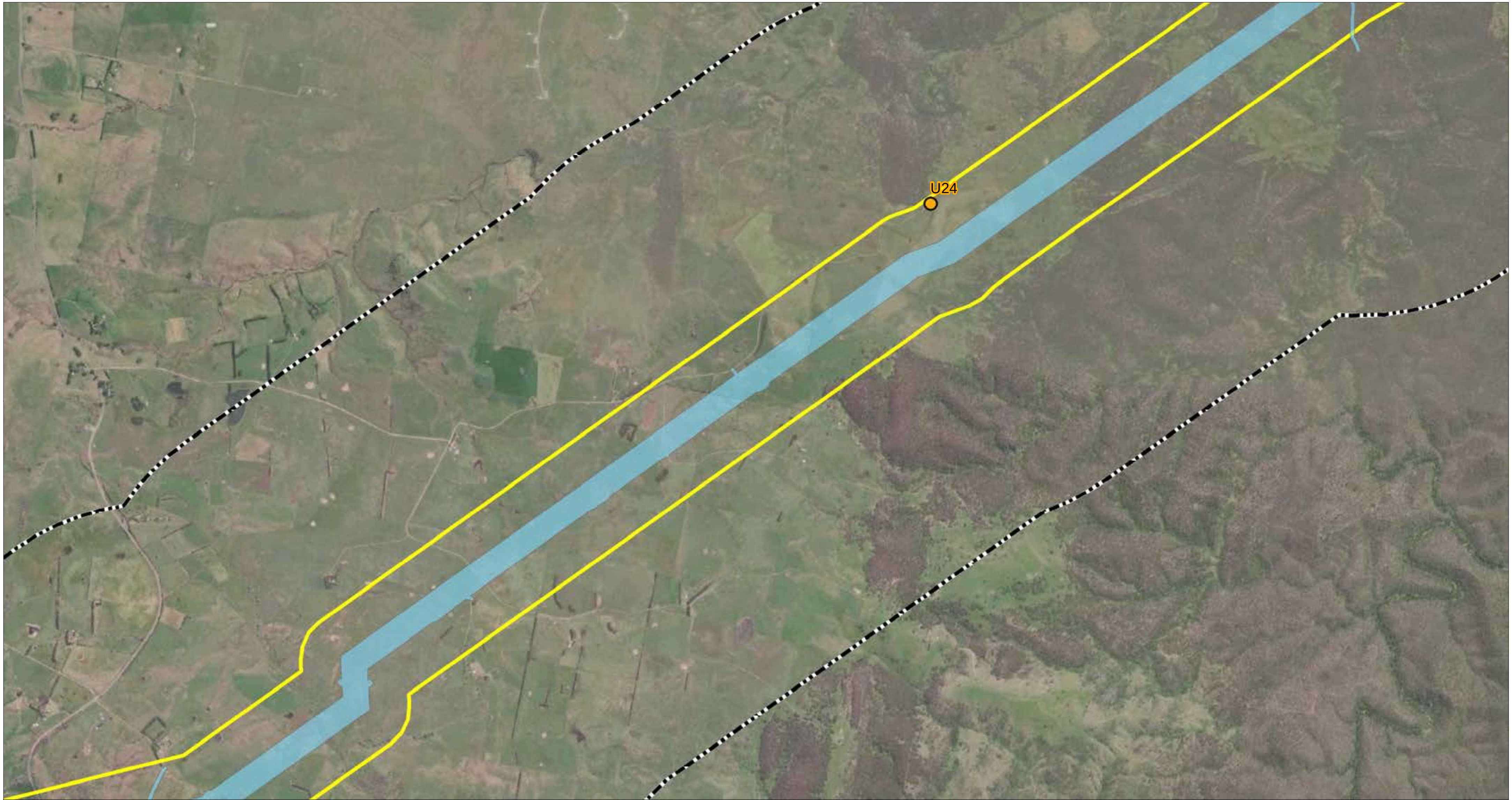

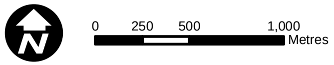

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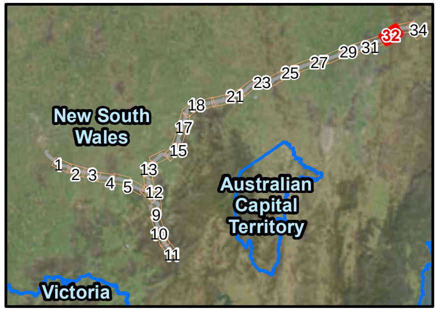

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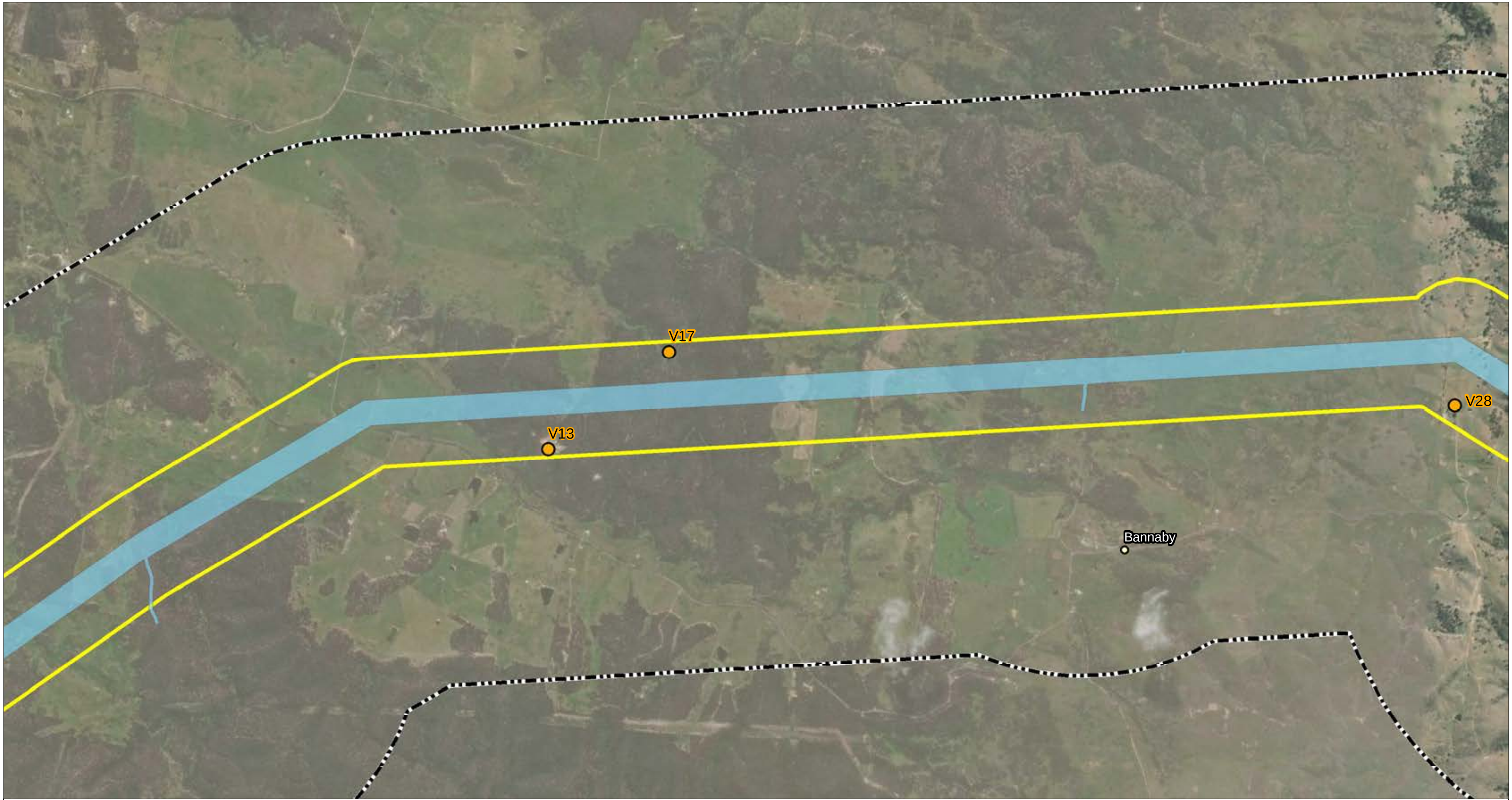

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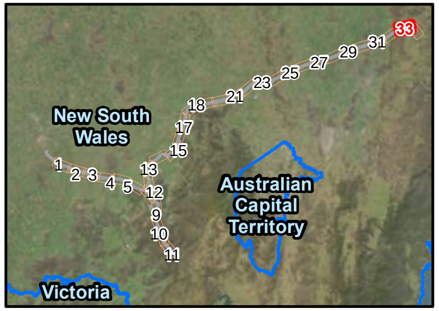

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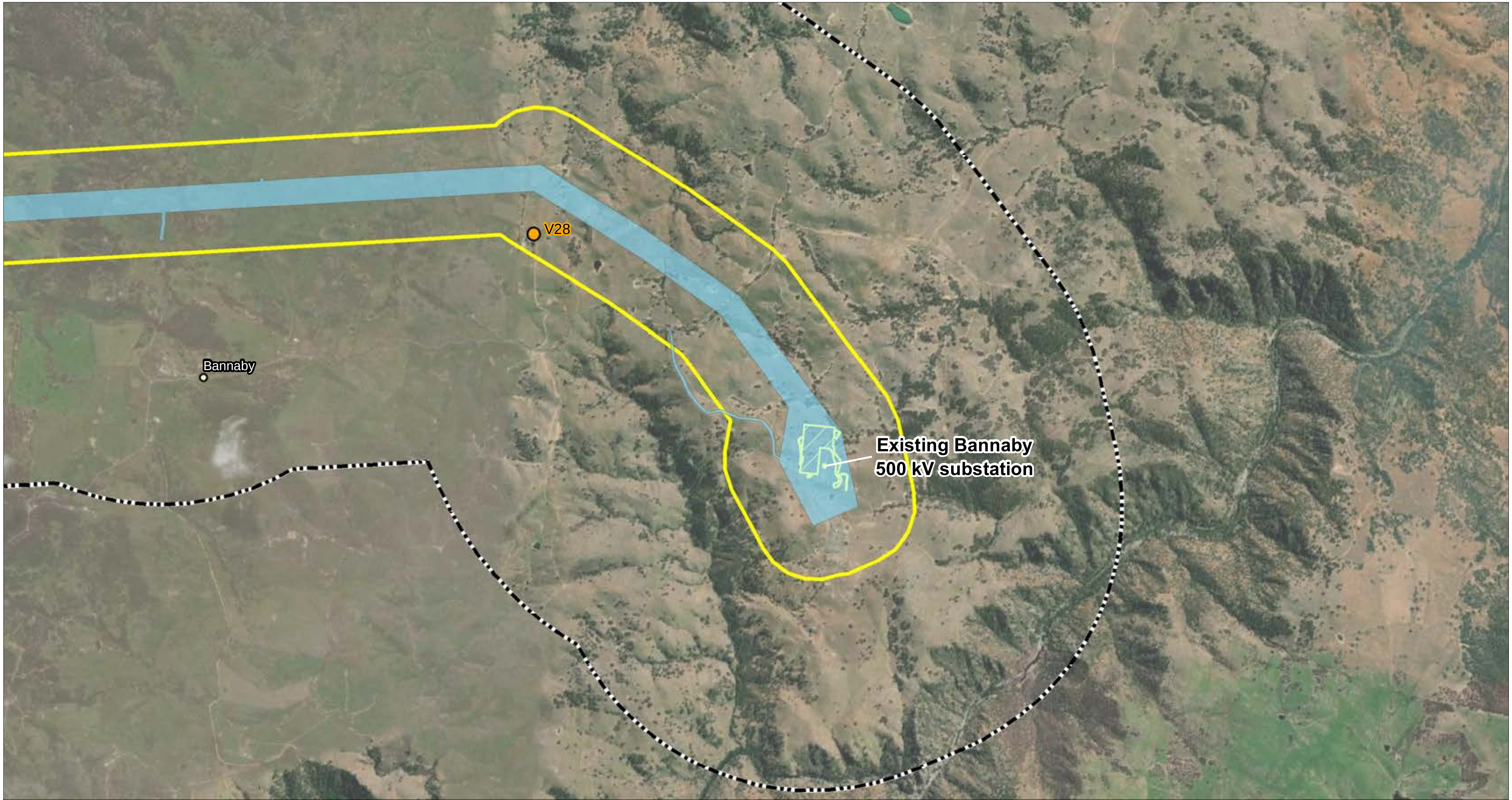

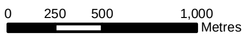

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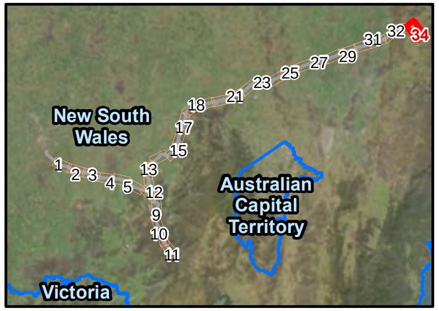

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ATTACHMENT J

CNVG mitigation measures

Table 1 CNVG standard mitigation and management measures

Action Required	Applies To	Details
Management measures		
Implementation of any project specific mitigation measures required.	Airborne noise	Implementation of any project specific mitigation measures required.
Implement community consultation or notification measures.	Airborne noise Ground-borne noise & vibration	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night time period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification should be a minimum of 7 calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. Please contact Roads and Maritime Communication and Stakeholder Engagement for guidance. Website (If required) Contact telephone number for community Email distribution list (if required) Community drop in session (if required by approval conditions).
Site inductions	Airborne noise Ground-borne noise & vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • all project specific and relevant standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries) • environmental incident procedures.
Behavioural practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Verification	Airborne noise Ground-borne noise & vibration	Where specified under Appendix C of the CNVG a noise verification program is to be carried out for the duration of the works in accordance with the Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Where required attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Update Construction Environmental Management Plans	Airborne noise Ground-borne noise & vibration	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
Building condition surveys	Vibration Blasting	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage

Action Required	Applies To	Details
Source controls		
Construction hours and scheduling	Airborne noise Ground-borne noise & vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite period during normal hours and out-of-hours work	Ground-borne noise & vibration Airborne noise	See Appendix C of the CNVG for more details on the following respite measures: • Respite Offers (RO) • Respite Period 1 (R1) • Respite Period 2 (R2) • Duration Respite (DR)
Equipment selection.	Airborne noise Ground-borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. Ensure plant including the silencer is well maintained.
Plant noise levels.	Airborne-noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Appendix H of the CNVG. Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the manufacturers specifications or Appendix H of the CNVG.
Rental plant and equipment.	Airborne-noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 of the CNVG.
Use and siting of plant.	Airborne-noise	The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers. Only have necessary equipment on site.
Plan worksites and activities to minimise noise and vibration.	Airborne noise Ground-borne vibration	Locate compounds away from sensitive receivers and discourage access from local roads. Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible. Very noise activities should be scheduled for normal working hours. If the work can not be undertaken during the day, it should be completed before 11:00pm. Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters. If programmed night work is postponed the work should be re-programmed and the approaches in this guideline apply again.
Reduced equipment power	Airborne noise Ground-borne vibration	Use only the necessary size and power.
Non-tonal and ambient sensitive reversing alarms	Airborne noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.

Action Required	Applies To	Details
Minimise disturbance arising from delivery of goods to construction sites.	Airborne noise	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Avoid or minimise these out of hours movements where possible.
Engine compression brakes	Construction vehicles	Limit the use of engine compression brakes at night and in residential areas. Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.
Path controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436:2010 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities.	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.
Receptor control		
Structural surveys and vibration monitoring	Ground-borne vibration	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, vibration monitoring should be conducted during the activities causing vibration.
See Appendix C of the CNVG for additional measures	Airborne noise Ground-borne vibration	In some instances additional mitigation measures may be required.

Table 2 CNVG additional mitigation and management measures

Additional Mitigation Measure	Description
Notification (N) (letterbox drop or equivalent)	Advanced warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of five working days prior to the start of works.
Specific notifications (SN)	Specific notifications are letterbox dropped (or equivalent) to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. The specific notification provides additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops.
Phone calls (PC)	Phone calls detailing relevant information made to affected stakeholders within seven calendar days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs.
Individual briefings (IB)	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Project representatives would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
Respite Offers (RO)	Respite Offers should be considered where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed three hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers. The purpose of such an offer is to provide residents with respite from an ongoing impact. This measure is evaluated on a project-by-project basis, and may not be applicable to all projects.
Respite Period 1 (R1)	Out of hours construction noise in 'out of hours period 1' shall be limited to no more than three consecutive evenings per week except where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and no more than six evenings per month.
Respite Period 2 (R2)	Night-time construction noise in 'out of hours period 2' shall be limited to two consecutive nights except for where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and six nights per month. Where possible, high noise generating works shall be completed before 11pm.
Duration Respite (DR)	Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration projects. In this instance and where it can be strongly justified it may be beneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly. The project team should engage with the community where noise levels are expected to exceed the NML to demonstrate support for Duration Respite.
Alternative Accommodation (AA)	Alternative accommodation may be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels. The specifics of the offer should be identified on a project-by-project basis. Additional aspects for consideration shall include whether the highly intrusive activities occur throughout the night or before midnight.
Verification (V)	Verification of construction noise and vibration levels should occur to ensure the actual impacts are consistent with the predicted levels. Appendix F of the CNVG contains further details about verification of Noise and Vibration levels as part of routine checks of noise levels or following reasonable complaints.

Table 3 CNVG triggers for additional mitigation measures – Airborne noise

Predicted $L_{Aeq(15minute)}$ airborne noise level at receiver			Additional mitigation measures	
Perception	**dBA above RBL**	**dBA above NML**	**Type[1]**	**Mitigation levels[2]**
All hours				
75 dBA or greater			N, V, PC, RO	HNA
Standard hours: Mon – Fri (7am – 6pm), Sat (8am – 1pm), Sun/Public Holiday (Nil)				
Noticeable	5 to 10	0	-	NML
Clearly Audible	10 to 20	<10	-	NML
Moderately Intrusive	20 to 30	10 to 20	N, V	NML+10
Highly Intrusive	>30	>20	N, V	NML+20
OOHW Period 1: Mon – Fri (6pm – 10pm), Sat (7am – 8am & 1pm – 10pm), Sun/Public holiday (8am – 6pm)				
Noticeable	5 to 10	<5	-	NML
Clearly Audible	10 to 20	5 to 15	N, R1, DR	NML+5
Moderately Intrusive	20 to 30	15 to 25	V, N, R1, DR	NML+15
Highly Intrusive	>30	>25	V, IB, N, R1, DR, PC, SN	NML+25
OOHW Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Public holiday (6pm – 7am)				
Noticeable	5 to 10	<5	N	NML
Clearly Audible	10 to 20	5 to 15	V, N, R2, DR	NML+5
Moderately Intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR	NML+15
Highly Intrusive	>30	>25	AA, V, IB, N, PC, SN, R2, DR	NML+25

Note 1: N = Notification, SN = Specific Notification, PC = Phone Calls, IB = Individual Briefings, R1 = Respite Period 1, R2 = Respite Period 2, RO = Project Specific Respite Offer, DR = Duration Respite, AA = Alternative Accommodation, V = Verification.

Note 2: NML = Noise Management Level, HNA = Highly Noise Affected (ie 75 dBA or greater for residential receivers).

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